

BALANCING TRADEOFFS IN THE DENALI WILDERNESS: AN EXPANDED APPROACH TO NORMATIVE RESEARCH USING STATED CHOICE ANALYSIS

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Abstract: Wilderness experiences are thought to be comprised of or defined by three dimensions, including social, resource, and management conditions. Decisions about how to manage wilderness recreation in Denali National Park involve potential tradeoffs among the conditions of resource, social, and managerial attributes of the wilderness experience. This study expands the normative approach to wilderness research by developing a decision-making model that considers social, resource, and managerial attributes of the wilderness experience within a holistic context. Specifically, stated choice analysis is used to evaluate the choices overnight wilderness visitors in Denali National Park make when faced with hypothetical tradeoffs among the conditions of social, resource, and management attributes of the wilderness portion of the park.

Introduction

There is general agreement in the recreation literature that wilderness experiences are comprised of or defined by three dimensions. These dimensions include the social conditions experienced (e.g., the number of other groups encountered), the resource conditions experienced (e.g., the amount of human impact at camping sites), and the management conditions imposed (e.g., the number of backcountry permits issued) (Hendee, Stankey, & Lucas, 1990). In general, wilderness recreationists are thought to prefer a wilderness experience characterized as having few encounters with other groups, a pristine natural environment, and a high degree of freedom from management control. While this is the ideal, in reality attempts on the part of managers to provide ideal conditions along one dimension of the wilderness experience typically involve having to make concessions along one or both of the other dimensions of the wilderness experience. As a result, decisions about how to manage wilderness involve potential tradeoffs among the conditions of resource, social, and managerial attributes of the wilderness experience. For example, the number of permits issued for recreational use of a wilderness area could be increased to allow more public access, but this might result in more resource impacts and encounters among groups within the wilderness area. Conversely, reducing the number of recreational use permits issued might reduce resource impacts and encounters among groups, but would allow fewer people to enjoy the wilderness area.

The normative approach to recreation research has been used to study a broad range of wilderness management issues, including crowding, ecological impacts, and management practices (Manning, 1999a). A fundamental element of the normative approach to recreation research is the measurement of indicators and standards of quality. Traditionally, wilderness studies designed to measure indicators and standards of quality have focused on a single dimension of the wilderness experience, without explicit consideration of related and potentially competing issues associated with other dimensions of the wilderness experience (Manning, 1999a). Recent studies in outdoor recreation have suggested that normative research should more explicitly consider the tradeoffs inherent in park and wilderness management decision-making (Hall, in press; Lawson & Manning, 2000; Manning, Valliere, Wang, & Jacobi, 1999).

This study expands the normative approach to wilderness research by developing a decision-making model that considers social, resource, and managerial attributes of the wilderness experience within a more holistic context. Specifically, stated choice analysis is used to evaluate the choices overnight wilderness visitors in Denali National Park make when faced with hypothetical tradeoffs among the conditions of social, resource, and management attributes of the wilderness portion of the park.

Denali National Park and Preserve

Alaska's first National Park, Mt. McKinley National Park, was established in 1917. In 1980, with the passage of the Alaska National Interest Lands Conservation Act, Mt. McKinley National Park was expanded from two million acres to six million acres, and renamed Denali National Park and Preserve. At the same time, most of the original two million acres of the park was designated wilderness. Today, this two million acre wilderness forms the core of Denali National Park and Preserve.

Visitor use of the Denali wilderness is managed through a permit system to maintain the area's primitive, undeveloped character. Through the permit system, the Park administers strict quotas on the number of overnight visitors issued a permit for each of 43 wilderness management units. The quotas exist to prevent resource degradation and to provide visitors with opportunities to experience solitude. During the busy summer months, quotas for many of the management units are regularly reached and some visitors interested in an overnight trip in the Denali wilderness are turned away or forced to hike and camp in less preferred management units.

The primitive character of Denali's wilderness is maintained through other management techniques as well. For example, traditional backcountry facilities such as bridges and trails are not provided in the Denali wilderness. Instead, visitors must navigate by map and compass, and visitors are frequently challenged with technical stream-crossings. There are no established campsites in the Denali wilderness, either. Visitors may camp anywhere within the management unit for which they were issued an overnight permit. As a result, visitors are often able to camp out of

sight and sound of other groups, in places with little or no evidence of previous human use.

Park managers and planners are currently working on updating the wilderness management plan for Denali National Park and Preserve. Revision of the wilderness management plan will include making decisions to maintain, reduce, or decrease the number of permits issued for each of the Denali wilderness management units. Previous research conducted by Bultena, Albrecht, and Womble (1981) studied the extent to which wilderness visitors in Denali National Park and Preserve supported use limitations. The authors conclude that future decisions concerning use limitations in Denali National Park and Preserve will have to weigh the importance of protecting park resources and the quality of visitors' experiences against the benefit of granting more visitors access to the Denali wilderness. This study uses stated choice analysis to provide Denali National Park and Preserve managers with information about overnight wilderness visitors' attitudes and preferences regarding such tradeoffs.

Stated Choice Analysis

Stated choice analysis models have been developed in the fields of psychometrics, econometrics, and consumer marketing to evaluate public preferences or attitudes (Green & Srinivasan, 1978). In stated choice analysis, respondents are asked to make choices among alternative configurations of a multi-attribute good (Louviere & Timmermans, 1990a).¹ Each alternative configuration is called a profile, and is defined by varying levels of selected attributes of the good (Mackenzie, 1993). For example, respondents may be asked to choose between alternative recreation settings that vary in the number of other groups encountered, the quality of the natural environment, and the intensity of management regulations imposed on visitors. Respondents' choices among the alternatives are evaluated to estimate the relative importance of each attribute to the overall utility derived from the recreational setting. Further, stated choice analysis models are used to estimate public preferences or support for alternative combinations of the attribute levels (Dennis, 1998).²

Stated choice analysis has been applied to study public preferences and attitudes concerning a range of recreation-related issues. Louviere and Timmermans (1990a) suggest ways in which stated choice models can be used to evaluate alternative recreation policies. Specifically, the authors state that one of the strengths of choice models is their predictive ability. That is, choice models provide recreation managers with foresight about how the public is likely to respond to various policy alternatives. Further, choice models provide managers with information about people's preferences for arrangements of resources, facilities, and/or services that may not currently exist.

There is a growing body of literature describing the application of stated choice analysis to outdoor recreation management issues in parks (Louviere & Timmermans, 1990b; Louviere & Woodworth, 1985; Schroeder, Dwyer, Louviere, & Anderson, 1990). Other natural resource

related applications of stated choice analysis include studies of river flow management (Adamowicz, Louviere, & Williams, 1994), tourism (Haider & Ewing, 1990), recreational hunting (Boxall, Adamowicz, Swait, Williams, & Louviere, 1996; Bullock, Elston, & Chalmers, 1998; Mackenzie, 1993), hazardous waste facility siting (Opaluch, Swallow, Weaver, Wessells, & Wichelns, 1993; Swallow, Weaver, Opaluch, & Michelman, 1994), watershed management (Johnston, Swallow, & Weaver, 1999), and wildlife management (Adamowicz, Boxall, Williams, & Louviere, 1998).

Study Methods

Selection of Attributes and Levels

Wilderness areas are managed, in general, to provide visitors with opportunities to experience solitude in a relatively unmodified natural environment with few management restrictions and facilities (Merigiano, 1990). Substantial research has been conducted to identify social, resource, and managerial setting attributes that reflect these general management objectives and contribute to or detract from the quality of the wilderness recreation experience (Merigiano, 1990; Roggenbuck, Williams, & Watson, 1993; Shindler & Shelby, 1992; Whittaker, 1992). These attributes are commonly referred to in the recreation literature as indicators of quality.

Manning (1999b) summarizes the results of a number of studies that have focused on identifying potential indicators of quality. Based on a review of this literature, six wilderness setting attributes were selected for this study to define the social, resource, and management conditions of the Denali wilderness setting profiles. Three levels were defined for each of the six wilderness setting attributes, based on recommendations from the Park's director of Resource Management and the Park's Planner. Table 1 lists the attributes and levels used to define alternative Denali wilderness settings in the study.

Pairs of hypothetical Denali backcountry settings were generated by combining the six wilderness setting attributes at varying levels, based on an experimental design. The experimental design resulted in four questionnaire versions, each containing nine pairwise comparisons (Seiden, 1954).³ An example of a typical Denali wilderness setting comparison is presented in Figure 1.

Survey Administration

Overnight wilderness visitors in Denali National Park and Preserve are required to obtain a permit and a bear resistant food container from the Visitor Center prior to their backpacking trip. The stated choice analysis survey was administered to overnight wilderness visitors at the Visitor Center when they returned the bear resistant food container at the end of their backpacking trip. The survey was administered from July 24 through September 2, 2000. The choice experiment was conducted as part of a larger study of Denali overnight wilderness visitors. Individuals who did not participate in other parts of the larger study were

Table 1. Denali Wilderness Setting Attributes and Levels

<u>Social conditions</u> Number of other groups encountered per day while hiking: Encounter 0 other groups per day while hiking Encounter up to 2 other groups per day while hiking Encounter up to 4 other groups per day while hiking Opportunity to camp out of sight and sound of other groups: Able to camp out of sight and sound of other groups all nights Able to camp out of sight and sound of other groups most nights Able to camp out of sight and sound of other groups a minority of nights <u>Resource conditions</u> Extent and character of hiking trails: Hiking is along intermittent, animal like trails Hiking is along continuous single track trails developed from prior human use Hiking is along continuous trails with multiple tracks developed from prior human use Signs of human use at camping sites: Camping sites have little or no signs of human use Camping sites have some signs of human use – light vegetation damage, a few moved rocks Camping sites have extensive signs of human use – bare soil, many rocks moved for wind protection and cooking <u>Management conditions</u> Regulation of camping: Allowed to camp in any zone on any night Required to camp in specified zones Required to camp in designated sites Chance of receiving an overnight backcountry permit: Most visitors are able to get a permit for their preferred trip Most visitors are able to get a permit for at least their second choice trip Only a minority of visitors are able to get a backcountry permit

Backcountry Setting A	Backcountry Setting B
• Encounter up to 2 other groups per day while hiking. • Able to camp out of sight and sound of other groups <i>all</i> nights. • Hiking is along continuous, <i>single track</i> trails developed from prior human use. • Camping sites have <i>some</i> signs of human use – light vegetation damage, a few moved rocks. • Required to camp at <i>designated sites</i>. • Only a minority of visitors are able to get a backcountry permit.	• Encounter up to 4 other groups per day while hiking. • Able to camp out of sight and sound of other groups <i>most</i> nights. • Hiking is along intermittent, animal-like trails. • Camping sites have <i>some</i> signs of human use – light vegetation damage, a few moved rocks. • Required to camp at <i>designated sites</i>. • Most visitors are able to get a backcountry permit for their <i>preferred</i> trip.

Figure 1. Example Denali Wilderness Setting Comparison

recruited for the stated choice experiment. Study participants were asked to complete one of four versions of the questionnaire on a laptop computer. In each of the nine choice questions, respondents were asked to read through each setting description (A and B) and indicate which they preferred. The response rate for the stated choice analysis survey was 81.2%, resulting in a total of 311 completed questionnaires (approximately 78 respondents for each version of the questionnaire) and 2,799 pairwise comparisons.

Study Findings

The responses to the stated choice questions were analyzed using logistic regression analysis.⁴ The regression coefficients for the Denali wilderness setting attributes, together with their standard errors, Wald Chi-Square values, and P values are presented in Table 2. All coefficients are significantly different than zero at <.001% level, except the coefficients on "Up to 2 other groups" and "Intermittent animal like trails". The overall fit of the model is supported by the results of the Hosmer and Lemeshow goodness of fit test ($\chi^2 = 3.492$, $p = 0.836$).

The magnitude of significant coefficients reflects the relative importance of the corresponding level of the attribute to Denali overnight wilderness visitors. The values of the coefficients in Table 2 imply that signs of human use at campsites influence Denali overnight wilderness visitors' utility or satisfaction more than any other wilderness setting attribute considered in this study. Specifically, camping site conditions characterized as having "Extensive signs of human use" are evaluated less favorably by Denali overnight wilderness visitors' than any other level of the six wilderness setting attributes studied. Additionally, camping site conditions characterized by "Little or no signs of human use" are preferred more than any level of any other wilderness setting attribute included in the study.

The magnitude of the coefficient estimates in Table 2 indicate that solitude related attributes represent a second tier of importance to Denali overnight wilderness visitors. That is, while the number of encounters with other groups per day while hiking and opportunities to camp out of sight and sound of other groups are less important wilderness setting attributes relative to campsite impacts, they demonstrate a relatively large influence on Denali overnight wilderness visitors' utility. The extent and character of trails, regulations concerning where visitors are allowed to camp in the Denali wilderness, and the availability of backcountry permits are less important to Denali overnight wilderness visitors, relative to campsite impacts and solitude related attributes of the Denali wilderness.

The relationship between the levels of each wilderness setting attribute and the average utility associated with all possible combinations of the six Denali wilderness setting attributes are plotted in Figures 2a-2f. The values on the x-axis of each plot represent the level of the corresponding Denali wilderness setting attribute, and the values on the y-

axis represent the amount by which the utility of the corresponding level of the attribute deviates from average utility or satisfaction. The values on the y-axis are expressed in units of utility, which is a measure of relative preference. Levels of attributes with high utility values are preferred to levels of attributes with lower utility values. The plots provide further insight into the relative importance of the wilderness setting attributes to Denali overnight wilderness visitors. For example, utility drops sharply as campsites change from having "Some signs of human use" (+0.2073) to "Extensive signs of human use" (-0.7896) (Figure 2d), whereas the loss of utility is less dramatic as the opportunity to camp out of sight and sound of other groups changes from "All nights" (0.2952) to "Most nights" (0.1452) (Figure 2b).⁵

The results of the stated choice experiment suggest that Denali overnight wilderness visitors support some level of management over where visitors may camp and a certain degree of visitor use limits. Denali overnight wilderness visitors' utility remains unchanged as regulations over where visitors may camp increases from "Allowed to camp in any zone on any night" to "Required to camp in specified zones" (Figure 2e). However, utility decreases to its lowest point with respect to camping regulations when visitors are "Required to camp in designated sites". A similar trend is observed concerning overnight wilderness use limits. Denali overnight wilderness visitors' utility associated with this attribute is statistically the same whether use limits are at their least restrictive level (i.e., "Most get a permit for their preferred trip") or at the intermediate level (i.e., "Most get a permit for at least their second choice trip") (Figure 2e). Use limits that result in only a minority of visitors receiving a permit lead to the lowest utility related to use limits (i.e., the chance visitors have of receiving a permit). A possible explanation for these results is that Denali overnight wilderness visitors may realize that without certain management restrictions, the resource and social setting attributes of the Denali wilderness are likely to deteriorate beyond acceptable conditions.

An additional use of the model developed in this study is to predict the preferences of Denali overnight wilderness visitors for alternative wilderness management scenarios. As an example, two hypothetical Denali wilderness management alternatives will be considered. The first alternative will be referred to as the "Solitude Alternative" and the second alternative will be referred to as the "Freedom Alternative" (Table 3). Under the "Solitude Alternative", overnight wilderness visitors would encounter zero other groups per day while hiking and be able to camp out of sight and sound of other groups all nights. However, the two management attributes would be at their most restrictive levels. That is, visitors would be required to camp in designated sites and only a minority of visitors would be able to get a backcountry permit. Under the "Freedom Alternative", overnight wilderness visitors would be able to camp in any zone on any night, and most visitors would be able to get a permit for their preferred trip. However, visitors would encounter up to four other groups

Table 2. Coefficient Estimates for Wilderness Setting Attributes

Variable	Coefficient	Standard Error	Wald Chi-Square	P Value
Encounters with other groups per day while hiking:				
0 other groups	-	-	-	-
Up to 2 other groups	0.0649	0.0433	2.2458	0.1340
Up to 4 other groups	-0.5044	0.0438	132.8263	0.0001
Able to camp out of sight and sound of other groups:				
All nights	-	-	-	-
Most nights	0.1452	0.0435	11.1482	0.0008
A minority of nights	-0.4404	0.0452	94.8138	0.0001
Hiking is along:				
Intermittent, animal like trails	-	-	-	-
Single track trails developed from human use	-0.0281	0.0443	0.4028	0.5256
Multiple track trails developed from human use	-0.2912	0.0428	46.3399	0.0001
Camping sites have:				
Little or no signs of human use	-	-	-	-
Some signs of human use	0.2073	0.0440	22.1506	0.0001
Extensive signs of human use	-0.7896	0.0485	264.9717	0.0001
Regulation of camping:				
Allowed to camp in any zone on any night	-	-	-	-
Required to camp in specified zones	0.1398	0.0476	8.6202	0.0033
Required to camp in designated sites	-0.2117	0.0452	21.9484	0.0001
Chance visitors have of receiving a permit:				
Most get a permit for their preferred trip	-	-	-	-
Most get a permit for at least their second choice	0.1430	0.0443	10.4236	0.0012
Only a minority get a permit	-0.2157	0.0434	24.6555	0.0001

Figures 2a-2f. Denali Wilderness Setting Attribute Levels and Corresponding Utility

Figure 2a. Hiking Encounters per Day

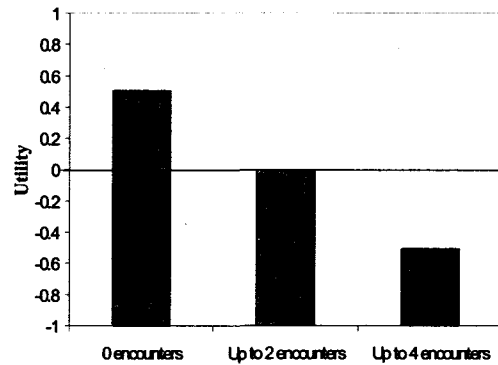


Figure 2b. Able to Camp Out of Sight and Sound of Others

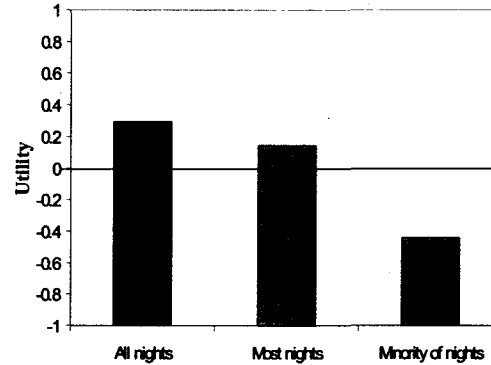


Figure 2c. Extent and Character of Trails

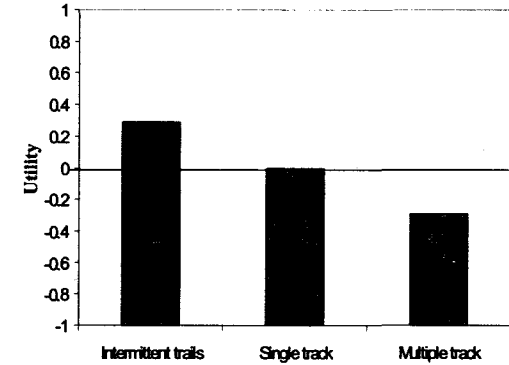


Figure 2d. Extent of Impact at Campsites

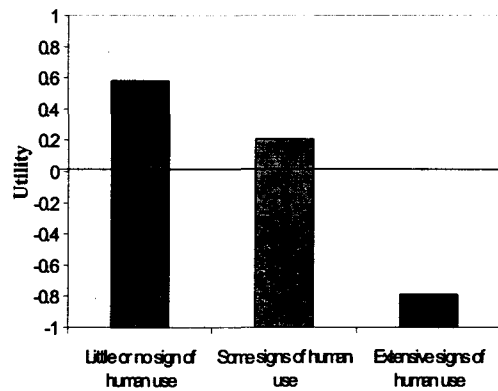


Figure 2e. Camping Regulations

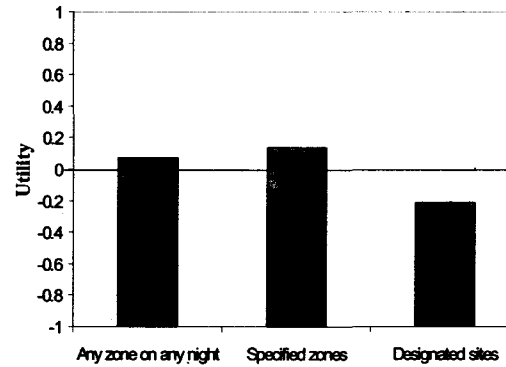
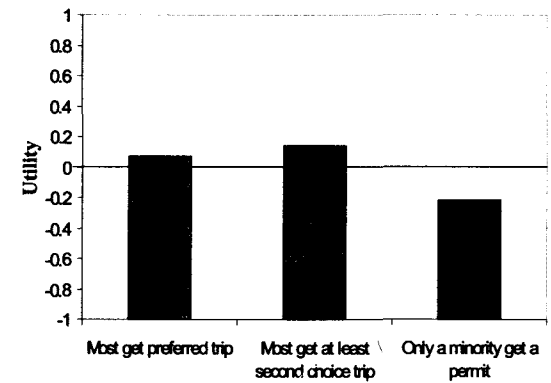


Figure 2f. Availability of Backcountry Permits



per day while hiking, and they would be able to camp out of sight and sound of other groups only a minority of nights. In both alternatives, the extent of social trails, and the amount of impact to campsites would be fixed at the intermediate level.

At the heart of the comparison between the "Solitude Alternative" and the "Freedom Alternative" are Denali overnight wilderness visitors' evaluations of the tradeoff

between freedom of access to the Denali wilderness and the opportunity to experience solitude. The model predicts that in a hypothetical referendum, 75% of Denali overnight wilderness visitors would choose the "Solitude Alternative" and only 25% would choose the "Freedom Alternative" (Table 3).⁶ This result implies that in general, Denali overnight wilderness visitors would prefer to forgo some freedom from management to improve opportunities to experience solitude.

Table 3. Scores for Two Hypothetical Denali Wilderness Management Alternatives

	Solitude Alternative	Freedom Alternative
Hiking Encounters:	0 other groups per day	Up to 4 other groups per day
Campsite Solitude:	All nights	A minority of nights
Hiking Trails:	Single track trails	Single track trails
Campsite Impacts:	Some signs of human use	Some signs of human use
Camping Regulations:	Designated sites	Any zone on any night
Availability of permits:	Only a minority of visitors receive a permit	Most get a permit for their preferred trip
Voting Proportion	75%	25%

Conclusions

In this study, stated choice analysis has been used to expand the normative approach to wilderness research by explicitly considering tradeoffs among the social, resource, and managerial dimensions of the Denali wilderness experience in the measurement of indicators and standards of quality. The results of the stated choice analysis presented in this paper have several important implications for wilderness management in Denali National Park and Preserve.

Consistent with the findings of previous wilderness research, Denali overnight wilderness visitors place particular importance on the extent of impacts at camping sites (Roggenbuck, Williams, & Watson, 1993). Management actions that provide Denali overnight wilderness visitors with places to camp that have no more than some signs of human use will make substantial positive contributions to the quality of their wilderness experiences. Camping conditions characterized by sites with extensive signs of human use greatly detract from the quality of visitors' wilderness experience in Denali. Further, Denali overnight visitors place relatively high importance on having limited contact with other groups while hiking and camping.

Several aspects of the study findings suggest that visitors would be willing to tolerate, and in fact support, management restrictions, including use limits, to achieve

desired social and resource setting attribute conditions. For example, the results suggest that Denali overnight wilderness visitors are indifferent between the current regulation in Denali National Park and Preserve which requires visitors to camp in specified zones and being allowed to camp in any zone on any night. Additionally, the results suggest that visitors' utility does not diminish if limits on the number of backcountry permits issued are increased from the least restrictive level considered in this study to the intermediate level, even though their chances of receiving a permit for their preferred trip would be reduced. As noted above, a possible explanation for these findings is that Denali overnight wilderness visitors might consider a certain degree of management regulations necessary to achieve desirable social and resource conditions in the Denali wilderness.

On a more general level, the model allows managers to evaluate visitor attitudes toward alternative management scenarios. This allows managers to consider combinations of setting attributes that are not currently in place, but may offer a better alternative than the status quo. Additionally, alternatives being considered under the new wilderness management plan can be generalized to the model, and managers can predict public response to each alternative. The results of the example application of the choice model provide further evidence that visitors are willing to trade off freedom from management restrictions for desired social conditions. Specifically, the results demonstrate that in a hypothetical referendum, Denali overnight wilderness visitors would prefer a wilderness setting that emphasizes

solitude through relatively restrictive management actions over a more congested wilderness setting with limited management restrictions by a margin of three to one.

From a management perspective, these results suggest that the majority of Denali overnight wilderness visitors support backcountry permit quotas in Denali National Park and Preserve to protect the primitive character of the park. A moderately restrictive quota system that is designed to enhance overnight wilderness visitors' opportunities to experience solitude and to maintain relatively undisturbed campsite and trail conditions will receive the greatest support from Denali overnight wilderness visitors. However, the results of the example application of the choice model indicate that there is also a substantial proportion of Denali overnight wilderness visitors (25.0%) that place high importance on freedom from management restrictions despite reduced opportunities to experience limited contact with other groups while hiking and camping. This finding suggests that Denali overnight visitors are at least somewhat diverse in their attitudes concerning the management of the Denali wilderness. Managers at the park could address this diversity through management of the Denali wilderness based on the concept of zoning to provide a spectrum of opportunities for visitors. For example, the quota system could be designed in such a way that quotas for most zones within the Denali wilderness are set at levels that emphasize opportunities for visitors to experience solitude, while quotas for a few zones of the wilderness are set at levels that provide greater visitor access.

The results of this study indicate that certain conditions of each of the six Denali wilderness setting attributes provide a greater than average level of utility to Denali overnight wilderness visitors. However, Figures 2a-2f illustrate that when the conditions of the Denali wilderness setting attributes deteriorate beyond "threshold" levels, they provide less than average levels of utility (e.g., when camping sites deteriorate from having some signs of human use to extensive signs of human use). These findings imply that the wilderness experience in Denali National Park and Preserve can be substantially improved by restoring the social and resource conditions of the wilderness from beyond "threshold" levels. Likewise, the wilderness experience can be protected from substantial decline by keeping wilderness setting conditions from deteriorating beyond "threshold" levels.

The threshold levels for each of the six Denali wilderness setting attributes, illustrated in Figures 2a-2f, could be used by park managers to help formulate standards of quality. For example, Figure 2a demonstrates that fewer than two encounters with other groups per day while hiking provides a greater than average level of utility to Denali overnight visitors and that encounters with more than two other groups per day while hiking provides a less than average level of utility. Therefore, a potential standard of quality for this attribute might be set at "up to 2 encounters with other groups per day while hiking". The use of stated choice analysis data to help formulate standards of quality for wilderness setting conditions represents a potential improvement to the conventional normative approach in

recreation research, in that resulting data reflect the tradeoffs visitors are willing to make among the conditions of social, resource, and managerial attributes of the Denali wilderness.

A potential limitation of this study is that the relative importance of the Denali wilderness setting attributes considered are influenced by the levels of the attributes selected. Our findings may have varied if we had used different levels to represent the range of conditions for each attribute. For example, we may have found the relative importance Denali overnight wilderness visitors place on the chance of receiving an overnight backcountry permit to be greater if we had used "Visitors have a 5% chance of receiving a backcountry permit" rather than "Only a minority of visitors are able to get a backcountry permit". However, the levels of the Denali wilderness setting attributes were selected to represent a realistic range of conditions for each of the Denali wilderness setting attributes, based on current conditions in the Park. As a result, it seems reasonable to conclude that the results of this study realistically represent Denali overnight wilderness visitors' attitudes and preferences concerning the conditions of social, resource, and managerial attributes of the Denali wilderness experience.

Previous recreation research indicates that attitudes and preferences concerning indicators of quality may be influenced by personal characteristics of visitors, such as the level of experience an individual has (Bryan, 1977; Ditton, Fedler, & Graefe, 1983; Graefe, Donnelly, & Vaske, 1986; Munley & Smith, 1976). Further research could be conducted to examine differences in the way novice and experienced Denali overnight wilderness visitors evaluate tradeoffs among the conditions of social, resource, and managerial attributes of the Denali wilderness. This information would provide managers with a better understanding of the preferences of different types of overnight wilderness visitors and could be used to identify wilderness setting conditions that are most suitable for different types of overnight wilderness visitors.

The findings of this study reflect the attitudes and preferences of overnight wilderness visitors in Denali National Park and Preserve concerning management of the Denali wilderness. The use of stated choice analysis should be considered for studies of visitors' preferences in other wilderness areas. Results of such studies would provide a basis for comparison of wilderness users' preferences for wilderness setting conditions across different types of wilderness areas. Further, while much attention has been focused on the preferences and attitudes of overnight visitors to wilderness areas, the amount of research focused on day use visitors is more limited (Roggenbuck, Marion, & Manning, 1994). However, day use constitutes a substantial proportion of visitor use in many wilderness areas (Lucas, 1980; Manning, Ballinger, Marion, & Roggenbuck, 1996; Roggenbuck & Lucas, 1987). Stated choice analysis can further inform wilderness management decisions through studies of day use visitors' preferences for the conditions of social, resource, and managerial attributes of the wilderness experience.

References

- Adamowicz, W., Louviere, J., & Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. Journal of Environmental Economics and Management, 26, 271-292.
- Adamowicz, W., Boxall, P., Williams, M., & Louviere, J. (1998). Stated preference approaches for measuring passive use values: Choice experiments and contingent valuation. American Journal of Agricultural Economics, 80, 64-75.
- Boxall, P., Adamowicz, W., Swait, J., Williams, M., & Louviere, J. (1996). A comparison of stated preference methods for environmental valuation. Ecological Economics, 18, 243-253.
- Bryan, H. (1977). Leisure value systems and recreational specialization: The case of trout fishermen. Journal of Leisure Research, 9, 174-187.
- Bullock, C., Elston, D., & Chalmers, N. (1998). An application of economic choice experiments to a traditional land use - Deer hunting and landscape change in the Scottish Highlands. Journal of Environmental Management, 52, 335-351.
- Bultena, G., Albrecht, D., & Womble, P. (1981). Freedom versus control: A study of backpackers' preferences for wilderness management. Leisure Sciences, 4(3), 297-310.
- Dennis, D. (1998). Analyzing public inputs to multiple objective decisions on national forests using conjoint analysis. Forest Science, 44(3), 421-429.
- Ditton, R., Fedler, A., & Graefe, A. (1983). Factors contributing to perceptions of recreational crowding. Leisure Sciences, 5, 273-288.
- Graefe, A., Donnelly, M., & Vaske, J. (1986). Crowding and specialization: A reexamination of the crowding model. In Proceedings - National Wilderness Research Conference: Current Research (Gen. Tech. Rep. INT-212, pp. 333-338). USDA, Forest Service.
- Green, P., & Srinivasan, V. (1978). Conjoint analysis in consumer research: Issues and outlook. Journal of Consumer Research, 5, 103-123.
- Haider, W., & Ewing, G. (1990). A model of tourist choices of hypothetical Caribbean destinations. Leisure Sciences, 12, 33-47.
- Hall, T. (in press). Use limits in wilderness. In Proceedings of the Use Density and Wilderness Experiences Workshop (Gen. Tech. Rep.). USDA, Forest Service, Rocky Mountain Research Station.
- Hanemann, W. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics, 66, 332-341.
- Hendee, J., Stankey, G., & Lucas, R. (1990). Wilderness management. Golden, CO: North American Press.
- Hosmer, D., & Lemeshow, S. (2000). Applied logistic regression. New York: John Wiley & Sons, Inc.
- Johnston, R., Swallow, S., & Weaver, T. (1999). Estimating willingness to pay and resource tradeoffs with different payment mechanisms: An evaluation of a funding guarantee for watershed management. Journal of Environmental Economics & Management, 38, 97-120.
- Lawson, S., & Manning, R. (2000). Crowding versus access at Delicate Arch, Arches National Park: An indifference curve analysis. In Proceedings of the Third Symposium on Social Aspects and Recreation Research.
- Louviere, J., & Timmermans, H. (1990a). Stated preference and choice models applied to recreation research: A review. Leisure Sciences, 12, 9-32.
- Louviere, J., & Timmermans, H. (1990b). Using hierarchical information integration to model consumer responses to possible planning actions: Recreation destination choice illustration. Environment and Planning, 22, 291-308.
- Louviere, J., & Woodworth, G. (1985). Models of park choice derived from experimental and observational data: A case study in Johnston County, Iowa (Iowa City Technical Report). University of Iowa.
- Lucas, R. (1980). Use patterns and visitor characteristics, attitudes and preferences in nine wilderness and other roadless areas (Research Paper INT-253). USDA, Forest Service.
- Mackenzie, J. (1993). A comparison of contingent preference models. American Journal of Agricultural Economics, 75, 593-603.
- Manning, R. (1999a). Crowding and carrying capacity in outdoor recreation: From normative standards to standards of quality. In Leisure studies for the twenty-first century (pp. 323-334). State College, PA: Venture Press.
- Manning, R. (1999b). Studies in outdoor recreation: Search and research for satisfaction. Corvallis: Oregon State University Press.
- Manning, R., Ballinger, N., Marion, J., & Roggenbuck, J. (1996). Recreation management in natural areas: Problems and practices, status and trends. Natural Areas Journal, 16(2), 142-146.
- Manning, R., Valliere, W., Wang, B., & Jacobi, C. (1999). Crowding norms: Alternative measurement approaches. Leisure Sciences, 21(2), 97-115.
- Merigliano, L. (1990). Indicators to monitor the wilderness recreation experience. In Managing America's enduring wilderness resource (pp. 156-162). St. Paul: University of Minnesota.

Munley, V., & Smith, V. (1976). Learning-by-doing and experience: The case of whitewater recreation. Land Economics, 52, 545-553.

Opaluch, J., Swallow, S., Weaver, T., Wessells, C., & Wichelns, D. (1993). Evaluating impacts from noxious facilities: Including public preferences in current siting mechanisms. Journal of Environmental Economics & Management, 24, 41-59.

Roggenbuck, J., & Lucas, R. (1987). Wilderness use and user characteristics: A state-of-knowledge review. In Proceedings of the National Wilderness Research Conference: Issues, state-of-knowledge, future directions (Gen. Tech. Rep. INT-220, pp. 204-245). USDA, Forest Service.

Roggenbuck, J., Marion, J., & Manning, R. (1994). Day users of the backcountry: The neglected national park visitor. Trends, 31(3), 19-24.

Roggenbuck, J., Williams, D., & Watson, A. (1993). Defining acceptable conditions in wilderness. Environmental Management, 17(2), 187-197.

Schroeder, H., Dwyer, J., Louviere, J., & Anderson, D. (1990). Monetary and nonmonetary trade-offs of urban forest site attributes in a logit model of recreation choice (Gen. Tech. Rep. RM-197, pp. 41-51). US Department of Agriculture, Forest Service.

Seiden, E. (1954). On the problem of construction of orthogonal arrays. Annals of Mathematical Statistics, 25, 151-156.

Shindler, B., & Shelby, B. (1992). User assessment of ecological and social campsite attributes. In Defining Wilderness Quality: The Role of Standards in Wilderness Management – A Workshop Proceedings (Gen. Tech. Rep. PNW-305, pp. 107-114). USDA, Forest Service.

Stevens, T., Belkner, R., Dennis, D., Kittredge, D., & Willis, C. (2000). Comparison of contingent valuation and conjoint analysis in ecosystem management. Ecological Economics, 32, 63-74.

Swallow, S., Weaver, T., Opaluch, J., & Michelman, T. (1994). Heterogeneous preferences and aggregation in environmental policy analysis: A landfill siting case. American Journal of Agricultural Economics, 76, 431-443.

Teisl, M., Boyle, K., & Roe, B. (1996). Conjoint analysis of angler evaluations of Atlantic salmon restoration on the Penobscot River, Maine. North American Journal of Fisheries Management, 16, 861-871.

Whittaker, D. (1992). Selecting indicators: Which impacts matter more? In Defining Wilderness Quality: The Role of Standards in Wilderness Management – A Workshop Proceedings (Gen. Tech. Rep. PNW-305, pp. 13-22). USDA, Forest Service.

Footnotes

¹ Stated choice analysis is based on the decision making framework of random utility theory, and is the basis of the analytical model used in this study. Refer to Hanemann (1984) for a comprehensive presentation of the random utility framework.

² Stated preference methods, including conjoint analysis, are related to stated choice methods, and are also used to evaluate public preferences for multiple attribute goods. Respondents to conjoint analysis studies are asked to rate or rank alternatives, rather than choose among alternatives. For a detailed discussion of conjoint ranking see Dennis (1998) and Mackenzie (1993). For a detailed discussion of conjoint rating see Mackenzie (1993), Stevens, Belkner, Dennis, Kittredge, and Willis (2000), and Teisl, Boyle, and Roe (1996).

³ The orthogonal fractional factorial design was constructed by Don Anderson of StatDesign Consulting, Evergreen, Colorado.

⁴ See Hosmer and Lemeshow (2000) for information about logistic regression analysis.

⁵ To test whether differences in utility associated with changes in the level of an attribute are significantly different than zero (e.g., the change in utility associated with a change in the opportunity to camp out of sight and sound of other groups from "All nights" to "Most nights"), two additional logistic regression analyses were performed. In the two additional analyses the wilderness setting attributes were represented in the statistical model using *dummy* coding rather than *effects* coding. Results of the additional analyses indicate that the difference in utility associated with being "Allowed to camp in any zone on any night" versus being "Required to camp in specified zones", and the difference in utility associated with "Most visitors are able to get a permit for their preferred trip" versus "Most visitors are able to get a permit for at least their second choice trip" are not significantly different than zero. All other utility differences associated with different levels of the attributes were found to be significantly different than zero.

⁶ See Opaluch, Swallow, Weaver, Wessells, & Wichelns (1993) for a demonstration of the methods used to calculate estimated voting proportions for management alternatives.