Social Carrying Capacity of an Urban Park in Vienna

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Abstract: The goal of this research was to investigate the social carrying capacity of an urban park in Vienna, Austria. We used a stated choice approach, combined with a referendum style conjoint model. Based on the hypothesis that the perception of crowding is influenced by several factors, digitally calibrated images were generated to depict in a systematic and rigorous manner different visitor numbers, user types, group sizes, the placement of visitors within the scene, numbers of dogs on or off leash, and the direction of visitor movement. The social carrying capacity was measured by asking each respondent whether the presented scenario was acceptable or not. Overall, visitor numbers, the placement of visitors within the image, and dogs being on or off a leash influenced the visitors' decisions the most. The results of the binomial logit model can be used to simulate and calculate the visitor norms for many different situations; in other words, the referendum style conjoint approach delivers recreation norms within a truly multivariate investigative framework.

Introduction

The fact that visitor volume and unwanted visitor behaviour can compromise a recreational experience and even lead to use conflicts has been documented in many recreation studies over the past two decades (Graefe et al. 1984, Manning 1999, Rudell & Gramann 1994, Shelby et al. 1989). We are expanding that work in two ways.

So far, most crowding research focused on recreation in wilderness or natural areas with rather low user densities as opposed to more developed or urban recreation settings. The latter have received much less attention (Westover & Collins 1987), partly because these areas are so different, partly because the research methods developed for low-use areas may not be appropriate in high-use areas. One can only suspect that the phenomenon of social carrying capacity and substitution behaviour is equally relevant in urban and sub-urban settings.

The perception of crowding is a complex phenomenon, which is not only influenced by use levels but also by user conflicts, unwanted visitor behaviour, or resource conditions. Therefore, we propose to pursue our research on social carrying capacity more holistically with a multivariate method and a visual presentation of stimuli.

Social carrying capacity

Social carrying capacity, often referred to as crowding, can be discussed as a normative concept and crowding norms are generally described as visitor-based standards that individuals and groups use for evaluating behaviour and social and environmental conditions (Donnelly et al. 1992). Social standards are considered to be normative if there is a strong consensus agreement about a norm and the relative importance of the norm (Heywood 2002). If visitors have such normative standards, then they can be used for social carrying capacity management of recreation and conservation areas.

Norm measurement approaches

Several approaches to measuring social carrying capacities have been developed. Visitors have been asked directly in a hypothetical manner, about the maximum acceptable numbers of encounters. This numerical approach (Manning et al. 1996) referred to the evaluation of encounters of other visitors during a specific time period, mostly per day. Analyses of such data resulted in encounter norms or preference curves. Such a norm curve traces the average acceptability ratings of a sample of visitors for encountering a range of groups of other visitors along a trail or at a site per time unit.

Occasionally, visual approaches have been applied to measuring crowding in outdoor recreation (Behan et al. 2001, Davis & Lindvall 2000, Manning et al. 1996, Manning et al. 1999). A visual presentation of crowding situations seems particularly appropriate in high-use areas where it may be unrealistic to expect respondents to accurately judge the maximum number of encounters (Manning et al. 1996). The advantage of visual presentation is that certain influences such as use levels are more conducive to visual presentation instead of verbal descriptions, as the former generate a more realistic and accurate normative evaluation of indicators (Hall & Roggenbuck 2002, Manning et al. 1996). Interviewees and managers are truly confronted with the same depictions of a situation, and there is no need to inferring use levels from mere verbal descriptions.

Many authors have used acceptance or preference as the evaluative response scale (Freimund et al. 2002, Manning et al. 1996). Manning et al. (1999) used the absolute tolerance as the evaluative response scale: visitors were asked whether the visually presented condition was so unacceptable that they would shift their use to a different location or time.

Most of these studies applied univariate research methods in the sense that visitors were asked about norms and standards in single item questions (Shelby & Heberlein 1986, Manning et al. 1999). However, many management problems in conservation and recreation area management are of a multi-attribute nature and involve tradeoffs among multiple and often competing values. Only recently have some backcountry studies broadened their scope to multivariate research methods and some researchers included the impact of visitor numbers among other values using choice analysis (Lawson & Manning 2002, McCormick et al. 2003).

Study area

Data were collected in an urban park, called ‘Wienerberg’, in the south of Vienna, the capital city of Austria. This park of 120 hectares is managed by the municipal forest department, and forested patches dominate the park structure. Several sections of the park are conservation areas. The park provides about 14 km gravel trails and innumerable paths; some trails are open for bicycling. A lake in the middle of the park is used intensively for bathing and angling in summer, and ice-skating in winter; only one main trail section provides appropriate lighting for night use. Dogs are allowed, but have to be kept on a leash.

This forest park is surrounded by residential and business areas, a hospital, and garden allotments. The park was established in the late 1980s, and park management has observed permanently increasing recreational use levels, primarily fuelled by recent housing developments in the vicinity. More residential high-rise buildings are currently under construction nearby, and will increase use pressure on the park further.

Methods

Stated Choice

To analyse the trade-off behaviour in recreation research, stated choice methods have been used in the past, whereby respondents are asked to choose among alternative configurations of a hypothetical multi-attribute good (Louviere & Timmermans 1990). One strength of choice models lies in their ability to predict how the public will respond to various policy and management alternatives, including arrangements of resources, quality of visitor experiences, facilities, and/or services that may not currently exist, and avoid the problem of multicollinearity (Haider 2002). Stated choice analysis has been applied to study public preferences concerning a range of recreation-related issues such as visitor preferences for wilderness management issues (Lawson & Manning 2002; McCormick et al. 2003), tourism destination choice (Haider & Ewing 1990), and beach preferences (Stewart et al. 2003).

In stated preference/choice models, alternatives are defined as combinations of attributes, and each set is evaluated as a whole. The alternative profiles are constructed by statistical design principles, such as fractional factorial designs (Montgomery 2001). If respondents rate or rank each profile separately, the technique is usually referred to as conjoint analysis (Green & Srinavasan 1978). In a discrete choice experiment, however, two or more such hypothetical profiles are combined to choice sets, and respondents choose the most or least preferred alternative (profile) from each set they are asked to evaluate (Louviere et al. 2000). The advantages of stated choice over traditional conjoint analysis are that behaviourally, the analysis of choice – even though it is only hypothetical choice – is closer to actual behaviour than a rating or ranking task, and that the statistical analysis relies on random utility theory.

The theory postulates that choices can be modelled as a function of the attributes of the alternatives (McFadden 1974, Ben-Akiva & Lerman 1985). Individual behaviour is considered as deterministic, but because of the inability of the research process to account for all influencing attributes and the need to aggregate individual choices across individuals, the modelling of behaviour is undertaken stochastically (Train 1986, Ben-Akiva & Lerman 1985). Therefore, it is assumed that the overall utility (U_i) contained in any one alternative is represented by a utility function that contains a deterministic component (V_i) and a stochastic component (ε_i). Selection of one alternative over another implies that the utility (U_i) of that alternative is greater than the utility of any other alternative (U_j). The overall utility of alternative i is represented as (McFadden 1974, Train 1986):

$U_i = V_i + \varepsilon_i$ (1)

Given this stochastic component, the probability of an individual choosing one alternative over another will depend on the relative sizes of the systematic components of their utilities compared with the size and sign of their random components. The larger the difference in systematic components compared with the difference in random components, the more likely is the alternative with the larger systematic component to be chosen (Louviere et al. 2000).

Prob {i chosen} = prob $\{V_i + \varepsilon_i > V_j + \varepsilon_j; \forall_j \in C\}$ (2)

where C is the set of all possible alternatives. If one assumes that, for the entire sample, the stochastic elements of the utilities follow a Gumbel distribution, the multinomial logit (MNL) model can be specified as

Prob {i chosen} = $e^{Vi} / \sum e^{Vj}$ (3)

For binary dependent variables, where "not acceptable" may be coded as 0, and "acceptable" as 1, the choice probability can be estimated as

Prob {i chosen} = $e^{Vi} / e^{Vi} + 1$ (4)

The analysis produces regression estimates, standard error and *t*-values for each attribute level, which are referred to as part-worth utilities. The results of the binomial logit model supports the estimation of parameters that allow the estimation of the probability of choice of a given alternative as a function of the attributes comprising that alternative and those attributes of all other alternatives in the choice set.

Data sampling

Data for this paper were drawn from a larger study designed to develop a baseline understanding of recreational use to the Wienerberg Park in Vienna. Investigations of the recreational use were conducted between 2002 and 2003 using a mix of long-term and short term counting methods, as well as on-site interviews. The data for the study presented here were collected in personal on-site interviews, and included the choice task with visual stimuli.

On six days in late summer and early autumn 2002 on-site interviews were conducted in the park along the main trail section. The interviews took place on three randomly selected work days and their immediately following Sundays. The interviewers were employees of the institute, mostly students, who were carefully trained in the use of the survey forms. The interviewers asked visitors if they were willing to participate in a fifteen-minute interview. Once the interview was completed the next visitor encountered, regardless of user type was asked to participate in the study. Interviewers registered group size, activity type (biking, hiking etc.), if the visitor was accompanied by dogs on or off a leash, and interview time. A total of 291 visitors agreed to the interview, of which only 241 completed all questions. Especially some elderly people did not have their glasses with them to assess the photos. Compared to the results of the visitor counting methods, walkers and dog walkers were over-represented, while bicyclists and joggers were underrepresented in our sample due to their unwillingness to stop for an interview. The survey instrument consisted of two distinct components. The first part contained a conventional questionnaire on socio-demographic aspects and visit-related questions such as motivations and perception of crowding, origin, length of stay, etc.

In the second part of the interview, each respondent was shown four choice sets. Each set contained four digitally calibrated images displaying various recreational scenarios (Figure 1). Eight versions of four choice sets respectively were created, displaying a total of 128 different images. The images were printed on an A4-sheet using a high-quality colour laser printer. To facilitate presentation, each choice-set was laminated. The order of choice-set and choice-version was varied systematically to avoid starting point bias. First, preferences were assessed by asking the visitors to choose the most and the least preferred scenario of each choice set (these results will not be presented here); then the crowding norm was measured by asking the visitors whether each one of the chosen scenarios was so unacceptable that it would shift their use to a different location or time.

Attributes of the visually calibrated images

The 128 computer-generated images contained the following attributes in a systematically varied manner (see Table 1): number of visitors, user type, group size, the placement of visitors within the image, dog numbers and dogs on or not on a leash, and the direction of movement. Four attributes consisted of four levels; the number of visitors was shown in eight levels, and the direction of movement in three levels. The persons depicted in the images originated from photos taken in a two-hour photo session with a digital camera on a sunny summer afternoon from a fixed vantage point of the main trail section, thereby controlling colour and light effects. Adobe Photoshop 6.0 software was used to create the images according to the design plan. In order to respect the privacy of displayed 'real' visitors, all persons in the foreground of the image facing the viewer were depicted with sunglasses.

The background of the images was a 200m-section of the main trail system in the north of the park. The presented trail segment is well-known, popular and heavily used, because it offers a panoramic view to the Alps and over the Pannonian plain. Consequently, the topic of crowding was particularly relevant to this trail section.

Table 1. Experimental attributes and levels.

Attribute and Attribute levels			
Number of persons in the image:			
0, 1, 2, 4, 6, 8, 10, 12			
User type			
1	80% Walkers,	10% Bicyclists,	10% Joggers
2	40% Walkers,	50% Bicyclists,	10% Joggers
3	40% Walkers,	10% Bicyclists,	50% Joggers
4	20% Walkers,	40% Bicyclists,	40% Joggers
Placement of visitors within the image:			
1	30% Foregrd.,	40% Midgrd.,	30% Backgrd.
2	60% Foregrd.,	40% Midgrd.,	0% Backgrd.
3	10% Foregrd.,	60% Midgrd.,	30% Backgrd.
4	0% Foregrd.,	40% Midgrd.,	60% Backgrd.
Number of dogs and dog on or off leash:			
1	10% of walkers have a dog unleashed		
2	10% of walkers have a dog leashed		
3	30% of walkers have a dog unleashed		
4	30% of walkers have a dog leashed		
Group size:			
1	30% Single,	40% Pairs,	30% Triplets
2	60% Single,	40% Pairs,	0% Triplets
3	30% Single,	60% Pairs,	10% Triplets
4	0% Single,	40% Pairs,	60% Triplets
Direction of movement:			
1	50% towards camera,	50% away from camera	
2	75% towards	25% away	
3	25% towards	75% away	

The number of people depicted ranged from no person to twelve persons. In order to stay in our simulations within realistic visitor numbers, the maximum number of people presented in the images was derived from actual counting results. User types were displayed as walkers, bicyclists and joggers. We avoided different subtypes of user types, such as sportive fast moving bicyclists and recreational bicyclists. User types were displayed to assess the potential influence of user conflicts.

The attribute ‘placement within the image’ described the placement of persons in the fore-, mid- or background. For an accurate position of people, the 200m-trail section was divided into three equal distance zones. To ensure that the scale and size of people was correct, size comparisons of people in actual photos depending on placement within the image were undertaken. By means of that attribute, the influence of proximity effects to other visitors as well as the need for minimum spatial requirements (Baum & Paulus 1991) for the satisfactory pursuit of recreational activities such as cycling could be evaluated.

The influence of visitor behaviour was presented in two ways. Potentially unwanted behaviour was included by displaying unleashed dogs, and groups walking, jogging or cycling side by side thereby narrowing the trail. Due to design limitations, reliable results concerning this attribute were only possible when more than three persons were displayed in the picture. All dogs depicted were of similar size, and only walkers were accompanied by dogs, because our long-term video monitoring showed that only a small minority of joggers and bikers were accompanied by dogs. The maximum number of dogs displayed was three, and the impact of unwanted behaviour varied with the number of leashed or unleashed dogs. The attribute “direction of movement” contained three levels and described the proportion of people walking, cycling or jogging away from vs. facing the vantage point.

The hypothetical scenarios (profiles) and the choice sets were created by following an orthogonal fractional factorial design plan (Montgomery 2001). The binomial logit regression analysis resulted in part-worth utilities for each attribute level with standard error and *t*-value associated with each estimate. All attributes, except the crowding variable, were effects coded (Louviere et al. 2000), where an N-categorical variable needs to be defined by N-1 estimates only. Consequently, for all attributes one level is defined as the negative sum of the other level estimates, and these base levels do not contain any reference to a standard error or *t*-ratio.

The attribute number of persons were transformed into a continuous variable with a linear and quadratic term using orthogonal polynomial coding (Louviere et al. 2000, Montgomery 2001) fitting the eight parameter coefficients best. As the orthogonal fractional factorial design permitted the estimation of all main effects as well as two-way interactions, transformation was necessary to analyse the interaction between user numbers and other attributes. This data analysis was undertaken in LIMDEP 7.0 (Green 1998).

Figure 1. Example of a choice set – each image depicts different levels of six social setting attributes.

Results

Visitor characteristics

The profile of respondents shows an equal mix of women and men, and over 53 % were between 31 and 60 years of age. Only 4 % were bikers and 6 % joggers, while the majority of visitors interviewed were walkers (63 %) and dog walkers (25 %). More than half of the visitors live within a 15-minute walking distance to the park, and nearly all visitors reside in Vienna. One quarter of the respondents visits the park daily in summer, and 52 % at least once a week. About 13 % of the interviewees perceived the park as overcrowded on weekends and on holidays; on working days use levels are too high for only 0,4 % of respondents.

Choice model results

Table 2 presents the binomial parameter coefficients, standard errors, *t*-values and *p*-values for each level of attributes in the tolerance model. The tolerance model is based on a referendum style conjoint approach which requires respondents to evaluate one conjoint profile at a time, and simply judge if the profile is acceptable or not. Our study design contained a slight variation to this simple conjoint approach, because respondents first chose the most preferred and least preferred images from the set of four, and thereafter the second question asked if the best and the worst image respectively were so intolerable that they would shift their use to another location or another time.

After the tolerances were determined for the best and the worst image of a choice set, we then applied the rule of transitivity to infer about the tolerance of the other two images of a set: whenever the most preferred scenario was not tolerable, than all other three scenarios of the choice set were also deemed as not tolerable; on the other extreme, when the least preferred scenario was still acceptable, than the other scenarios were also deemed acceptable. This type of question together with the further inferences permit us to determine visitor norms for the main trail sections of the park, because based on Equation 4 we can predict the proportion of visitors whose standard would be violated.

The rho-square statistic of 0.74 indicates that the model (Table 2) has an excellent fit. The high intercepts indicate that the majority of the depicted recreational scenarios were tolerable for the respondents. The most important attribute was the number of persons depicted in the image. The high *t*-values indicate a strong agreement of respondents' evaluations of use levels, and consequently one should have confidence in using such data to formulate standards of crowding.

Other important attributes were numbers of dogs and whether they were leashed or unleashed, and group size. A low number of dogs leashed resulted in the highest positive part-worth utilities of that attribute, and many dogs not on a leash were evaluated as the worst attribute level. Somewhat surprisingly, respondents preferred bigger group sizes compared to single persons. Initially we had assumed that the behaviour of walking side by side, thereby narrowing the trail, would be intolerable for park users, in particular at high-use times. But apparently bigger groups imply fewer social contacts in total, and probably a more ordered situation for the respondents, which needed less attention. This assumption was confirmed by the significant interactions between user numbers and group size: the more people an image contained, the more bigger groups were preferred. Although all main effects were insignificant for the placement of people within the image, most of the interactions were. People in the background of the image were more acceptable. The more people were depicted in the foreground, the more this condition was refused. Violations of personal space due to the proximity to others led to crowding perceptions.

Table 2. Model estimates.

Attribute and levels	Parameter estimate	Standard error	*t*-Value	*p*-Value
Intercept	3.666	0.129	28.309	0.000
Number of persons depicted				
Linear term	-0.433	0.073	-5.934	0.000
Quadratic term	-0.114	0.028	-4.037	0.000
Placement of visitors				
30% Fore-, 40% Mid-, 30% Background	0.058			
60% Fore-, 40% Mid-, 0% Background	-0.275	0.194	-1.414	0.157
10% Fore-, 60% Mid-, 30% Background	-0.006	0.136	-0.046	0.963
0% Fore-, 40% Mid-, 60% Background	0.223	0.232	0.960	0.337
Dog number and leash rate				
10 % of walkers have a dog unleashed	-0.225			
10 % of walkers have a dog leashed	0.332	0.139	2.389	0.017
30 % of walkers have a dog unleashed	-0.312	0.121	-2.585	0.010
30 % of walkers have a dog leashed	0.205	0.139	1.468	0.142
Group size				
30% Single, 40% Pairs, 30% Triplets	0.333			
60% Single, 40% Pairs, 0% Triplets	-0.248	0.120	-2.077	0.038
30% Single, 60% Pairs, 10% Triplets	-0.356	0.179	-1.987	0.047
0% Single, 40% Pairs, 60% Triplets	0.271	0.139	1.946	0.052
User type				
80% Walkers, 10% Bicyclists, 10% Joggers	0.077			
40% Walkers, 50% Bicyclists, 10% Joggers	0.041	0.129	0.315	0.753
40% Walkers, 10% Bicyclists, 50% Joggers	-0.148	0.209	-0.708	0.479
20% Walkers, 40% Bicyclists, 40% Joggers	0.031	0.197	0.157	0.875
Direction of movement				
50% towards camera, 50% away from camera	-0.392			
75% towards camera, 25% away from camera	0.176	0.140	1.262	0.207
25% towards camera, 75% away from camera	0.216	0.144	1.499	0.134
Interactions number of persons with				
Linear x 40% Walkers, 10% Bicyclists, 50% Joggers	0.271	0.122	2.221	0.026
Linear x 20% Walkers, 40% Bicyclists, 40% Joggers	-0.236	0.120	-1.964	0.049
Quadratic x 40% Walkers, 10% Bicyclists, 50% Joggers	-0.104	0.048	-2.177	0.029
Quadratic x 20% Walkers, 40% Bicyclists, 40% Joggers	0.139	0.046	3.028	0.002
Linear x 0% Single, 40% Pairs, 60%Triplets	0.142	0.075	1.891	0.059
Linear x 60% Fore-, 40% Mid-, 0% Background	-0.207	0.117	-1.777	0.076
Linear x 0% Fore-, 40% Mid-, 60% Background	0.448	0.138	3.255	0.001
Quadratic x 60% Fore-, 40% Mid-, 0% Background	0.085	0.045	1.896	0.058
Quadratic x 0% Fore-, 40% Mid-, 60% Background	-0.181	0.059	-3.084	0.002

$Rho^2 = 0.737$, $Rho^2_{adj.} = 0.667$;
Log Likelihood (0): -3377.01; Parameter model: –888.12

Similarly, the attribute "user type" also did not emerge with any significant main effects, but the interactions revealed that the more people an image contained, the less favourable respondents were about a mix of users and a high share of walkers. At first glance, the negative evaluation of walkers seemed to be surprising, but only walkers were accompanied by a dog according to the design plan. The direction of movement was less important, and no level was significant. Respondents preferred when the majority of users were facing into one direction, as compared to an even distribution of direction.

By substituting the part-worth utilities into Equation (4), the proportion of respondents whose tolerance norms have been violated can be calculated for any possible combination of variables. Results for four scenarios (each represented by a line) are graphed in Figure 2. Each line represents a different combination of two variables, and the line links the changing tolerance levels over the number of persons depicted in the image.

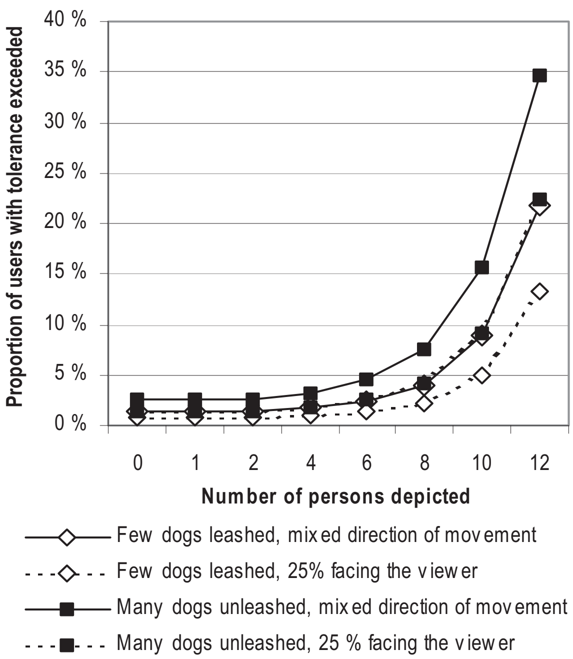

Figure 2. Share of respondents judging a situation as unacceptable

Overall, situations with six users or fewer are acceptable to almost all users (more than 95%), regardless of the accompanying social situation in the image. However, when use density increases to 8 persons or more, then acceptability starts to vary significantly as a function of the accompanying situation. Especially if most dogs remain unleashed and the number of users increases to 12, then the situation is quickly regarded as unacceptable by 23% of users, and by 35% if the direction of movement is equal into both directions.

Discussion

Visitor numbers, proximity to others, unwanted visitor behaviour and the complexity of the situation at high-use situations due to mix of users and movement directions influenced the respondents' decision to shift their use due to intolerable social conditions from the main trail network. When use levels increase to eight people or more per scene, then acceptability of the situation decreases drastically, as documented by the drastic increases in the absolute tolerance curve. More importantly, the tolerance levels are sensitive to accompanying social conditions, especially unleashed dogs, and less organized situations with people walking into both directions equally.

Unwanted visitor behaviour influenced the tolerance of social conditions remarkably. Consequently, park management can increase the social carrying capacity of a park by enforcing the existing regulations such as keeping dogs leashed. Obviously, park management has also other options to increase the social carrying capacity of a recreation area, as variables such as visitor numbers, the placement of visitors within the image, group size and dogs on leash influenced the visitors' decisions significantly.

Such conclusive and statistically significant results could not have been achieved with traditional univariate research techniques. As the tolerance for social conditions is influenced by several factors, controversial management measures such as limiting use, which may be completely unacceptable measures to start with, can be avoided and substituted by other, more acceptable, management actions to ensure the quality of the recreation experience. As such, this method represents a significant advancement to the field of recreation carrying capacity research compared to classical approaches, which are based on one-dimensional Likert scaling.

The factors and theories with regard to crowding perceptions were thought to be useful in defining a crowding norm for urban recreation areas and indicators of standards could also be formulated. This multivariate elicitation of crowding norms has been successful because of a very specific tolerance type question, as formulated in the referendum style conjoint question, combined with the application of digitally calibrated images, which carefully followed a predefined design plan. With this application we have documented that the phenomenon of social carrying capacity is also highly relevant to the planning and management of recreational areas in urban areas, in particular as coping behaviours of park visitors lead to changes in the specific recreation area, as well as in neighbouring recreation areas on the urban and sub-urban level.

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References

Baum, A. & Paulus, P.B. 1991. Crowding. In: Stokols, D. & Altman, I. (eds.). Handbook of Environmental Psychology. Volume 1. Second Edition. Krieger Publishing Company, Malabar. 533–570.

Behan, J.R., Richards, M.T. & Lee, M.E. 2001. Effects of tour jeeps in a wildland setting on non-motorized recreationist benefits. Journal of Park and Recreation Administration 19/2: 1–19.

Ben-Akiva, M. & Lerman, S.R. 1985. Discrete choice analysis: Theory and application in Travel Demand. MIT Press, Cambridge.

Davis, J.B. & Lindvall, M. 2000. Standards of quality for river use within the Fort Niobrara Wilderness Area. In: Cole, D., McCool, S.F., Borrie, W.T. & O`Loughlin, J. (eds). Wilderness visitors, experience, and visitor management. Proceedings RMRS-P-15-Vol-4. Ogden, UT. USDA Forest Service, Rocky Mountain Research Station. p. 265–273.

Donnelly, M., Vaske, J. & Shelby, B. 1992. Measuring backcountry standards in visitor surveys. Defining wilderness quality: The role of standards in wilderness management. USDA Forest Service, General Technical Report PNW-305: 38–52.

Freimund, W.A., Vaske, J.J., Donnelly, M.P. & Miller, T.A. 2002. Using video surveys to access dispersed backcountry visitors` norms. Leisure Sciences 24: 349–362.

Graefe, A.R., Vaske, J.J. & Kuss, F.R. 1984. Social carrying capacity. an integration and synthesis of twenty years of research. Leisure Sciences 6(4): 395–431.

Green, W.H. 1998. LIMDEP, Version 7.0 – User's Manual Revised Edition. Econometric Software, Inc., New York.

Green, P.E. & Srinivasan, V. 1978. Conjoint analysis in consumer research: issues and outlook. Journal for Consumer Research 5(3): 102–123

Haider, W. & Ewing, G.O. 1990. A model of tourist choices of hypothetical Caribbean destinations. Leisure Sciences 12: 33–47.

Haider, W. 2002. Stated preference and choice models – A versatile alternative to traditional recreation research. In: Arnberger, A., Brandenburg, C. & Muhar A. (eds.). Monitoring and management of visitor flows in recreational and protected areas. Proceedings of the Conference held at Bodenkultur University Vienna, Austria, January 30–February 02, 2002. Institute for Landscape Architecture and Landscape Management, Bodenkultur University Vienna. p. 115–121.

Hall, T.E. & Roggenbuck, J.W. 2002. Response format effects in questions about norms: Implications for the reliability and validity of the normative approach. Leisure Sciences 24: 325–337.

Heywood, J.L. 2002. The cognitive and emotional components of behavior norms in outdoor recreation. Leisure Sciences 24: 271–281.

Lawson, S.R. & Manning, R.E. 2002. Tradeoffs among social, resource, and management attributes of the Denali Wilderness experience: A contextual approach to normative research. Leisure Sciences 24: 297–312.

Louviere, J. & Timmermans, H. 1990. Stated preference and choice models applied to recreation research: A review. Leisure Sciences 12: 9–32.

Louviere, J.J., Hensher, D.A. & Swait, J.D. 2000. Stated Choice Methods – Analysis and Application. Cambridge University Press.

Manning, R.E., Lime, D.W., Freimund, W.A. & Pitt, D.G. 1996. Crowding norms at frontcountry sites: A visual approach to setting standards of quality. Leisure Sciences 18: 39–59.

Manning, R.E. 1999. Studies in Outdoor Recreation, Search and Research for Satisfaction. Oregon State University Press.

Manning, R.E., Valliere, W.A., Wang, B. & Jacobi, C. 1999. Crowding norms: alternative measurement approaches. Leisure Sciences 21: 97–115.

McCormick, S., Haider, W., Anderson, D. & Elliot, T. 2003. Estimating wildlife and visitor encounter norms in the backcountry with a multivariate approach: a discrete choice experiment in Kluane National Park and Reserve, Yukon, Canada. In: Proceedings of the Fifth Sampaa—Conference, Book of Abstracts, Victoria, Canada. p. 87.

McFadden, D. 1974. Conditional logit analysis of qualitive choice behavior. In: Zarembka P. Frontiers in Econometrics. Academic Press, New York. p. 105–142.

Montgomery, D.C. 2001. Design and Analysis of Experiments. 5th ed. Wiley, New York.

Ruddell, E.J. & Gramann, J.H. 1994. Goal orientation, norms, and noise-induced conflict among recreation area users. Leisure Sciences 16: 93–104.

Shelby, B. & Heberlein, T. 1986. Carrying Capacity in Recreation Settings. Oregon State University Press, Corvallis.

Shelby, B., Vaske, J.J. & Heberlein, T.H. 1989. Comparative Analysis of Crowding in Multiple Locations: Results from Fifteen Years of Research. Leisure Sciences 11/4: 269–291.

Stewart, W., Larkin, K., Orland, B. & Anderson, D. 2003. Boater preferences for beach characteristics downstream from Glen Canyon Dam, Arizona. Journal for Environmental Management 69: 201–211.

Train, K.E. 1986. Qualitative Choice Analysis: Theory, Econometrics and an Application to Automobile Demand. MIT Press, Cambridge.

Westover, T.N. & Collins, J.R. 1987. Perceived crowding in recreation settings: an urban case study. Leisure Sciences 9: 87–99.