Methods for visitor monitoring in recreational and protected areas: An overview

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Monitoring and Management of Visitor Flows in Recreational and Protected Areas
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Methods for Visitor Monitoring in Recreational and Protected Areas: An Overview

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Abstract: The objective of this paper is to present a systematic overview on methods used for visitor monitoring in recreational areas. Emphasis is given on quantitative methods such as direct observation, video observation, counting devices and registration books. The various approaches are discussed with regard to practical, legal and organisational aspects, such as costs, maintenance requirements, dependence on infrastructure (e.g. electricity), risk of vandalism or suitability for remote and ecologically sensitive locations.
For the design of a visitor monitoring scheme in a specific recreational area it is necessary to determine the best combination of devices and methods, depending on the objectives of the monitoring program. This relates also to the temporal resolution of monitoring activities (permanent, periodic, selective). In areas where the recreational use is largely depending on external factors such as weather, daytime and season, the representativity of a sampling scheme becomes crucial for the statistic validity of the obtained data.
As visitor monitoring can also be regarded as an interference with the privacy of the persons being monitored, ethic aspects of the application of the various methods must also be addressed.

INTRODUCTION

Monitoring of vegetation and wildlife in recreational and protected areas has a long tradition. In particular in national parks, the scientific interest in creating inventories and in observing the development of ecosystems has often been a driving force for the establishment of monitoring schemes. In many countries, systematic long-term research programs are seen as part of the duty of a national park service.

Opposed to that, a systematic monitoring of recreational uses and visitor flows is rarely carried out. This is particularly true for the situation in most European countries, where visitor monitoring, if at all done, is usually organised on an ad-hoc basis without systematic planning. Very often, results from improvised one-day countings are being extrapolated and used for management decision without consideration of the significance of the results.

The design of a monitoring project has to consider many practical, organisational, financial and also legal aspects:

Why should be monitored?

The goal of a monitoring scheme has to be clearly defined. Very often, it is unclear, whether a monitoring campaign is carried out to identify specific problems within a protected area, e.g. overuse, or simply to justify funding requests. Other goals could be to check the adherence to limitations of use, to minimise conflicts between user groups or to collect comprehensible data for planning decisions such as the allocation of infrastructure and services. Every such goal will require a different mix of monitoring methods.

What should be monitored?

From the definition of the goals of a monitoring scheme the measurement units can be determined:
Number of visits
Number of (individual) visitors
Visitor load (e.g. visitor hours)
Visitor flow (e.g. persons/hour/direction)
Visitor density (e.g. persons/length unit of trails)
Visitor activities etc.
In many cases it will be essential to register not only the visitors themselves and their activities but also some external factors which might have an effect on the visitation such as weather conditions, special events (e.g. sports competitions) or holidays.

Who should be monitored?

Not every person encountered in a park or recreation area is a visitor. The typical motives of a visitor are outdoor recreation or cultural appreciation (Hornback & Eagles 1999). Persons just passing through (e.g. by car on their way to work) or persons working in a recreational area such as forest workers, farmers or park employees should therefore not be considered as visitors. In order to report visitor numbers, they should not be included in use statistics. This distinction is only feasible in remote areas, whereas in urban recreation areas it is almost impossible to identify the motive of a person entering a park.

In any case, if the goal of a monitoring scheme is to quantify the interactions between humans and the ecosystem, the total number of persons has to be accounted, independent from the reasons of their presence.

Where should be monitored?

Very often, monitoring is primarily carried out at entrance points (e.g. park gates, parking grounds) or visitor centers. These are also the locations where counting stations can easily be installed (electricity supply, security etc.). This leads to an over-representation of short-time users or users with minimal activity radius (e.g. picnickers) in the usage statistics. If the goal of the monitoring activities is to quantify interactions between visitors and the ecosystems, visitor monitoring in the core areas of a park is essential.

It might be easy to select counting points in recreational areas with a limited number of entrance points or key attractions. In the European context, the more typical situation is an open road or trail network with multiple entrance points. This is particularly the case in urban forests. In such situations, numerous pre-tests will be necessary to determine the most significant nodes in the trail network for the placement of counting stations.

When should be monitored?

In most European countries, systematic long-term visitor monitoring is hardly ever carried out. The most frequent type of counting activities are single-day countings. Very often, expected peak visitation days (e.g. Sundays in early summer) are selected for counting campaigns, and the results from these days are then being used to alarm the public because of excessive use-levels.

From numerous monitoring projects both in urban and in remote locations we learnt that for the understanding of the dynamics of recreational uses it is essential to have data which cover all seasons and all other external influences such as weather, daytime etc. However, this does not mean that every single visitor has to be recorded: For our time-lapse video monitoring projects we found that in heavily used recreational areas a sampling time of 15 minutes per hour is sufficient (Brandenburg 2001).

MONITORING TECHNIQUES

Numerous techniques are available for the monitoring of visitor flows in recreational areas. In the following section a short description of each approach will be given. A summary of the techniques and their fields of application is given in Table 1 (see also Watson et al. 2000).

Interviews

Oral and written interviews are an integral part of visitor monitoring concepts. They provide mainly qualitative information about the needs and motivations of visitors, their origin, their habits and activities as well as their routes within a recreational area. When combined with quantitative data from counting stations, important conclusions can be drawn for the management.

Direct observation

<u>Roaming observers</u>: In many national parks, rangers also records of the number of people they meet during their inspections of the area. These data can be used as additional information within a data gathering process, in particular in remote areas, but need to be treated cautiously, unless the roaming is set up in a systematic way.

<u>Fixed counting stations</u>: Specific manned counting stations are usually only set up for short observation periods. However, personnel working at information booths, souvenir shops etc. can also be integrated in a long-term monitoring concept, provided that the circumstances are clearly described (keeping of records also at peak times etc.).

Indirect observation

<u>Automatic cameras, time-lapse video</u>: Video recordings or photographs are an excellent source of information for visitor monitoring. In order to maximise the operating time without maintenance (change of tapes), time-lapse video recorders can be used, which take images at fixed intervals (e.g. 5 seconds). Most of the devices available commercially had been developed for security surveillance of homes, public buildings, factories etc. and usually depend on standard electricity supply.

The main cost factor is the interpretation of the video images, in particular, if not only the number of persons has to be recorded but also other aspects such as group size, mode of transport (hiking, biking), direction of movement etc. First attempts to automate the interpretation with the help of digital image analysis had been promising (Muhar et al. 1995), yet the calibration of the system for different locations and under different seasonal and weather conditions turned out to be very difficult.

Current development directions are independence from standard electricity supply (e.g. solar panels with buffer batteries) and wireless transmission of image data. There are already commercial systems available which can transmit image data over a short distance via an infrared interface, a combination with mobile telephones seems also possible.

<u>Arial, satellite imagery</u>: Airphotos can only be used for the detection of users in open areas such as beaches, lakes, grassland, or roads. New high-

resolution satellite images such as those from the IKONOS project will probably take over the role of conventional airphotos in many fields of application. However, both types of images offer only a single snapshot of the recreational use, the acquisition of a time series is usually far too expensive.

Counting of access permits and tickets

Where access to an area is restricted either by a quota or by selling entrance tickets, it is very easy to keep records of the permits or tickets issued to visitors.

Records from commercial facilities such as cable-cars, ferries, or even restaurants (number of meals served) also form a good source of information, provided that private enterprises and park administrations are willing to cooperate.

Counting devices

As counting of persons in the field is very labour-intensive, automatic counting devices are often applied in order to reduce costs. Some these devices have originally been developed for road traffic counting and are of limited use for non-road traffic.

<u>Turnstiles</u>: The use of turnstiles is usually limited to entrance situation of areas with restricted access (e.g. fenced areas) and high visitor numbers. Visitor numbers derived from turnstile countings are very often over-estimated, in particular when the devices are not permanently guarded (children love to play with turnstiles) and serviced (unwanted freewheeling).

<u>Photoelectric counters</u>: Light barriers, active or passive infrared sensors, linked with data loggers are very useful counting devices. Their energy consumption is relatively low, therefore they can be installed as battery-supplied counting stations even in remote locations.

A big challenge for all types of counting devices is the site-specific set-up and calibration of the counting station: A counting signal can be triggered not only by visitors, but also by wildlife or - on windy days - by twigs. Visitors walking in groups, even visitors with very dark or light clothing might also be wrongly recorded (Gasvoda 1999). In our own projects, we found good correlations between monthly or daily sums of visitors and the corresponding sensor signals, however, on an hourly basis, the correlation was sometimes weaker. The results illustrated in Fig.1 could only be achieved after a long calibration phase.

A big disadvantage of most of these devices is that they usually only record the number of visitors but not their direction. Differential approaches (e.g. two light barriers at short distance) work only in settings with low use levels.

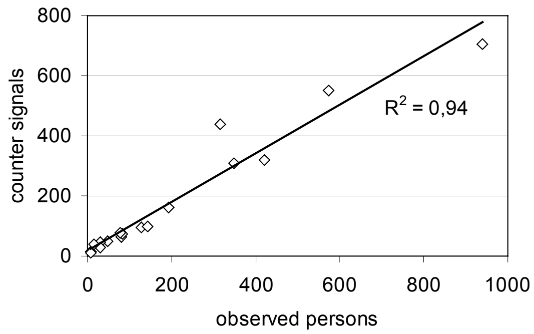

Fig.1: Correlation between light barrier signals and daily numbers of visitors at 16 counting days in the Danube Floodplains National Park

<u>Pressure sensitive devices (Pneumatic tubes, mats)</u>: Various types of pneumatic tubes and other pressure sensitive devices have been developed, mainly for the detection of road traffic. When used for counting hikers, there is again a need for a good calibration to infer from the number of signals to the real number of persons (bikers will trigger a tube twice etc.).

<u>Inductive loop sensors</u>: These devices are extensively used for the monitoring of road traffic. As the signal is triggered by the movement of metallic objects, their application makes sense only for vehicle counting within a recreational area (including bike travel; also horseshoes might trigger a signal).

Self-registration

<u>Trail registers</u>: There are two types of trail registers: In many American parks trail registers are placed at trailheads on order to monitor the number of visitors, to check for permits and sometimes also to provide information for rescue teams about the intentions of a group. These data can be used to determine the number of persons entering an area and their routes, provided that the ratio between the total number of visitors and the number of persons actually registering can be estimated (Leatherberry & Lime 1981).

In European countries, registers at trailheads are uncommon, however, registers are sometimes placed in climbing routes, usually at the end of the most difficult section. They are then a good source of information on the number of persons actually mastering a route.

<u>Summit books</u>: It is again more a (Central) European tradition to place books on summits. The primary function of these books is not visitor registration but rather the provision of a “guest book”. It is very difficult to determine the percentage of persons actually signing theses books. As a general rule, the higher the number of visitors, the lower will be the percentage of registration. On the other hand, on “famous” peaks, more people will like to have their names in these books than on “normal” hikes.

Hut or campground registers: In many areas it is compulsory to register in a hut or campground when staying overnight. Therefore data derived from these registers can be quite reliable. The registration usually also includes data on the origin of the visitor and the next destination. Therefore, they can be a useful source for the determination of typical routes (Muhar 2001).

In some areas e.g. of the Alps, also day visitors register in huts, but the percentage of registered visitors can vary from hut to hut, depending on the placement of the register within the hut, the policy of the warden and also the weather: In dubious weather situations, more hikers would register in a hut and leave information on their next destination in order to be found by rescue teams.

Mapping of traces of use

Although it is obvious that there is a correlation between the intensity of recreational use and “traces” left by the users in the landscape, it is very difficult to conclude from the mapping of these traces to actual visitor numbers (Coch & Hirnschal 1998).

Garbage: The amount of garbage left either in bins or in the landscape certainly is not only correlated to visitor numbers, but also to individual behaviour and local traditions.

Trail deterioration, damage to vegetation: Long lasting effects of recreational use are often seen as an indicator for overuse, however, there are so many other factors that contribute to this (e.g. trail design). Also, once a trail is already damaged, deterioration will continue even with lower use levels.

Footprints and sandbeds: Footprint data are used extensively in wildlife monitoring. In areas with low use levels human footprints can also be counted. As the age of a footprint is difficult to determine, it would, again similar to a technique applied in wildlife studies (Angold et al. 1999), be possible to provide sandbeds which are checked and raked at regular intervals.

USEFUL COMBINATIONS OF METHODS

It is obvious, that in the design of a monitoring scheme a mix of methods will be considered in order to compensate for the disadvantages of single counting techniques and to derive additional information from comparisons and correlations.

As an example, temporally selective counting at many different locations can be combined with permanent video observation on a few selected sites. Once the correlation between the various locations has been established, an extrapolation of the number of visitors can be performed.

Also visitor counting at selected locations can be combined with qualitative interviews on the motivation of visitors and their routes in order to determine the visitor load in different sections of the area (Arnberger et al. 2000).

One of the big advantages of combined monitoring schemes is the possibility to crosscheck data from one method with data from a different method. Fig.2 shows the results of different approaches to determine the percentage of dogs kept on leash in the Danube Floodplains National Park. In this park it is compulsory to keep dogs on leash.

			visitor numbers	direction of motion	routes	distribution within area	group size	visitor charac- teristics (age, sex)	visitor characteristics (origin, expectations etc.)	behaviour
direct methods	interviews	oral interviews			x	x	x	x	x	x
		written interviews			x	x	x	x	x	x
	direct observation	roaming observers	(x)	(x)	(x)	(x)	(x)	(x)		(x)
		fixed counting stations	x	x		x	x	x		x
	indirect observation	automatic cameras	x	x		x	x	x		x
		time-lapse video	x	x		x	x	x		x
		arial, satellite imagery	(x)	(x)	(x)	(x)	(x)			
	counting of access permits	tickets sold	x							
		permits issued	x				x			
	counting devices	turnstiles	x	(x)			(x)			
		photoelectric counters	x	(x)			(x)			
		pressure sensitive mats	x	(x)						
		pneumatic tubes	x	(x)						
		inductive loop sensors	(x)	(x)						
	self-registration	trail registers	x	x	(x)		x			
		summit books	x	x	x		x			
		hut registers	x	x	x		x			
indirect methods	mapping of traces of use	garbage	x			(x)				
		trail deterioration	x			(x)				
		damage to vegetation	(x)			(x)				
		footprints	x	(x)		(x)				
		sandbed	x	(x)						

Table 1: Techniques for visitor monitoring and their fields of application

People were interviewed at a visitor information both about their willingness to accept this rule. At the same location the actual number of dogs on leash was counted. The results were almost identical. However, the data from a hidden video observation station a few minutes away from the information booth show a much lower percentage for the same day. On days when the information both was not manned, the percentage was even lower.

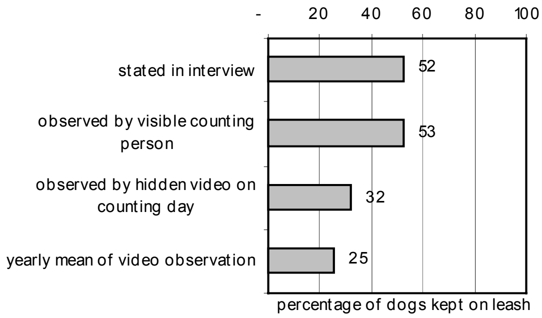

Fig.2: Rate of dogs kept on leash in the Danube Floodplains National Park, determined from different data gathering methods (Brandenburg 2001)

DISCUSSION

Ethic aspects

Some visitor monitoring methods can be seen as an intrusion into the private sphere of a visitor. This is true for most methods where images are taken (video recordings, automatic cameras), but also for other methods of hidden observation (human observers), in particular in remote locations, where visitors do not expect to be watched: In urban environments, people are already quite familiar with video surveillance, and it can even bee seen as a motive to visit remote areas, that one can behave there more freely, without being monitored.

However, as discussed in Fig.2, data on the behaviour of visitors derived from hidden observation can be much more realistic than from open observation (see also Vanderstoep 1986)

For our own research projects, we established a rule that every observation station (video camera) should be set up in a way, that it is not possible to identify individual persons in these images. The image resolution is just fine enough to count people and to identify e.g. their direction of movement, but not to identify the individual. As a second precaution, we do not use persons from the study areas as interpreters, who might be able to infer from identifiable behaviour to certain locally known persons. Nevertheless, we think that park managers should be very cautious when installing video cameras in remote locations; wherever possible, alternative solutions should be considered.

Vandalism

Counting devices in unguarded situations are of course exposed to vandalism. The mildest form of vandalism is the manipulation of devices so that they report no or wrong results, but sometimes gear will also be completely destroyed. We found that light barriers are in particular attracting vandals, even when we had the impression that they were well hidden. In such cases the application of totally buried counters (pressure sensitive devices) might be a useful alternative.

Costs vs. accuracy

Many devices currently used for visitor monitoring are mass products from the security surveillance sector. Therefore the hardware costs are no longer a big issue. The main cost factor are labour costs, for the installation and maintenance of counting devices, for conducting interviews or for the analysis of data (e.g. video interpretation). It is crucial for the success of a monitoring concept that from the beginning the required accuracy level is clearly identified. Reasonable accuracy can be defined as the level which is good enough to detect changes that are significant for management decisions (Hendee et al. 1990).

CONCLUSIONS AND OUTLOOK

A large number of techniques and methods have been developed for visitor monitoring.

From our point of view there are three key issues for the future developments in visitor monitoring:

Awareness of decision makers: First of all, there is still not enough awareness of the needs of visitor monitoring and management. At least in the European context, there is a big gap between the importance of recreation for the public and the resources invested into the management of recreational and protected areas as well as into research activities.

Standardisation of methods: It is very difficult to compare results from different areas when also different methods are applied. While for example within the US Forest Service a nation-wide monitoring program with standardised methods has been installed (English et al. 2001), not much has been done at the European level. On an international level, there are initiatives to establish standardised guidelines for visitor monitoring (Hornback & Eagles 1999). However, these initiatives did not have much response yet at national level.

Development of more reliable automatic sensors: As discussed above, privacy of visitors must be respected. Video monitoring, although well-tried, and delivering excellent results for further analysis, will always remain a criticisable technique in this context. We hope that in the future more reliable automatic counting devices with better options for analyses (e.g. direction of movement) will be available.

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Visitor Structure of a Heavily Used Conservation Area: The Danube Floodplains National Park, Lower Austria

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Abstract: National parks in close proximity to large conurbations are not subject to the normal conflicts between conservation and ecological tourism but to those between conservation and urban recreational requirements. The Danube Floodplains National Park, Lower Austria is situated to the east of Vienna, the capital city of Austria, with a population of 1.6 million. Between June 2000 and May 2001, visitors were monitored in the Lower Austrian part of the National Park. An analysis of the results of the interviews, as well as their integration with the results obtained using long-term video monitoring, counts by human observers and route analysis, led to the identification of specific visitor categories with individual behavioral patterns and spatio-temporal distribution. In particular, regular recreational visitors from adjacent residential areas were very concerned about overcrowding and would react to the high visitor frequency through a change in their habits. This alteration of visiting habits would lead to grave problems for the environmental management of the National Park.

INTRODUCTION

Conservation areas, such as national parks, in close proximity to large conurbations present managers and researchers with a variety of challenging problems, due to the high number of visitors and the multifaceted visitor structure (Heywood, 1993). The visitor structure is characterized by a high percentage of visitors who come from the adjacent suburbs and villages using the park for everyday spare-time activities, such as walking the dog, jogging, and picking flowers. Only a low number of tourists explicitly wants to visit conservation areas to experience nature (Arnberger, Brandenburg 2001). The temporal stress on such areas is not limited to the weekends or particular seasons; due to the varying motives visitors have for visiting the protected areas, there is a continual high daily visitor stress throughout the year. The management of protected areas is made even more difficult if a recreational area, which has existed for decades and been used intensively, is converted into a national park. Traditional behavior patterns, long-established claims regarding its use and excellent local knowledge make management measures, limiting its use for leisure time activities, even though inevitable from the conservation standpoint, more difficult. These national parks, therefore, are not subject to the normal conflicts between conservation and ecological tourism but to those between conservation and urban recreational requirements.

If there are particular attractions at one location within an already highly-frequented conservation area, such as a well-developed recreational infrastructure (parking sites, easy accessibility) or natural features, visitors will be attracted for a variety of reasons and needs. If visits by these individual groups coincide also temporally this can lead to conflicts between the groups, due to their specific individual requirements and high numbers, as well as to negative influences on the nature of the area. In order to develop strategies to mitigate negative consequences associated with use, managers must be able to quantify the types and amount of use that occur. Some sound knowledge of the visitor structure is, therefore, one of the most important challenges and tasks in the development of national parks.

The Danube Floodplains National Park stands between these two fields of interest - conservation and the requirements of an urban population for nearby recreational possibilities. Taking the most frequented access point of the National Park as a model example, a discussion follows on the visitor structure and the resulting problems for the management of the area. This visitor monitoring study (Arnberger, Brandenburg, in press), which combines long-term monitoring and survey data, was commissioned by the Danube Floodplains National Park Administration, Lower Austria.

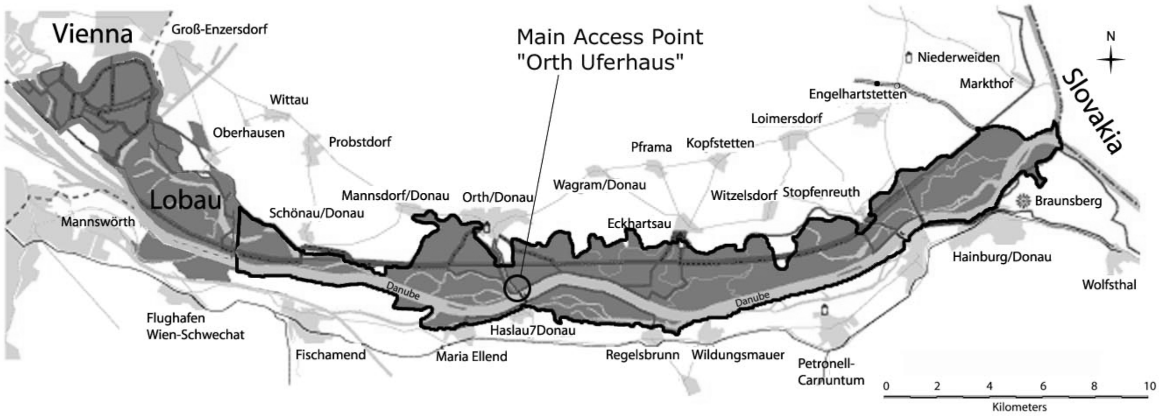

Fig. 1: The Danube Floodplains National Park, (the Lower-Austrian section is outlined in black)

STUDY AREA

The Danube Floodplains National Park is situated to the east of Vienna, the capital city of Austria, with a population of 1.6 million. The Lower-Austrian section of the National Park, with an area of 6.900 hectares, extends about 38 kilometers along the Danube river from Vienna to the border of Slovakia. In 1997, the Danube Floodplains, Lower Austria, were declared a National Park, and received international recognition, IUCN category II.

The location "Orth Uferhaus" is the most frequently used entrance. This entry point lies on the north bank of the Danube, south of the village of Orth, with a population of approximately 1,800. Orth is only 15 kilometers distant from the Vienna city limits. It is easy to reach this location by car - public transportation, on the other hand, is not optimal. The entrance "Orth Uferhaus" offers the visitors an abundance of attractions and manifold possibilities for recreation in the attractive environment of the Danube with its old arms. The "Orth Uferhaus" is well known for the following reasons:

- a traditional excursion restaurant with excellent cooking,
- a large parking area only a short distance from Vienna and the National Park,
- close to highly frequented transnational biking routes,
- close to the village of Orth,
- starting or meeting point for excursions into the National Park,
- hiking trails, possibilities for swimming, children's playgrounds, renovated mills,
- the only ferry across the Danube east of Vienna,
- boat rentals and a small yacht harbor.

METHODS

Between June 2000 and May 2001, visitors were monitored in the Lower Austrian part of the National Park. As the quality of data collected in short-term monitoring campaigns is heavily affected by statistical variations, the use of long-term monitoring is a very important complement to short-term, in-depth visitor observation and interviews. Therefore, the combination of long-term monitoring and survey data, obtained using various methods, permitted a thorough analysis of visitor activities.

Permanent time-lapse video recording: Video-cameras were installed at two access points to monitor recreational activities (see Leatherberry & Lime 1981) year round, from dawn to dusk. For the analysis, only 15-30 minutes of observations per hour were taken into account, but this had no negative impact upon the significance of the results (Brandenburg 2001, Muhar, Zemann & Lengauer 1995). Given the type of video system installed, it was not possible to identify individual persons, so anonymity can be guaranteed.

Interviews: At 11 main entrance points into the Park, visitors were interviewed on eight days; the interviews took place on a Thursday and the immediately following Sunday, in March, June, August and September. The survey was conducted on days with fine weather, to permit the collection of as much data as possible. The total sample size for this study was 394.

Personal observations: Additionally, at 11 main entrance points to the Park and on the days of the survey, visitors were counted; the results of counting were combined with video data for extrapolating the total number of visitors per year.

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

Infrared Sensors: Infrared sensors were installed at six (entrance) points to monitor recreational activities, year round. The sensors were properly calibrated by test series and by counting persons.

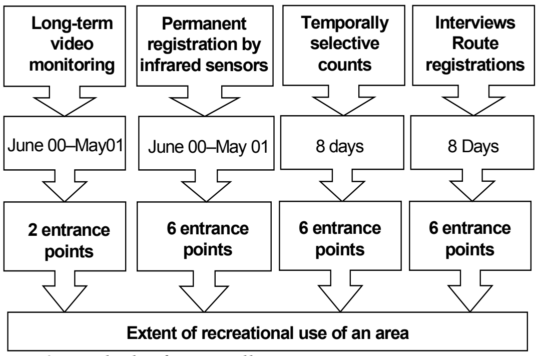

Fig. 2. Methods of Data-collection

OVERVIEW OF RECREATIONAL USAGE IN THE LOWER-AUSTRIAN SECTION OF THE NATIONAL PARK

From the video monitoring and counting data it could be calculated that there were close to 400,000 visits to the Lower-Austrian section of the National Park in the year of the study. The visitor density was calculated as 55 visits per year/per hectare. May was the month with the most visits, the fewest were registered in December. Sunday afternoons were the most highly frequented periods. One third of recreationists visited the national park at least once a week. The main users of the national park enjoyed biking and hiking, and a minority went jogging and canoeing. Only 4% of recreationists interviewed came due to motives focusing on the National Park (see fig. 3). More than 50% of the visitors to the National Park arrived in private cars.

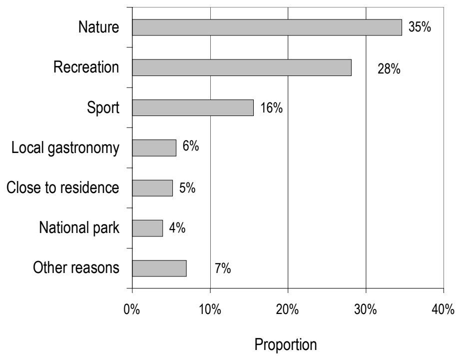

Fig. 3: Main reason for visit (n = 231)

QUANTIFICATION AND TEMPORAL DISTRIBUTION OF LEISURE-TIME ACTIVITIES AT THE MAIN ACCESS POINT "ORTH UFERHAUS"

The video observation of the access road to the location "Orth Uferhaus" showed 224,000 visitors entering the National Park, either on foot or using a vehicle, during the year of our research. The high season for visiting this location was the period between April and August. In May, 30,000 visits were registered. Itemized, according to the time of the year, we see that visitors using bicycles or motorbikes only arrive during the warm season.

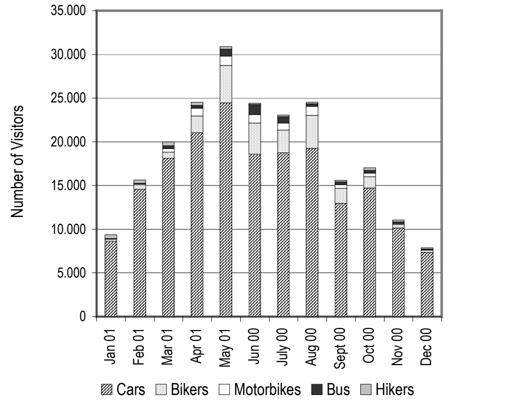

Fig. 4:Yearly progression of visitors according to means of transportation (Video-recording)

The highest visitor frequency was recorded on Sundays and public holidays. All user groups were concentrated on the weekends.

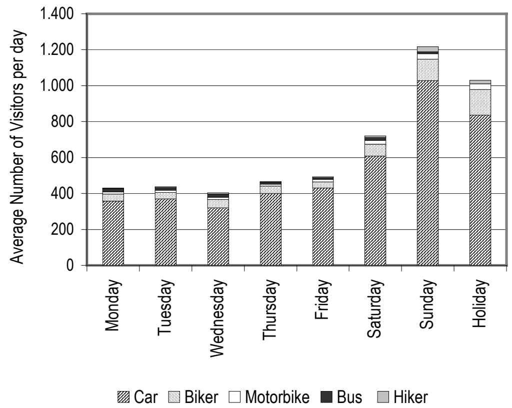

Fig. 5: Weekly progression of visitors according to means of transportation (Video-recording)

As can be seen, the highest frequency of visitors occurred on the weekends of the spring and summer. The daily results showed a peaking at noon and in the afternoon.

CATEGORY OF VISITORS AT THE LOCATION " ORTH UFFERHAUS"

An analysis of the results of the interviews, as well as their integration with the results obtained using video, counts and route analysis, led to the identification of five specific visitor categories with individual behavioral patterns and spatio-temporal distribution at this area. The linkage of video data with the data from our questionnaires concerned, principally, the choice of the means of transport (see fig. 6). Based on the results of a year-long video-observation the number of visits, were quantified according to the category of visitor.

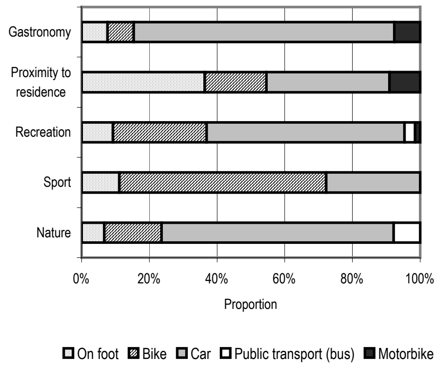

Fig. 6: Principal reason for visiting / according to means of transportation (n = 231)

The person interested in nature as visitor to the National Park

This person usually arrives by car or, sometimes, by bicycle to visit this natural region and/or the National Park. The main visiting periods are the weekends and spring.

The gastronomic- visitor

The gastronomic-visitor chooses this entrance solely because of the specialties offered in the "Ufergasthaus" restaurant. The National Park does not play a role in his decision-making process.

This category of visitor predominantly arrives by car, concentrated at noon (see fig.7). A hike through the national park is unusual.

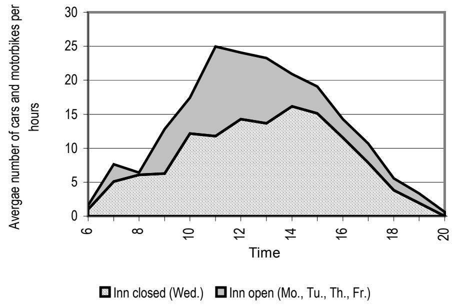

Fig. 7: Average daily progression, on workdays, of the number of cars and motorbikes travelling towards Orth, for the period October 2000 until Mai 2001. Video-observation.

The sporty, active type

This category of visitor usually arrives in the Danube Floodplains by bicycle or are joggers. The peak season is between April and August.

The person seeking recreation

The person seeking recreation predominantly arrives in the Danube Floodplains by car or bicycle. Weekend afternoons in spring and summer are the principal periods.

Characteristics	**Interested in nature and National Park visitor**	**Recreation seeker**	**Gastronomic visitor**	**Sporty, active**	**Visitors for whom the National Park is a part of the immediate environment**
Access	Car, bicycle (public transport)	Car, bicycle	Car (Motorbike, on foot, bicycle)	Bicycle, car, on foot	On foot, bicycle, car
Relative percentage at the location "Orth Uferhaus"	33 %	23 %	19 %	15 %	10 %
Main reason for visiting	To experience nature and the landscape, National Park	Recreation	Gastronomy	Sport	Proximity to home Recreation
Origin	Vienna, provinces	East Austria	Vienna	Proximity to the National Park, abroad	Settlements bordering on the National Park
Duration	More than 2 hours	Approx. 2 hours	Less than 2 hours	More than 2 hours	Less than 2 hours
Regularity of visiting	At least once a month	At least once a month	Less than once a month	Less than once a month	At least once weekly
Main day of visit	Weekend	Weekend	During the week and also at the weekend	During the week and also at the weekend	During the week and also at the weekend
Time of the National Park visit	All day	At noon and in the afternoon	At noon	All day	Early and late in the day
Average distance covered	7,6 km	10,6 km	3,4 km	16,5 km	8,2 km
Main season	Year-round, with peak in spring	Year-round, with peak in spring	Year-round, with peak in spring	Bicyclist between May and August, Joggers year-round	Year-round, with peaks in spring and early summer.

Table 1: Categories of visitors at the location Orth Uferhaus. Source: Surveys (n = 394(76)), Surveys of the route, counting, video-observation

Persons for whom the National Park is a part of their immediate environment

This group, from the nearby settlements (up to 1,5 km from the National Park), arrives in the National Park on foot, by bicycle or by car. The duration of their stay is the shortest of all visitor categories. They visit the National Park at the weekend and also during the week.

Due to the many possibilities offered, the location "Orth Uferhaus" is a center of attraction for visitors of the most varied categories. Approximately only one-third is really interested in the environment or the National Park. One hundred and fifty thousand visitors have other motives for their visit.

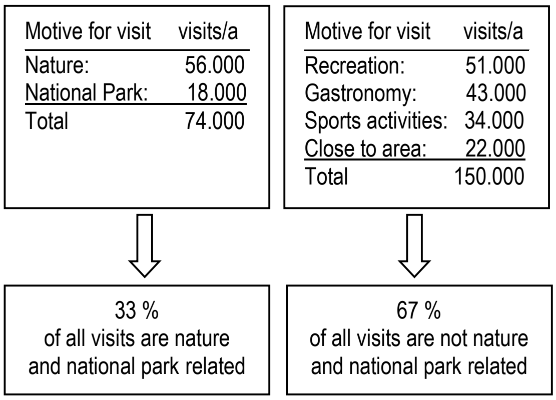

Fig. 8: Categories of visitors and frequencies at the main access point to the National Park

EFFECTS OF THE HIGH NUMBER OF VISITORS

Within the scope of our survey, visitors were also asked to give their views on the number of visitors. One-third was of the opinion of all visitors that the frequency was very high, particularly in the vicinity of the "Orth Uferhaus" and here, particularly at weekends in spring and in summer. Every second person interviewed at the access point "Orth Uferhaus" thought that there were a great number of or too many visitors. In particular, regular recreational visitors from adjacent residential areas were very concerned about overcrowding (see table 2).

	Residence adjacent to National Park	Residence in Eastern Austria	Residence in Western Austria or abroad
Appropriate number of visitors in the NP	49 %	71 %	83 %
Very many or too many visitors in the NP	51 %	29 %	17 %

Table 2: Occurrence of visitors with residence (n = 385;Pearson Chi-Square: Value: 25,347, df: 2, Sig. 0,000)

Those seeking recreation were asked to explain their reactions to the large number of visitors. This question is of particular importance for the management of the area because a spatial or temporal modification of the visitors to the byroads or to the evening or morning hours would lead to additional stress being placed on the animal world through leisure time activities. More than half of the interviewed groups, who stated that there were too many visitors in the National Park, alter their behavior. A change of their itinerary or other visiting times are the most common reactions to the high number of visitors (see fig. 8).

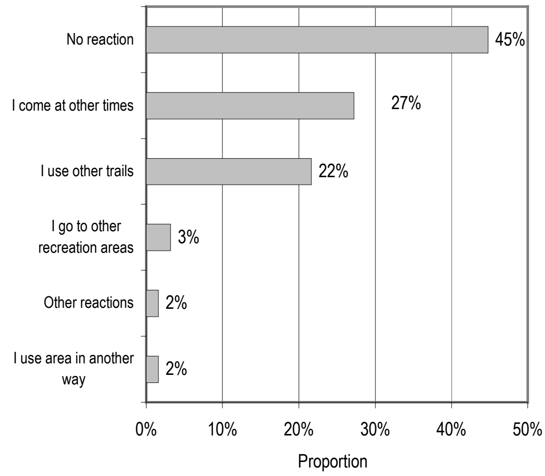

Fig. 9: Reactions to the large number of visitors (n = 125)

Above all, recreationists living in the vicinity or coming regularly, would react to the high visitor frequency through a change in their habits. Of those members of this group, 60% change the habits of their visits (see fig. 9).

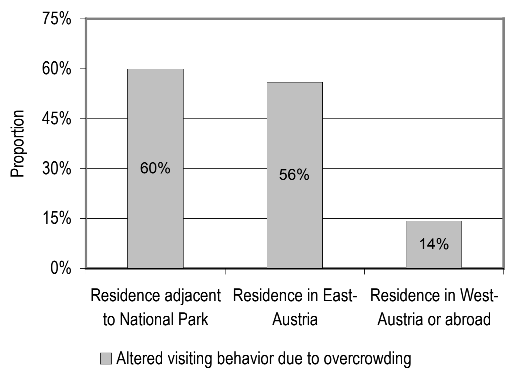

Fig. 10: Visitor reactions according to place of residence (n = 125)

This shows that visitors from Vienna and the other Austrian provinces partially oust the local population from their traditional surroundings. This alteration of visiting habits would lead to grave problems for the environmental management of the National Park. Due to the existing pressure, resulting from the large number of visitors, there are hardly any rest areas or rest periods for the endangered species. If there was an alteration in the habits of those seeking recreation, these animals would be concentrated into even smaller areas and their rest periods would be even more reduced. This pressure would lead to the environmental potential of the National Park not being optimally utilized, in respect to the number of species and individual animals (see also Sterl et al., in print). The extreme, permanent recreation pressure seems particularly critical from the point of view of wildlife ecologists as the National Park represents the only remaining migratory corridor between the Alps and Carpathians (Völk 2001). Therefore, overcrowding is one of the main, principal challenges for the park management.

CONCLUSIONS

The high visitor frequency at the location "Orth Uferhaus" and in the entire National Park is only caused, to a minor extent, by visitors to the National Park and other nature areas. The necessity for recreation, along with the traditional recreational habits of the Viennese, leads to high stress being placed on this conservation area. Seeing that suitable areas for this group of visitors to the National Park do not exist within the urban area of Vienna, or that these have already reached their social carrying capacities (e.g., the upper section of the Lobau in the Viennese section of the National Park), other nearby recreational areas are frequented. Urban inhabitants are now highly mobile and can, therefore, take advantage of more distant recreational offers. This is accompanied by traffic problems, particularly during the weekends, and an exceeding of the social and ecological carrying capacity of some sections of the National Park, such as near the entrance "Orth Uferhaus". Measures to regulate visitors in the area are necessary and can only be precisely targeted using the information on the types of visitor available from the visitor monitoring of the National Park.

In the neighboring residential areas, building is proceeding rapidly, an increasing number of city dwellers is looking for recreation in natural areas and motorization is increasing. It can, therefore, be assumed that there will be an intensification of recreational activities in the National Park. In addition, advertising and improvements to the recreational infrastructure (visitor centers) will also increase the reputation of the National Park. This will lead to visitors to the National Park being increasingly, explicitly addressed. These additional visitors will affect the quality of the outdoor experience of others and their own needs were not satisfied.

The National Park is not able to solve these described problems and tendencies by itself, a form of co-operation with the City of Vienna and the Government of Lower Austria is essential in order to establish sustainable measures in the areas of urban, regional and traffic planning which can be kept within, more or less, acceptable ecological and social limits. Measures taken at the source itself, such as improvements to the housing environment through the establishment of convenient green areas, in addition to a buffer zone around the National Park - particularly around the Viennese area - would be some possible approaches to a reduction of visitor pressure (Arnberger, Brandenburg 2001).

PERSPECTIVES

Through the linkage of data on year-long visitor frequency with the survey results and weather data (Brandenburg 2001) it is possible to develop a spatio-temporal model for the prediction of the flow of visitors to the National Park combined with their categories. This would be a proactive approach to managing carrying capacity. The realization that visitor behavior changes due to higher visitor density makes research into the social carrying capacity, as well as on crowding issues (Shelby & Heberlein 1986, Manning 1999), based on the types of visitors and in combination with long-term video data seem absolutely imperative. Additionally, data on visitor flow forms the basis for studies on the effects of recreational usage on the fauna (see Sterl et al. in press), particularly in respect to wildlife ecology and the flora.

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Monitoring and Management of Visitor Flows in Recreational and Protected Areas
Conference Proceedings ed by A. Arnberger, C. Brandenburg, A. Muhar, 2002 pages 14-20

Developing New Visitor Counters and their Applications for Management

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Abstract: Developing visitor flow models for managing visitors to conservation areas is not possible without accurate visitor count data from the field. However, obtaining such counts in a reliable and cost-effective manner has proven to be more difficult than may be expected. Reasons for this are reviewed, and the features that park managers want in their visitor counting tools are discussed. Based on these demands, development of new visitor counters is underway, along with integrated systems for systematic collection and management of the data they provide. However, more effective direction is required from visitor flow models to guide the deployment of these new counter systems. This is an ongoing programme, and the presentation provided here summarises background information and progress to date.

INTRODUCTION

Information on visitor numbers is essential for a variety of strategic and operational planning tasks in park management, such as that carried out by the Department of Conservation (DOC). These may include:

- justification for visitor facility, service and staff provision;
- design standards for some visitor facilities and services;
- performance reporting on visitor service provision;
- relating use-levels to social and physical impacts;
- identifying demand trends and making forecasts;
- scheduling of maintenance tasks, staff allocations and resource provision; and
- linking particular sites into wider systems of visitor flow and impact modelling.

These are only some of the many management outcomes supported by visitor count data (Hornback and Eagles, 1998; AALC, 1994; Watson et al., 2000; DOC, 1992; AALC, 2000). The important point is that visitor monitoring is concerned with more than counting methods and technology - it is about providing fundamental visitor management data. The more reliable the data from visitor counting techniques and systems, the better the outcomes from its applications in processes such as visitor flow modelling. Without reliable data, no matter how good a model is developed, the old saying always applies - 'garbage in-garbage out'.

OBTAINING VISITOR COUNT DATA

Collection of visitor count data in conservation areas is not an easy task, given that many of them are remote, have few roads or towns, have many entry and exit points, do not have electricity supply, and usually have few staff present on-site. Moreover, visitor counting practice across park management agencies has generally been accompanied by uncertain specification of monitoring objectives, a wide variety of counting and sampling methodologies, and few examples of structured visitor monitoring frameworks to integrate count data and apply the information to management. In this context, visitor monitoring can often be characterised as an opportunistic exercise, involving a mix of different counting methods and techiques, and a strategic sampling of visitor sites that optimises data needs and site conditions with resourcing capacities.

Management agencies have a wide variety of counting techniques available to them (Table 1), of three broad types:

- Direct observations – using staff observers or camera recordings at sites
- On-site counters – devices to record visitor presence and store the counts at sites
- Inferred counts – other data counts used to provide on-site estimates

Management agencies will use some combinations of these counting approaches, depending on their particular information needs, visitor use patterns, site characteristics, operational resource capacities and staff capabilities. In an extensive interview study, Cope et al. (2000) summarised a wide variety of monitoring approaches taken by land management agencies in the UK countryside. In a previous study of the same agencies, Cope and Hill (1997) found that a high proportion of managers were undertaking some sort of visitor monitoring, but that the methods used were widely varied from place to place. Overall, these approaches were not co-ordinated or systematic, and many relied on on-site questionnaire surveys or car counts. With reference to more remote settings, a survey of over 400 US wilderness managers in multiple agencies (McClaran &Cole, 1993) found that 63% relied on 'best guess' estimates of visitor use and 21% used 'frequent field observation'. Only 16% had any systematic procedure for deriving their estimates (permits or counts). In a survey of 308 managers from across the four main park management agencies in the US, Washburne (1981:165) found that the techniques for measuring use-levels fell into four classes: 'best guesses' based on informal observations, trail registers, trail registers calibrated by visitor counters, and agency administered permits. Almost 40% were using the 'best guess' informal observations, although this approached 80% for the Fish and Wildlife Service, reflecting their more highly dispersed sites and low visitor use profile. Permits were used by about 40% overall, although this approached 70% in the National Park Service, reflecting their more defined visitor sites and extensive use of permit systems. Australian experience perhaps sums up this situation best. When reviewing the status of visitor monitoring in the several parks comprising the Australian Alps National Parks, the AALC (1994:29) stated that, "with the exception of Namadgi National Park, existing visitor monitoring systems are more 'opportunistic' than 'systematic'".

In more recent times, other technology options have developed. For example, most use-level estimates in the US National Parks Service now come from vehicle counters located on key access roads (Street, 2000). The higher population levels present in and around UK natural areas have allowed greater use of manual counting and visitor survey techniques (Cope and Hill, 1997; Cope et al., 2000). Many different counting techniques are used across different park systems in Australia (AALC, 1994), with the most common being – automatic counters, ranger observation and fee collection (McIntyre, 1999). Most agencies develop a blend of these different techniques, and some interesting new possibilities can be developed. For example, while vehicle counts are the most common technique across the State Parks of Victoria, in some places use estimates based on car counts were highly related to particular weather conditions. An inferential weather-based model and associated use-estimation formulae were applied, releasing the expensive car counters for use elsewhere (Zanon, 2001). In other cases, stratified sampling for visitor counts using observational surveys, combined with probability calculations and associated projections, may be used rather than monitoring by onsite counting devices (e.g. Gregorie & Buhyoff, 1999).

CHOICE OF COUNTER OPTIONS

All of these methods have advantages and disadvantages (Table 1), and the final selection of a visitor counting approach and technique will always be based on a necessary compromise between need for accuracy and practical capacity to measure. Assuming that appropriate management objectives have been determined for a visitor monitoring system, there are three main factors that will determine what combinations of counting techniques and sampling approaches are used: visitor use patterns, physical settings, and availability of resources.

Visitor Use Patterns

Visitor use patterns vary at different places and times, including the number of visitors, the activities they are engaged in, group sizes, and the areas and facilities that they use. These variations have different implications for counting strategies, depending on the scale of the monitoring system required. Many examples exist of different monitoring systems developed for application to individual parks as stand-alone units (e.g. Cope et al., 2000). This may be a relatively simple exercise of identifying strategic points where visitors can be counted such as key access roads or trails. Sometimes particular facilities such as visitor centres or accommodation sites can give strategic counts.

However, once visitors are within a park and are entering more remote locations, their activity tends to be widespread and diverse. Counting options become more limited, with techniques such as periodic observation combined with visitor counter devices being more applicable. These counters will not generally pick up distinctions between different visitor types and activity groups, (e.g. bikers and walkers). So in particular cases of need, specific observation programmes may be required to complement the raw visitor counts. However, collections of parks and other protected areas may be considered together, and strategic locations must be determined to represent the whole system. The strategy recommended by AALC (1995) is that a modest number of priority sites should be selected across the park system, which may be:

- places of specific management concern
- places where specific management actions are under consideration
- places which are considered representative of broader management issues.

Overall this suggests some hierarchy of visitor counts is required through a series of key index count locations, allowing some flexibility to undertake different site- and issue-specific counting as required. To maintain the internal integrity of a visitor counting system over time and allow

Observation	Descriptions – including advantages (+) and disadvantages (-)
Field observers	*Onsite recording of visit numbers by staff using hand counters or recording forms.* (+) - Accurate, flexible and mobile, can include descriptive data, can be permanent in some staffed sites, preferred means for calibration of other counts. (-) Costly in staff time, competing staff tasks and priorities, often used in unsystematic and opportunistic ways, less feasible away from permanent sites or key access ways.
Camera recordings	*Film/video onsite and visitors count carried out when returned to base. Sometimes time-lapse photography is used to give sample shots. Special cases have used aerial photograph survey samples.* (+) - Accurate, flexible and mobile, can include descriptive data, main alternative to observations for calibration of other counts. (-) - Costly and vulnerable equipment to use and maintain, staff time needed to interpret films, power requirements mean not a long-term option, less feasible away from permanent sites or key access ways, privacy issues.
Counters	
Mechanical	*Physical displacement/movement triggering an attached mechanical count device (e.g. hinged boardwalks, turnstiles, gates, doors, stiles). In some cases, the displacement of paired magnets has been used to generate counts.* (+) - Simple to build and maintain, low cost, built in to existing structures, long history of staff use and experience, can be linked to electronic loggers. (-) - Moving parts susceptible to wear, water, deformation and/or blockage, associated high maintenance, often detectable and subject to vandalism or false counts, no date/time references, specific on-site structures required.
Pressure	*Direct pressure triggering a sensor, transmitting a count to a data recording devices (e.g. pneumatic tubes, sensor cables, pressure pads, strain gauges).* (+) - Wide variety of technology for people and vehicles, can connect to variety of devices (electronic loggers, camera, video), easy to conceal, small size and weight, easier to protect from weathering, low power use, adjustable sensitivity and interval to exclude some false counts, can get time and date data. (-) - Needs careful sensitivity calibration when constructed, maybe temperature variable, limited battery life, subject to integrity of electronics, usually requires being built in to a structure.
Seismic and vibration	*Vibrations from direct pressure triggering a buried sensor, transmitting a count to a data recording devices (e.g. buried mats or tubes linked to sensor, geophones). Sonic vibrations have been investigated.* (+) - Easy to conceal, small size and weight, easier to protect from weathering, low power use, can get time and date data. No structures are needed, can be buried in paths, may identify bicycles. (-) - Soil type, compaction, moisture content, freezing and bury-depth can all affect sensitivity, as can footfall weight. Needs very careful sensitivity calibration at each site used. May undercount groups.
Active optical	*Light beams interrupted by visitor passing, transmitting a count to a data recording device (e.g. active infra-red, visible light beam).* (+) - Small size and weight, inexpensive, accurate, not temperature sensitive, long range, adjustable sensitivity and interval to exclude some false counts, can get time and date data. (-) - Needs careful alignment of transmitter and receiver (or reflector if not a through-beam system), alignment sensitive to disturbance, hard to conceal so susceptible to vandalism, lenses/reflectors may be obscured or soiled, higher power consumption, light-beam counters maybe highly visible.
Passive optical	*Change in infra-red signature triggering a count, transmitted to a sensor (e.g. passive infra-red).* (+) - Small size and weight, inexpensive, accurate, adjustable sensitivity and interval to exclude some false counts, can get time and date data, low power consumption. (-) - Variable detection range depending on object infra-red characteristics relative to background, may undercount groups if distance large, large sudden lighting changes may trigger false counts, lenses may be obscured or soiled.
Magnetic sensing	*Changes in magnetic fields from passing metallic objects, trigger a count to a data recording devices (e.g. induction loops, magnetic pads, countcards).* (+) - Small size and weight, inexpensive, loop/pad sensors buried so not easily detected, other sensor boxes/cards sometimes buried (or on surface), can get time and date data, can indicate vehicle type, adjustable sensitivity and interval to exclude some false counts. (-) - Primarily for vehicle detection (including bicycles), need sensitivity adjustment and calibration for different vehicle types and loadings, possibly needs specialised interpretative software, relatively expensive for sensor and download interface units.
Microwave sensing	*Detects changes in reflected radio waves from moving objects.* (+) - Small, can be set to detect vehicles or people, can be set to detect direction, can get time and date data, adjustable sensitivity and interval to exclude some false counts. (-) - Usually for vehicles, needs clear line of sight, set high making it hard to conceal, will undercount groups, cannot distinguish vehicle type, high power consumption, relatively expensive, not much park application to date.
Inferred	
Visit registers	*Voluntary self-registration of visits (e.g. track registers, hut books, visitor books).* (+) - Flexible and low cost, simple, can gather basic extra data, can link with safety check in/out processes, good indicator if well calibrated. (-) - Limited by voluntary basis, requires ongoing calibration, sites vulnerable to vandalism, response rates vary with site location, presentation, maintenance and advocacy, regular maintenance and checking required.
Permits Bookings Fees/charges	*Records from site or trip permits, facility or trip bookings, and of fee payments for facilities/trips.* (+) - Flexible and low cost, simple, accurate, can gather considerable extra data, can link with safety management processes, can cover concession activity clients. (-) - Permits not required in most NZ sites, non-permit visitors missed (day users, other activity groups, non-compliant visitors), applicable for areas/activities only where permits required. Bookings not required in most NZ sites, other visitors missed (day users, other activity groups), applicable only for areas, activities or facilities where bookings required. Fees only required for some facilities (huts/camps), other visitors missed (day users, other activity groups), applicable only for areas, activities or facilities where fees required, often major fee-compliance problems.
Indicative counts	*Counts of elements linked to visitor use (e.g. carpark use, accommodation, public transport, weather indexes and many other options).* (+) - May offer local calibration advantages if suitable option available. (-) - Highly opportunistic and variable potential at different sites.

Table 1: The main visitor counting options

calibration and indexing functions, some count sites should be permanent, some periodically rotating according to identified need, and others allowed on a case-by-case basis to meet particular short-term needs. This diversity of function indicates that a variety of count techniques should be available to managers.

Physical settings

The physical settings used by the visitors, and their behaviours within them will also affect what counting options are available to managers. Roads and tracks are obvious channels where visitor counts can be carried out, particularly if they are key access points. For some counting devices, locations where visitors are confined to single file are also required. Sometimes the physical layout of a visitor use system needs to be modelled to identify where different types of counts can be used.

When counter devices are being applied as the preferred counting option, as is often the case in New Zealand, climatic elements are also an important consideration. Water penetration has proven to be a particular problem for most kinds of counter devices, corroding metallic components and destroying electronics. If combined with sub-zero temperatures, the freeze-thaw cycles can seriously damage the structural integrity of counters. While low temperatures can reduce battery life, high temperatures may cause warping and deformation of structures holding counters. Sometimes mechanical parts may be jammed through soil or ice intrusion, or count sensitivity reduced by snow or run-off soil cover, leading to serious under-counting. And where such counters can not easily be concealed (e.g. unforested settings) problems with vandalism and tampering have been commonly identified.

Overall, the physical demands placed on counters in outdoor environments require that they be water-resistant, discreet, robust and include few if any moving parts.

Availability of resources

The main limitation to developing a visitor counting system will be the availability of staff and funding resources to operate a system. In the past many agencies have not identified the systematic collection of visitor data as being as high a priority as the collection of other biophysical data (AALC, 1994; Cope et al., 2000; Loomis, 2000;). This situation is changing as the importance of visitor data is being more widely recognised, and it’s collection is more often systematically planned. For example, a very specific implementation program has been developed and applied incrementally in the Australian Alps National Parks over the last 10 years (AALC, 1994; 1995).

No matter how much funding is made available, the high number and diversity of places used by visitors across park management systems means that some compromise, in the form of a sampling solution, will always be required. Improved efficiency in counting accuracy, operational costs, strategic sampling strategies and data management processes will maximise the utility of a visitor monitoring system. The important point is that the visitor counting task must be seen as being only one component of a complete visitor data management system driven by a series of specific management objectives (AALC, 1994; 1995; Hornback & Eagles, 1998; McIntyre, 1999; Watson et al., 2000;). Such a system, based on traffic counts, has been established over the last five years in South Australia. This features a central reporting system, a standardised set of traffic counters, customised software interfaces, staff training procedures, and the capacity to integrate data from other monitoring modules when developed (NPW, 1999).

PREFERRED COUNTER FEATURES

Once the three main factors above have been addressed, the questions for managers then become which counting options to use. Given the nature of visitor use of New Zealand conservation areas, where permit and fee systems are rare, staff and resources are widely spread, electricity supply is absent, vehicle access is limited and environmental conditions are often harsh and variable, there is particular emphasis on having good visitor counters in the field. While the requirements of the overall visitor management system are the key determinants of data needs, sampling strategies, and the associated resource allocations for locating monitoring effort, park managers in New Zealand have also developed considerable experience in the actual operation of such counters. When asked what features they consider important in visitor counter hardware, their responses have been largely consistent (Raine & Maxey, 1996), and in accordance with similar managers overseas (Gaveda, 1999; Watson et al., 2000). The desired features commonly include:

- high portability
- lightweight construction
- accurate counts
- low maintenance
- low cost
- robust
- easily concealed
- low power consumption
- water resistance
- tolerant of temperature variations
- minimal moving parts or electronics.

Simplicity was a consistent theme. In some cases reservations were expressed about the value of having more sophisticated systems collecting more detailed data, due to the greater vulnerability of the hardware and software involved. “The responses also suggested that complex systems with cameras and date-stamps are not in demand”

(Gaveda, 1999:3). Furthermore, "The most surprising result of the survey was that enthusiasm for more sophisticated data collection came quite low on the series of priorities for counter performance. DOC staff cared much less for direction-of-travel and time-based data logging than they did for accurate, reliable performance" (Raine & Maxey, 1996:9).

Such preference for simplicity and reliability reflects the previous experience of managers with counter development. Manager accounts of their experiences with different types of counters (Raine & Maxey, 1996) show a highly variable success rate, with many examples of hardware and software failure. Manager preference for simple systems is therefore understandable, and there is often warranted scepticism about the promise of better results from new technology.

In addition, the purpose of the counts has not always been clearly specified, nor has any integrated data management system usually been available to collate count data and provide reporting options back to park managers, or to other potential users of the data. This failure to ensure data delivery back to managers in a practically useful way has added to scepticism about the value of visitor counting, counting devices and count modelling systems, and sometimes reduced commitment to their applications.

Recent developments indicate that this situation is changing, as shown by the development of new counter options and more integrated data management systems in Australia (NPW, 1999), and New Zealand. The remainder of this paper describes recent progress made in New Zealand in developing visitor counters and an integrated counting system.

NEW DEVELOPMENTS IN NEW ZEALAND

Two separate streams of work in the DOC have converged to provide the basis for an integrated visitor counting and reporting system. The first has been development of the Visitor Asset Management System (VAMS). The second has been initiation of a visitor counter development project within the Science and Research Unit of the DOC. Both are required to provide an adequate basis for the application of any visitor flow modelling tools.

Data integration through the VAMS

The VAMS is an interactive database based on key management information about the approximately 4000 designated visitor sites throughout the 30% of New Zealand's land area managed by the DOC. Each specific site may be referenced individually from the database, and there is extensive site-specific information attached to each site. This includes the physical condition of the site and any facilities provided at it, the recreational setting and social values associated with it, and any management prescriptions and task scheduling required. The system is designed to allow new information fields to be added as required, including visitor count information. This provides a practical template for storing, accessing and reporting on visitor count data. Data may also be accessed in different ways from the central database to allow wider analysis processes.

Current development of these data management processes in VAMS accompanied by development of new visitor counter hardware, and associated data download and transfer software. This download and transfer function is provided through a handheld data logger (PSION Walkabout) to which count data may be downloaded from counters in the field, and transferred to the central VAMS database.

New Visitor Counter Development

Based on literature review, personal experience, and feedback from park managers, many of whom had experience of developing their own counting options in the past, the preference was for developing on-site counters as the basis for a counting system. Four distinct types of counter units were identified as being necessary for covering the general range of DOC visitor counting needs (Table 2). Where necessary for counter calibration checks and count projections using visitor flow models, these could be supplemented by other counting options, as described in Table 1.

A need for case-specific counter options was also identified for meeting more specialised management information needs, such as finding use levels for particular facility types (e.g. toilets) or visitor groups (e.g. mountain bikes). However, these were considered secondary priorities in the counter development process, and will be addressed on a case-by-case basis as required.

Developing the step counter

The step-counter was the first unit to be developed, and this has incorporated development of most of the data logging and VAMS integration software that will be required for operation of the other units. It is simply a modified wooden board incorporating a pressure sensor, and is placed on tracks as a frontboard in the lowest step in earth-filled or fully wooden step sequences (Figure 1). Its' development was based on video recordings, field observations and research generalisations (e.g. Irvine et al., 1990; Templar, 1992; Crosbie, 1996), that in a series of steps in a stairway:

Counter Units	Proposed Setting and options
Step-Counter	Pressure-sensor built in to the vertical front-board of a back-filled earth step or multi-step structure. On a wide range of tracks from frontcountry to remote backcountry. *Development action –design new unit*
Boardwalk-Counter	Pressure/strain-sensor built in to a boardwalk path or bridge structure. On a range of tracks - mainly in the high-use frontcountry and the more developed backcountry areas. *Development action – design new unit*
Path-Counter	Pressure/vibration sensor buried under a hard path surface, or infra-red detection across it. On high use tracks with priority on full access (e.g. wheelchairs, prams, disabled, elderly - steps or boardwalks not present). *Development action – new application of existing units*
Vehicle-Counter	Pressure, vibration or inductive loop-sensor buried under road surface, or built into road structures such as bridges or culverts on strategic roads. *Development action – assess new design or new application of existing units*

Table 2: Counter types, settings and development options.

- Almost all walkers stand on the leading edge of the last step down, and almost none extend their stride to stretch over the leading edge from further back on the stair tread.
- Most walkers use the first step up and stand on the leading edge, and both these behaviours increase with increased stair height.
- Walkers scan ahead and hesitate to adjust their stride to the first step in an up-stair sequence.
- Preferred stair heights are 20-22cm, with greater step height increasing 'hits' by people on the leading edge.

The simple design and installation requirements of the step-counter has resulted in a robust unit that is simple, water proof, has no moving parts, and is relatively cheap (under € 300). Yet it also includes electronic capacity to store many thousands of records, including the date and time of each count made. When installed and operated according to instructions, the counter has proved to consistently and reliably produce a high 'hit rate' of counts. From visual and video-based field observations, around 95% of people descending, and 80% ascending consistently stepped on the counter. This gives an effective overall 'hit-rate' between 85-90%. Based on these observations, and feedback from field managers, the contact area on the leading edge of the step was increased in width to increase the hit-rate further.

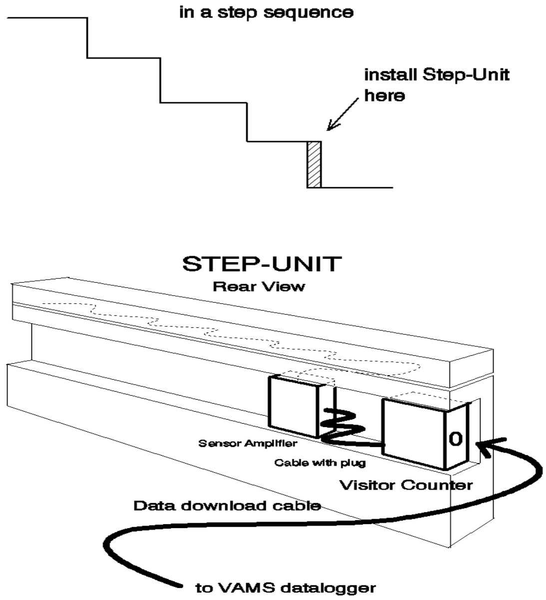

Figure 1: Step Unit construction and placement

While it must be acknowledged that such a counter can never be 100% accurate, the key point is that any discrepancy will be largely constant, and can be estimated using field calibrations. As long as any error is found to be consistent, its size is less important.

Other counters and applications

Work is underway on a counter design to be installed in the wooden boardwalks that are commonly used to protect sensitive soils and vegetation, or are provided as bridges over small streams. With the availability of step counters, and new boardwalk counters, a practical visitor counter option will be available for most of the tracks provided in natural areas by the DOC. In addition, passive infra-red detection units are currently being evaluated as the basis for development of a path-counter option. These will provide coverage of those more developed tracks where steps and boardwalks are not required. Work on vehicle counters has not yet commenced, as commercial units are available, and some count data can also be obtained from road management agencies. However, more site-specific information needs at access points to natural areas will require further development of more cost-effective vehicle counters.

The component software required for count logging, data downloading, integration into the VAMS database, and output reporting is being completed. This provides a complete link between counts taken in the field and data being available online to park managers. As the other counter options become available (e.g. path and vehicle), the effective coverage of visitor counting needs will increase to a wider range of sites. These developments will be reported on as they are completed.

CONCLUSIONS

The development of new counter units and associated data management systems is providing a more reliable and practical mechanism for park managers to collect visitor count data. However, even with correct counter installation, some error in counts is inevitable. These are acceptable as long as they are checked using field calibrations of observed and logged counts, the error levels found are relatively constant, and that the appropriate corrections are applied to the counts.

All of this work represents development and refinement of the counting mechanisms. However, only a small sample of the sites managed by the DOC can practically be monitored with these mechanisms. These must be selected according to a deployment strategy that provides representative coverage, and allows indexing and extrapolation of counts into wider visitor flow systems. This is the other main stream of work required to provide a comprehensive visitor counting system to park managers, and is currently being investigated.

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Predicting transgressions of the social capacity of natural areas

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Abstract: Within the urbanized Dutch society, the social function of forests and nature areas is becoming more and more important. The same holds for agricultural areas. However, planning and management tools for this social function are almost absent. This paper presents a tool to be used by policy makers at regional and higher levels. By means of a normative analysis the local supply of and demand for nature-based recreation are confronted with each other. Because of its normative nature, the analysis does not offer a good description or prediction of actual recreational behavior. However, it does offer insight into where, according to the policy norms, the local supply of nature-based recreation opportunities cannot accommodate local demands. The method has been applied nation-wide and outcomes are momentarily used to substantiate spatial claims to develop new recreation areas.

INTRODUCTION

Besides their ecological function, the social function of forests and nature areas is becoming more and more important in the Netherlands. This is signified by the title of the new act for nature management: "Nature for people, people for nature" (LNV, 2000). Also agricultural areas are changing from production to consumption spaces. However, data, norms, and planning tools for the social function are almost absent. This makes it difficult for policy makers to do justice to this function, especially in the Netherlands, where spatial claims for different functions often exceed the available amount of land. In this paper we will describe the development and use of a planning tool for the recreational function of forests and nature areas, as well as agricultural areas. The tool is intended to serve policy makers at regional and higher levels.

In this paper we will limit ourselves to the two most popular outdoor-recreational activities in the Netherlands: walking and cycling. Although these activities sometimes take place in a built-up environment, green environments are generally preferred. This is why in Dutch recreation policies the accommodation of the desire to undertake this type of activity in a green or natural environment is a common goal. Moreover, since it is seen as a basic type of amenity, this desire should be accommodated at a local level. Furthermore, meeting local demands at a local level is thought to help to minimize leisure mobility (by car).

The above policy goal raises the question when the local supply of nature-based recreation opportunities may be considered sufficient to cover the local demand for this type of opportunity. In this paper a method to answer this question is described, as well as its nation-wide application. For an extensive description of the method the reader is referred to De Vries and Bulens (2001).

The structure of the paper is as follows. To begin with, the inventory of the local supply of nature-based recreation opportunities is presented. This includes the normative determination of its social capacity. Second is the presentation of the local demand assessment, especially on the norm day: the day on which supply and demand should be in equilibrium. This is followed by the procedure for the confrontation of supply and demand. Fourth the outcomes of a nation-wide application of the method will be reported. Finally, the method and the practical usability of its outcomes will be discussed.

THE SUPPLY INVENTORY

The basis of the supply inventory is the GIS-database on land use of Statistics Netherlands (CBS). In this database 33 types of land use are distinguished. However, not all of these types have a reception capacity for nature-based recreation in the form of walking and/or cycling. Criteria that were used to decide which land use types had a positive capacity for land-based outdoor recreation are the following:

- it should be a predominantly green area with some significance for outdoor recreation
- by and large the type of land use should be publicly accessible
- 'man-made' attractions should not dominate the area; it should be a resource-based facility
- the reception capacity of the area should be significant

All infrastructure types were assigned zero capacity, even dirt roads. The latter may be of recreational significance, but capacities are assigned to areas (that may include recreational infrastructure). Areawise the small roads themselves are of little significance. Residential areas were also assigned no capacity. Although they may be used for recreational activities, they were not considered green enough. Campgrounds and other types of holiday resorts were excluded because in general they are not open to the public.

A few refinements were made with regard to the remaining types of land use. To begin with, all nature areas that are known to be (completely) closed to the public, were also assigned zero capacity. A GIS-database compiled by Goossen and Langers (1999) was used for this purpose. The most important refinement deals with the category "areas for agricultural use, with the exception of cultivation under glass". As one might imagine, this is a quite extensive and diverse category. That is why it was split up into six subcategories.

It is known that not all types of agricultural area are considered equally attractive for recreational use. Especially very open areas are not very well liked as an environment for walking and cycling (see Renemann et al, 1999). Using a GIS-database developed by Dijkstra and Van Lith-Kranendonk (2000) agricultural areas with 95% or more low cover were defined as open agricultural land. The remainder was considered enclosed agricultural land.

Considered even more important was the density of the recreational infrastructure: quiet country roads, dirt roads, cycle and footpaths. Goossen and Langers (1999) developed a GIS-database that describes the density of this type of infrastructure for the Dutch countryside. It was decided to distinguish three levels of density: low, medium, and high. The average density in these three categories was 13, 37, and 74 meters per hectare. The three density levels were crossed with the two openness levels to create six categories of agricultural land.

Assigning capacities to land use categories

Before assigning capacities, first we have to determine what we mean by the term 'capacity'. Different types of capacity may be distinguished: social, ecological, physical, traffic. We defined capacity as the maximum acceptable user intensity of an area, predominantly from a social point of view. We placed an upper limit on this capacity: it can never be higher than the maximum user intensity that can be expected given an ample supply of the type of area. This proviso has been made to prevent that a capacity that 'technically speaking' is available, but will never be used in practice, will unduly influence the analysis. This may happen in case of low quality areas.

The capacity of a type of land use is expressed as the maximum acceptable number of people that can make use of this type of area per day, per hectare. Most of the capacity figures are derived from previous studies (LNV, 1984; Provincie Zuid-Holland, 1999). Only for agricultural areas the figures are based on the maximum number of people willing to recreate in this type of area, rather than the number of people that could 'technically' recreate in this type of environment. The density of the recreational infrastructure was considered a major factor.

In second instance the capacity figures, which used to be for the combined category of activities, were split up for walking and cycling. This was done according to best professional judgement. Although the exact division is open to discussion, it was thought helpful to be able to make a rough distinction between opportunities for walking and opportunities for cycling. In table 1 the capacity figures for different categories of land use are given in terms of the number of recreation places it offers.

Land use category	**Walking**	**Cycling**
wet natural	3	1
dry natural	6	2
agricultural (excl. greenhouses)		
- high density infra & open	0.3	0.9
- high density infra & enclosed	0.6	1.8
- medium density infra & open	0.1	0.5
- medium infra & enclosed	0.2	1.0
- low density infra & open	0	0.2
- low infra density & enclosed	0	0.4
Forest	9	3
Beach	8	0
city parks & green areas	8	2

Table 1: capacity figures for different types of land use (number of persons per day per hectare).

Some of the land use categories were also assigned capacities for other types of activities, such as sitting, playing & sun bathing. Parks, for example, were assigned a capacity of 90 for this more stationary type of activity. Specific recreation sites (within a larger recreation area) were assigned a capacity of 100 for this type of activity. However, for a large part these recreation areas consist of forest or nature areas, and were assigned capacities for walking and cycling accordingly.

THE DEMAND ASSESSMENT

In the demand assessment differences between people are not taken into account. This does not mean that such differences do not exist. However, a study by De Vries (1999) has shown that already at the level of small residential areas the population tends to be so heterogeneous that these differences average out to a large degree. As a consequence, only demand characteristics for the average Dutchman are needed as input. By multiplying this with the size of the population of a residential area, the total demand originating from that residential area is known. We will start with the latter.

Because the analysis takes place at a local level, the residential areas should be small is size. For this reason neighborhoods were chosen as spatial units of origin. The Netherlands is divided into over

10,000 of such neighborhoods. The average size is about 340 hectares. Statistics Netherlands (CBS) offers a register that includes the number of inhabitants of each neighborhood, as well as a GIS-database with the neighborhood boundaries. For the present situation the 1995-version of this database was used.

Since the supply capacity is defined on a daily basis, the demand for recreation opportunities also must be expressed on a daily basis to allow for a confrontation. However, while the supply capacity remains more or less the same for all days of the year, this obviously does not hold true for the demand. On some days the demand is much higher than on other days. That is why a norm day must be decided upon. This is the day on which supply and demand should be in equilibrium. Confrontation on a yearly basis does not seem very useful, since then days with overuse and days with underuse may average out. Traditionally the fifth or the tenth busiest day is chosen as norm day. We have chosen the fifth busiest day.

The percentages of the Dutch population that participate in the activities walking and cycling on this fifth busiest day have were derived from empirical material as far as possible. Two sources were used. On the one hand this was the 1995/'96 day trip study of Statistics Netherlands (CBS, 1997). This study offers data on day trips that last at least two hours (including transport). The average yearly number of such day trips with walking as the dominant activity is 4.3 (including jogging). The yearly average for bicycling is 2.8. These figures include non-participants.

Based on previous studies, it was assumed that 1.2% of the total yearly number of trips for this type of activity will take place on the norm day (Goossen & Ploeger, 1997). For walking and cycling combined, this is 8.6 % of the population (see also Provincie Noord-Holland, 1996). This leaves us with one problem: not all trips with walking or cycling as the dominant activity will last two hours or longer. And also, or especially, the short trips will make use of the local supply of recreation opportunities. This means that these short trips have to be added to the long trips. The assumption is made that after adding the short trips to the long trips the norm day will still be the same day.

The number of short trips to be added was determined using a different study, performed by the province Zuid-Holland (1998). In this study a sample of the population of this province was questioned regarding its recreational behavior on three days that were likely candidates for the norm day, namely sundays in the late spring with reasonable to good weather conditions for the time of the year. These data suggested a ratio of long to short trips of about one to one. Using this ratio, the participation percentages on the norm day would be 10.4% for walking and 6.7% for bicycling.

An alternative way of arriving at norm day percentages was based solely on the study of the province Zuid-Holland. This province conducted the same study twice: once in 1993 and once in 1997. In each year the figures for two sunny sundays were available. Averaging these figures over both sundays and both years led to the following percentages: 11.4% for walking and 6.2% for cycling. Compared to the previous figures, the participation rates are a little bit higher for walking and a little bit lower for bicycling. However, the province Zuid-Holland is among the most highly urbanized within the Netherlands. The aforementioned day trip study of the CBS shows that in highly urbanized areas there is a tendency to walk somewhat more and bicycle somewhat less, compared to the national average. That is why it was decided to stay with the first figures: 10.4% for walking and 6.7% for bicycling.

THE CONFRONTATION

By far the easiest way to perform a demand-supply confrontation would have been to look at the number of inhabitants of, for example, a municipality, and to confront this with the recreational capacity available within this same municipality. However, such a confrontation has several drawbacks. To begin with, not all municipalities have the same size. In the Netherlands sizes may differ by a factor 50! Furthermore, in such an analysis people living in a small, rather urban municipality would not be 'allowed' to make use of the excess capacity of a neighboring, more rural municipality. That is why a different type of procedure was chosen. This procedure will be described below.

The neighborhood was chosen as the smallest unit of origin. Using the center of a neighborhood as point of origin, a norm distance was selected. This is the distance within which the local supply should be sufficient to accommodate the local demand. In the present analysis the norm distance was set at 10 kilometers (airline). This is the average of the maximum distance from home after one hour of walking (5 km) and that for cycling (15 km) at a leisurely speed (by road). Another hour is required to get back home. A maximum trip duration of two hours, excluding the time used for stops along the way, is thought to cover the vast majority of the walking and cycling trips made by the Dutch. Note that transport by car to an attractive destination area is not included in this normative analysis. Consequently the time spent on traveling by car, or another form of motorized transport, should not be taken into account when determining the trip duration.

The next step was to determine the capacity that was available to each inhabitant of a neighborhood within this norm distance. However, there is an important distinction between the capacity that is within reach, and the capacity that is available on a per capita basis. For the latter it does not suffice to merely divide the total capacity present within the

10-kilometer zone by the number of inhabitants of the neighborhood. The same supply unit may also be within reach of other neighborhood centers. And the same capacity should not be allocated twice, or even more often.

To avoid this, we started our analysis at the supply side. First the GIS-data concerning the supply were converted from vector to grid format for ease of calculation. Gridcells of 25x25 meters were used, because some categories of land use are characterized by quite small continuous areas but very high reception capacities (e.g. parks). The reception capacity of such a gridcell is 625/10000 that of a hectare. The centers of the neighborhoods were also converted from a point into a grid theme. Next, for each supply cell it was determined which neighborhood centers were located within 10-kilometer distance of this cell, and what the total number of inhabitants of these neighborhoods was. Subsequently the capacity of the supply cell was divided by this total number of inhabitants. Finally, these per capita capacities were summarized for all supply cells within 10 kilometers of the center of a neighborhood. This cumulative figure gives the available capacity per person within the neighborhood. The above procedure was performed for each activity separately.

On a more technical note, the whole procedure was performed within ArcView, extended with the Spatial Analyst module. Especially the neighborhood statistics available within this module have been used. Scripts were written to make the analysis easy to repeat. The outcomes for each neighborhood were stored in new variables added to the attribute table of the neighborhood theme, one for each activity. This made them available for subsequent analysis.

If the available capacity per person for a given activity equals one, then for every person in the neighborhood there is a place to participate in this activity. To be more specific: a place within 10 kilometers of his or her neighborhood on every day of the year, without that social capacities are transgressed. However, since not all inhabitants will participate in the given activity on the same day, lower amounts of available capacity are acceptable. In fact, if we express the available amount per capita as a percentage of one, we have a supply figure that may be directly confronted with the participation percentage for the activity on the norm day.

By subtracting the supply percentage from the demand percentage neighborhoods with insufficient local supplies may be identified. In those cases the percentages are positive. By multiplying a positive percentage with the number of inhabitants of the neighborhood, the size of the deficit may be determined. This more or less completes the description of the confrontation procedure. A final note is that the procedure allows for the deficits of the neighborhoods to be aggregated to larger spatial units of origin, such as municipalities.

THE RESULTS

Using supply data for 1996 en demand data for 1995, supply and demand were confronted according to the procedure described above. In first instance the confrontation was performed for walking and cycling separately. In second instance the confrontation was repeated, but now under the assumption that walking and cycling are perfect substitutes for each other. This implies that a lack of supply for walking may be compensated by an excess supply for cycling.

A first result of the procedure is the available capacity per capita. Figure 1 shows a map for this characteristic when walking and cycling are assumed to be perfect substitutes. In this case the required capacity per capita is 17.1%. Not surprisingly, the capacity per capita is lowest in the most urbanized areas of the Netherlands. By multiplying the positive values of this characteristic that remain after subtracting the required 17.1% with the number of inhabitants, deficits in terms of recreation places are determined.

Table 2 shows the deficits for the Netherlands divided according to the four quarters (see figure 1). Clearly the deficits for both activities are highest in the West quarter: this quarter comprises over 90% of the total deficit in the Netherlands. Furthermore it may be pointed out that assuming a perfect substitutability between walking and cycling does not help much in reducing overall deficits. Presumably there are only a few regions in which a large deficit for the one activity can be compensated for to a considerable degree by an excess supply for the other activity.

Quarter	**Walking**	**Cycling**	**Substitutable**
North	19,800	0	4,300
East	3,000	0	300
West	338,200	169,800	488,300
South	15,200	1,600	8,700
Total	376,300	171,400	501,500

Table 2: Deficits for the four quarters of the Netherlands in 1995, using a 10-km norm distance (number of recreation places) .

To assess the sensitivity of the outcomes with regard to the norm distance, the analysis was repeated using a distance of 5 kilometers. The results show that although the deficits increase, the increase is rather small, given that local demands now have to be satisfied within a much smaller action radius (see table 3). While the potential supply surface decreases by a fourth, a national map (not presented here) indicates that the deficits increase mainly in regions in which isolated cities are found. When the region as a whole is quite urbanized, deficits now are more concentrated within the larger cities. On the other hand, in the residential areas just outside the 5-km reach of big cities deficits become smaller. There is a relocation of deficits, rather than an overall increase.

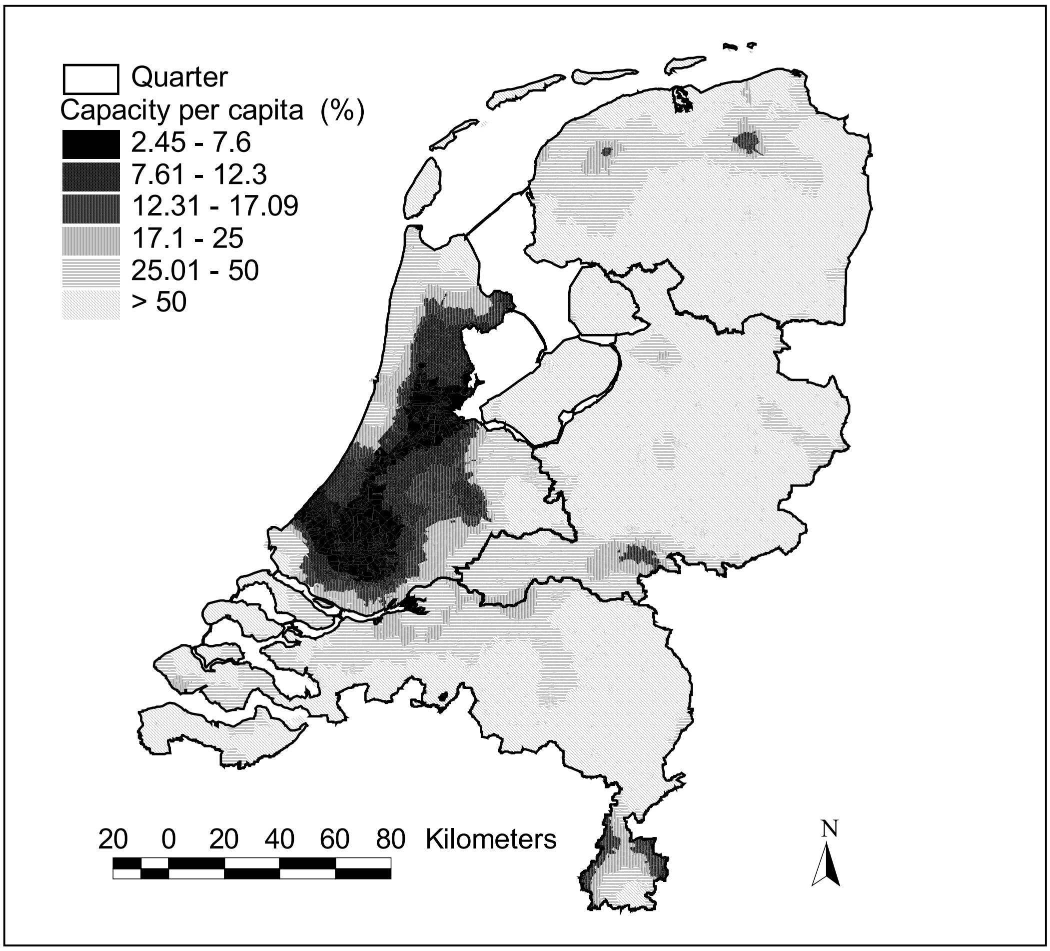

Figure 1: Available capacity per inhabitant for walking and cycling (when substitutable) in 1995, within a 10-km distance (by neighborhood).

Quarter	Walking	Cycling	Substitutable
North	28,200	4,900	22,400
East	21,200	2,600	14,800
West	378,400	188,300	535,600
South	40,000	9,900	37,700
Total	467,800	205,800	610,500

Table 3: Deficits for the four quarters of the Netherlands in 1995, using a 5-km norm distance (number of recreation places).

In first instance the deficits are expressed in terms of recreation places. They may be translated into deficits in terms of hectares. The conversion ratio depends on the type of land use. Suppose we use forests, as one of the most efficient land use types, to reduce the deficits that result when using a 10-km norm distance. In that case the amount of new forests required to eliminate all deficits within the Netherlands for walking & cycling under the substitutability assumption is (501,500/12 =) about 41,800 hectares. One should remember, of course, that usually new forests are not located on new land, but replace another type of land use. The recreational capacity of the afforestation area according to its present type of land use should be subtracted to get the correct figure for the gain that is realized.

DISCUSSION

In this paper a method to assess to what extent the local supply of recreation opportunities can accommodate the local demand for such activities has been presented. An important criterion to judge any new method, is its validity. Are the outcomes generated by the method valid? In answering this question it should be kept in mind that the present analysis is a normative one: it does not aim to describe actual recreation behavior as accurately as possible. This implies that empirical figures regarding actual behavior are not the ultimate criterion to decide on the validity of the method. Moreover, to the degree that the method is descriptive of actual behavior, it may become impossible to detect deficits: 'ought' and 'is' will coincide more and more.

On the other hand, if large deficits have no effect on the local population whatso ever, one may question the reason to match local supply with local demand. Although the latter is a policy issue rather than a scientific one, we would like to suggest a number of possible effects. We will only discuss 'direct' effects, i.e. concerning recreational experiences and behavior. To begin with, recreational behavior may not be affected by the supply to demand ratio. In that case more people than is considered desirable will make use of the local supply of opportunities. This may affect the quality of the recreational experience. Quietness is known to be highly valued aspect of the outdoor recreational experience (Reneman et al., 1999).

Recreational behavior may be affected by a bad local supply situation in at least two ways. People may participate less often, or they may decide to recreate further away from home. Empirical evidence from a study by De Vries (1999) clearly shows that a bad local supply situation (according to objective criteria) leads to a significant increase in car mobility. Moreover, the areas that show the largest deficits in the present study are by and large the same ones that are judged as poorly by Dutch citizens in this previous study. In this respect the face validity of the method seems high.

Other aspects of validity are robustness and reliability. To start with the latter, the method is highly reliable as far as the supply input data are concerned. The land use database is fairly accurate. As for the capacities assigned to each type of land use, this is a normative choice, not an empirical fact. The demand input data are somewhat less reliable. This is not because of the number of inhabitants of a neighborhood, but because of the participation rates on the norm day. Although the CBS day trip study is thought to yield reliable results, this study only deals with day trips that last at least two hours (including transport). The number of trips shorter than two hours had to be estimated. However, since two procedures to arrive at the total number of trips generated quite similar results, we feel confident that the demand input data are quite acceptable.

As for the choice of the fifth busiest day as norm day, once again this is a normative choice. However, indications based on a study by Visschedijk (1997) suggest that using the 10-th busiest day would not have led to drastically lower participation rates. For several forests, the number of visits on the 10-th busiest day seem to range between 0.85 and 0.90 of that on the 5-th busiest day. Of course, this not only benefits the reliability of the method, but also its robustness. Regarding this robustness, in this paper it was shown that halving the norm distance did not affect the outcomes as much as one might have expected beforehand.

Probably the method is the most sensitive to changes in the capacity assigned to the six categories of agricultural land use. As a whole, the category of agricultural land use is by far the largest in terms of the number of hectares concerned. Consequently, changing the capacity of this type of land use a little will already have a large impact on the supply capacity in many areas. For example, according the figures used here, the average capacity per hectare of agricultural land in the province of Zuid-Holland for walking and cycling is 0.8. The province itself uses a figure of 1.7 (Provincie Zuid-Holland, 1999). This results in a difference of more than 100,000 recreation places, or more than 8,000 hectares of forest.

The assigned capacities are normative figures: they are thought to indicate the social capacity of an area. However, the fact that they are normative, does not mean that the values are arbitrary. The logic is mainly based on the (expected) density of the recreational infrastructure and the visibility of other (recreational) users of the area. This is the reason for the high capacity figure for forests: a high density of infrastructure, combined with a low visibility of other users. This line of reasoning has also led to wet nature areas having a lower capacity than dry nature areas. However, the exact figures to be used remain open for discussion.

It may be noted that the method described here only deals with a quantitative confrontation of supply and demand. It gives an answer to the question whether there is enough space to accommodate the local demand for recreation opportunities. It tells us little about the quality, or attractiveness, of this space. In general a higher capacity per hectare is not meant to indicate a higher attractiveness. This is only the case for open versus enclosed agricultural areas, because here supply may easily exceed demand. Apart from this, recreation places are assumed to be substitutable regardless of the type of land use that generates them. Of course the method could be refined. For example, we could demand that at least 50% of the demand has to be satisfied by recreation places generated by forests and nature areas. This would be a first start to bring quality considerations into the play. Differences in attractiveness within a specific land use category are more difficult to take into consideration: these would require addition data.

After having discussed the validity and the limitations of our method, a next question is its practical usability. It it of use to our target group: policy makers and spatial planners at regional and higher levels? We are confident that it is. In a small country such as the Netherlands the spatial claims of different sectors (housing, infrastructure, industry, agriculture, nature, recreation) often exceed the available amount of land. This makes it important to be able to substantiate these spatial claims. It is also important to be able to quantify the claims. This is exactly what our method offers. For this reason the outcomes of a prognosis for the year 2020 according to this method, are being used by the Dutch Ministry of Agriculture, Nature Management, and Fisheries, under whose competency outdoor recreation falls.

Furthermore the method also shows where the supply deficits are largest. This makes it possible to evaluate the efficiency of spatial plans in reducing these deficits. This efficiency is not only affected by the type of area (land use), but also by the location of the new areas. Momentarily such an evaluation is performed for the province of Noord-Holland. Preliminary results suggest that not all planned recreation areas are optimally located in this respect.

In short, the fact that this newly developed method is already being used intensively, confirms it is of practical use. This does not necessarily imply that the method is a very good one (although we tend to think it does pretty well). It is also the case that up till now it is more or less the only one in its kind (as far as we know). Its use therefore also demonstrates the need for methods and tools to help policy makers and spatial planners to do justice to the social function of green spaces.

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Monitoring and Management of Visitor Flows in Recreational and Protected Areas
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GIS-Supported Network Analysis of Visitor Flows in Recreational Areas

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Abstract: The application of GIS tools for visitor monitoring facilitates a profound analysis of visitor flow patterns. Giving a visual impression of the distribution of visitors within an area via maps, interpretation of visitor use data is much easier and better. Furthermore, a GIS also allows to determine and analyse quantitative parameters of visitor use such as trail and visitor density. These parameters can also be used to characterise and compare different areas within a park. With a standardised approach, also comparisons between parks can be realised. Therefore, GIS is increasingly used in the area of visitor monitoring to assist recreation planners and park managers in their everyday work. This paper demonstrates how a GIS-based trail network analysis was used in the framework of a visitor monitoring project in the Danube Flood Plains National Park, Austria.

INTRODUCTION

Recreational areas located close to big cities are often used by high numbers of visitors and show a highly diverse visitor structure. As visitor numbers increase, there is a simultaneous increase in environmental impacts, crowding, and conflicts between different recreational types and users. Additionally, modern leisure activities and behaviour of visitors do often not fit traditional concepts of recreation. Therefore, an intensive monitoring of visitors in these areas in needed, in order to be used as prerequisite for successful and effective management.

Network analyses based on Geographic Information Systems (GIS) offer a possibility to analyse spatially referenced data describing traffic flows. While they have been used in road traffic planning for a long time, they have only rarely been applied to recreation planning and analysis. Here it is a very useful tool to trace out areas of potential conflicts between recreational use by visitors and the needs of fauna and flora (Volk, 1995, Roth et al., 2000), as well as conflicts between different groups of visitors having complementary interests or simply crowding too much. Once these conflicts and their potentials are recognized, the recreational infrastructure and the management scheme can be adequately adopted.

STUDY AREA

The Danube Floodplains National Park is situated east of Vienna, the capital city of Austria, with a population of about 1.6 million. One part of the national park, the Lobau, actually lies within the city boundaries of Vienna. The national park extends about 50 kilometres along the Danube river from Vienna to the border of Slovakia. In 1997, the Danube Floodplains were declared a National Park, and received international recognition in the IUCN category II. The Park is used predominantly by the Viennese and Lower Austrian population for everyday recreation purposes.

In order to deal effectively with the high number of visitors, the park management needs in-depth information on the leisure and recreational usage of the area. Therefore, the Institute for Landscape Architecture and Landscape Management at Bodenkultur University Vienna, commissioned by the Vienna City Council, forest department, and the National Park Administration, collected data on the number and structure of the visitors to the area as well as their spatial and temporal distribution.

METHODS

Investigations on the recreational use of the Viennese (western) part of the national park were conducted in 1998 and 1999. Between June 2000 and May 2001, visitors were also monitored in the Lower Austrian (eastern) part of the national park. Various different methods were applied for the monitoring of the visitor activities: permanent long-term video monitoring over one year, short-term visitor observations, interviews as well as route registrations.

Permanent time lapse video recording, installed at highly frequented access points, gathered information about the number of visitors entering and leaving Lobau from dawn to dusk.

At the main access points into the park visitors were interviewed about their motives, activities, expectations etc. The interviews took place on either four or eight days, at each case a Thursday and the following Sunday, once in each season. In order to obtain high data volumes, the survey was conducted on days of fine weather. In addition, at the same time also the total number of visitors at the main entrance points was determined. This temporally selective counting was combined with video monitoring data for extrapolating to the total number of visitors per year.

As part of the survey, visitors were asked to mark in a simple map the route through the national park, which they took or planned to take (see also Wang et al. 2000). All the trails contained in the Austrian topographic map 1:50.000 were considered. The trail network was digitised and the route information from the interviews was spatially referenced and stored into a database. In a first step, all records have been checked for topologic consistency (e.g. contiguous route segments). By linking the route data and interview results with the help of the Access database, an analysis by topic was possible and the respective number of visitors per segment of trail could be made visible on maps of the study area (Hinterberger, 2000).

RESULTS

Distribution of visitors

Figure 1 gives an overview of the spatial distribution of visitors within the Lobau. The map shows the parts of the park with high or low use levels. Heavily frequented paths could easily be identified and potential conflicts between user groups as well as between nature conservation and recreational goals were allocated. By linking the route information with other interview data, an analysis of routes by access point was possible.

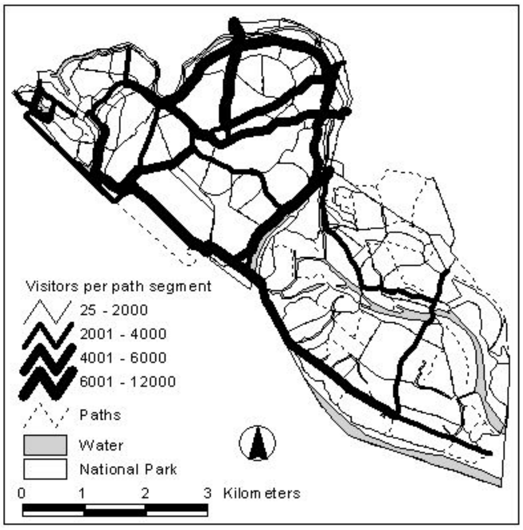

Figure 1: Spatial distribution of visitors in the Viennese part of the Danube Floodplains National Park, on 8 counting days

Figure 2 shows the routes of the visitors entering the Lobau at three selected entry points. At the entry point ‘Essling’ a settlement is very close to the national park. The visitors entering there are mainly staying in the area very close to this access point. The analysis of the questionnaire also showed, that these people are predominantly hikers and regular visitors. At the access points ‘Uferhaus’ and ‘Lausgrund’, in contrast, more bikers were observed. This is also reflected in the spatial patterns of routes reported by visitors passing these two observation points. The routes are fairly long and show high frequencies along the official bike trails within the national park. The video observation showed furthermore, that the numbers of visitors observed at these two stations are highly correlated, which is also represented in the routes.

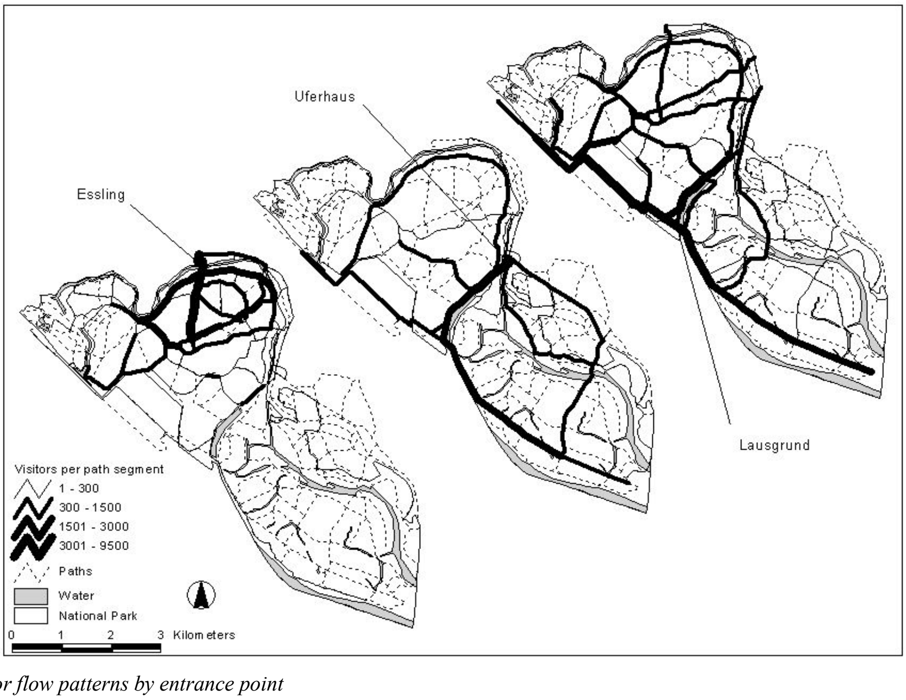

Figure 2: Visitor flow patterns by entrance point

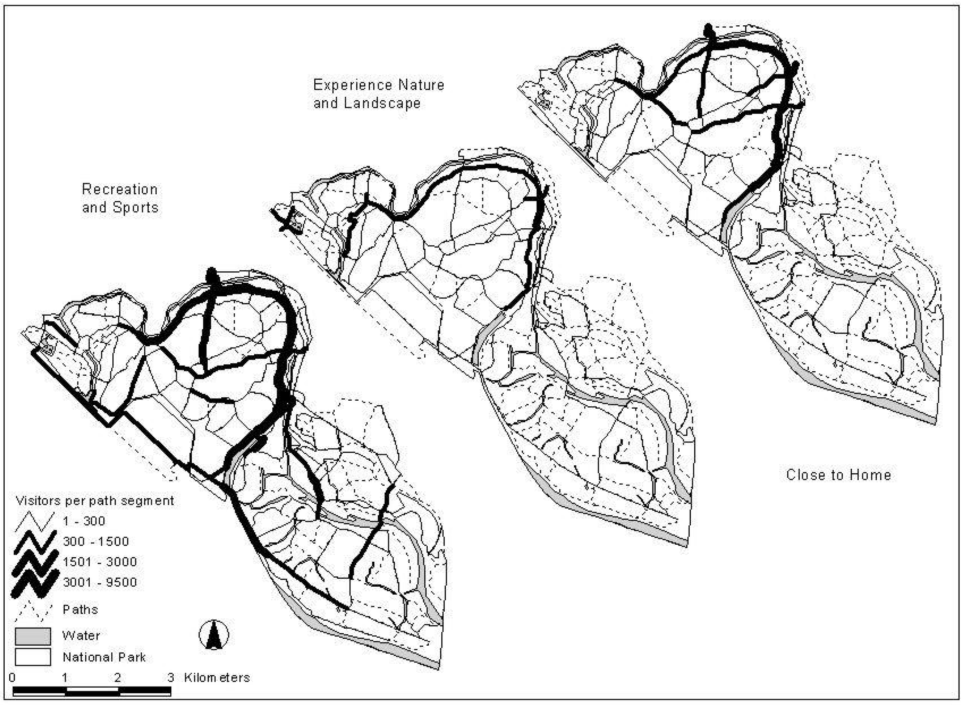

Figure 3: Visitor flow patterns by motivation

By linking the route data to other results of the questionnaire, the spatial distribution of recreationists by visiting motive can be analysed. Figure 3 shows use concentrations of nature related visits along the old branches, whereas visitors coming from the settlements adjacent to the Lobau tend to stay in the parts close their own residential area. Visitors who stated to use the Lobau for recreational and sportive activities, show a wider distribution over the study area.

Calculation of total visitor load

Route data obtained from interviews were also linked with visitor countings from permanent video recording, thus facilitating an estimation of the total visitor load during the one-year period of video observation.

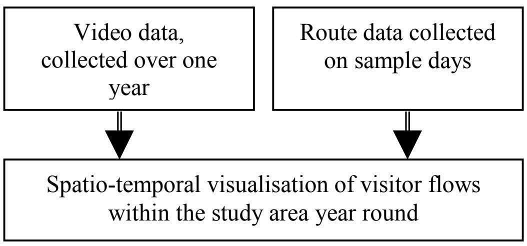

Figure 4: Combination of video data and route data

At the access point 'Lausgrund', for example, bikers were monitored by video recording as well as interviewed. Therefore, one knows both the patterns of routes taken by the bikers and the temporal distribution of bikers passing the station year round (see fig 5). This information can be combined in order to do some first and simple calculations of distribution of cyclists within the study area during the year.

The number of cyclists in the study area is particularly susceptible to the temperature, an increasing number was observed between April and September when the temperatures rise above 10°C (Brandenburg, Arnberger, in print). Consequently, also different spatial patterns of cyclists could be observed between April and September.

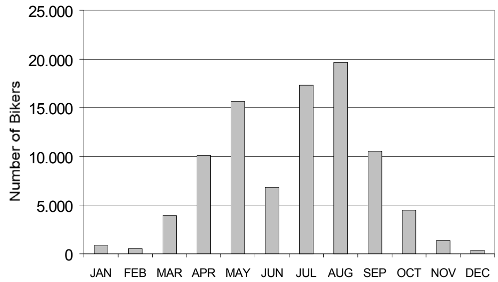

Figure 5: Bikers at access point 'Lausgrund' per month

Indices of Public Use

It is quite difficult to compare the amount of visitor use regarding pressure on resources in different parks due to different spatial characteristics such as size, shape and relief (Dawson 2000). Attempts have been undertaken to make the usage and the recreational impacts on various wilderness areas somehow comparable by defining indices of recreational infrastructure and use.

Table 1 shows two such simple indices for the two parts of the Danube Floodplains National Park. By combining these indices with actual visitor data from both the route analysis and the visitor counting, more refined parameters can be derived.

Indices	***Viennese Part of National Park - Lobau***	***Lower Austrian Part of National Park***
Entry points per km²	***0,9***	***0,8***
Kilometres of trail per km²	***5,9***	***3,8***

Table 1:Comparing study areas by representative numbers

Length of Routes

Analysing visitor routes with the help of GIS tools offers the possibility to explore also the length of routes. The shortest route reported in the Lobau was only 163 meters long, leading from the entrance point to a water pond and return. The longest route (27.8 km) was reported by a biker, spending his time in the Lobau on a Sunday in spring.

Seasonal variations of the route length could also be observed. First of all, the skewness of the histograms shows characteristic differences. In summer, many visitors only come to the Lobau to swim in the old branches of the Danube. These visitors tend to hike or bike only for a short distance in order to get to their favourite spot (Fig.6), where they often spend the whole day.

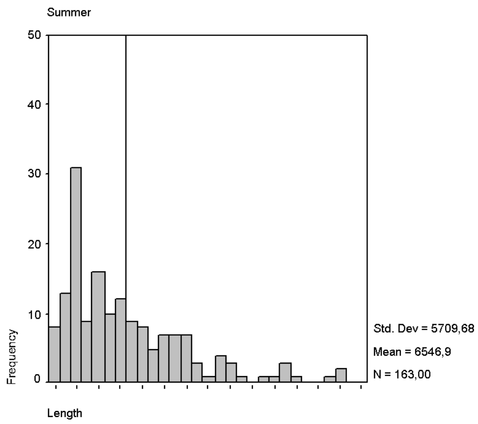

Figure 6: Distribution of route lengths in summer

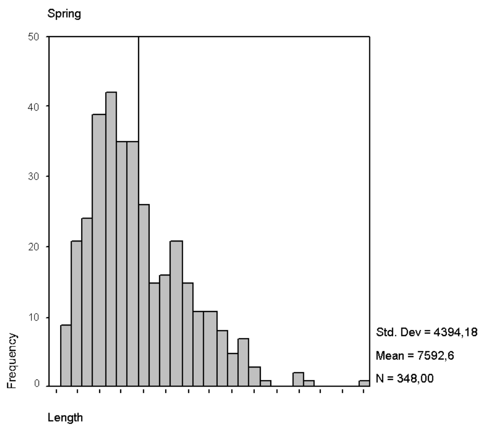

Figure 7: Distribution of route lengths in spring

In contrast, the distribution of route lengths in spring (Fig.7) is more symmetric and many of the distances are grouped around the mean route length. This shows, in measurable numbers that in spring people are moving around much more, spending time biking or walking instead of resting in one place for a long time. Also the means of the distributions of routes are slightly different. In spring the mean distance, taken by the visitors is bigger than in summer. As the number of visitors counted in spring is about twice the number of the summer visitors, the overall impact in spring is significantly higher.

Visitor load

The combination of video recording data with the mean route length allows a calculation of the visitor load, calculated as visitor kilometers per year within the area. This parameter gives an idea of the use intensity of recreational infrastructure, in particular the trail system. The results are also indices in order to compare different recreation areas.

In the Viennese part of the National Park the average route length is 7.26 kilometers. With 600,000 visits counted per year, this section of the National Park is charged by 4,356,000 visitor kilometers per year. Opposed to that, the Lower Austrian part had 390,000 visits with 4,356,000 visitor kilometers per year. Referring to the size, the trail network of the Viennese part is stressed by visitor kilometers more than three times as much as the Lower Austrian part. As the Viennese trail network is more dense, the visitor load per respective trail segment is about twice as high compared to the Lower Austrian part.

Study area	***Mean length of routes / total visitors per year***	***Visitor kilometers per year within area***	***Visitor kilometers per km² per year***	***Visitor kilometers per trail km per km² per year***
Lower Austrian part of National Park	***9.04 km (n = 340) / 390,000***	***3,525,600 km***	***51,100 km/km²***	***13,500 km/km/ km²***
Viennese part of National Park - Lobau	***7.26 km (n = 511) / 600,000***	***4,356,000 km***	***181,500 km/km²***	***30,800 km/km/ km²***

Table 2:Visitor kilometers per year within area

Trail Use Concentration

Ordering the path segments by intensity of use and plotting the total cumulative percent of visitor meters against the cumulative percent of trail meters, results in a graph representing the density of visitor use within an recreational area (see also Lucas, 1990).

In Lobau, for example, fifty percent of the visitor kilometers refer to about fifteen percent of the total trail kilometers.

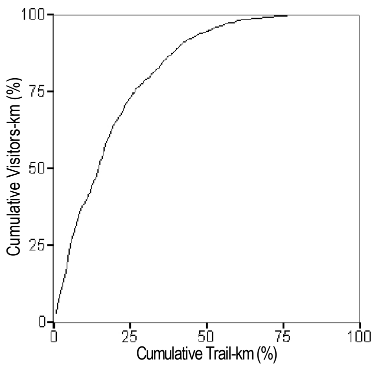

Figure 8: Graph of total travel in cumulative percent of visitor kilometers against cumulative percent of trail kilometers Viennese part, Lobau

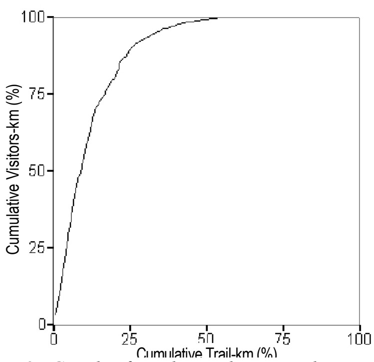

Figure 9: Graph of total travel in cumulative percent of visitor kilometers against cumulative percent of trail kilometers, Lower Austrian part

In the Lower Austrian part, however, fifty percent of the visitor kilometers refer to only nine percent of the total trail kilometers, which indicates an extremely high concentration of visitors on few path segments.

DISCUSSION AND OUTLOOK

The combination of data on visitor numbers, routes and visitor characteristics with the spatial functions of a GIS has proven to be a very useful method to investigate and analyse visitor flows in recreational areas.

One important next step will be to link our data with road traffic data from areas close to the National Park.

So far, our analyses were mostly explorative. Single models have been developed to predict total visitor loads (Brandenburg, Arnberger) depending on weather factors; however, the next step will be to apply these models in a spatial context.

To achieve reasonable models, the data gained from permanent video observation will play an important role and the connection of these data to the routes needs to be done very carefully. These models could also be improved by including information about the directions of the visitors´routes.

Concerning the conservation function of an area, the use of GIS in combination with quantitative data of the recreational use can help exploring the effects on fauna and flora caused by people spending their leisure time in recreational areas. Building more complex models of agents moving trough the recreational area (Itami et al., 2001), interacting with their surrounding according to a bundle of attributes they are applied with, should enable predictions about changes in visitor flow, if certain paths or entrances need to be closed.

Exploration of the visitors opinions in terms of comfort and attractiveness of paths will also be contributing to predictive models.

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Spatial Requirements of Outdoor Sports in the Nature Park Southern Blackforest – GIS-based Conflict Analysis and Solutions for Visitor Flow Management

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INTRODUCTION

The fascination of outdoor-sports has been growing in recent years. The affected areas offer numerous experiences of nature and activity in which the image of an exclusive outdoor lifestyle plays an important role. A continuous differentiation of classic outdoor sports into various new types of outdoor sports, including a very specific use of the natural landscape structure, is characteristic for this growth.

From an ecological point of view, this increasing use of landscape related to space and time, offers severe problems for the affected areas. Especially the multiple all-year of landscape bears a high ecological risk. The increasing pressure on nature and cultural landscape evokes numerous conflicts between protection and use of nature and landscape. Nevertheless, all outdoor sports activities have one thing in common: They depend on an intact natural landscape that offers the basis for an exclusive experience connected to outdoor sports activities.

The aim of the project is to analyse the differentiation of classic types of outdoor sports and the resulting utilisation of the specific types of landscape and area. The requirements for the area are defined from a sport scientific prospective and are judged from an ecological point of view. There are two important dimensions for the use of space through outdoor sports: Apart from the sole requirement of space, it is also very important to consider the time of use of the specific area. The multiple use of specific areas is often a crucial point.

RESEARCH AREA AND AIMS OF THE PROJECT

The Nature Park Southern Blackforest in the southwest of Germany was founded in 1999 and, with its 3300 km2, it is the second largest nature park of the country. The park consists of two geologically different sections: The western part is relatively steep and valleys are numerous. The eastern part is more flat. The medium height of the nature parc is 780 metres above sea level. The lowest regions are 222, the highest 1496 metres above sea level. The parc is by far the most important sports tourism region in southwest Germany. In the catchment area relevant for the daily tourism (radius of 100 km) there live more than 11 million people. Moreover, there is a high number of tourists from other parts of Germany and abroad. The Nature Park Southern Blackforest offers an extensive infrastructure for various nature sports, in summer as well as in winter. At the same time, major parts of the park are considered to be ecologically valuable areas. This is evident because of the existence of many nature conservation areas as well as „Natura 2000“-areas. They alone come to 40% of the nature park.

The development of an all-year sports tourism therefore brings about partially massive impacts. This research project aims to develop strategies that will be consistent in the future and to propose measures that enable an attractive development of outdoor sports in the region. The objective is to conserve the opportunity for experience and sports in an intact landscape and to suit the development of sports tourism to the needs of locals and guests.

METHODS

The methodology of the project can be structured as follows:

- mapping out and enquiry of sports infrastructure and data on nature conservation for the analysis of the status quo.
- Count of visitors and enquiring participant profiles with the help of various methods
- Development of a data base for the GIS-supported analysis of the collected data
- Interpretation of the findings and implementation of a strategic management
- Evaluation and monitoring of the strategic goals.

The use of geographical information systems serves as a basis for all those steps.

Analysis of the status quo

The basis of a serious planning is the recording of the infrastructure related to sports tourism and the up-to-date use of sports- and leisure opportunities. All activities and structures relevant to sports tourism were recorded: hiking, cycling, mountain biking, alpine skiing, cross-country skiing, water sports, climbing, paragliding, golf, trendsports and big sport events. At the same time, all relevant landscape ecological data has to be recorded (land use, digital terrain model, protected areas, traffic infrastructure). The collection of data was carried out by mapping out and questionnaires as well as by digitalising of maps. The aim was the implementation of an extensive data base.

Count of visitors and participant profiles

Apart from the mere inquiry of the sports related infrastructure, the basis for the next steps of the analysis is the recording of the spatial and time related distribution of the visitors. Because of the size of the park there could not be carried out an extensive count of visitors, so single model areas were chosen. For the recording of visitor numbers the outdoor activities hiking, mountain biking and cross country skiing were taken into account. Therefore, three different counting methods were used. The participant profiles were recorded with questionnaires.

Automatic count systems

These immobile systems count the visitor numbers at defined points or stretches. At the model areas, three such systems were installed. They consist of a light barrier and an electronic counter. All movements within a defined period of time are recorded for that specific stretch. The data collected allows the comparison of the visitor numbers of different days but does not give information on the overall visitor number.

Complete count

The prospective of complete counts is the recording of the overall number of visitors of an area. For this purpose counting personell at every parking place and every access counted every visitor and recorded their activities (hiking, biking, cross-country skiing, etc.).

Moment recording

By this method developed by Karameris (1982 and 1987) it is possible to record the distribution of visitors in a specific area. For this, the footpaths, MTB-trails or cross-country ski runs are parted into short stretches. A person hikes, rides or skies on the specific stretch and records the visitor number for a specific period of time. Popular stretches and points can be recorded this way. With the moment recordings average results are gathered which characterise the relative importance of the single stretches. Every stretch is only observed for a short period of time, so normally the actual use is much higher. To be able to compare the intensity of use of different stretches, the moment recording has to be combined with a complete count.

Implementation of a landscape information system

The gathering and preparation of spatial data, their evaluation, linking and carrying out in a strategic management is nowadays unthinkable without the help of electronic data processing. Systems which are able to take into account the spatial dimension apart from the objective dimension are mostly relevant for this purpose. For the strategic management of the nature park, most decisions made are based on spatial data. Because of this, the use of up-to-date geographical information systems (GIS) is indispensable.

GIS enables to collect, edit and analyse area related data digitally and to visualize it numerically or graphically. Additionally, apart from the administration of thematic data (attributes, key data) and geometric data (position, shape, size) GIS also allows topologic data analysis (space related). This data can be used for area overlay- and intersection-operations and complex terrain analysis.

For the Nature Park Southern Blackforest a specific GIS user surface was developed and implemented for the different requirements of the project, which also supports the further work of the employees of the nature park offices. All analyses described in the following are GIS-based.

CONFLICT ANALYSIS

Intensity of use

To quantify the intensity of use, the results of the gathered data, infrastructure, visitor counts and participant profiles (see 3.1 and 3.2), were related to each-other.

For the evaluation, crucial points are the real number of visitors and the intensity of use due to the specific activity.

The results suggest that beside the space and time related use of the natural landscape by a single activity especially the multiple use of the same landscape by several activities is one of the major conflicts.

Furthermore there are significant differences between the use in summer and winter. In summer mostly the whole area of the nature parc is affected. The intensity of use is relatively low because visitors are widespread throughout the whole area. In contrast, in winter the visitors are concentrated on single spots which results in a high intensity of use at these specific locations. (Fig. 2)

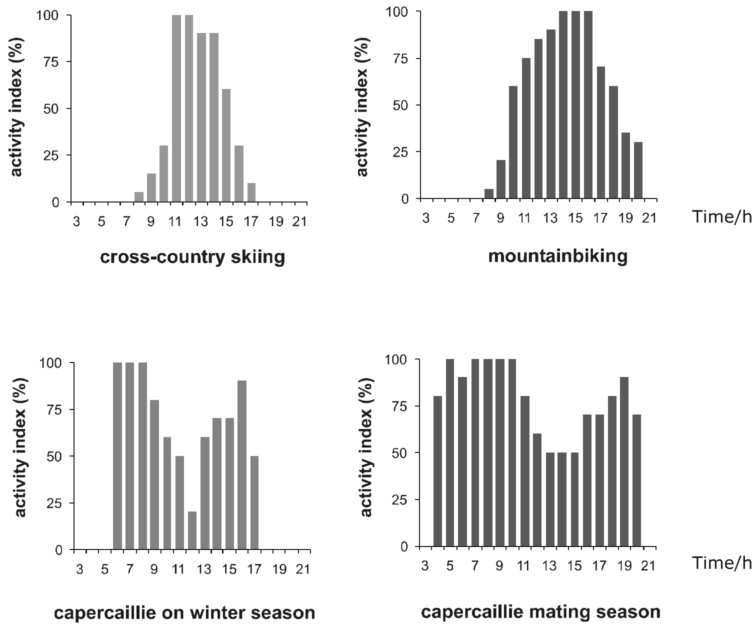

Fig. 1: Time conflict between capercaillie and cross-country-skiers and capercaillie and mountainbikers.

The example of the capercaillien (Fig. 1) illustrates the importance regarding the time of human activity compared to the time of animal activity (time conflict). The capercaillie is a bird species active during the day with specific peaks of activity in morning and evening. If the time of activity of the visitor coincides with the peak of the capercaillie’s activity, the disturbance is high. On the other hand, peaks in visitor activities coincide with times of low activity, causes low levels of disturbance. Therefore different types of sports activities have different levels of disturbance on capercaillie. Due to their large action radius, mountain bikers, for example, use the landscape also after 7 p.m., a peak of capercaillie‘s activity. In consequence, capercaillies have to feed, mate and rear its young at times when mountain bikers use the same territory.

Potential for sports tourism in the Nature Park

Apart from the actual use of landscape through sports tourism, potential areas were singled out. As a result, areas were described which bear a high potential for specific sports activities, either for summer or for winter activities. These areas can be kept in mind for future planning.

Important factors for the usability for summer sports are the variety of landscape, the slope and the altitude. Variety of landscape can be measured by the number of changes of landscape characteristics (vegetation, use of landscape by agriculture, forestry, settlement, etc.) in a defined area, for example per km^2.

The slope- and altitude-impact on the potential is measured by the number and level of changes in altitude per km^2. High changes in altitude increases the number of potential sports activities in the area. The results suggest that almost the whole nature park area is excellent for summer sports activities (Fig. 2).

For winter sports, especially the reliability on snow is the most important factor. To calculate this, long-term data on precipitation and temperature were taken into account. In addition to this, morphologic parameters (altitude, slope, aspect) were regarded.

As expected, highest potential for winter sports could be found along the central mountain range which divides the park from north to south. Due to the higher impact of continental climate, the eastern parts of the park have a higher potential for winter sports than the western parts if the same altitudes are compared.

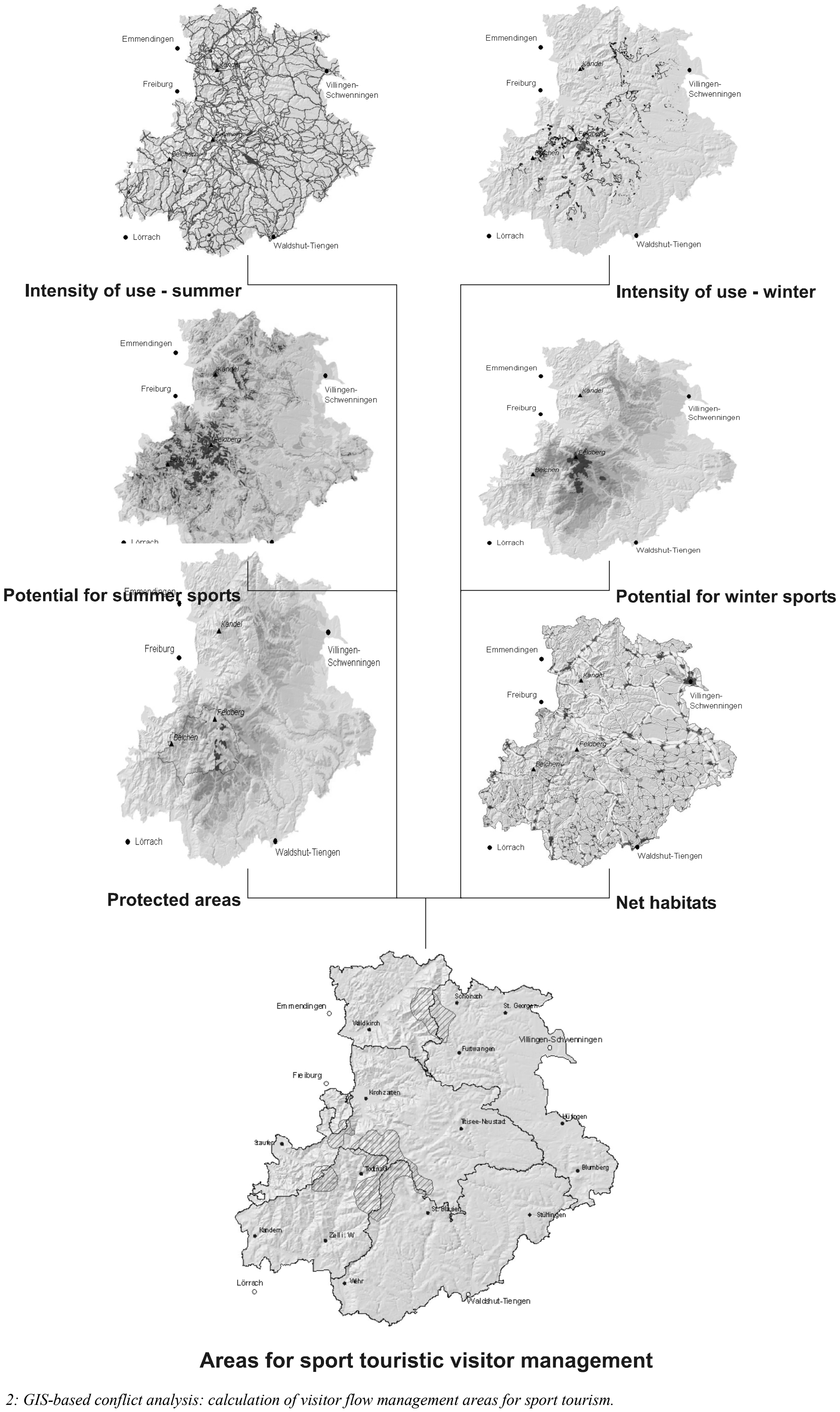

Fig. 2: GIS-based conflict analysis: calculation of visitor flow management areas for sport tourism.

Spatial conflicts

To figure out areas of conflict between nature conservation and sports activities further overlay and intersection operations have to be done in GIS.

The theme sport in landscape consists as described on two maps based on several layers: First the maps of the intensity of use, second the map of potential areas for sport activities (both separately for summer and winter; Fig. 2).

The theme nature conservation consists of protected areas and net habitats. For a large scale view the highest ranks of protected areas, "Naturschutzgebiet" and "Natura 2000"-areas, are respected. Net habitats are defined as areas, which are not intersected by settlements or traffic routes and therefore could function as potential habitats also for more demanding species.

Via different punching tools and with the help of different weight factors the themes are combined and overlayed by GIS. As a result, areas can be figured out which have a high potential for conflicts: On the one hand these areas show a high intensity or potential of sports use and on the other hand they are valuable areas for nature conservation.

Using this strategy our results display an area of 236 km² in the Nature Park Southern Blackforest with high potential for spatial conflicts. These are the areas with the highest requirements for the implementation of visitor flow management systems.

VISITOR FLOW MANAGEMENT FOR SPORT TOURISM

Channelling sport activities in designated areas with high potential for conflicts is a balance act. On the one hand the use of broad areas for sport activities should be enabled also in a high quality and on the other hand nature conservation has to be assured. Channelling measures have to be carefully planned and sometimes creativity is necessary to design an appropriate measure. Goal is always to minimize conflicts.

The level of possible adverse effects of sport on nature and landscape is determined by the factors intensity of use, kind of use, exact location, time and duration of activity.

The strategy for these designated areas is to channel and concentrate sport tourists by forming attractive sites for sport activities. Areas of concentration are either extraordinary resistant against impacts because of their natural characteristics or parts of a site are released which is the prize for protecting more valuable parts of the area.

Important tools to concentrate activities are skiing slopes, tracks and trails. They are part of a strategy which could be described as "channelling by offering comfort". Therefore the guidelines for the Nature Park Südschwarzwald follow the principle "offerings are better then proscriptions".

The components of a visitor flow management for sport tourism are shown in figure 3. As described, positive channelling measures are the heart of the strategy. Naturally it is important that sport activities in conflict areas are proper planned using the methods of landscape planning.

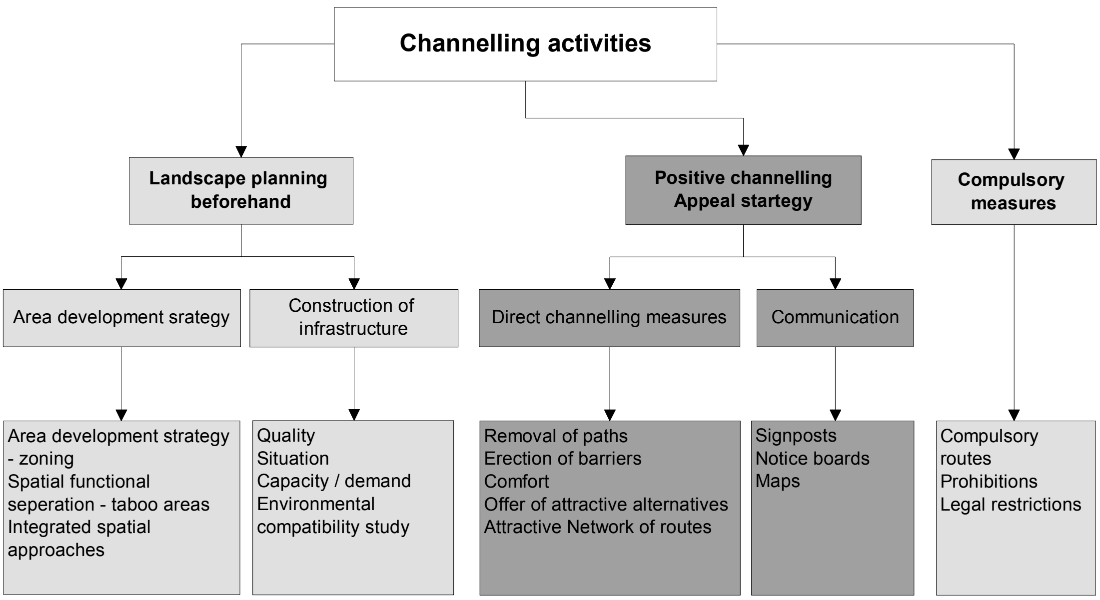

Fig. 3: Different aspects of a visitor flow management systems for sport tourism: voluntary channelling measures must become the central feature; compulsory measures should only be enforced as a last resort.

Compulsory measures are just the last solution. They should be used very careful for high sensible areas or when other measures lead to no success.

Basis for a successful implementation of a channelling strategy is co-operation between public authorities, municipalities, sport, forestry and nature conservation. Sectoral thinking has to be abandoned for an integrative approach.

EXAMPLES OF "GOOD PRACTISE" AND CHECKING SUCCESS

To perform the results of the research in designated conflict areas concrete projects have been initialised. Work groups were formed made up with all parties involved. These work groups escorted the implementation of the measures.

On basis of the carried out research on status quo and conflicts (as described above) infrastructure for sport tourism was newly designed. When rebuilding of trails (hiking, cross-country skiing, mountain biking) was done aspects of nature conservation and sport were respected. For example in the model-area called "Rohrhardsberg" the yore existing system of trails was strongly shortened. Parallel, the quality of remaining infrastructure was raised by offering new possibilities of trail combinations, resulting in a more attractive site.

In stretches highly valuable for nature conservation trails were abandoned and blocked. The trails were displaced in neighbouring less sensible zones.

Figure 4 shows an example of the application of the "ladder"-system used to create a new cross-country trail-system. With the help of short connection trails various skiing-possibilities are created and the disturbance-area can be minimized.

In the same time, in co-operation with the "Forstliche Versuchs- und Forschungsanstalt" (a governmental forestry agency of the federal state Baden-Württemberg), in the calmed down and valuable zones measures for melioration of habitats were planned and performed. Target species in the first line was the capercaillie. For a checking of the success of these measures a monitoring program is necessary. For this counts of visitors were done to proof the acceptance of the marked trail system. Simultaneously on basis of long term research habitat structures were mapped and analysed, as well as a intensive estimation of the stock was done.

A large proportion of nature sports activists will allow themselves to be channelled by convenience. This means extremely good and functional signposting (no profusion of signs), attractive sports opportunities (single trails for MTB, for example), concentrating and extending opportunities to allow the user to choose his own sequence of shorter course loops.

A good public relation and information could be reached by creating pleasing information material and meaningful maps. These information campaign is essential to impart knowledge and acceptance for the channelling measures.

Furthermore manuals exemplary for mountain biking and hiking were made, serving as guideline and information source for municipalities, sport organisations and tourist service providers. The manuals include (amongst other things) the ecological compatible and attractive (in the view of sport) installation of trails as well as sign posting and mapping of trails.

The manuals should help to implement the results of the "good practise"-examples to the whole nature park area.

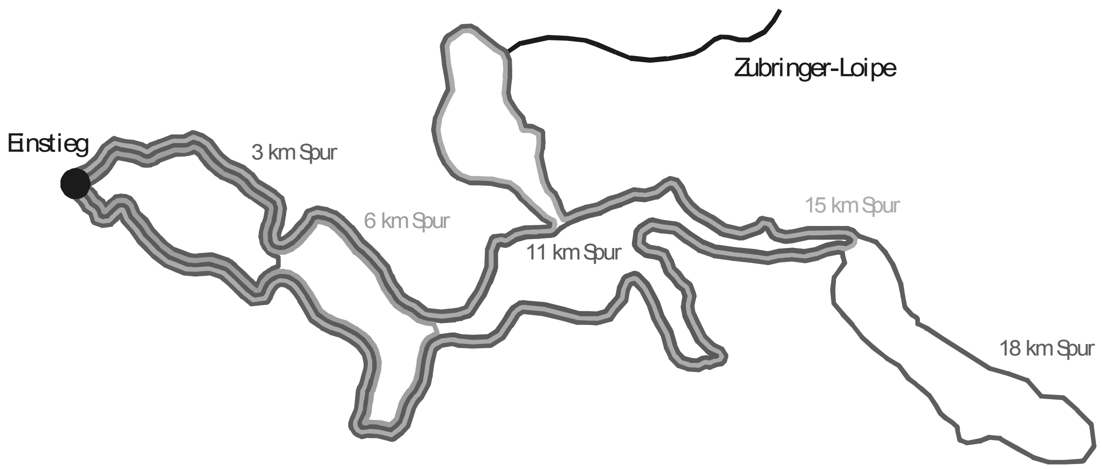

Fig. 4: Cross-country trails as result of the application of the "ladder"-system.

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Observation as a Technique for Establishing the Use made of the Wider Countryside: a Welsh Case Study

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Abstract: Surveying the use made of the wider countryside for recreation is problematic due to the scale of the area to be covered. In particular the distribution, numbers and activities of countryside visitors are difficult to ascertain using conventional methodologies such as questionnaires and counters. This paper describes an observational methodology that has been used investigate recreational activity in a 466 square kilometre area of Mid Wales. The results illustrate the countryside resources that are being utilised, the activities undertaken and the number of people involved. It is concluded that observation is a valuable tool in understanding the nature of recreation in the wider countryside.

INTRODUCTION

The strategic planning of recreation in the countryside is becoming increasingly important as a means of ensuring that the demands of visitors to the countryside are met whilst controlling any adverse effects that recreation may have on the environment. Strategic planning normally involves considering large areas of countryside such as the area contained within a national park or within an administrative boundary. Research has shown that such strategic planning is often based upon inadequate levels of information regarding countryside usage and is often based on nothing more than presumption (Curry and Pack, 1993).

To plan countryside recreation strategically a wide variety of information is required about the countryside and the visitor. Information requirements include:

- The countryside resources that are available for countryside recreation
- The constraining factors that may limit the use of areas for recreation
- The profiles of visitors
- The number of visitors
- The distribution of visitors
- The activities carried out by visitors
- The attitudes of visitors

Trends in visitor usage of the countryside

There are a variety of established methodologies for providing answers to many of these questions (such as questionnaires, focus groups and facilities audits). Many of these methodologies work at a localised site level but are not so effective when it comes to larger countryside areas. In particular, present methodologies find it difficult to establish visitor numbers, visitor distribution and the activities carried out by visitors in open countryside where visitor density may be low. This paper presents an observational methodology that can establish use, distribution and activities over areas of open countryside.

OBSERVATIONAL STUDIES

Observational studies, often labelled as ‘naturalistic’ and sometimes referred to as behavioural mapping, are characterised by the systematic and unobtrusive observation and recording of behaviour (Ely, 1981; Campbell, 1970; Glancy, 1986; Beer, 1987). When studying large or highly mobile mammals to establish distribution, resource usage and behaviour, researchers are forced into an observational approach (mammals are not known for their ability to fill in questionnaires or sit on focus groups!). Can we adapt the methods used to survey mammals to study *Homo sapiens?* An example of an observational approach is the national badger survey carried out in the United Kingdom by Professor Stephen Harris of the University of Bristol (N.C.C., 1990, Wilson, Harris and McLaren, 1997). This survey was carried out between 1985 and 1988 and repeated between 1994 and 1997. This survey sought to find answers to key questions concerning badgers such as how many badgers there were in the countryside, their distribution (both at a national and habitat scale) and whether the population was changing (both in numbers and distribution)? The methodology used for the national badger survey was based upon systematic observation for signs of badgers within randomly selected one-kilometre squares, selected in proportion to land area as classified by a land classification scheme, (Bunce, Barr, Clarke, Howard and Lane, 1996). Similar surveys have also been carried out on bats (Walsh and Harris, 1996a and b; Walsh, Harris and Hutson, 1995).

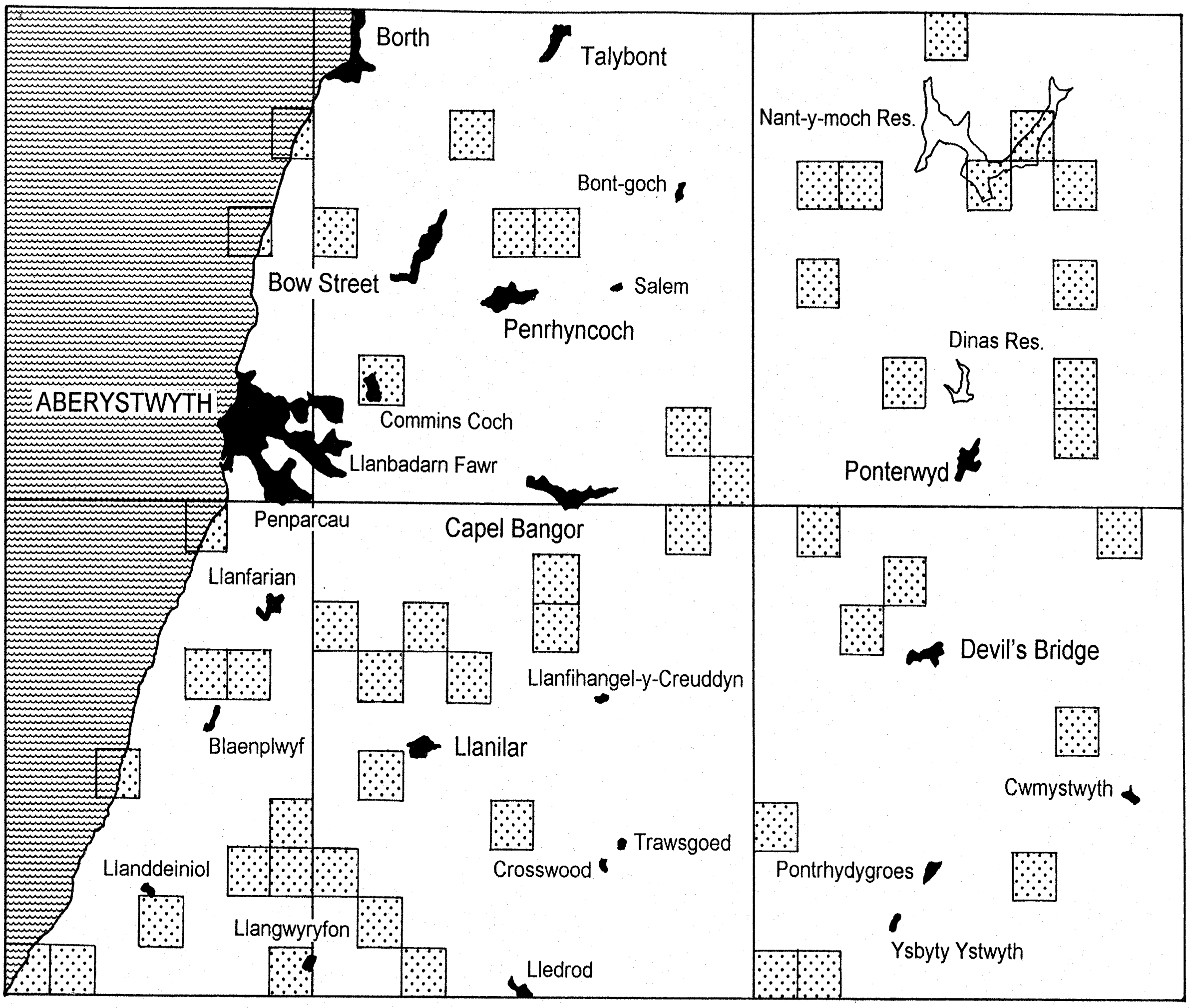

Figure 1. Map of the Aberystwyth area, showing the randomly chosen 52 Ordnance Survey one by one kilometre grid squares that were surveyed for the study

There are therefore tried and tested methodological approaches for systematic research through the use of observation, of mammal distribution, numbers and behaviour.

It can be noted that the issues the national badger survey tried to answer are very similar to the issues identified for countryside recreation, that of numbers using the countryside and distribution.

OBSERVATIONAL STUDY OF NORTH CEREDIGION

This paper describes a methodology, adapted from observational studies of mammals, that has been used to investigate recreational activity in a 466 square kilometre area of Mid Wales during the summer of 1996. This survey in particular sought to find out:

1. the activities people undertake as countryside recreation
2. the exact types of access people use when visiting the countryside
3. the types of countryside people visit
4. an estimate of the number of people using the wider countryside

This study was carried out in North Ceredigion in Mid Wales. An area described by six adjacent Ordnance Survey ten by ten kilometre squares, in a three by two rectangle, (grid reference of the South West corner being SN5/7) was selected, giving 466 Ordnance Survey one-kilometre grid squares containing land above the high water mark. From within this 52 one-kilometre squares (11.2% of the study area) were chosen using random numbers (Figure 1). The survey was conducted between the 4th and the 26th of August 1996. During this period each square was surveyed three times, once on a weekday, once on a weekend day and once over the three days of the August Bank Holiday weekend. Surveys were carried out between 11.00 a.m. and 6.00 p.m. with each surveyor covering no more than three squares in any one day.

INFORMATION GATHERING

Within each square all access routes considered to be open to the public were walked to assess the most appropriate positions from which to observe recreationalists and to collect information regarding the nature of the countryside within the square.

All legal access routes displayed on the Ordnance Survey map and observed on the ground within the square, were mapped onto an enlarged (1:10,000 scale) photocopy taken from a 1:25,000 Pathfinder Ordnance Survey (O.S.) map. Each discrete length of path was assigned a unique link number to which additional information was referenced. The length of each link was measured from the O.S. map using a digital opisometer, it is thus a plan measure and takes no account of the rise and fall of the terrain. The legal status of each link, as identified by the O.S. map, was recorded.

OBSERVATION OF DISCRETE AREAS

Each square was observed to record recreational activity. Pilot testing on the ground established that in most cases it is impossible to observe a whole kilometre square from one observation point. This problem was addressed by observing discrete areas within each square for a standard amount of time. A discrete area was defined as an area that could be viewed from one location or whilst walking slowly along a linear access route so that all recreational activity could be observed. In some cases this was just one field or length of footpath, whereas in others a whole square could be observed at one time (for example an open hillside). By careful observation of a series of separate discrete areas it was possible to survey the whole square such that each area within the square is observed for an equal amount of time. For this study each discrete area was observed for a period of five minutes.

The data from all the discrete areas within one square was combined to estimate the recreational use of the square. As an example, if a one kilometre grid square can be observed as four discrete areas recording will take twenty minutes plus the time taken to move between observation points. The net effect of this is that the whole square will have had the equivalent of a standard five minutes of observation.

For each person or group of people observed during the survey a location, description and activity were recorded with each person being allocated to a single activity code. Most categories of data were pre-coded, but each surveyor was also asked to give a written description (to validate the pre-coding). Where an individual was not observed on a linear access route another coding system was used to record the category of landscape they were in. During the observation of any one square each person was only recorded once. This meant that if an individual was recorded within one discrete area at the start of a square's observation that person would not be subsequently recorded for that square if rediscovered in another discrete area.

All recreational activity was recorded including the use of off road vehicles away from metalled roads. No attempt was made to record people within the curtilage of their houses or travelling through the countryside on metalled roads in motor vehicles. The nature of the study area and the random sample meant that no extensive urban areas were included and therefore the surveyors needed no urban definition or exclusion instructions. Data were entered onto a relational database (Microsoft Access) for analysis.

NATURE OF THE STUDY AREA

The results must be viewed in relation to the rural nature of the study area, which contains no intensively visited and managed sites such as theme or countryside parks. There are also no extensive urban areas with only one town of significant size (Aberystwyth: population size approximately 12,000). The landscape of the study area is a mixture of upland and lowland grassland with extensive areas of conifer plantations and to a lesser extent broad-leaved woodland.

RESULTS

Numbers and type of people observed within the study area

A total of 540 people were observed, of which 448 were classified as being involved in a countryside recreational activity. Of the 98 people not classed in this way 57 were working out of doors (agricultural workers) and 35 were classed as non-recreational utilitarian walkers (people shopping or walking from home to their car for example). The results given in Table 1 are calculated excluding these 98 people. It can therefore be said that in this survey 82.9% of people observed were undertaking some form of recreational activity.

Group size	Number of groups observed	Number of people observed	Percentage of people observed
1	57	57	12.7
2	57	114	25.4
3	22	66	14.7
4	20	80	17.9
5	5	25	5.6
6	5	30	6.7
8	3	24	5.4
10	1	10	2.2
17	1	17	3.8
25	1	25	5.6
Totals	172	448	100

Table 1. Group sizes of observed recreationalists.

The activities people undertake as countryside recreation

It can be seen from Table 2 that walking was clearly the most common activity with 48.7% of all observations being coded as this. A miscellaneous coding of "other static activities" comprised the second largest recreational category with 11.2% of people being observed sunbathing, talking or admiring the view. Cycling accounted for nearly 6.9% of the observations, with road bicycles out-numbering mountain bicycles. However, all cyclists seen were using metalled roads. A range of 14 other activities were observed. This illustrates the variety of countryside recreational activities undertaken within the study area.

Activity	Percentage of observations (n=448)
Walking	48.7
Other static activity	11.2
Sitting in a car	5.6
Picnicking	5.4
Cycling	6.9
Off road motor vehicle	3.6
Boating (sea)	3.6
Children playing	2.7
Horse riding	2.5
Fishing	2.2
Model plane flying	2.2
Camping	2.2
Swimming/paddling	1.3
Horse and cart driving	0.4
Collecting	0.4
Shooting	0.4
Kite flying	0.4
Reading information board	0.2
Total	100

Table 2. The activities ordered by percentage participation, that countryside recreationalists were undertaking when first observed.

Locations of recreationalists within the study area

The locations of observed recreationalists can be put into three categories with 148 people using public rights of way, 106 people on roads (excluding 12 people observed on unclassified tracks) and 182 people observed away from linear access routes. Of these 182, 40.6% were found near their cars in car parks, on the side of roads or in caravan and camping grounds (which occurred in 7 of the 52 sampled squares). The remainder was recorded in 6 categories with 37.9% being found on or near water bodies.

The linear access routes that people were observed using within the study area

To enable a comparison of the relative amount of use of different categories of linear access route, using analysis of variance, the data were transformed using the formula *log (x+1)* to create an approximately normal distribution with a variance almost equal to the mean. The analysis showed that there was no significant (at 95%) difference between the density of people (numbers per unit length) observed on public roads, public footpaths and the amalgamated category of bridleways, roads used as public paths (RUPPs) and byways open to all traffic (BOATs). These results show that the use made by recreationalists of roads, footpaths and other public rights of ways are in proportion to their length and no significant preference could be found (see Figure 1).

An estimate of the number of people using the wider countryside

For the observed squares an estimate of the average density of countryside recreationalists in any one five minute period of the study time frame was calculated at 2.87 people per km^2. From this it may be further estimated that 1,337 countryside recreationalists were at large in the wider countryside of the 466 square kilometres of the study area in any one five minute period between 11.00am and 6.00pm during the August survey period. However, this does not take account of known managed sites within the survey area that were not sampled or people touring in cars, but does reflect the use made of the wider countryside.

Number of recreationalists	Expected percentage of one km squares
0	21.3
1	12.3
2	9.1
3	7.3
4	6.1
5	5.1
6	4.4
7	3.8
8	3.3
9	2.9
10	2.6
15	1.4
20	0.8

Table 3. The probability (expressed as a percentage) of finding between 0 and 20 recreationalists within one by one kilometre squares within the study area of north Ceredigion.

From observations of the number of people found in each surveyed square a negative binomial distribution was found. From this data the *expected* negative binomial distribution of people for all 466 squares in the study was calculated (Fowler and Cohen, 1998) from the observed (52 surveyed squares) sample. The results from this calculation can be seen in Table 3. This calculated data predicts for example, that 21.3% of the surveyed one-kilometre squares contain no recreationalists at all and that 43.9% contains five or more.

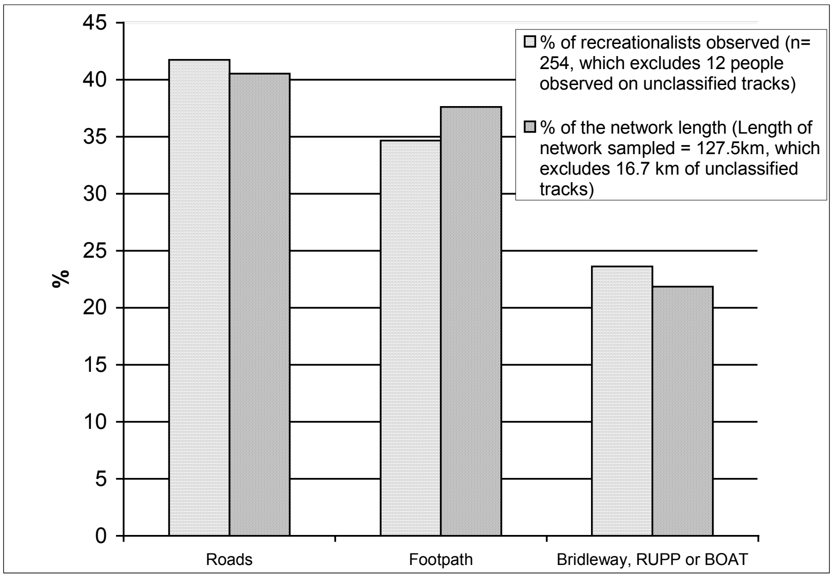

Figure 1. A comparison of the percentage of observed countryside recreationalists found on each category of linear access route and the percentage that each access route comprises of the whole rights of way network within the observed squares.

DISCUSSION OF RESULTS

The results must be viewed in relation to the rural nature of the study area which contains no intensively used and managed sites such as theme or countryside parks. There are also no extensive urban areas with only one town of significant size (Aberystwyth: population size approximately 12,000). It is also important to view each observation as one moment in time, as peoples' activities were coded using the activity in which they were first observed, which is often only a small element of their countryside trip. The results are records of observations of real behaviour and introduce a spatial element and level of detail not normally available to the countryside planner.

CRITIQUE OF METHODOLOGY

This study was undertaken to evaluate the potential of observation as a method of collecting data about countryside usage. While useful data were collected, several refinements to the methodology may be identified. Difficulties were experienced in establishing the legal status of access to certain areas. In particular, on O.S. maps access routes such as white roads do not have their status shown and public rights of way may be recorded inaccurately. The development of survey maps based upon the definitive map and the highways register held by the local authority would improve the accuracy, by confirming the current legal status and location of public rights of way. The status of unclassified tracks or white roads is likely to be an area of uncertainty until procedural or legal changes are made. In this survey no urban areas were encountered, but future application of this methodology is likely to include such areas. The adoption of a definition of 'countryside' may be required in these cases. A reliable definition is not easily constructed although it is suggested that, for convenience, areas of dense urban housing or industrial areas, often with dedicated pedestrian walkways or pavements are excluded. A clear and robust definition would be needed if future observational surveys were to be comparable.

The survey squares observed in this study were selected in a purely random manner and did not deliberately cover know busy recreational sites (in fact the study area contains no known sites which have a large visitor pressure such as country or theme parks or attractive villages). In future surveys it may be useful to ensure a large enough proportion of squares are sampled to ensure that the studies obtain a representative sample of heavily used managed sites as well as the wider countryside. Another issue not encountered within this study is how to record large numbers of people that may be observed at busy sites. It is suggested that one approach to this may be to subdivide the area into smaller areas that will allow for accurate recording.

CONCLUSION

It can be concluded that the use of observation of discrete areas of the countryside as outlined in this paper is a viable and practical method for analysing recreational behaviour of the wider countryside. It provides a truly systematic method of recording real behaviour and distribution. In comparison to other methods this type of survey allows for the collection of information about countryside usage which is beyond that collected by traditional methods. As such it provides a valuable and additional tool to aid the understanding and planning of countryside recreation. It is important in any study of countryside usage to ensure that data collected is comparable over time and space. For future studies using this technique it is therefore important to standardise the method and sampling frame used. Future studies using such a standardised approach could then provide the first regional or national picture of the abundance, distribution and behaviour of countryside recreationalists. Such data could provide a baseline upon which trends in recreational behaviour can be analysed. The method is considered to be very adaptable and could be used to gather important information on many facets of the behaviour and use made of the countryside that have not been covered in this study.

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Monitoring and Management of Visitor Flows in Recreational and Protected Areas
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Understanding Visitor Flows in Canada's National Parks: the Patterns of Visitor Use Study in Banff, Kootenay, and Yoho National Parks[1]

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Abstract: Parks Canada and its stakeholders are seeking to better understand visitors' movements, behaviour, and motives to support ecological integrity and sustainable tourism. Traditional market research describes these dimensions one at a time, but few studies have focused on the segmentation needed to addresses all three dimensions together. This study develops a complex visit typology and compares its practical value to a more common segmentation approach: visitor origin. Results suggest that both approaches have practical value, but that the post hoc visit type approach is more useful as a management tool for describing visitor movements.

INTRODUCTION

Canada's system national parks and park reserves represents thirty-nine natural areas of Canadian and global significance. The Government of Canada has given Parks Canada – the agency that manages the system – the mandate to protect these special places as examples of those natural areas for public understanding, appreciation and enjoyment in ways that leave them unimpaired for future generations.

Parks Canada has adopted the principle of ecological integrity to fulfil this broad mandate. An ecosystem is considered to have integrity "when it is deemed characteristic for its natural region" and its "native components (plants, animals and other organisms) and processes (such as growth and reproduction)" are intact (Parks Canada, 2000).

Together, the mandate and definition of ecological integrity are consistent with the definition of sustainable tourism as that which:

"...meets the needs of present tourists and host regions while protecting and enhancing opportunities for the future... leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems." World Tourism Organization (2001)

Parks Canada is developing an integrated science strategy so that natural, social, and cultural sciences can work together in support its mandate. In the tourism area, this requires support from external stakeholders because the agency does not have jurisdiction over all aspects of a park's tourism system. An effective social science strategy will need to accommodate those perspectives, including:

- **Physical/Spatial**: Those with this perspective feel that tourism has an ecological basis, so planning should be based on spatial patterns and capacities to minimise the negative impacts of tourism on the environment. Planning is used to redirect, concentrate, or disperse visitor use to minimise impacts in sensitive areas.
- **Economic Perspective**: Those with this perspective see tourism as a means to promote growth and development. Planning emphasises economic benefits and ways to efficiently create income and employment benefits. It is seen as being equal to other industries.
- **Community Perspective**: Those with this perspective see tourism in its social and political context. The planner is a facilitator who helps host communities define desired outcomes in socio-cultural terms. Host communities – on the "factory floor" of the tourism industry – thus acquire the control they need to help balance tourism development.

[1] The author acknowledges the partnership between Parks Canada, Alberta Economic Development, and the Banff – Lake Louise Hotel Motel Association that sponsored the research described in this paper. Visit typologies were developed in conjunction with Accord Research, University of Calgary.

Getz (1987) proposed a theoretical perspective that integrates these approaches in a way that is consistent with sustainable tourism and ecological integrity:

- **Integrated Perspective**: Tourism is a system that should offer lasting and secure livelihoods with minimal depletion of resources, degradation of the environment, cultural disruption, or social instability. Planning is integrated with other planning processes and with its own implementation.

The Tourism Optimization Management Model (TOMM) is a recent innovation that operationalizes Getz' integrated model (Manadis Roberts Consultants 1997; Jack 1999). It views tourism and visitor use as a system and seeks to optimize its outcomes based on a broad understanding of its function (McArthur, 2001).

Those with knowledge of a system's function can manipulate it in support of established aims (Bellinger *et al*, [n.d.]). In tourism, this requires an understanding of visitor volumes and visitor behaviour. Research can foster an understanding of tourist activity, the patterns in visitors' behaviour, and monitor and predict the change that tourist activity brings (Consulting and Audit Canada, 1994; McArthur, 1996).

The literature offers few studies that describe visitor use based on travel behaviour and spatial distribution (Flognfeldt, 1999). Specifically, the optimization literature does not suggest how best to describe visitor behaviour in ways that relate directly to management of outcomes. This is important for protected heritage areas, where visitors' behaviour can have significant long-term impacts on resources.

Recent literature has discussed the relative value of demographic, geographic, psychological, and behavioural segmentation bases (Moscardo, Pearce, and Morrison, 2001), but few studies have compared of the effectiveness of different segmentation solutions to respond to the challenge of optimization.

Moscardo *et al* suggest that the traditional approach uses *a priori* demographic variables, or variables that are chosen before the data are analysed. They point to numerous studies that have found significant relationships between visitors' origin and both travel behaviour and satisfaction.

While demographic descriptions are the norm, some argue, "Demography is not destiny" and advocate *post hoc* segmentation, determined by the data rather than by the researcher (Adams, 1997). These segments, then, can be described with geographic variables (Moscardo *et al*, 2001).

Regardless of the approach, effective visitor segmentation would describe visitor use reliably in several dimensions, producing segments that are:

- **homogeneous** (unique from each other, but internally consistent);
- **durable** (over an extended period of time);
- **measurable** (can be identified and counted with reasonable accuracy);
- **responsive** (a unique marketing approach required);
- **relevant** (to the organisation commissioning the research);
- **accessible** (easily reached via one or more media);
- **substantial** (large enough to warrant attention); and
- **compatible** (with existing markets) (Moscardo *et al*, 2001).

The study by Moscardo *et al* compared the value of geographic origin versus activity participation in Australia's Wet Tropics region. That study focused on visitors to the Australian rainforest, but the study's sample size was too small to make clear conclusions (n=549).

Like that study, this one compares the relative value of *a priori* visitor origin segments and a more complex *post hoc* approach to determine which is most useful from several different perspectives. The *post hoc* approach is based on 1,127 respondents':

- level of the pre-trip importance placed on different visit opportunities;
- activities in each of the parks' main visitor nodes; and
- parties' reported spending in Banff National Park.

Each base is compared against the eight criteria for effectiveness to evaluate the two segmentation approaches. It uses data collected in a study of visitors to Banff, Kootenay, and Yoho National Parks of Canada in the summer and autumn of 2000, but reports only the findings of the Banff sample.

BACKGROUND

Banff, Kootenay, and Yoho National Parks are among the country's most recognised tourist destinations. Over six million visitors from Canada, the United States, and overseas enjoy the parks each year, spending hundreds of millions of dollars in their hotels, restaurants, and stores. Yet, as representative examples of Canada's natural heritage – and as a World Heritage Site – the integrity of their resources is an national and international issue.

Last year, three organisations joined together to study visitor use of Banff, Kootenay, and Yoho National Parks: Parks Canada; Alberta Economic Development; and the Banff Lake Louise Hotel Motel Association. They wanted a single, reliable base of commercial, economic, and ecological data to describe visitors' movements in the parks and the outcomes of visitor use.

Each organisation approaches tourism in the parks from a different perspective:

- **The Banff - Lake Louise Hotel Motel Association** works on behalf of the parks' tourism industry and the communities of Banff and Lake Louise to help achieve common commercial and political goals (Banff - Lake Louise Hotel Motel Association [n.d.]).
- **Alberta Economic Development** is the provincial ministry that provides leadership for Alberta's economic development. Besides seeking to stimulate growth in the tourism industry, the ministry promotes trade and helps to attract investment in the province (Alberta Economic Development, 2001).
- **Parks Canada** is the federal agency responsible for Canada's system of national parks and national historic sites. Its mandate is to ensure the ecological and commemorative integrity of the resources in its stewardship in ways that foster understanding, appreciation and enjoyment by this and future generations. (Parks Canada, 2001).

DATA COLLECTION

The data for this study was collected in a study of visitors to Banff, Kootenay, and Yoho National Parks between June 12th and October 13th, 2000. Similar but separate research methods and instruments were used to sample from three populations:

- visitors travelling as part of a commercial tour, including those in motor coaches and vans;
- those travelling via scheduled carriers (trains and buses); and
- independent visitors (those travelling in personal vehicles, on foot, or by bicycle).

Brief personal interviews with a randomly selected sample of group leaders established population parameters (available in English and French; park residents, employees, and commuting workers were excluded from the sample). A mail-back questionnaire collected more detailed information from selected respondents (available in English, French, German, and Japanese).

This paper focuses only on independent visitors to Banff National Park. These results are based 5,405 personal interviews and 1,127 returned questionnaires (representing 41% of those who were given a form).

Results were weighted to correct for response bias by origin (local residents were under-represented in the up to the questionnaire) and to reflect the number of visitor party entries by gate and date. Thus, all results are presented as the actual number of independent visitors (or visit parties, where noted).

HYPOTHESIS

This study uses a null hypothesis: *A priori and post hoc segmentation will be equally useful as market segmentation techniques.*

If there are no significant differences in usefulness, the results will suggest that traditional segmentation bases – like origin – can represent the complexity of visitor use.

But if the null hypothesis is rejected – and one type is shown to be more useful than the other –then that approach may be a useful tool for:

- defining a complex tourism system;
- helping stakeholders understand the outcomes of that system and the relationships between those outcomes; and
- helping them cooperate in support of sustainable tourism.

RESULTS

Defining A Priori Segments: Visitor Origin

Visitors' origins were divided into seven categories that reflect the proportions of visitors by origin in previous research in the parks (see Figure 1). Because the survey's unit of analysis is the visit-party, one questionnaire was distributed to each party in the sample. For this reason, Figure 1 also shows the origin of survey respondents.

The two are similar enough to be considered the same, so this paper will substitute respondent origin for visitor origin.

Defining Post hoc Segments: Visit Types

To develop meaningful visit types, three types of information were analysed:

- importance of 16 visit opportunities to respondents' visit decision;
- their reported activities in each of the parks' visitor nodes; and
- reported spending in Banff National Park.

The segmentation was a multi-step process. First, a principal component analysis was applied to the respondents' reported importance levels. It used a varimax rotation and component scores were calculated for the rotated components. Then a hierarchical cluster analysis was applied to the components score using Ward's clustering method with squared Euclidean distances. A three-cluster solution was selected based on the agglomeration schedule. Finally, the cluster centres from this solution were used as initial clusters for a 3-cluster, k-means cluster analysis.

	Origin of all Visitors**		Origin of Respondents++	
Visitor Origin	**Estimated Number of Independent Visitors**	**Pct. of Visitors**	**Estimated Number of Independent Visit Parties**	**Pct. of Visit Parties**
Alberta	336,774	21.4%	112,300	20.6%
Other Canada	275,064	17.4%	93,260	17.1%
U.S.A.	523,669	33.2%	195,024	35.7%
U.K.	94,063	6.0%	38,376	7.0%
Germany	115,573	7.3%	40,005	7.3%
Other Europe	85,729	5.4%	18,288	3.3%
Other International	57,970	3.7%	34,239	6.3%
Unreported	88,400	5.6%	14,841	2.7%
Total	**1,577,242**	**100.0%**	**546,333**	**100.0%**

** The survey asked for the origin of each visitor in the party. The first two columns illustrate the origin of all visitors in the surveyed parties, weighted up to the estimated number of parties.
++ One respondent (over the age of 16) was randomly selected from each visit party to answer on behalf of the group to minimize response bias on the basis of origin, age, and sex.

Figure 1: Origins of Visitors and Respondents

Visit Type	**Est. No. of Independent Visit Parties**	**Pct. of Independent Visit Parties**
Getaway Visit	241,462	44.2%
Comfort Visit	188,656	34.5%
Camping Visit	116,215	21.3%
Total	**546,333**	**100.0%**

Figure 2: Visit Types

	Visit Type							
	Getaway Visit		Comfort Visit		Camping Visit		Total	
	Est. # of Parties	% in Type	Est. # of Parties	% in Type	Est. # of Parties	% in Type	Est. # of Parties	% in Type
Alberta	102,537	42.5%	2,721	1.4%	7,043	6.1%	**112,301**	**20.6%**
Other Canada	51,358	21.3%	22,441	11.9%	19,461	16.7%	**93,260**	**17.1%**
U.S.A.	59,583	24.7%	96,296	51.0%	39,145	33.7%	**195,024**	**35.7%**
U.K.	10,388	4.3%	22,326	11.8%	5,662	4.9%	**38,376**	**7.0%**
Germany	4,830	2.0%	10,400	5.5%	24,775	21.3%	**40,005**	**7.3%**
Other Europe	978	.4%	7,496	4.0%	9,814	8.4%	**18,288**	**3.3%**
Other International	6,395	2.6%	18,752	9.9%	9,091	7.8%	**34,238**	**6.3%**
Total	**241,462**	**100.0%**	**188,657**	**100.0%**	**116,214**	**100.0%**	**546,333**	**100.0%**

Figure 3: Relationship between Visitor Origin and Visit Typ

The resulting segments are presented in Figure 2 and are briefly described below:

- The largest proportion of park visits are categorised as **Getaway Visits** (44%). These are often day trips or 2-3 day visits that that tends to focus on a specific activity or area.
- About one-third (35%) of the visits are categorised as **Comfort Visits**. These visits tend to use the parks' hotels and restaurants... and its visitors spend the most money.
- The final visit type is **Camping Visits**. In addition to its range of accommodation and restaurant opportunities, the parks offer an ideal destination for camping and recreational vehicle touring.

A chi-square analysis suggests that visit type and respondent origin are strongly related (p=0.000, Goodman Kruskal tau = .209; see Figure 3). Getaway visit type parties are mainly from the host Province of Alberta, neighbouring British Columbia, and bordering American states. Half of the Comfort visit type parties are from the U.S.A., with almost no parties from the Province of Alberta. Finally, the Camping visit type is about one-third American (34%) but features a disproportionately large number of German visitors (21%).

Comparing the Two Segmentation Approaches

The variables selected for the comparison were selected for their relevance to the three funding partners for the study. Together, these organisations represent the interests of many of the stakeholders in the park's operation. The variables put into the analaysis are:

- party-visit spending in Banff National Park
- importance to visit decision of opportunities to learn about Canada's natural and historic heritage; and
- propensity to stay in a hotel, motel, or bed and breakfast facility while in Banff National Park.

Table 4 compares the overall results, results for each segmentation approach, and statistical analysis for each item.

Party Visit Spending in Banff National Park

Visitor spending is the basis for analysing the economic impact of tourism and visitor use. This is essential information for stakeholders who wish to understand the economic dimension of visitor use.

Visitors were asked for the total amount (in Canadian dollars) their party spent in Banff National Park during their current visit, including taxes, tips, and prepaid expenses, using cash, credit card, and debit card. They were then asked to indicate the proportion of this total that was spent in each of nine categories. Note that only the aggregate total is used in this analysis.

International respondents report the highest party spending, except for German respondents. Albertan respondents report the lowest amount. The differences are statistically significant, and ETA squared results suggest that visitor origin explains 11.2% of the variance in spending.

Using the *post hoc* approach, Comfort Visit parties report the highest party spending. Albertan respondents report the lowest amount. The differences are statistically significant, and ETA squared results suggest that visitor origin explains 17.6% of the variance in spending.

Thus, for spending, results suggest that the *post hoc* visit type segments explain more of the differences between respondents.

Importance of Opportunities to Learn About Canada's Natural and Historic Heritage

Parks Canada manages special examples of Canada's heritage for public benefit, including public understanding, appreciation, and enjoyment of their significance. The agency wishes to better understand the importance that visitors place on learning to address the mandate in a client-focussed manner.

Visitors indicated the importance of 16 different opportunities on five-point scales where 1 was "Not at all important" and 5 was "Very important". Two of the opportunities relate directly to the Parks Canada mandate: opportunities to learn about Canada's natural and historic heritage. Some other items on the list include: opportunities to enjoy time with friends and/or family; see wildlife in its natural environment; and mix outdoor experiences with modern comforts.

Results suggest a significant relationship between both items and the *a priori* origin segments. European respondents from outside Germany report the highest importance scores for historic heritage, while all others report similar levels of importance. The ETA squared results suggest that origin explains only 1.8% of the variance. International visitors – especially those from Germany – report the highest scores for opportunities to learn about Canada's natural heritage, whereas North Americans report relatively low scores. In this case, origin explains 13.5% of the variance.

Using the *post hoc* approach, the segments report similar levels of interest in opportunities to learn about Canada's historic heritage. The differences are statistically significant, but visit types explain less than 1% of the variance. There is a more pronounced difference for the importance of learning about Canada's natural heritage, but the segments explain only 1.5% of the variance.

Thus, for the importance of learning opportunities, the *a priori* origin segmentation explains is more effective.

Propensity to stay in commercial accommodation

The survey asked visitors to list their specific activities in each of the park's visitor nodes.

The *a priori* origin approach illustrates significant differences, with the segments explaining 10.8% of the variance. International respondents report the highest propensity, although German respondents are only slightly higher than Canadians.

The *post hoc* visit type approach also shows significant differences, although the segments explain 24.5% of the variance. Not surprisingly, Comfort Visit parties report the highest propensity to use commercial accommodation and Camping Visit parties report the lowest.

Thus, for spending, results suggest that the *post hoc* visit type segmentation explains more of the differences between respondents.

Assessing the Value of Each Approach

The findings support those of Moscardo, Pearce, and Morrison (2001), that each approach has its merits. This section compares the two approaches to the eight criteria established in the introduction.

Homogeneous: Both approaches develop distinct segments with little internal variation. The origin approach was more effective for visit motives, but neither approach explained much variance. The visit type approach explained more variance for spending and hotel use. Moscardo *et al* also had mixed findings, although in different areas. That study found that activity-based segments were more useful for describing participation, interests, and image; but that origin was more useful for describing transportation used, age, party composition, and visit history.

At first, the visitor origin approach seems to be more **durable** and **measurable,** as most people change residence infrequently and residence data are simply captured and objectively reported. Visit types, on the other hand, are based on more data and the analysis is subject to judgement.

Mean Party Visit Spending
Overall Mean = $698 Standard Deviation = $1,122

	Mean	S.D.
Alberta	$164	$424
Other Canada	$411	$578
U.S.A.	$992	$1,300
U.K.	$903	$651
Germany	$296	$173
Other Europe	$674	$863
Other International	$1,037	$1,338
Sig. < 0.001 ETA squared: 0.112		

	Mean	S.D.
Getaway Visit	$290	$474
Comfort Visit	$1,308	$1,557
Camping Visit	$434	$469
Sig. < 0.001 ETA squared: 0.176		

Importance of Opportunities to Learn about Canada's Historic Heritage to Visit Decision
1 = Not at all Important, 5 = Very Important
Overall Mean = 2.7 Standard Deviation = 1.2

	Mean	S.D.
Alberta	2.7	1.4
Other Canada	2.8	1.3
U.S.A.	2.6	1.2
U.K.	3.2	1.2
Germany	2.8	.9
Other Europe	3.1	.9
Other International	2.7	.9
Sig. < 0.001 ETA squared: 0.018		

	Mean	S.D.
Getaway Visit	2.7	1.3
Comfort Visit	2.8	1.1
Camping Visit	2.8	1.2
Sig. < 0.001 ETA squared: 0.001		

Importance of Opportunities to Learn about Canada's Natural Heritage to Visit Decision
1 = Not at all Important, 5 = Very Important
Overall Mean = 3.2 Standard Deviation = 1.3

	Mean	S.D.
Alberta	2.8	1.5
Other Canada	2.9	1.4
U.S.A.	2.9	1.3
U.K.	3.6	1.0
Germany	4.4	.8
Other Europe	4.2	.9
Other International	3.9	1.0
Sig. < 0.001 ETA squared: 0.135		

	Mean	S.D.
Getaway Visit	3.0	1.4
Comfort Visit	3.3	1.2
Camping Visit	3.5	1.4
Sig. < 0.001 ETA squared: 0.015		

Propensity to Stay in a Hotel or Motel During This Visit
Overall Propensity = 37%

	Propensity
Alberta	12%
Other Canada	22%
U.S.A.	48%
U.K.	66%
Germany	27%
Other Europe	41%
Other International	57%
Sig. < 0.001 Goodman & Kruskal tau = .108	

	Propensity
Getaway Visit	23%
Comfort Visit	74%
Camping Visit	6%
Sig. < 0.001 Goodman & Kruskal tau = .245	

Figure 4: Comparing Geographic and Visit Type Segments

Note, however, that the same visit types emerged independently in both the summer and autumn samples, suggesting that the visit type approach has some stability. And the stability of the visitor origin approach may be questioned, since Calgary is one of Canada's fastest-growing cities (changing in size and composition); the proportion of international visitors to the park has grown significantly in the past decade; and events like those on September 11th can quickly change a market's composition. Visitor origin has an advantage, but not by a wide margin. This supports the findings of Moscardo *et al*.

Responsive: The findings suggest that the most useful approach depends on the situation. The visit type segments explain much more behavioural variance and origin segments may possibly respond better to messages based on visit motives (although neither approach explained more than 10% of the variance). Findings suggest that pre-trip information could be targeted at geographic segments with messages that reflect their unique interests patterns, but that activity information is best targeted to on-site visit type segments. This differs from the findings of Moscardo *et al*, who found that activity-based segments explained more motive variance.

Relevance is in the eye of the beholder. Those who wish to appeal to visitors' interests may be best to pursue origin segments, but those interested in visitors' activities in the park – and their movements through it – would find more value in the visit type approach. Strategies to influence the tourism system may investigate similar *post hoc* approaches. Moscardo *et al* came to a similar conclusion, but for different reasons. In that study, activity segments were better predictors of visit motives.

Accessible: Without these findings, visitor origin segments seem more practical for pre-trip and en route information and for building awareness. But with the results, it is clear that visit type segments are accessible – and more useful – for targeting on-site activity information. Results suggest where to find each segment, and which activities to target. Moscardo *et al* suggested that visitor origin segments were generally more accessible.

Substantial: Both approaches provide segments that are large enough to warrant attention. In recent years, data miners and proponents of 1:1 marketing have suggested that new models may render this criterion obsolete. Many successful enterprises cater to individuals or to very small niches, or create new segments when the opportunity is truly unique (Behrens, 1987). But, when faced with a need to describe the outcomes of visitor use, market segmentation is still an appropriate activity. This supports the findings of Moscardo *et al*.

Assessing **compatibility** is beyond the scope of the variables used for this paper, although the survey did include items to help assess this criterion (*e.g.*: desire for solitude versus desire for companionship). Moscardo et al did find support for their activity-based segments on this criterion.

SUMMARY

Visit type segmentation was more useful for predicting variables of relevance to the development of park tourism and management of its facilities. It should be more useful to managers who wish to assess the size, competitiveness, and compatibility of segments within the market. They were also shown to be relatively stable and reasonably accurately measured.

The visitor origin segments performed well on accuracy of measurement and pre-trip accessibility. They were also related to participation in specific activities, but less than visit types.

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Monitoring and Management of Visitor Flows in Recreational and Protected Areas
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Monitoring Low Volume Walker Use of a Remote Mountain Range: a Case Study of the Arthur Range, Tasmania, Australia

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Abstract: Registration data are the major source of information about bushwalker (hiker, tramper, rambler) volumes and basic characteristics in the Arthur Range within the Tasmanian Wilderness World Heritage Area. This paper describes the problems encountered with the existing registration system and the simple and practical solutions adopted to address them.

INTRODUCTION

Twenty per cent of the land area of the Australian state of Tasmania is listed as World Heritage Area (WHA) and is managed by the Parks and Wildlife Service. This is a rugged, glacially-formed mountainous region of exceptional natural beauty. Along with some regions of New Zealand and South America, it used to be part of the ancient supercontinent of Gondwanaland. The three areas are linked in their geology, flora, fauna and weather—wet, windy and westerly.

Figure 1.The location of the Arthur Range within the Tasmanian Wilderness World Heritage Area..

Within the WHA lies the Arthur Range, renowned amongst Australian bushwalkers (hikers, trampers, ramblers) for its walking opportunities and weather, both of which are unparalleled in the country. Federation Peak (1224m), the highest peak in the range, was first climbed by Europeans in 1949, and a visit to this peak is still considered a rite of passage for many serious bushwalkers. Road access was first extended to within 10km of the Range in the 1960s and currently the entire range receives fewer than 1000 walkers each year.

Apart from an entry fee that is only collected at large, well-staffed sites, there is no walker regulation in Tasmania. Registration books have always been the major source of information about overnight track use in the WHA being an inexpensive information-gathering tool for a track network most of which is remote, low use (by European or North American standards) and infrequently visited by Service staff. Registers are located at all track heads to the Arthurs, and on the summit of Federation Peak itself.

During the late '80s, there was some evidence that use of the Arthurs was expanding rapidly. Serious consideration was given towards more restrictive management, such as a quota-based permit system to regulate walker numbers. During the ensuing public consultation, it became obvious that the existing registration data was inadequate. In short, the information was poorly accessible and difficult to interpret as it was plagued with missing data. The accuracy of the data pertaining to intended route was suspect while no reliable information was collected about actual patterns of use. This was a major problem because—and as detailed below—walkers frequently change their plans due to weather and the terrain. Consequently, anecdote was resorted to as a major source of information. This was not acceptable when dealing with the public over access issues: clearly more accurate and reliable information was required.

In 1997 additional resources were allocated to walker monitoring in the range. Some simple, practical and cost-neutral changes were made—and are described in this report—that resulted in a standard of information that both management and the public found acceptable. The revised system is by no means perfect but in the world of modern protected area management perfect systems are usually not practical or affordable. Modern land managers have to make do with what is *acceptable* within resource constraints.

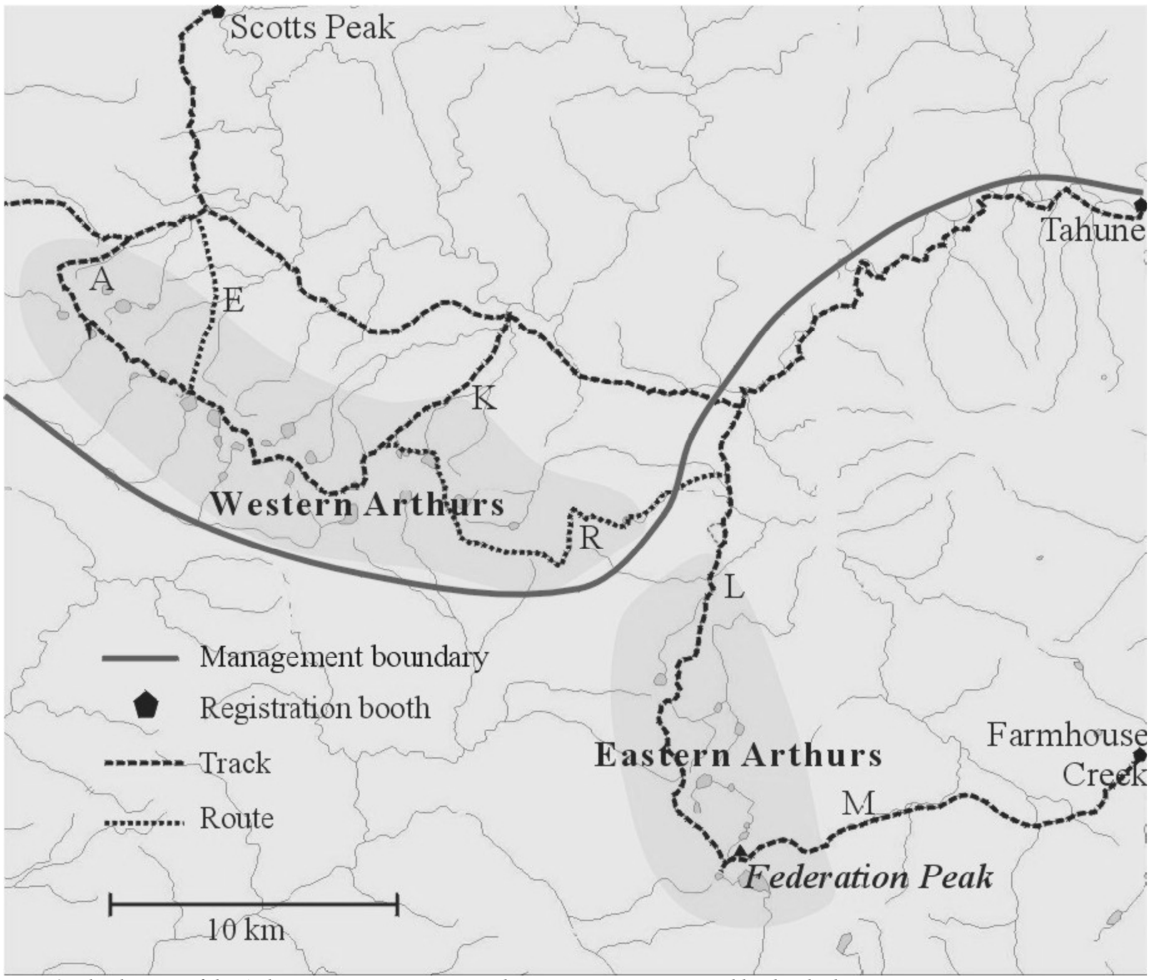

Figure 2. The division of the Arthur Range into Western and Eastern sections, as noted by the shading..

Topography of the range

There are three major track heads servicing the range (Scotts Peak, Farmhouse Creek and Tahune, see figure 2). The range itself is divided into eastern and western sections that are treated as two separate destinations by most bushwalkers. Federation Peak is the major destination in the eastern section, and is accessed by either routes L or M. In the Western Arthurs most walkers follow rough tracks along the skyline amongst the glacial lakes and small rugged peaks that feature on that part of the range. Most walkers access the range via route A, and there are three further escape routes, E, K and R, along the range so a large number of permutations of route are possible. Most tracks are formed, with the exception of routes E and R, which are pads or routes only. Given the ruggedness of the range and the ferocious scrub, walkers stay to tracks and routes so that prediction of movement through the range is straightforward if the access and egress points are known.

PROBLEMS AND SOLUTIONS

As stated in the introduction, there were four problem areas with the available information pertaining to walker use of the Arthurs prior to 1997. These were problems with missing data; lack of knowledge of actual—as opposed to intended—patterns of use; perceived unreliability of existing intention information and poor accessibility of data. These problems were addressed by the simple application of information management tools: through better coordination of field operations, changes in register design, data handling and reporting.

System coordination and administration

A district management boundary bisects the range (figure 2). Both districts had different operational systems and maintenance and collation of registers in the two districts was undertaken independently, even though walkers' routes cross these boundaries at will: many start at a track head in one district and end in the other. One district changed the registers over and collated data every month. The other changed the book over every year and data collation was not undertaken in the district at all.

Frequent field servicing of registers is desirable as this means that missing data due to theft of registers or their running out of pages is minimized. However this must be balanced against the considerable cost of travelling to the register stations. In this example one district was expending too many resources in servicing registers, while the other district was expending too few. The optimum for the two districts was quarterly servicing.

Prior to 1997, districts manufactured their own registers and this required many hours of tedious photocopying and binding. Districts are now supplied with a stock of registers that are made up in head office, and all they need do now is swap over the register during the quarterly visit. This has freed time for district staff. It has also meant that all registers meet a standard format and standard of quality as office equipment in Head Office is usually a higher standard than in the district. Unused pages from old registers are recycled in new registers.

The major paradigm shift of the entire exercise was the recognition that registers from different track heads should not be treated as independent entities, especially when there are through routes connecting them. Failure to recognise this results in *n*-tuple overestimation of walkers on that through route, where *n* represents the number of registers servicing the route. That the registers should be treated independently was something that simply evolved over the lifetime of the Service, but has now been eliminated from all walker monitoring systems maintained by the Service.

Furthermore, prior to 1997 handling the data from the registers was treated as a clerical chore. Data was entered verbatim from the register to database without any data checking. Obtaining valid information from the register requires that the person working with the data is an experienced walker in the area.

What this meant in effect was that all data handling became a head office task. Optimally, districts should be in control of their own data management systems as they have first priority need for the data. However in order to address the problems described above, it was necessary that the work be done in Head Office. In fact, the districts were happy to relinquish the task so long as information was accessible.

Register design

A standard design was devised in 1992. This required the registrant to sign across a row that spanned two A4 pages. While a vast improvement on the blank-page, journal-style logbook it replaced, the 'new' format was contributing to the problem of missing data. Registrants were breaking rows across the two pages; they overlooked columns and they were frequently confronted with books where the wrong pages were bound next to each other. Changing the format to a single, landscape orientated page (figure 3) resulted in better compliance for all items across the row. The width of the page does limit the amount of information that can be requested, but that means that the management agency has to limit their data requests to only the highest priority information.

Limit information requests to one item per column. Better compliance results when only one item of information is requested per column. In the 1992 format, we asked for party leader's name and address in the first column. After 1997, we asked for party leader's name in the first (for cross matching parties for through routes) and origin in the second. This resulted in an improvement in compliance from a yearly average of 75% (SD 5.9%) of parties in the 5 years preceding the format change, to a yearly average of 98% (SD 1.0%) over the 4 years since the new format was introduced.

Use unambiguous column headings. Use column headings that cannot be misunderstood. For instance, ask for walk start date and finish date rather than 'length of trip in days' which people often interpret as 'number of nights'. Never say that an item is optional, and never include 'if' in a column heading (see below).

Scotts Peak Logbook

For search and rescue purposes, in case you are reported overdue

The route number may be on the map in front of you. If not, describe your route in 'sidetrips/other routes' column

									Complete on finish of walk			
Party Leader's Name	Party Leader's postcode or overseas country of origin	Contact phone no. or car rego	Route No.s	Sidetrips/ other routes	Walk start date	Walk finish date	No. in party	complete on finish of walk	Where did you start the walk?	Return signa-ture	Date	Where did you actually walk?
for example Z. Smith	5024	088 9999999	31		1/1/99	5	3		here (scotts peak)	ZS	4/1/99	Lake Oberon return (on Moraine A)

Figure 3. Revised register format

If you want information, ask for it. As already stated, one of the insurmountable problems with the Arthurs walker data was not knowing what routes were actually walked, as opposed to what was intended. There was no provision within the registers for that information. In 1992, the registers included a column for people to sign out and to state where they started their walk (even though the data was collected it was never systematically used). In 1994, this was expanded to include a date that the trip was finished. Finally, in 1997, a further column was added which asked 'if you changed your walk from your intentions, list actual route here'.

It was found that some registrants were filling in the confirmation columns at the start of the walk. Also, the use of the word 'if' confused some walkers. So, two further changes were made in 1999: the confirmation block was made physically separate from the intentions block in the registration, and the column header was changed to 'where did you actually walk?' (see figure 3). The few remaining entries where walkers fill in the confirmation column at the start of the walk can usually be detected by the characteristics of the handwriting.

Compliance with the 'where did you walk' column was 90% in 1999/00 and 84% in 2000/1. So far, there has been no consistent association between route walked and whether confirmation details are provided. However, of those who did provide these details, about 45% walk a shorter route than intended.

Installing a temporary register on route K for 15 months between 1998 and 2000 validated information obtained in the confirmation section of the register. Almost complete agreement was obtained between details provided in the confirmation columns in the track-head registers and the information collected in the temporary register. This confirmed that those people who confirmed a particular route on route K were physically there. Furthermore, very close agreement has been found between the Federation Peak summit and track-head registers.

Use of auxiliary information in registration booths

Maps are located within each of the permanent registration booths. The more frequently undertaken routes in the area are drawn on the maps and each is given a code number. This can make registration easier for walkers as they just have to write in a number rather than write the route out in painstaking detail. This practice has been in place many years.

For the track manager, however, route codes are only useful if they accurately represent where people are walking. Inappropriate route codes were in place in the Western Arthurs, which lead managers to believe that a certain pattern of use existed when in reality it did not.

The map in the major booth (Scotts Peak) was renewed in September 1997. The old map contained a code that described a circuit that included routes A and E. Prior to 1997 it was believed that up to 40% of registrants were attempting the A to E circuit. Route E is untracked and management were concerned to keep it that way, so the route code for A to E was deleted from the new map to deter people from using it. The results were surprising.

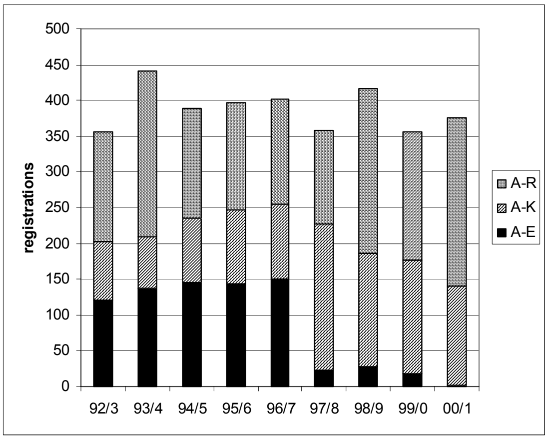

Figure 4. Registrations by route for Western Arthurs, November to March. The route code for A-E was removed from the booth in September 1997.

Numbers registering for A-E route dropped from 150 in 1996/7 to 20 in 1997/8 (figure 4). It became clear over the next few years that substantial numbers of walkers were walking to one of the lakes on the hardened route A and then returning on A, and not walking E at all.

Route codes can only be used where there are few choices of route and those routes are unambiguous. Where there is any doubt, plenty of space should be provided to encourage walkers to describe their route in detail.

Registration compliance rates

Knowing what proportion of the total visitor population to the Arthur Ranges signs in the registers is essential. Not knowing this in the past is one of the reasons why the data were treated with suspicion.

Some of the ways that compliance can be determined (eg. Watson *et al*, 2000) simply are not appropriate for the area. For instance, one method requires an observer near the registration booth to see who registers and who doesn't. However, during the busiest time of the year—a couple of weeks in January—the busiest booth will average three parties departing per day. Likewise, in order to calibrate the track counter installed at the top of route A, an observer should watch parties walking over the counter and compare counts. During the busiest time of the year, it may take one week to observe 40 passes. Movement-activated cameras, of course, would be the ideal solution, but in the current climate these are not politically acceptable.

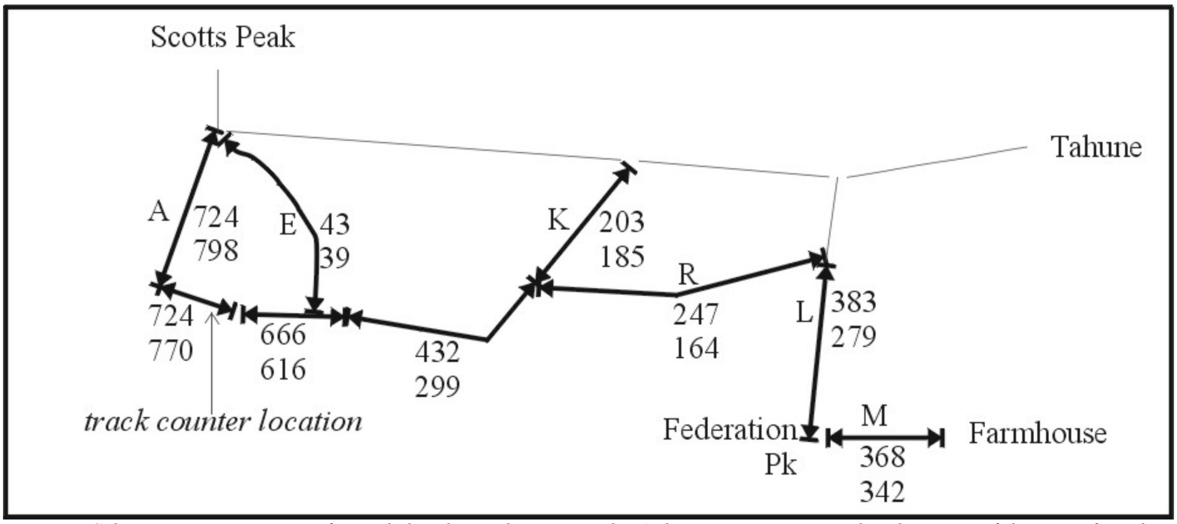

Figure 5. Schematic segment map of intended and actual passes in the Arthur Range. Not to scale. The upper of the pair of numbers adjacent to each arrow denotes the intended number of passes for that segment, and the lower, the actual number of passes as determined by registration confirmation details

The results of walker surveys conducted in a similar areas of the WHA over the past three years have suggested that the registration compliance rate for overnight walkers is 90% or higher.

Reporting

Inaccessibility of data was the final problem identified with the Arthurs data. This was addressed in two ways.

Firstly, registration data is now published regularly as part of the routine yearly reporting cycle, along with frontcountry visitor numbers. Prior to this, data were published sporadically. While stating the obvious, if the data is not made available, the data will not be used.

The more difficult problem is knowing what to report, given the complexity of what is being reported. A simple approach, that has been received very favourably by managers and public alike, is a track segment map of walkers and/or passes per segment. This illustrates how use is distributed across the range, and how this differs when actual use is compared to intended use.

Given that most walkers' intended and actual routes are known, and that those routes are linear, it is a simple matter of allocating the number of passes or walkers to each defined track segment by some simple manipulations of the data (figure 5). These maps do not take registration compliance into account. Also, for those who do not confirm their route, it is assumed that they completed what they intended.

As a crude guide to the accuracy of the system, track counter readings can be compared against predicted number of actual passes. A seismic counter is installed at the location identified in figure 5. The counter is only crudely calibrated, in that Service staff check that it counts on single walker passes. Its behaviour under real life conditions is not known. These counters will record animal (wombat) passes as well, but these are not taken into account. However, the agreement between the predicted value and the counter value provides some reassurance that our predictions are not orders of magnitude in error, which is the first objective of the exercise.

LIMITATIONS OF THE REVISED SYSTEM

The system as described has proved to be useful when monitoring areas where routes are linear. When routes are more complex, as is the case in more open country where people do not stay on tracks, linear maps are not possible. However, zone maps can be produced instead.

Track-head registration data is not useful in predicting use of side-routes. Use of side-routes occurs on the spur of the moment and depends on weather and group dynamics.

The system is labour intensive and is not appropriate for high use areas. Roughly speaking, office time required for data handling is about eight hours per 1000 walkers.

SUMMARY

This paper has described the process by which the walker monitoring system in the Arthur Range was improved by implementing some simple and practical changes in system coordination, data handling and reporting. Another round of public consultation relating to management of walkers in the Arthur Range will proceed in 2002, and it is anticipated that the improved quality of data pertaining to use of the range will assist in providing better environmental and recreational outcomes.

ACKNOWLEDGEMENTS

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Monitoring of Recreation-Affected Forest Stands in the National Park Losiny Ostrov

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Abstract: The effect of recreation on the forests of National Park Losiny Ostrov located within the boundaries of Moscow is examined. The methods of monitoring of recreation-affected forest stands are represented, and the preliminary results of their application for the revealing of the most damaged forest areas are discussed. Some practical measures are suggested in order to redistribute visitor flows across the territory of the most visited part of the national park.

INTRODUCTION

The monitoring and management of visitor flows are very urgent for the National Park Losiny Ostrov. Being organised in 1983, the park inherited high recreation loads, which have always existed in the forest massif of Losiny Ostrov, as it is surrounded by dwelling and industrial regions. The population of adjacent districts of Moscow reaches 2 mln people and that of Mytishchi, Korolev, Balashikha, and Shchelkovo (other cities of Moscow conurbation) exceeds 500 000 people. Let us take into account that new dwelling regions will be built in the peripheral part of Moscow and the nearest suburban areas. Therefore, the population of the regions bordering with the national park is expected to increase, as well as the recreation loads.

The major goal of the national park is to preserve the natural forest and wetland ecosystems under the conditions of an intensive daily recreation. For this purpose, a very accurate monitoring of the status of natural ecosystems is needed in order to detect and prevent their degradation at initial stages.

CHARACTERISTIC OF THE TERRITORY OF THE NATIONAL PARK LOSINY OSTROV

The National Park Losiny Ostrov occupies the territory of 120 km^2. This is a whole forest and wetland massif, dissected by the Moscow Circle Highway. Approximately 35 km^2 of forests are located within the boundaries of Moscow itself. The territory of Losiny Ostrov is a slightly wavy plain with an absolute altitude of 140-165 m above the sea level. It includes the chain of low moraine hills, the glaciofluvial terraces of the Yauza River, and the floodplain itself. The soil cover is represented by loamy or sandy-loamy soddy-podzolic and gley soddy-podzolic soils (Podzoluvisols and Gleyic Podzoluvisols, according to FAO Classification); Yauza floodplain is occupied by eutrophic bog soils (Histosols). The forests represent the most important recreational resources of the national park. They are quite diverse: lime, pine, and indigenous spruce forests constitute 11, 17, and 24% of the territory, respectively. A significant part of the national park (41%) is occupied by secondary birch forests. Despite the neighbourhood of urban areas, the natural complexes of the national park, especially of its central part, possess a high biological diversity: the list of plants found at the territory of Losiny Ostrov includes approximately 600 species, that of birds, more than 150 species, and that of mammals, almost 40 species. It is this relative wilderness of nature, which attracts multiple visitors.

RECREATIONAL SITUATION IN THE NATIONAL PARK LOSINY OSTROV

The direct calculations of visitor flows were made in 1990s by the students of Moscow State University. The observations demonstrated that in peak days, up to 150 000 visitors could be present at the territory of the national park simultaneously (Butorina & Chizhova, 1996). The researchers from the International Forest Institute (Moscow) calculated the recreation carrying capacity of the territory and real recreational loads on different functional zones. The calculations revealed the 5-6-fold exceeding of the carrying capacity, especially in the peripheral part of the national park (Project of Forest Management, 1998).

High visitor flows cause multiple negative effects on the ecosystems of Losiny Ostrov. Some of them are listed in Table 1.

Recreation activities	Character	Effect	Ecological consequences
Visitor flows along roads and paths	Linear		Introduction of non-typical plant species along roads; waste
Picnics	Point	Logging, emergence of new fireplaces surrounded by severely disturbed areas	Formation of multiple hot spots of forest degradation
Spontaneous out-of-path recreation	Spatial	Emergence of multiple new unmanaged paths	Soil compaction, disturbance of soil aeration and moisture regime, losses of organic matter, disturbance of soil vegetation cover, enfeeblement of trees, and degradation of an ecosystem as a whole
Recreation + dog airing	Linear or spatial	Disturbance of wild birds and animals	Reduction of the number of ground-nesting birds and small mammals, concentration of animals in the central part of the national park

Table 1. Ecological issues of mass recreation in the NP Losiny Ostrov

In addition, disturbed ecosystems loose their aesthetic properties, which enhances the advance of visitor flows towards the central undisturbed part of the national park. As a result, the area of recreation-affected natural ecosystems enlarges.

In order to regulate the visitor flows, several strategies are used in the national park.

Functional zonation based on recreation intensity (Figure 1). The central part of the park forms the nature conservation zone where the access is allowed to a limited number of visitors (mainly, researchers). This zone is designated to maintain the ecological stability and biological diversity of the whole national park. The most visited peripheral part forms the recreational zone, which is designated for a short-term outdoor rest and recreation. The belt between them is a buffer zone designated for regulated recreation and ecological education. However, at present, the functional zonation should be revised, because the real recreational situation does not correspond to the existing boundaries of functional zones. Figure 1 demonstrates that some areas of the nature conservation zone are at the same time the most visited ones.

Ecological education. Together with preventing the violations of the regime of the national park, the ecological education helps to reduce the effect of the most aggressive human activities, such as logging, fires, mechanical damage to trees, picking up rare plant species, etc. Another important aim of ecological education is to transform spontaneous visitor flows into organised groups. The effect of such groups on the nature of the national park can be controlled. At present, the national park offers 11 ecological excursions; the summary carrying capacity of the ecological roots is ca. 50 000 visitors annually (calculated according to Kalikhman et al., 1999). However, their real carrying capacity is limited by the number of rangers and level of management.

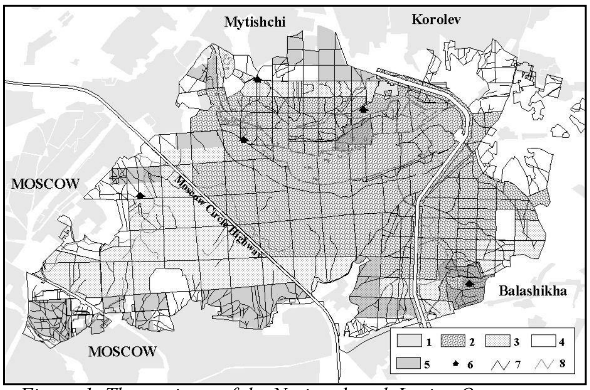

Figure 1. The territory of the National park Losiny Ostrov: (1) urban areas, (2) nature conservation zone, (3) excursion zone, (4) recreational zone, (5) areas with the highest recreational loads, (6) visit-centres, (7) major pedestrian roads, and (8) rivers and streams

Management of the recreational zone and, especially, roads and paths. It should increase the recreational carrying capacity of the elements of NP territory: paths, sport and playgrounds, banks of ponds, etc. In addition, the attraction of visitors to some well-managed areas should remove the visitor flows from those parts of forest ecosystems, where high recreational loads are not desirable. Unfortunately, the recreation infrastructure in Losiny Ostrov is very primitive and the level of service is very low. For example, there are no special service areas in our functional zonation.

The prospective goals of the management of the recreational zone are: (a) the maintenance of the biodiversity and (b) the formation of recreation-resistant forest stands. This envisages a detailed analysis of the structure of forest fund, the determination of the most and least damaged ecosystems, and the alternation of species and age structure of the forests of the recreational zone. For this purpose, the visitor flows and their effect on the ecosystems should be evaluated.

Although the direct calculation of visitor flows is the most widespread method, we avoided using it in our monitoring studies. There are several reasons for that.

The territory of the national park is paled fragmentarily, so there are many uncontrolled entrances and paths.

Significant length of park boundaries with dwelling regions, which are the sources of visitor flows, demands a large number of accounting persons, so the work becomes too expensive.

The intensity of visitor flows varies with season, day of week, period of the day, weather conditions and many other factors. As a result, an almost continuous account is needed to get reliable results.

Direct calculations give an absolute number of visitors, but not the spatial distribution of recreation effect. At the most, it characterises the recreation loads on basic linear elements, while in the NP Losiny Ostrov, the spontaneous out-of-road recreation causes the greatest damage to forest ecosystems.

However, we do not underestimate the results of direct account. They can be used successfully in sociological studies and planning of the development of recreational and tourist infrastructure, especially in the most visited sites.

METHODS OF COMPLEX MONITORING

The programme of monitoring of recreation-affected forest stands is a part of the general complex programme of forest monitoring in the NP Losiny Ostrov. The latter is based on the results obtained at permanent observation sites (Shapochkin and Lameborshai, 2000). However, the permanent observation sites are point objects and do not characterise the spatial distribution of negative factors. The recreational monitoring was initiated in order to detect the most damaged forest areas and elaborate the strategy of redistribution of visitor flows across the territory of the NP. The works are rather ecosystem-oriented than visitor-oriented, therefore, the status of forest ecosystems was the general criterion of acceptable visitor flows.

The current research programme partly includes the traditional methods of evaluation of recreation effect, which were elaborated in the former USSR in 1970s (Mukhina, 1972; Chizhova and Smirnova, 1976; Kazanskaya et al., 1977). However, the methods of complex monitoring of recreation-affected forest stands elaborated by M. S. Shapochkin are much wider.

According to this complex approach, the monitoring studies include three stages.

1. Selection of monitoring objects

The unit of monitoring is the forest inventory unit, i.e., a forest area with a homogeneous species and age composition of the tree layer, soil, and vegetation cover. In order to characterise the studied territory in a representative way, the forest inventory units are selected in proportion to the share of each species and age class in the whole forest fund of the territory and distributed evenly across the territory. Hence, a statistically reliable sampling is made. Each forest inventory unit is characterised by several circle test sites. The number of test sites (from 3 to 10) is determined in accordance with unit size and density of forest stands. Within a unit, the test sites are located regularly with the interval of 25-30 m in a latitudinal or longitudinal direction, depending on unit configuration.

2. Field observations

The tree layer, which determines the properties of a forest ecosystem, was characterised by tree species, considering the ecosystem biological productivity expressed via the basal cover of trees and wood storage.

From the centre of each test site, the trees are accounted using standard forest survey devices (angle gauge or prism). A qualitative characteristic of sanitary status of each accounted tree is given according to a 6-gradation scale. The following gradations are set: 1 – healthy, 2 – weakened, 3 – strongly weakened, 4 – declining, 5 – dead-standing trees of a current year, and 6 – dead-standing trees of previous years. The centremost trees are used for more detailed observations, the predominating species being represented by 3 and accompanying species, by 1 tree each. For these test trees, the height and diameter are measured, and the samples of timber are bored out in order to determine the radial increment during the last 10 and 20 years. The distance from the site centre to the three nearest trees is determined in order to calculate the number of trees per hectare, which characterises both ecosystem productivity and aesthetic properties.

The lower layers of forest communities were characterised by Dr. V. I. Obydennikov and his colleagues from Moscow Forest University. The undergrowth, grass, and moss layers of studied forest inventory units are described using the series of small observation plots. The status of undergrowth is evaluated quantitatively via the number of young trees per unit area and qualitatively, via its viability. It is a very important characteristic of ecosystem self-reproduction capacity. For grass and moss layers, the number and abundance of species and projective cover are determined. The decrease in projective cover and increased percentage of photophilous species and weeds determine the degree of recreation effect.

Sometimes, the visual determination of the category of tree sanitary status is not reliable. In connection with this, visual observations and measurements of tree increment were completed by anatomic analysis of wood tissues, which were conducted by the Assistant Professor of Moscow Forest University V. D. Lomov. The samples of wood tissues of the trees of different species and sanitary status were collected at the circle test sited. The tissues of trees growing under optimal ecological conditions were regarded as control samples. Wood samples are conserved for further xylotomic studies. The series of characteristics is determined, such as the width of annual layer, width of early and late wood, thickness of tracheid membranes, their lifetime, etc.

The recreation effect on soils is characterised by soil compaction and changes in some morphological and chemical properties. The compaction is measured by a durometre and expressed in kg/cm^2. Soil compaction is measured both under tree canopy, where the vegetation cover looks undisturbed, and at disturbed fragments of soil cover of a circle test site, such as paths, areas around fires, etc. The measurements are made in 3-5 replicates. The percent of bare soil surface (without vegetation cover and forest litter) is evaluated and considered as an important indicator of the degree of recreational digression (Kazanskaya, 1972). The thickness of forest litter and upper humuc horizon is measured, the latter being sampled. The content of moisture, organic matter, and base cations, and soil acidity are then determined.

The series of field measurements should be repeated each 5 years. For the most visited and endangered sites, the frequency of observations can be increased.

3. Data Processing

The data of field observations provide an integral characteristic of studied forest inventory units. For each unit, the following values are calculated:

- basal cover of trees by species and categories of sanitary status,
- mean weighed category of sanitary status, which is an integer indicator of unfavourable ecological conditions,
- radial increment of test trees, which is then recalculated into the volume increment, and the losses of volume increment with time are determined, and
- mean weighed percentage of bare soil and soil compaction.

These calculated parameters make it possible to reveal the critical areas of forest stands. The following critical values are set (Table 2).

Measured and calculated values are mapped, and the indirect characteristic of spatial distribution of the effect of visitor flows is obtained.

The losses of volume increment and organic matter are used to calculate the ecological damage, which is represented in financial equivalent per unit area. For this purpose, the computer programme created in the All-Russian Research Institute of Forestry is used.

Parameter	***Unit of measure***	***Critical value***
Mean weighed category of sanitary status	***none***	***2.5***
Losses of annual increment	***%***	***Exceeding normal values by the factor of 2 and more***
Percent of bare soil	***% of test site area***	***25***
Stage of recreational digression	***none***	***transition from stage 3 to stage 4***

Table 2. Critical values assessed for the characteristics of recreation-affected forest stands.

DISCUSSION OF PRELIMINARY MONITORING RESULTS

In 2001, the first stage of field observations was conducted in the recreational and excursion zones of the city part of the national park. Here, the secondary birch forests constitute approximately 60% of the forest fund. The rest is represented by pine and lime forests, spruce and oak forming fragmentary stands. Twenty-seven forest inventory units subjected to the recreational loads of different intensity were studied. Nineteen of them are represented by secondary birch forests and 6, by pine forests of both natural and artificial origin. The age of examined forest stands varies from 30 to 150 years and the relative density of stands, from 0.3 to 0.9. The species composition of the tree layer is either simple or complex, the predominating species constituting from 30 to 100% of the stand. To characterise this sampling, 127 circle test sites and 455 test trees were examined.

The mean weighed category of sanitary status of studied units varies from 1.5 to 3.0. For the majority of units, this index is between 1.5 and 2.5, i.e., they are referred to the category of weakened. Two units, located at the distance of ca. 1 km from the boundaries of the national park at the intersection of two roads, are classified as strongly weakened. Seven of the rest 25 units comprise the fragments of strongly weakened forest stands. These areas should be considered in the first turn, when the redistribution of visitor flows is planned. Healthy forest stands with the category of 1.4 were observed only at 3 separate test sites at the distance of more than 1.5 km from the park boundary, and no completely healthy forest inventory units were found. That is, healthy stands occupy only 2% of the studied area. This points to a general trend towards the decline of forests in the city part of the national park. Hence, a very accurate monitoring of their status is needed in order to prevent their degradation.

The vegetation cover and upper soil horizons of many test sites are damaged. On paths, the forest litter is destroyed completely, the thickness of the humus horizon is reduced by 25-50%, and the soil is compacted significantly. Bare soil surface constitutes up to 15-20% of the area of some test sites. At the same time, 25% of test sites have an undisturbed soil cover. When the percent of bare soil surface exceeds 5%, the compaction of the upper soil horizons is observed. The mean weighed soil compaction of disturbed forest units is 3-4 kg/cm^2, while normally, it constitutes 1-2 kg/cm^2 in forest soils. Soil compaction on paths and around fires reaches 15-20 kg/cm^2. The spatial distribution of the percentage of bare soil and soil compaction demonstrates that the forest stands located within a 1-kilometer belt along the boundaries with dwelling regions are the most affected by recreation (Figures 2 and 3).

At present, no forest stands with the 4th degree of recreational digression were found, i.e. all studied ecosystems have a potential for self-regulation and reproduction. However, the area with a pre-critical 3rd stage of recreational digression demands an immediate improvement. It should include:

- the reconstruction of path net in order to make the existing paths more comfortable for visitors and concentrate the major visitor flows along these managed roads,
- the creation of a dense artificial undergrowth, which will prevent the penetration of visitors into the forest massif and give refuge to birds, and
- the organisation of some new playgrounds or lawns to attract the visitors there.

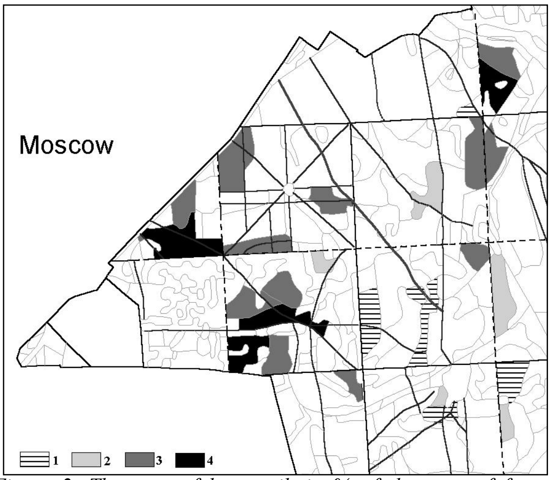

Figure 2. The area of bare soil, in % of the area of forest inventory units: (1) below 1%, (2) 1-5%, (3) 5-10%, and (4) 10-25%. Here and on Figure 3, solid lines represent major pedestrian roads

In addition, some corrections in GIS layers must be made. For example, the area with the highest recreational loads must be enlarged, as compared to that represented at Figure 1.

The preliminary analysis of the composition of vegetation cover demonstrates that typical forest species predominate at the majority of test sites.

Figure 3. Soil compaction, kg/cm^2: (1) 1.0-2.0, (2) 2.0-2.5, (3) 2.5-3.0, and (4) >3.0

Meadow flora and weeds appear only along roads, broad paths, boundaries of playgrounds etc.

The coefficients of correlation between the examined characteristics were determined in order to reveal their interrelation. The coefficients proved to be low, which points to a complex character of interrelation among the intensity of recreation and the status of forest ecosystems. The highest coefficient of correlation (equal to 0.38 at $P = 0.90$) was found between the sanitary status of forest stands and the area of damages soil and vegetation cover.

We expect that the equations of multiple regression will make it possible to reveal the most important factors determining the status of forest stands, and probably, to reduce the number of measured parameters.

CONCLUSIONS

The monitoring studies indicated the appropriateness of the complex monitoring methods for the evaluation of visitor flow effect on the forest ecosystems of the National Park Losiny Ostrov.

The results obtained can be used for the compilation of thematic maps and new layers of geoinformational systems, as well as for the calculations of ecological damage.

The first stage of monitoring studies revealed the areas where the forest stands are in a pre-critical status, according to the category of sanitary status of trees and percent of disturbed soil and vegetation cover. Immediate measures reducing the recreation press must be undertaken in these areas, including the improvement of roads and passes, creation of artificial undergrowth, and translocation of visitor flows to other areas.

The analysis of increment losses, anatomic features of wood tissues, and soil chemical properties is expected to provide a more detailed information about the status of recreation-affected forest stands. The statistical treatment of obtained data will help to determine the leading factors of forest degradation and the interrelations among the characteristics of forest stands and recreation effect.

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Monitoring and Management of Visitor Flows in Recreational and Protected Areas
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Recreation Monitoring at the Dutch Forest Service

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Abstract: In 1996 the former Institute for Forestry and Nature Research (now Alterra) started to develop a system to monitor the recreational use of forests and other grounds owned by the Dutch forest service. The aim was to determine the number of visitors, their activities and the percepted quality. This information provides a valuable management tool for targeting of resources. The system uses three methods to gather the information:
1. Monitoring vehicle and bicycle use at the sites by using traffic counters with induction loops installed in the road (all year round).
2. Visual counting of visitors at all entrances (on 12 days during the year).
3. Survey of visitors (on 12 days during the year).
When the system is fully implemented their will be a network of 48 sites. All of these will be monitored by using this method once in every 10 years, on average 5 sites a year.

INTRODUCTION

Management of nature parks need data about the recreational use of their areas in order to control and direct the flow of visitors. Several sociological founding studies were carried out by the former Institute for Forestry and Nature Research, now Alterra (Visschedijk 1997a, Visschedijk 1997b) before the set up of a recreation monitoring system (Visschedijk 1998a). The number of visitors to a site, the recreational use as well as the quality of the experience are monitored. It serves as a knowledge base for the future.

METHODS

The study was carried out in several areas managed by the Dutch forest service across the Netherlands, among which Ugchelen-Hoenderloo. This area serves as an example for this paper (fig 1).

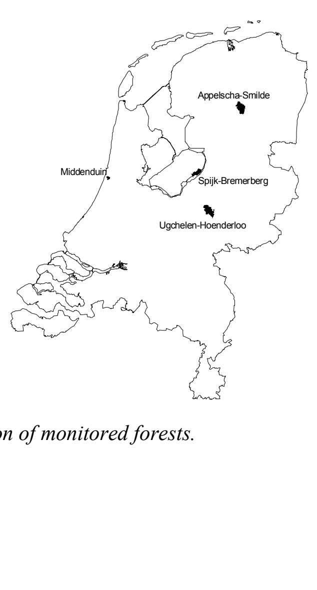

Fig 1. Location of monitored forests.

1. Monitoring vehicle and bicycle use at the sites by using traffic counters with induction loops installed in the road (all year round).

The use of traffic counters enables one to gather information about the number of passing vehicles and bicycles all year round. The counters automatically register the numbers and also provide other details such as date, time and speed. With this information it is possible to see the variation in use throughout the year.

2. Visual counting of visitors at all entrances (on 12 days during the year).

Counting all the site-entrances visually is essential for determining the exact number of visitors. With traffic counters is it impossible to cover the complete site, only cars and bicycles can be counted and you don't know how many people are for instance in the vehicles. In combination with the figures from the traffic counters it is possible to calculate the number of visitors during a certain period of time.

3. Survey of visitors (on 12 days during the year).

With the visitor surveys information is gathered among other things about activities, use of facilities, number of visits a year, place of residence, duration of visits and last but not least the percepted quality of the site.

The quality-score is generated by asking the visitors their opinion about 17 items concerning outdoor recreation. First through 17 thesis about recreation in general in which the visitors are asked about the importance of the items (general importance), in the next question the same thesis are asked in connection with the visited site (verdict).

Then the questions are combined, the answers about the site itself are weighted by the answer about the general importance of a certain subject. Table 1 shows the weightfactors.

		General importance				
		Very unimportant	Unimportant	Neutral	Important	Very important
Verdict	Very negative	-1	-2	-4	-6	-8
	Negative	0	-1	-2	-3	-4
	Neutral	0	0	0	0	0
	Positive	0	1	2	3	4
	Very positive	1	2	4	6	8

Table 1. Quality-scores

When an item is being considered as very important by the visitor, then his verdict about the item in the visited site can raise a score between -8 and +8. However, when an item is qualified as unimportant then a score is between -2 and +2. When an item raises a total average score of more than 1 the quality is qualified as being sufficient.

Since this system of monitoring is only carried out in 48 sites, there was a need to get information about all the other grounds of the Dutch forest service. Since counting is too expensive to be done in all sites, in the sites not covered by the monitoring network visitors are going to be given a questionnaire which they can fill out and send back by mail. Through extrapolation we try to predict the unknown factor, the number of visitors.

SOME SELECTED RESULTS

Results of traffic counters

The trafficcounters give year-round information about the number of cars and bicycles. With this information the 10th busiest day is determined. The 10th busiest day in Ugchelen-Hoenderloo was the 25th of July. Figure 2 shows the division of vehicles per day where every bar represents a day. The black bars indicate the days where interviews were held and visual counting took place.

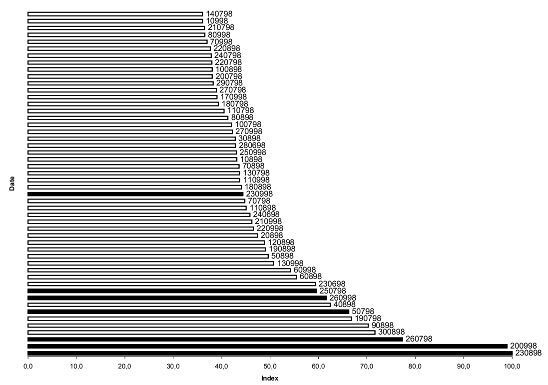

Fig 2.Number of vehicles per day where the busiest day is set at 100.

Results of visual counting

The number of visitors on the 10th busiest day was 2,093. As the size of the area is 1,814 ha this means an average visitor intensity of 1,15 per ha. The amount of facilities for recreation depends on this number. Figure 3 shows the number of visitors present in the area during the day.

Fig 3. Number of visitors present in Ugchelen-Hoenderloo at certain period of time.

Results of interviews

The quality score showed a score lower than 1 for the number of benches and the chance of seeing birds and other animals (Fig. 4). This should be improved by management.

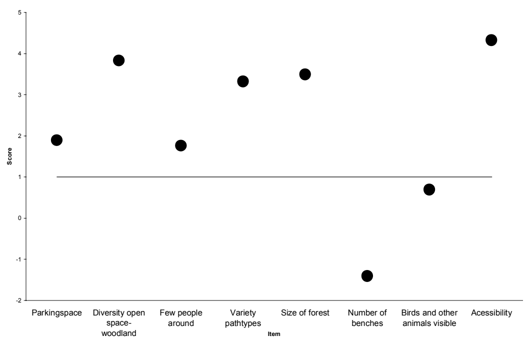

Fig 4. Quality-scores of Ugchelen-Hoenderloo

CONCLUSIONS AND OUTLOOK

The recreation monitoring system proved to be a valuable management tool.

At the moment Alterra is improving its system of: combination of monitoring and smaller onsite surveys through extrapolation of results (Visschedijk 1998b).

Besides Alterra is working on a model which predicts the number of visitors to a site based upon:

Number of different sites in an area

Quality of the site

Quality of the routes leading to a site

Number of inhabitants in an area of approx. 25 km around the site.

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Visitor Management by Visitor Monitoring? Methodological Approach and Empirical Results from the Wadden Sea National Park in Schleswig-Holstein

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Abstract: Even today monitoring in most large nature reserves is mainly concerned with ecological environmental observations. Socio-economical parameters and special parameters concerned with tourism are rarely part of such programmes. This is not the case in the Schleswig-Holstein Wadden Sea National Park (SH-WSNP). During an extensive ecosystem research project the necessary basis for a better understanding of the structure and dynamics of the Wadden Sea was made. The local population and economy of the Wadden Sea region, especially tourism, played an important role in the project right from the start. The knowledge gained by the project was used as a basis for the revision of the national park law and in the concept for an interstate monitoring programme for the Wadden Sea. The three modules of the socio-economic monitoring (SEM): SEM-Regional, SEM-Trend and SEM-Poll document the, for Germany, unique and thus innovative character of this monitoring programme which is orientated towards comprehensive data collection and assessment. Extensive experience with different methods and results of the quantitative and qualitative monitoring of visitors were gathered during a three year test phase. The possible use of the results for an optimisation of the management of visitor flow in and adjacent to the National park and for more targeted information and public relations work are discussed.

INTRODUCTION

Monitoring[2] is a well established tool in protected areas and the field of environmental issues. It can be regarded as an integrated part of national park or nature reserve management and it is vital in order to control i.e. the efficiency of management measures or the ecological situation for endangered species and biotopes. The necessity of monitoring these ecological aspects can not be doubted. However, the dominating concept of monitoring seems to consider man solely as an impact factor and in a more or less negative way. With respect to the Wadden Sea, Kellermann et al. (1994) define monitoring as repeated measurement of „parameters which indicate the status of the Wadden Sea and of each of its compartments (...) or activities or natural and anthropogenic inputs which may affect the quality of the environment or the effects of such activities".

On the other hand in research models such as Man and Biosphere projects (Kerner et al. 1991) or ecosystem approaches as in the Wadden Sea Region (Leuschner 1988, Stock et al. 1996) social and economic systems are an integrated part. They define the relationship between man and nature with reciprocal action. Thus the consequences and effects on the anthropogenic system deriving from the natural system or its protection are equally regarded.

It is this theoretical and empirical concept of reciprocal action which actually seems to meet practical management needs. To achieve protection of nature against the will of people and visitors has proved futile in many cases, at least it demands a steadily growing effort with extensive measures for controlling and prosecuting prohibited actions and behaviour. To monitor attitudes of visitors and the local population towards nature protection can therefore be very useful. Last but not least it is also a legally and politically fixed goal for nature reserves and National parks to inform their visitors and to enable a special kind of nature experience (IUCN[3] 1994). Visitor management in a broader sense of the word therefore is more than just guiding people and keeping them away from sensitive areas. Besides control and management measures it comprises nature education, information, guidance, even tourist packages. A rising need for non governmental funds and sponsoring puts forward the need to know more about the visitors, their expectations and

[2] A short definition is given by BAYFIELD (1997) „Monitoring is to record change", whereas HELLAWELL (1991) describes monitoring more detailed as „intermittent (regular or irregular) surveillance carried out in order to ascertain the extent of compliance with a predetermined standard or the degree of deviation from an expected norm".

[3] International Union for Conservation of Nature

willingness-to-pay. This sums up to a monitoring concept which also supplies information for advanced visitor marketing.

The case of the Schleswig-Holstein Wadden Sea National Park (SH-WSNP) illustrates the long process of putting these experiences into a working socio-economic monitoring system (SEM). Although the original research concept (Leuschner 1988) for the area was already based on a reciprocal approach, it took 6 years of socio-economic basic research within the ecosystem research program and another 6 years from presentation of a monitoring concept (1993) to establish SEM in the National Park office in Tönning (Möller & Feil, 1997). Today it is the most comprehensive socio-economic monitoring system that includes a continuous visitor monitoring in nature reserves and national parks in Germany.

THE SEM – CONCEPT: AN HOLISTIC APPROACH ON MONITORING THE ANTHROPOGENIC SYSTEM RELATED TO THE WADDEN SEA NATIONAL PARK

The SEM – Modules

Socio-economic monitoring performed in the region of the SH-WSNP consists of three modules (figure 1):

- A basic monitoring "SEM Regional" describes the development of the regional population and economic structure;
- A second module "SEM Trend" focusses on quantitative and qualitative data about park visitors, e.g. numbers, visitor structure, publicity and valuation of national park attractions, attitudes and motivations;
- "SEM Poll" provides information on knowledge, profile and acceptance of the national park within the region itself and nationwide.

VISITOR MONITORING – STRUCTURE AND EMPIRICAL INSTRUMENTS OF THE MODULES SEM TREND AND SEM POLL

SEM Trend combines visitor counts, surveys of visitor structure and visitor polls using face-to-face interviews at 16 locations (figure 2 – map of study area) which serve as entrances to the national park. The geographical situation – the landward boarder of the national park stretches along about 450 km of coastline and island shores, principally accessible at any time - required the selection of a few typical sites for the counts and opinion polls. Their number is also limited by financial and work resources. Selection of locations followed two criteria:

- Locations on islands, Halligen and at the coastal mainland along the national park boarder;
- hot spots of tourism, locations with moderate visitor frequency and day trip destinations.

An important precondition was the presence of national park service ranger at the respective coastal section, who simultaneously carried out the counts and interviews at the selected locations. Workers were thoroughly and repeatedly trained to minimise probable bias caused by the interviewers.

SEM Poll uses the instrument of representative (computer-aided) telephone interviews with random sampling. Co-operation with a neighbouring university of applied sciences was established in the case of the opinion polls of local residents. An independent market research institution was charged to carry out the nation wide poll.

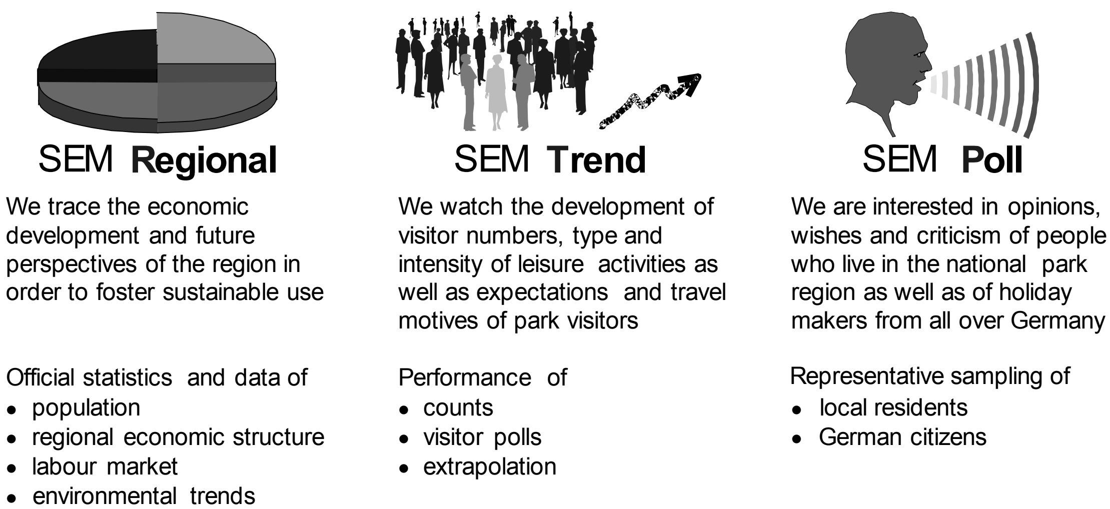

Fig. 1: Modules of socio-economic monitoring

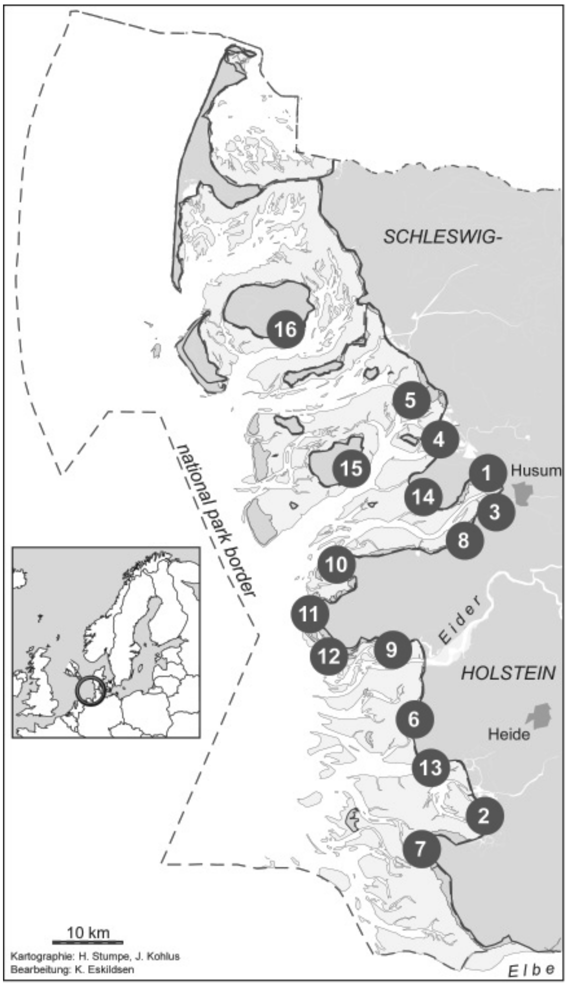

Fig. 2: Map of study area with locations for visitor monitoring. Numbers of locations refer to figure 3.

RESULTS FROM SEM VISITORMONITORING – MEASURING MORE THAN JUST AN IMPACT FACTOR

Who is the visitor? - Identifying target groups

Unlike the situation in world famous national parks like Kruger National Park or Yosemite many, if not most, of the visitors to the SH-WSNP are not primarily visiting the national park. They are mainly tourists, looking for a holiday or day off near the seaside. The SH North Sea coast and Islands already became a recreation and spa region at the end of 19th century. The National park itself was founded much later, in 1985.

From earlier studies (Feige et al. 1993a, 1993b) visitors found along the coastline and island shores can be roughly categorised into:

- The North sea holiday makers, staying in the adjoining tourism sites and recognised as traditionally nature and health oriented guest group;
- Day trippers from outside the coastal region, who spontaneously decide to go for a weekend break or day trip to the beach or seaside;
- The local people, using the National park as their traditional leisure, living and working environment, who often avoid tourist hot-spots and retreat into less popular but ecologically more vulnerable areas;
- Other visitors, such as people visiting friends and relatives, people on business trips, or people with a second home in the region etc.

SEM tries to assess the spatial and seasonal distribution of these visitor groups and to produce additional information on their - site related - behaviour, attitudes and expectations.

As shown in figure 3 i.e. shores on Islands (Föhr, Pellworm, Nordstrand) are dominated by holiday makers whereas smaller, so-called „green beaches“ along the coastline (Schobüll, Husum) or specialised sites like wind-surfing resorts (Elpersbüttel) have a higher percentage of local residents and day trippers.

These findings are important for the design of site related information, such as the established visitor information system (VIS) and service offers (i.e. National Park Service).

SEM also asks for additional socio-demographic visitor structures: age, number of persons and children, place of living.

General results on numbers and attitudes

The exact amount of visitors to the park is and will remain unknown, due to the above mentioned geographical situation which lacks a central entrance. Nevertheless SEM aims to collect and assess more information, conducting counts site by site and season after season. Using data from the selected locations a first extrapolation has been made:

The extrapolation for the selected 16 sites sums up to ca. 2,46 Mio visitors for one year, with numbers ranging from 15.000 in the smallest place to 0,5 Mio per year at the beach of Büsum, a traditional tourism site at the mainland coast. 35% of the visits are made during the two summer months July and August and 53 % in spring and autumn (April to June, September, October). Winter counts have been stopped because of a paucity of visitors. However, the winter season is estimated at about 5 to 12 % of the total.

The visitor structure throughout the busy tourist season (April to October) is dominated by North Sea holiday makers (75%), followed by day trippers from outside the region (13%). Locals and other visitors account for another 12%.

Table 1 gives an impression of the effort which has been undertaken by SEM until now.

	1999	2000	2001	Total
Number of visitors counted[1)]	42.803	27.489	49.492	119.784
Registered visitor structure[2)]	4.089	3.264	5.167	12.520
Number of visitors interviewed[3)]	572	670	1.019	2.261
Number of work days[4)]	84	116	112	312

[1)]Counts without interview
[2)]Short questionnaires, only visitor type, age, number of persons and children
[3)]Interviews on attitudes, knowledge and expectations
[4)]Appointed personnel x days of counting/interviewing

Table 1: SEM Trend effort from 1999-2001

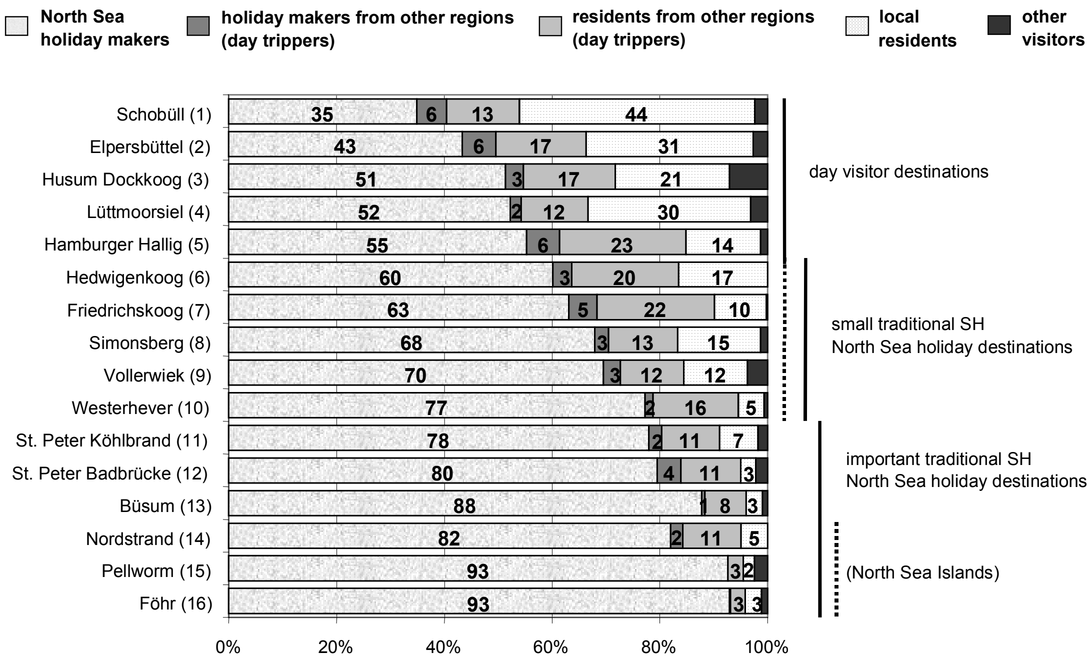

Fig. 3: Visitor structure at 16 locations at the Schleswig-Holstein Wadden Sea National Park in 2000 and 2001. Numbers of locations refer to figure 2

Change in visitor structures by management measures – A-priori and ex-post analysis (Hamburger Hallig)

The Hamburger Hallig is a small island within the national park territory with a causeway to the mainland. It could also easily be reached by car until 1996 when, after intensive negotiations, a toll-bar combined with an entrance fee was established. The national park office, in consensus with the adjoining community, who rejected a strict ban on cars, aimed to cut down car numbers in this way.

Counts of cars and visitors impressively illustrate the effects of this management measure: The number of registered car crossings to the Hallig declined by one third between 1997 and 2000 (see figure 4). Counts which also regarded the modal split show that in 1990 ca. 86% of the visitors came by car. In the year 2000 visitors by car only represent 26% of the total. The bicycle has now become the most important transport vehicle (48% in 2000, 6% in 1990).

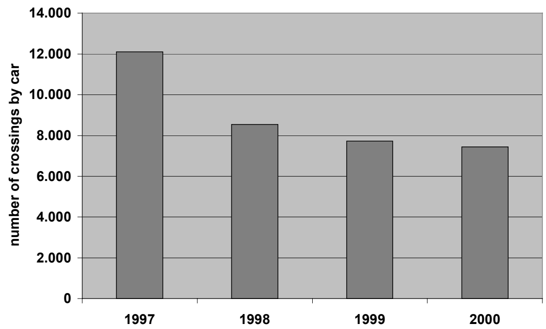

Figure 4: Numbers of registered car crossings at Hamburger Hallig 1997-2000

QUO VADIS? CONCLUSIONS AND PERSPECTIVES

Three years of continuous visitor monitoring have improved the knowledge on visitors to the national park and have built a solid basis of information. Monitoring is not an end in itself, but is designed to provide benefits. Three characteristic steps mark the process of building up a qualified SEM in its way from visitor monitoring to visitor marketing (figure 5):

Step 1: Visitor Monitoring

Step 1 comprises the construction of an empirical and methodological framework with selection of locations for counting and interviewing as well as designing the sample, considering especially seasonal aspects. Because of the variety, number and different attractiveness of beaches, sites, harbours etc. This became quite a challenge in case of the SH-WSNP. This methodological step might prove much easier in other areas with different preconditions.

Developing a standardised procedure for extrapolation of visitor numbers was a second task, which has to be continuously improved upon. Supplementary opinion polls of the regional population as well as representative polls served additional qualitative information on acceptance of the SH-WSNP, interest and behaviour concerning nature protection, the knowledge of its existence and its potential for visitors.

Another future gain may be the multiple use of market research instruments and data by different regional stakeholders. The communities and tourism organisations are equally interested in tourism data as is the national park office. The linking-up and exchange of instruments and information will stimulate co-operation, synergetic effects will result in more effective application of funds.

Step 2: Visitor Management

Step 2 is made up of two parts. First of all processing the collected information into visitor profiles. This aims at identifying specific types of attitudes and behaviour through socio-demographic and other attributes. These are useful for designing customer-oriented products, information and services. SEM will, therefore, be able to provide useful information for the improvement of the already existing visitor information system (VIS).

Secondly we need analysis and a better understanding of interrelations and interdependencies. Up to now, we have only little comprehension of how i.e. weather conditions might influence visitor numbers and structures in certain sites and seasons. Successful visitor marketing requires a deepening of knowledge concerning influencing factors and their reciprocal relationships. Especially interesting are the opinions on information offers and nature experience by different types of visitors at varying sites. Detailed market research has to be conducted. With a special kind of „Hot spot“-monitoring we also learn about conflicts and their implications for visitors.

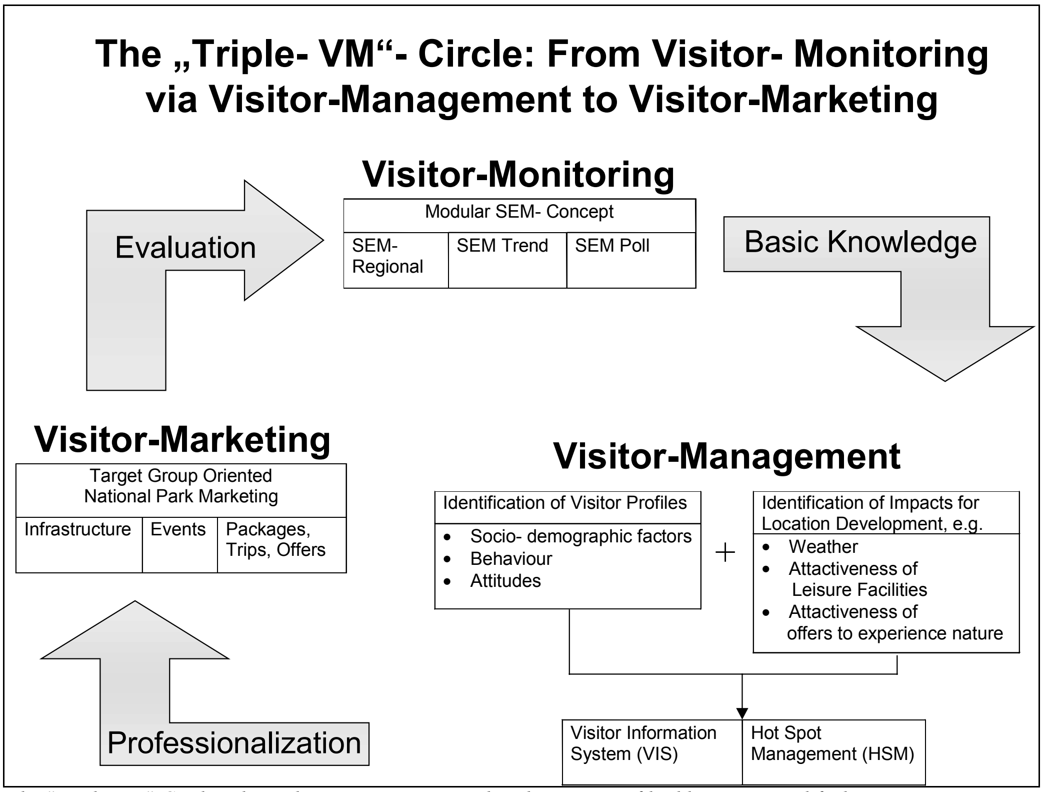

Figure 5: The "Triple-VM"-Circle: Three characteristic steps within the process of building up a qualified socio-economic monitoring (concept: M. Feige)

Step 3: Visitor Marketing

Summing up all information and findings SEM aims at a proactive and integrated visitor marketing. Of course there has always been some sort of visitor marketing. Nevertheless, it needs to become more and more orientated toward the specific needs and attitudes of various types of visitors (sun and beach, bird watchers, families, senior travellers, singles, technical visits etc.). SEM helps to offer them an attractive SH-WSNP experience, simultaneously safeguarding nature protection needs and respecting regulations.

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