

Integrating Multiple Wilderness Values into a Decision-Making Model for Denali National Park and Preserve

Steve Lawson, Robert Manning

School of Natural Resources
University of Vermont

Abstract: Decisions about how to manage wilderness recreation in Denali National Park and Preserve require managers to integrate a diverse set of public values, a process that typically involves balancing tradeoffs among multiple and often competing values. While decisions about how to manage wilderness are often contentious, previous research suggests that if managers are able to predict public support for various management alternatives the decisions become more tractable. This study develops a decision-making model that integrates social, resource, and managerial values associated with the Denali wilderness experience. Specifically, stated choice analysis is used to evaluate the choices overnight wilderness visitors make when faced with hypothetical tradeoffs among the conditions of social, resource, and management attributes of the Denali wilderness. Study findings offer an empirical approach for predicting and evaluating the likelihood of public support for Denali wilderness management alternatives.

INTRODUCTION

Recent research suggests that recreation use of wilderness is on the rise, particularly in the national parks (Cole, 1996). In the face of burgeoning public demand for outdoor recreation, national park and wilderness managers must make decisions that integrate a broad array of public values. Several decades of research suggest that wilderness recreationists' values span a range of social, ecological, and management factors (Manning, 1999). For example, wilderness recreationists value, to varying degrees, opportunities for solitude, pristine resource conditions, and recreation opportunities unconstrained by management restrictions. Decisions about how to integrate the diverse set of public wilderness values is complex and involve potential tradeoffs among competing values (Hall, 2001; Lawson & Manning, 2000a; 2000b; 2001a; 2001b; In press; Manning et al., 1999). For example, a fundamental tradeoff managers face among wilderness values is between providing public access to wilderness and protecting resource conditions and opportunities for solitude. Visitor use of a wilderness area could be limited through a permit system to protect resource conditions and opportunities for visitors to experience solitude, but fewer people would be allowed to enjoy the wilderness area. Conversely, managers could emphasize public access to a wilderness by reducing or eliminating use limits, but this might result in more resource impacts and diminish the quality of the visitor experience. While decisions about how to manage wilderness are often contentious, Cole, Watson, Hall, and Spildie (1997) and Shindler and Shelby (1993) suggest that if managers are able to predict public

support for various management alternatives the decisions become more tractable.

This study develops a decision-making model that integrates wilderness values characterized by social, resource, and managerial attributes of the Denali wilderness experience. The model provides managers with a tool to predict public support for a range of wilderness management alternatives. Specifically, stated choice analysis is used to evaluate the choices overnight wilderness visitors in Denali National Park and Preserve make when faced with hypothetical tradeoffs among the conditions of selected social, resource, and management attributes of the wilderness portion of the park. By making the tradeoffs associated with Denali wilderness management explicit to respondents, this study measures what respondents think *ought to be managed for* given the relationships among multiple management objectives. Study results provide managers with insight into the relative importance visitors place on values associated with the Denali wilderness experience and allow managers to predict public support for management alternatives that emphasize those values to varying degrees.

DENALI NATIONAL PARK AND PRESERVE

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. Most of the original two million acres of the park was designated wilderness, forming 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. Strict quotas on the number of overnight visitors issued a permit for each of 43 wilderness management units are used to control resource degradation and to provide visitors with opportunities to experience solitude. The primitive character of Denali's wilderness is maintained through other management techniques as well. For example, trails and bridges are not provided and there are no established campsites in the Denali wilderness.

Park managers and planners are currently formulating a new wilderness management plan for Denali. Revision will include decisions to maintain, reduce, or increase the number of permits issued for each of the Denali wilderness management units. Previous research (Bultena, Albrecht, & Womble, 1981) concluded that Denali visitors supported use limitations, but also suggested that future decisions 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. Our study uses stated choice analysis to provide park managers with information about overnight wilderness visitors' choices regarding such tradeoffs.

STATED CHOICE ANALYSIS

In stated choice analysis, respondents are asked to make choices among alternative configurations of a multi-attribute good (Louviere & Timmermans, 1990a). Each alternative configuration 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).¹

Stated choice analysis has been applied to study public preferences concerning a range of recreation-related issues (Adamowicz, Louviere, & Williams, 1994; Boxall, Adamowicz, Swait, Williams, & Louviere, 1996; Bullock, Elston, & Chalmers, 1998; Haider & Ewing, 1990; Louviere & Timmermans, 1990a; Louviere & Timmermans, 1990b; Louviere & Woodworth, 1985; Mackenzie, 1993; Schroeder, Dwyer, Louviere, & Anderson, 1990). A strength of choice models lies in their ability to predict how the public will respond to various policy alternatives, including arrangements of resources, facilities, and/or services that may not currently exist.

STUDY METHODS

Selection of Attributes and Levels

Research is helping to identify resource, social, and managerial setting attributes that reflect wilderness management objectives and influence the quality of the wilderness recreation experience (Merigliano, 1990; Roggenbuck, Williams, & Watson, 1993; Shindler & Shelby, 1992; Whittaker, 1992). Based on previous literature reviews (Manning, 1999) and consultation with Denali park staff a set of six wilderness setting attributes were selected to define the social, resource, and management conditions at Denali. Three levels were defined for each of the six wilderness setting attributes, based on recommendations from Park staff (see Table 1).

Experimental Design

Given three levels of each of the six study attributes, a full factorial design would produce a total of 3^6 (729) hypothetical Denali wilderness settings. Therefore, an orthogonal fractional factorial design was constructed containing 36 paired comparisons blocked into four questionnaire versions, each containing nine pairwise comparisons (Green & Srinivasan, 1978; Seiden, 1954).² An example of a wilderness setting comparison is presented in Figure 1.

Survey Administration

Overnight wilderness visitors in Denali 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. Study participants were randomly assigned to complete one of four versions of the questionnaire on a laptop computer. In each of the nine choice questions included in each version of the questionnaire, 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.

Effects coding was used to represent the wilderness setting attributes in the statistical model. For more information about the effects coding used in this study see Lawson and Manning (In press).

<p><u>Social conditions</u></p> <p>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</p> <p>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</p> <p><u>Resource conditions</u></p> <p>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</p> <p>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</p> <p><u>Management conditions</u></p> <p>Regulation of camping: Allowed to camp in any zone on any night Required to camp in specified zones Required to camp in designated sites</p> <p>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</p>
--

Table 1. Denali Wilderness Setting Attributes and Levels

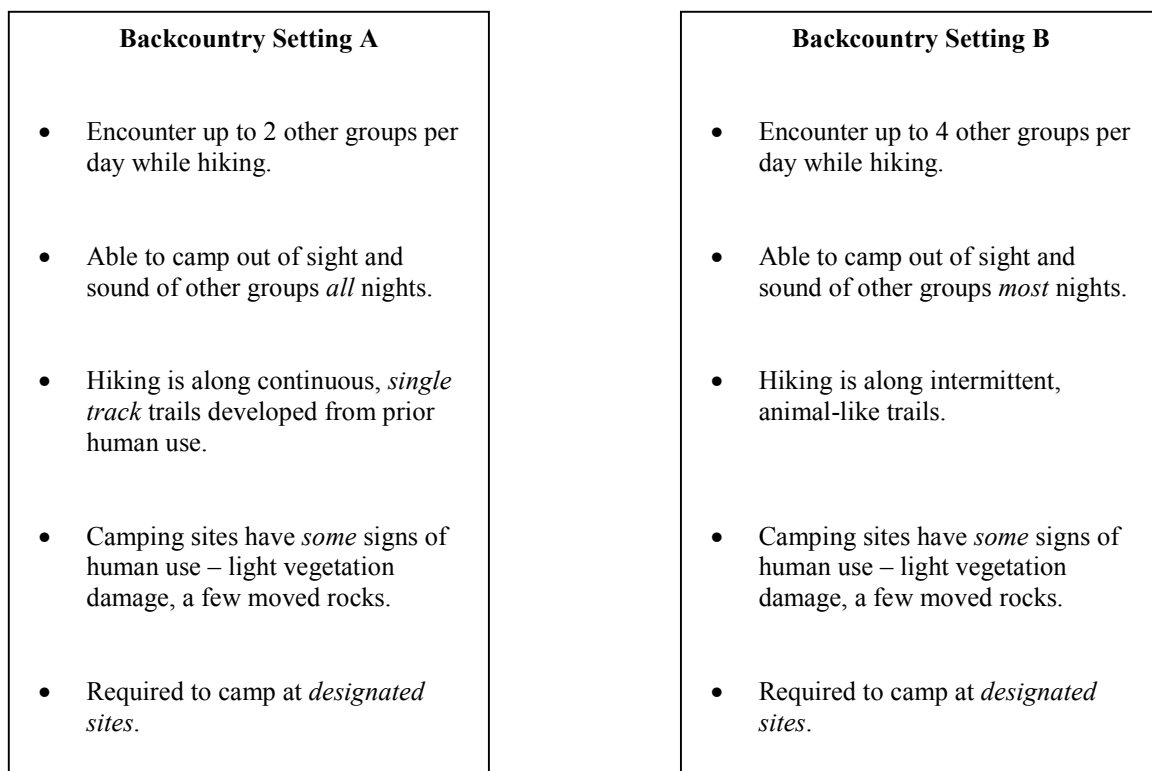


Figure 1. Example Denali wilderness setting comparison

Variable	Coefficient	Standard Error	Wald Chi-Square	P Value
Encounters with other groups per day while hiking:				
0 other groups	0.440*	-	-	-
Up to 2 other groups	0.065	0.043	2.246	0.134
Up to 4 other groups	-0.504	0.044	132.826	<0.001
Able to camp out of sight and sound of other groups:				
All nights	0.295*	-	-	-
Most nights	0.145	0.044	11.148	<0.001
A minority of nights	-0.440	0.045	94.814	<0.001
Hiking is along:				
Intermittent, animal like trails	0.319*	-	-	-
Single track trails developed from human use	-0.028	0.044	0.403	0.526
Multiple track trails developed from human use	-0.291	0.043	46.340	<0.001
Camping sites have:				
Little or no signs of human use	0.582*	-	-	-
Some signs of human use	0.207	0.044	22.151	<0.001
Extensive signs of human use	-0.790	0.049	264.972	<0.001
Regulation of camping:				
Allowed to camp in any zone on any night	0.072*	-	-	-
Required to camp in specified zones	0.140	0.048	8.620	0.003
Required to camp in designated sites	-0.212	0.045	21.948	<0.001
Chance visitors have of receiving a permit:				
Most get a permit for their preferred trip	0.073*	-	-	-
Most get a permit for at least their second choice	0.143	0.044	10.424	0.001
Only a minority get a permit	-0.216	0.043	24.656	<0.001

*Coefficients for the excluded level of the attribute were not estimated by the statistical model. They were calculated as the negative sum of the coefficients on the other two levels of the corresponding attribute.

Table 2. Coefficient Estimates for Wilderness Setting Attributes

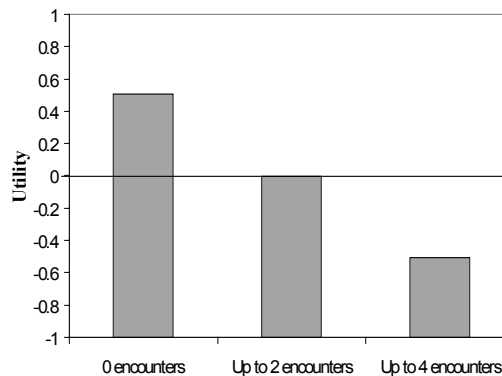
STUDY FINDINGS

Logistic regression was used to analyze the stated choice data. The coefficients of the utility difference function corresponding to 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 the <.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 the coefficients reflects the relative importance of the corresponding level of the attribute to wilderness visitors (Table 2). Signs of human use at campsites influence Denali overnight wilderness visitors’ utility or satisfaction more than any other wilderness setting attribute considered. Solitude-related attributes represent a second tier of importance to Denali wilderness visitors (Table 2). 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 coefficients of the stated choice model can also be examined graphically. As an

Figure 2. Hiking Encounters per Day



example, Figure 2 plots the coefficients of the attribute representing the number of other groups encountered while hiking. Values on the x-axis represent the level of the hiking encounters attribute. 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 associated with all possible combinations of the six Denali wilderness setting attributes. Levels of the attribute with high utility values are preferred to levels of the attribute with lower utility values. For plots of all six study attributes and further interpretation of the coefficients of the stated choice model see Lawson and Manning (In press).

As mentioned earlier in this paper, the stated choice model developed in this study can be used to predict visitor preferences for alternative wilderness management scenarios. For example, consider two hypothetical Denali wilderness management alternatives that emphasize potentially competing wilderness values; opportunities for solitude and freedom from management constraints. 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, 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 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 maximum likelihood coefficients and the effects codes corresponding to the levels of the six wilderness setting attributes for each hypothetical alternative are presented in Table 3. 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”.³ This result implies that, in general, Denali overnight wilderness visitors would prefer to forgo some freedom from management to improve opportunities to experience solitude. These findings are suggestive of the balance overnight wilderness visitors think ought to be struck among these potentially competing wilderness values. In the context of this example, if Denali wilderness managers choose a balance of tradeoffs more consistent with the “Freedom Alternative”, they may receive relatively little public support for their management actions as a consequence.

DISCUSSION AND CONCLUSIONS

In this study, stated choice analysis has been used to integrate a range of public wilderness values characterized by conditions of social, resource, and managerial attributes of the Denali wilderness into decisions about how to manage the park’s wilderness. The results of the stated choice analysis presented in this paper have several potential implications for wilderness management at Denali and elsewhere.

Study findings provide Denali wilderness managers with information about the relative importance overnight wilderness visitors place on the attributes of the Denali wilderness experience selected for this study. For example, study results 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. Information concerning the relative importance of the attributes included in this study reflects how visitors think managers ought to prioritize the wilderness values

	Solitude Alternative	Freedom Alternative
Hiking Encounters:	0 groups per day	Up to 4 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%

Table 3- Scores for Two Hypothetical Denali Wilderness Management Alternatives

associated with the study attributes, given the relationships and inherent tradeoffs among these attributes.

The decision-making model developed in this study allows managers to predict Denali overnight wilderness visitors' support for 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 the response of current users to each alternative. The results of the example application of the choice model provide 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 (by a margin of three to one) a wilderness setting that emphasizes solitude through relatively restrictive management actions over a more congested wilderness setting with limited management restrictions.

From a management perspective, these results suggest that the majority of Denali overnight wilderness visitors support backcountry permit quotas at Denali to protect the primitive character of the wilderness. Further, the results suggest that 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 substantial support from Denali overnight wilderness visitors. However, the results of the example application of the choice model suggest 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 wilderness visitors are at least somewhat diverse in their attitudes concerning the management of the Denali wilderness. Park managers 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.

Stated choice analysis shows promise as a tool to make complex and often controversial decisions of wilderness management more tractable. The decision-making model developed in this study provides managers with a means to predict support for various management alternatives, increasing the

chances that wilderness management will reflect a balance among public values that visitors are likely to support. Further, by asking respondents to consider the tradeoffs associated with wilderness management, visitors may become more aware of the difficult task wilderness managers face in trying to balancing public wilderness values.

ACKNOWLEDGMENTS

Appreciation is expressed to Darryll Johnson and Mark Vande Kamp of the University of Washington for their help with the larger research project at Denali National Park and Preserve of which this study was a part. Park staff, especially Mike Tranel and Joe van Horn, were very helpful in designing and administering the study questionnaire. Don Anderson of StatDesign Consulting, Evergreen, Colorado, constructed the orthogonal fractional factorial design used in this study. Don Dennis of the U.S. Forest Service, Daniel Krymkowski of the University of Vermont, and Stephen Swallow of the University of Rhode Island assisted with the design of the study questionnaire and interpretation of the study results. Finally, this study was conducted under the auspices of the National Park Service's Conservation Study Institute housed at Marsh-Billings-Rockefeller National Historical Park. Appreciation is expressed to Nora Mitchell, Rolf Diamant, B.J. Dunn and Mea Arego for their administrative support.

LITERATURE CITED

- 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.
- 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.
- 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.
- Cole, D. (1996). *Wilderness Recreation Use Trends, 1965 Through 1994*. USDA Forest Service Research Paper INT-RP-488.
- Cole, D., Watson, A., Hall, T., & Spildie, D. (1997). *High-use Destinations in Wilderness: Social and Biophysical Impacts, Visitor Responses, and Management Options*. USDA Forest Service Research Paper INT-RP-496.
- Dennis, D. (1998). Analyzing Public Inputs to Multiple Objective Decisions on National Forests Using Conjoint Analysis. *Forest Science*, 44(3), 421-429.
- 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. (2001). Use Limits in Wilderness: Assumptions and Gaps in Knowledge. *Visitor Use Density and Wilderness*

- Experiences: Proceedings. USDA Forest Service Proceedings RMRS-p-20, pp. 29-38.
- Hanemann, W. (1984). Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses. American Journal of Agricultural Economics, 66, 332-341.
- Lawson, S. & Manning, R. (2000a). Crowding Versus Access at Delicate Arch, Arches National Park: An Indifference Curve Analysis. Proceedings of the Third Symposium on Social Aspects and Recreation Research.
- Lawson, S. & Manning, R. (2000b). Evaluating Multiple Dimensions of Visitors' Tradeoffs Between Access and Crowding at Arches National Park Using Indifference Curve Analysis. Proceedings of the Third Symposium on Social Aspects and Recreation Research.
- Lawson, S., and R. Manning. (2001a). Crossing experiential boundaries: Visitor preferences regarding tradeoffs among social, resource, and managerial attributes of the Denali wilderness experience. The George Wright Forum, 18 (3), 10-27.
- Lawson, S., & Manning, R. (2001b). Solitude Versus Access: A Study of Tradeoffs in Outdoor Recreation Using Indifference Curve Analysis. Leisure Sciences, 23 (3), 179-191.
- Lawson, S., and R. Manning. (In press). Tradeoffs Among Social, Resource, and Management Attributes of the Denali Wilderness Experience: A Contextual Approach to Normative Research. Leisure Sciences.
- 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. University of Iowa, Iowa City Technical Report.
- Mackenzie, J. (1993). A Comparison of Contingent Preference Models. American Journal of Agricultural Economics, 75, 593-603.
- Manning, R. (1999). Studies in Outdoor Recreation: Search and Research for Satisfaction. Corvallis: Oregon State University Press.
- 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. Managing America's Enduring Wilderness Resource. St. Paul, MN: University of Minnesota, 156-162.
- 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 and Management, 24, 41-59.
- 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. USDA Forest Service General Technical Report RM-197, 41-51.
- Seiden, E. (1954). On the Problem of Construction of Orthogonal Arrays. Annals of Mathematical Statistics, 25, 151-156.
- Shindler, B. & Shelby, B. (1993). Regulating Wilderness Use: An Investigation of User Group Support. Journal of Forestry, 91, 41-44.
- Shindler, B. & Shelby, B. (1992). User Assessment of Ecological and Social Campsite Attributes. Defining Wilderness Quality: The Role of Standards in Wilderness Management – A Workshop Proceedings. USDA Forest Service General Technical Report PNW-305, 107-114.
- Whittaker, D. (1992). Selecting Indicators: Which Impacts Matter More? Defining Wilderness Quality: The Role of Standards in Wilderness Management – A Workshop Proceedings. USDA Forest Service General Technical Report PNW-305, 13-22.

FOOTNOTES

¹ Decision making models developed using stated choice analysis are based on the theoretical framework of random utility. Refer to Hanemann (1984) and Opaluch, Swallow, Weaver, Wessells, and Wichelns (1993) for detailed presentations of the random utility framework.

² The orthogonal fractional factorial design was constructed by Don Anderson of StatDesign Consulting, Evergreen, Colorado.

³ Refer to Opaluch, Swallow, Weaver, Wessells, and Wichelns (1993) for a presentation of the methods used to calculate scores for the hypothetical management alternatives.