Social Carrying Capacity of Canoeists in Austria´s Danube Floodplains National Park

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Abstract: Increasing recreational activities in National Parks affect natural resources as well as the recreational quality. In the Danube Floodplains National Park, stagnant waters, such as the Stopfenreuter and Spittelauer Arm, are a crucial component for ecological integrity, and at the same time constitute a main visitor attraction. In the summers of 2002 and 2003 a visitor survey investigated the perceived crowding of canoeists and whether the social carrying capacity is exceeded. Results of this study are that the social carrying capacity of this area has obviously been reached at certain times.

Introduction

According to the International Union for Conservation of Nature and Natural Resources, a National Park has to satisfy the demands for nature protection as well as the needs of a quality recreation (IUCN 1994). A circumspect and well-considered management is necessary to meet the requirements of both. In Austria, use levels in National Parks increase consistently, and therefore, research concerning the social effects in heavily used National Parks is necessary.

The concept of carrying capacity in leisure sciences was first mentioned in 1964, when Wagar (1964) developed the hypothesis that the relationship between nature and visitors can exceed certain ecological capacities. This hypothesis was broadened by the integration of social and managerial aspects, comprising, carrying capacity bases on three dimensions (Manning 1999): environmental, social and managerial. High visitor use can impact nature, can influence the experiences of the other visitors and can require management measures. Wagar (1964) defined carrying capacity as „the level of recreational use an area (could) withstand while providing a sustained quality of recreation, a quality environment and a quality recreational experience".

Factors influencing crowding

Factors that influence the sense of crowding can be classified into three groups (Manning 1999): characteristics of the visitors themselves; characteristics of the encountered visitors and characteristics related to the area visited. Examples of visitors' characteristics include motivation, preferences, expectations or attitudes (Manning 1999, Stankey & Manning 1986). The feeling of crowding can be influenced by group size, activity and kind of use (Jensen 1981, Stankey & Manning 1986). Ditton et al. (1983) describe the relevance of earlier experiences. Demographic factors (Arnberger 2003) can have an effect on crowding in urban recreational areas as well. Characteristics of the encountered, like size of the encountered group, their behaviour and their alikeness, are other factors that can have an effect on crowding (Manning 1999). Area-specific characteristics, such as the type of the recreational area, the location within the area (Manning 1999), accessibility, vandalism and waste (Budruk et al. 2001) are factors contributing to crowding as well.

Lucas (1964) was one of the first to carry out crowding studies with canoeists. Canoeists and users of motorboats experienced different levels of crowding, as the perception of crowding was related to the kind of use and the kind of encounter. Tarrant et al. (1997) found that encounters with kayaks and canoes seem to be less of a concern for many boaters than encounters with rafters. Use levels, time, day and water release explained perceived crowding of whitewater boaters quite well (Tarrant & English 1996). Expectations, preferences and former experiences of canoeists can influence the perception of crowding stronger than perceived encounters and use levels (Ditton et al. 1983).

Coping behaviour

Visitors can cope with crowding by rationalizing, shifting or displacing (Shelby et al. 1988). As recreational and leisure activities are based on self-selection, users tend to be quite content with their activities, as

they choose actions they like. If users experience negative factors, like crowding, they try to cope with this situation by e.g. displacing themselves to another area. Manning (1999) distinguishes interspatial, intraspatial and temporal relocation. Becker et al. (1981) mention a displacement of activities as well.

Spatial displacement was carried out by users of two rivers (Becker et al. 1981), justifying this coping behaviour with high use levels. Robertson and Regula (1994) describe various occurences of displacement; some boaters used the lake less, others changed the way of using it, and others carried out temporal displacement such as coming in the early morning hours or on days other than usual. More than one third of interviewed boaters (Shelby et al. 1988). stated that high use levels would lead to a redefinition of the way they thought about the river About 20% of them would displace spatially.

Crowding measurement approach

To define standards of quality related to crowding, visitors are usually asked to state the hypothetical acceptance of different numbers of encounters or to assess the maximum number of encounters that seems acceptable to them (Manning et al. 1996). In the last years, image-based methods came into operation. Freimund et al. (2002) describe that one of the advantages of image-based surveys is that images are more conducive to visual presentation as compared to verbal descriptions; also, interviewees and managers are truly confronted with the same conditions, as opposed to inferring from mere verbal descriptions. Images are more realistic representations of an area or a situation than a verbal description; nevertheless, not even pictures can represent a situation really realistically (Manning 1999).

Study area

One of the five Austrian National Parks, which are accredited by the IUCN, is the Danube Floodplains National Park (see Figure 1). It was founded in 1996 and is situated between the two conurbations of Vienna and Bratislava, extending over a length of 38 kilometres with an area of 9,300 hectares. The National Park protects one of the largest natural riparian wetlands in Central Europe, which to a high degree remain ecologically intact (www.donauauen.at).

There are one million visits per year counted in the National Park and the main users are hikers and bikers (Arnberger & Brandenburg 2002).

The National Park consists of nature zones, nature zones with management measures and external zones. The nature zones are not used commercially at all, and there are no attempts of influencing the nature, the ecological system, or the landscape. Temporary management measures are carried out in order to support natural development. In the nature zones with management measures, no interventions except for measures which serve to protect the ecological system and biodiversity (e.g. mowing of grass) take place. The external zone includes special areas, like the Danube waterway or flood protection dikes.

In the eastern section of the National Park an old-arm region is situated, the Stopfenreuther and Spittelauer Arm, which stretches for a length of approximately 4.5 kilometres along the Danube river and has a width of about ten metres. In the National Park boating with non-motorized boats is permitted on four old branches; the study area represents the most attractive and longest stretch of water. The entry point is easily accessible over an asphalt road. Due to the proximity of the old arm system to a

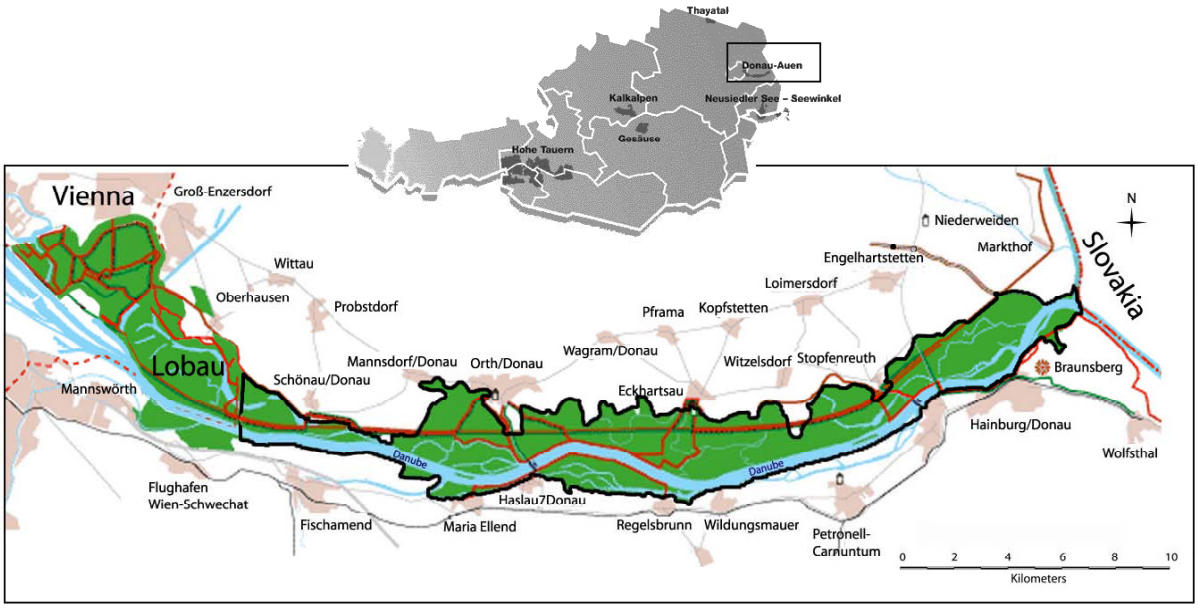

Figure 1. Austria and Danube Floodplains National Park (the section of Lower Austria is outlined in black), Source: Nationalpark Donau-Auen.

canoe rental and to a kayak club, this old arm system experiences the highest boater frequencies in the National Park region. In the last decade, canoeists' use levels have highly increased, caused by promotional activities of the National Park as well as the installation of the canoe rental. These are the reasons for conducting investigations about the social carrying capacity of this old-arm system.

Methods

Different methods, like on-site interviews, visitor observation and long-term visitor monitoring were carried out within the reach of this study (Sterl and Wagner 2003):

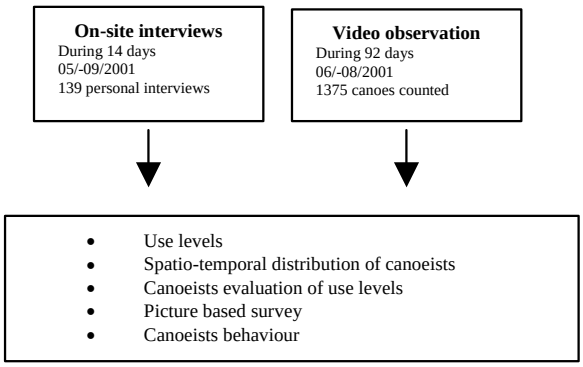

Figure 2. Methods of data collection.

On-site interviews

The visitors' survey was carried out in the summers of 2002 and 2003. Over fourteen days, canoeists leaving the old arms were interviewed by the authors using a standardized questionnaire. General demographic data was collected as well as the motivation for boating and the canoeists' earlier experiences with boating in this area. Visitors were also asked about their perceived crowding (ranging from "very few visitors" to "very many visitors") during the actual trip, the numbers of encounters, and if they react to crowding with coping behaviour. In addition, a multivariate image-based survey was developed, containing visual stimuli representing different levels of crowding, presence of wildlife, direction of travel, group size and placement of the canoes within the image (see Table 1).

Five sets each containing four pictures were chosen to analyse the influence of the displayed factors by asking the interviewees to choose the most pleasant and the least pleasant scenario in each set (see Figure 3). All pictures show the same background: an open part of the old-arm near the access point. Therefore, it can be assumed that the interviewees knew the scene. Also, the factor levels were kept constant and always shown at the same placement, e.g. the animals shown are always at the same location and in the same position. Sunshine or shade-effects were kept constant and therefore did not have any influence on the decision. The images were arranged using Adobe Photoshop 5.5 and the sets were systematically chosen from 96 possible combinations. This data was analysed using a logistic regression. The total sample size was 115 canoeists, interviewed on-site. In addition, 24 kayakers who are members of a kayak club located close to Stopfenreuth participated in a postal questionnaire survey.

Video observation

A day-long permanent video monitoring was carried out over a period of three months in the year 2001 in order to acquire counting data of the canoeists. All visitors entering the National Park with canoes were registered. The evaluation of these recordings provided information about use levels and the visitors´ temporal distribution. The data was proved to apply to the years 2002 and 2003 as well, through comparison with actual count-data. It was not possible to identify individuals in the video images, therefore anonymity of those observed is guaranteed.

Results

Intensity of leisure time usage

Based on the results of the video-monitoring (n=1375), it can be seen that use levels are at 3-7 canoes per weekday, rising to about 13 canoes on Saturdays and Sundays, and increasing even more on holidays (up to 18 canoes per day) (see Table 2). On the peak day, 32 canoes were observed in the old branch-system in the National Park. All in all, 1,375 canoes were counted during the three months of video monitoring.

Table 1. Attributes and attribute levels of image-based survey.

Attributes	Attribute levels			
Presence of wildlife	yes	no		
Use level	no canoe	one canoe	two canoes	three canoes
Direction of travel	facing the viewer	not facing the viewer		
Allocation of canoes within the image	foreground	background		
Group size	1 canoe per group	3 canoes per group		

Figure 3. Example of a choice- set.

Table 2. Mean of daily use level (n=1375).

Time unit	Mean of daily use level (canoes)
June 2001	9.0
July 2001	5.3
August 2001	8.2
per day	7.5
per weekday	4.7
on weekends	13.0

Visitor structure

The following results base on the survey (n=139). As many men as women used the area for boating within the range of this study; about 50% of the visitors were aged between 31 and 45 years and 20% were younger than 15 years. Interviewed visitors showed a comparable higher educational level than Austrian inhabitants in general. About 60% of the visitors are inhabitants of Vienna, which is situated only one hour by car from Stopfenreuth. The remaining visitors come from the surrounding areas.

About 70% of the visitors go boating with canoes, usually used by two persons. The others use kayaks or other boats. About 7% of the visitors are joining a field trip organized by the National Park. About 80% of the visitors go boating for up to four hours. Only one third of the respondents go boating more often than three times a year.

A special user group are the members of the kayak club who go boating almost the entire year. They use the old branches throughout the week, and are very experienced in boating.

Nature, pristine landscape and silence are the most frequently mentioned (each more than 90%) expectations of visitors of the National Park. Motivations for boating are the experience of an unspoiled nature and landscape as well as recreation. More than 50% mentioned the “pristine nature experience” as the highlight of the day, and 30% of the visitors enjoyed the silence and solitude.

Canoeists were also asked to evaluate different statements: more than 80% stated that they would accept bans on use if justified with nature protection. Likewise, about 70% think that low use levels are necessary to be able to experience nature and stated that they would react to high use levels with displacement. In contrast to this, 30% are happy if they would meet other canoeists on their trip.

Perceived crowding

A 5-point-crowding-scale was used to determine visitors’ feelings of perceived crowding ranging from

"very few visitors" to "very many visitors": 40% of the interviewees indicated that the number of canoeists seen during their trip was neither very many nor very few. Interviewed canoeists stated as well that the number of canoeists encountered agreed mainly with their expectations on use levels. There exists a negative correlation between perceived crowding and the expectation of solitude (1=solitude is expected very strong, 5=solitude is not expected at all) in the National Park (Linear regression: dependent variable: perceived crowding; R=0.195, p=0.041). No relationship could be detected between the experiences of crowding and day or use levels. Cross-tabs revealed that perceived encounters with up to six groups are seen as agreeable by 60% of the interviewees. 80% of those, who feel crowded ("many or very many visitors"), encountered at least 10 groups of canoeists.

A prediction model for the feeling of crowding was developed by integrating diverse variables (see Table 3). Two of these variables could significantly explain perceived crowding: expected use level and perceived encounters. The more canoeists are met, and the less canoeists were expected, the more crowded interviewees feel. By combining these two variables, 35% of perceived crowding can be explained, whereas expected use level has a stronger influence.

Preferences for use levels

The picture-based survey (n=139)was conducted by asking the visitors to choose one picture out of a set of four pictures which described for them the most and least pleasant scenario. Preliminary analysis only includes the evaluation of use levels, not considering other attributes, shown on the images:

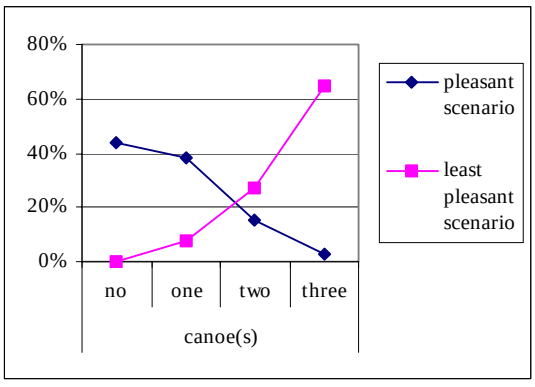

Figure 4. Relationship between use levels and share of preference for the scenarios.

On average, up to one canoe was evaluated as pleasant scenario, and three canoes as crowded scenario (see Figure 4). Scarcely half of the interviewed evaluated the scenario displaying no use level (no canoes) as pleasant scenario, and about 80% rated up to one canoe within sight as pleasant. Contrary to this, about 70% of the interviewed canoeists evaluated the highest use level (three canoes displayed) as least pleasant and therefore as a crowded scenario. But, already 9% feel crowded if one canoe is displayed. In contrast, 5% of the interviewed visitors evaluated the scenario with three canoes as not crowded. Scenarios displaying up to two canoes are evaluated as still being pleasant, whereas scenarios showing three canoes in any case represent a crowded situation.

The point of interception between the two curves of pleasant and crowded scenarios is situated at about 1.8 canoes depicted on the image, which signifies that two canoes are the critical point, where the perception of use level changes from pleasant to crowded. Visitors, whose main interest is either sports or nature, show a lower interception point at about 1.5 canoes; whereas, recreation-interested visitors display an interception point situated at about 2 canoes. The highest tolerance level have the family-orientated visitors, who would accept up to 2.4 boats. It can be seen that those who are interested in sports and nature evaluated use levels quite differently than visitors, who go boating with family and friends.

Data was additionally analysed with a logistic regression analysis, using this multivariate approach, for being able to determine the probability for each picture to be chosen, based on the attributes depicted. All significant coefficients ($p<0.05$) are marked in bold except the coefficient for "direction", which is significant at the 10%-level (italics) (see Table 4). The influences of the variables use level, presence of wildlife, direction of travel, position of boats within the picture and group size were analysed: the decision for the most pleasant situation was significantly influenced by use level, presence of wildlife and direction of travel.

Table 5 presents the probability of the four images shown in the methods chapter, to be chosen as a pleasant scenario: i.e. pleasant canoeing situations were described by low use levels, presence of wildlife and boats not facing the viewer: more than 60% of the interviewees would chose the image, repre-

Table 3. Regression model: dependant variable: perceived use level (1=very few visitors, 5=very many visitors).

Variable	Coefficient	SE	Beta	P
Constant	3.921	0.328		0.000
Expected use level	-0.456	0.085	-0.447	0.000
Perceived use level	0.061	0.018	0.084	0.001
r^2 /$r^2_{adjusted}$	0.382/0.371			
F/P	32.799/0.000			

senting the lowest use level as most pleasant, whereas only 4% would evaluate the scenario indicating the highest use level as pleasant. The logistic regression predicted 75% of the observed cases correctly.

Pictures representing a crowded situation were chosen if high use levels were shown (see Table 6). In this case, all variables depicted did not significantly influence the decision except use levels. Nevertheless, it can be observed that high use levels, boats displayed in the foreground of the picture and a big group size negatively influence the decision. 80% of the observed cases were predicted correctly.

In general, high use levels diminish the canoeing experience, the presence of animals is favoured in both cases (preferred or not preferred), small groups are seen as more agreeable than bigger groups and boats in the background of the picture (i.e. boats that are more distant) tend to reduce crowding perceptions based on the sign of coefficients. It can be assumed that a bigger sample size would lead to a significant confirmation of the tendencies shown in Tables 4 and 6.

Discussion

Within the reach of this study, several factors influencing perceived crowding could be assessed: perceived and expected use levels did significantly exert influence on crowding. In addition to that, crowding was related to expectations like solitude. Use level, presence of wildlife and direction of travel did influence the choice of recreational scenarios.

As perceived encounters with up to six groups of canoeists were evaluated as “neither too much, nor too few encounters” (with a scale ranging from “very few” to “very many”), standards of quality could be acquired. Six encounters corresponded to three boats that were encountered two times each during the trip.

Consequently, up to four boats could be in the old-branch-system at the same time. As the duration of stay averaged three hours, and if different times of arrival were assumed, 12 boats per day could stay in the old branches without violating standards of quality. This use level was exceeded on 22 days during the months of June to August registered via the video monitoring.

Table 4. Coefficients of the pleasant scenario of the logistic regression model.

Variable	Coefficient	Standard Error	Wald Chi-Square	P-Value
Wildlife	0.557	0.262	4.534	0.033
Use level	-1.480	0.415	12.692	0.000
Position	0.273	0.288	0.903	0.342
Direction	0.728	0.402	3.273	0.070
Group size	-0.672	0.932	0.520	0.471
Constant	-0.435	0.229	3.627	0.057

Table 5. Probability of images to represent a pleasant scenario.

Attribute	Image 1	Image 2	Image 3	Image 4
Use level	no canoe	one canoe	two canoes	three canoes
Wildlife	yes	no	no	yes
Direction	/	same	against	same
Share	64%	24%	11%	4%

Table 6. Coefficients of the crowded scenario of the logistic regression model.

Variable	Coefficient	Standard Error	Wald Chi-Square	P-Value
Wildlife	0.047	0.294	0.026	0.873
Use level	1.105	0.355	9.699	0.002
Position	0.599	0.398	2.263	0.133
Direction	0.265	0.385	0.474	0.491
Group size	0.921	0.603	2.335	0.127
Constant	-6.269	1.416	19.606	0.000

The pictures presented show 0.5 kilometres of the old-branch. One canoe per 0.5 kilometres was rated as an acceptable use level (see Figure 4); therefore, a use level of two boats per kilometre seems to be an acceptable standard. Considering the length of this old-branch, with 4.5 kilometres, nine boats at one time could use the old branch, which means 4 to 5 boats going in both directions, not assuming a clustered appearance as well. Boats stayed in the system on average for three hours, therefore 15 boats per day could use the old branch system, staying for about three hours, without feeling crowded. This use level was exceeded on 13 days in the summer months.
As canoeists boated on the average for one kilometre per hour, and as they stayed in the old branch for three hours, up to six encounters per trip seem to be an acceptable use level.

With the use of visual and narrative methods similar standards could be developed:
– 2 perceived encounters per kilometre (visual method)
– 6 perceived encounters per trip (same results with narrative and visual method)
– 12/15 boats as maximal use level per day (narrative/ visual)

Big group size of the encountered seems to intensify perceived crowding, as a small group size was generally evaluated as more pleasant.

Conclusions

About 60% of the interviewees (n=139) stated that they would displace because of high use levels: less than one third react to high use levels with temporal relocation and another 30% of the visitors react with spatial relocation (see Table 7).

Table 7. Coping behaviour (n =139).

Reactions due to crowding	Share
"I do not react at all."	44%
Temporal displacement	26%
Intraspatial displacement	22%
Interspatial displacement	9%
"I would not visit this place any more."	3%
"I would go home."	1%

Alternating routes and visiting times are the most common adaptive behaviours to crowding. About 10% of the visitors even displace to other boating areas, maybe giving place to less sensitive canoeists.

The analysis of the picture-based survey lead to the identification of standards of quality: six perceived encounters per trip were deemed acceptable by the canoeists. Another result of the image-based survey is that the variables canoeists' use level, group size and presence of wildlife do significantly influence the choice of a picture.

Within the reach of this study, the ecological carrying capacity, related to Grey Herons´ (*Ardea cinerea*) ability to cope with high canoeists´ use levels was assessed as well. As Grey Herons´ flight distances have not changed within the last ten years, even though use levels have risen significantly, it can be assumed that Grey Herons were able to habituate up to a certain extent to these high use levels (Wagner et al. 2003).

Experiencing nature is an important motivation for visiting the National Park and 80 % of the canoeists want to observe animals. As high use levels lead to disturbances to the fauna, animal observations become rare situations and therefore can diminish the recreational quality of the canoeists.

As the Danube Floodplains National Park is predominantly used as a local recreation area, management, therefore, needs to decide whether the National Park should provide local recreation opportunities for users, or should focus on providing a quality recreation for those who want to visit the National Park and desire to experience nature.

It seems problematic to implement management measures targeting use limits, as in Austria, since such measures do not have a tradition like e.g. in American National Parks. In addition, it would be very difficult to put such measures into operation, as the National Park area is used as an everyday recreational area by the local inhabitants. Another aspect is the limited resources of the National Park, limiting the possibility of executing bans on use.
Nevertheless, management measures are necessary, since about 60% of the interviewees indicated that they would react with temporal or spatial displacement to high use levels and 30% stated that this area of the National Park is crowded. Therefore, it is necessary to provide possibilities for a quality recreation.

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