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EVALUATING MULTIPLE DIMENSIONS OF VISITORS' TRADEOFFS BETWEEN ACCESS AND CROWDING AT ARCHES NATIONAL PARK USING INDIFFERENCE CURVE ANALYSIS*

Steven R. Lawson

Ph.D. Candidate in Natural Resources, University of Vermont, Burlington, VT 05405

Robert E. Manning

Professor of Natural Resources, University of Vermont, Burlington, VT 05405

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Abstract: Tradeoffs are an inherent part of many of the decisions faced by outdoor recreation managers. For example, decisions concerning the social carrying capacity of popular attraction sites involve tradeoffs between limiting visitor use to ensure a high quality experience and allowing high levels of visitor use to ensure that large numbers of visitors retain access to park and outdoor recreation resources. This study uses indifference curve analysis to evaluate the tradeoffs visitors are willing to make between access and visitor use levels at Delicate Arch, Arches National Park. Differences in the evaluation of tradeoffs between access and crowding are examined for first time visitors versus repeat visitors; local visitors versus non-local visitors; and across questionnaire formats. The results of the indifference curve analysis allow Arches National Park managers to make informed evaluations of alternative management options for visitor use at Delicate Arch.

Introduction

Tradeoffs are an inherent part of many of the decisions faced by outdoor recreation managers. One of the more challenging and pervasive issues outdoor recreation managers face concerns the appropriate level of use, or social carrying capacity, of popular attraction sites. Decisions about appropriate levels of visitor use involve inherent tradeoffs between limiting visitor use to ensure a high quality visitor experience and allowing high levels of visitor use to ensure that large numbers of visitors retain access to park and outdoor recreation resources (Manning, Valliere, & Jacobi 1997).

A number of frameworks have been developed to provide park and outdoor recreation managers with a basis for making decisions about the social carrying capacity of outdoor recreation settings. These frameworks include Visitor Experience and Resource Protection (VERP) (National Park Service 1997), Limits of Acceptable Change (LAC) (Stankey et al. 1985), and Visitor Impact Management (VIM) (Graefe, Kuss, & Vaske 1990). Common to these approaches is the formulation of indicators and standards of quality. Indicators of quality are measurable, manageable variables that serve as quantifiable proxies for management objectives. Standards of quality define the minimum acceptable condition of indicator variables (Manning, 1999).

While a number of studies have been conducted to define the social carrying capacity of various outdoor recreation settings, there have been few attempts to explicitly consider the inherent tradeoffs between quality and access. There is evidence that social carrying capacity may be significantly affected when management implications are explicitly considered by study respondents (Manning, Valliere, Wang, & Jacobi 1999). That is, visitors may be more tolerant of higher levels of visitor use when they are aware that their standards of quality may result in limitation or regulation of visitor access to attractions and facilities.

This paper describes techniques used to apply indifference curve analysis to evaluate the tradeoffs associated with the social carrying capacity of Delicate Arch, Arches National Park. Specifically, this study examines the tradeoffs visitors are willing to make between the number of visitors at one time at Delicate Arch and the percentage chance of receiving a hypothetical permit to hike to Delicate Arch.

Indifference Curve Theory

Indifference curve theory, developed in economics, provides a model representing the tradeoff decisions an individual makes in allocating a fixed level of income between two consumer goods (Nicholson 1995). There are two primary components to the indifference curve model, the individual's indifference curves and his/her budget constraint. A single indifference curve represents all possible combinations of two goods (e.g. A and B) that provide the individual with the same level of utility (Pindyck & Rubinfield 1995). The curves labeled IC_1 and IC_2 in Figure 1 are examples of indifference curves. The budget constraint represents the possible combinations of goods A and B the individual can purchase, assuming the individual spends all of his/her income (Pindyck & Rubinfield 1995). For example, the budget constraint labeled BC in Figure 1 represents all possible combinations of the two consumer goods A and B, for a fixed income level.

According to indifference curve theory, the optimal combination of goods A and B for a given level of income is located where the budget constraint is tangent to one of the individual's indifference curves (Nicholson 1995). This represents the highest level of utility the individual can achieve from the consumption of goods A and B, given a fixed level of income. In Figure 1, the optimal combination of goods A and B is represented by point X. A more complete discussion of indifference curve theory is presented in Lawson and Manning (2000).

Methods

Indifference curve analysis was applied to the evaluation of social carrying capacity at Delicate Arch by substituting lack of crowding at Delicate Arch and accessibility to Delicate Arch for consumer goods (i.e., goods A and B in Figure 1). Specifically, the number of people at Delicate Arch was substituted for good B along the y-axis, and the percent chance of receiving a hypothetical permit to hike to Delicate Arch was substituted for good A along the x-axis.

Indifference Curves
Indifference curves were estimated following a procedure adapted from MacCrimmon and Toda (1969). In this procedure, respondents are presented with a series of pairs of crowding and accessibility conditions. The first component of each pair of conditions is a fixed reference condition, against which respondents evaluate an alternative condition. Respondents are asked to indicate their preference within each pair of conditions they evaluate. For example, respondents were asked to express their preference between a first set of conditions – having a 100 percent chance of receiving a permit to hike to Delicate Arch and seeing 108 people at Delicate Arch – and a second set of conditions – having a 50 percent chance of receiving a permit to hike to Delicate Arch and seeing 36 people at the Arch. See Lawson and Manning (2000) for a graphical description of the methods used to estimate indifference curves.

Regression analysis was used to estimate an indifference curve for each respondent based on the data points derived from his/her evaluation of a series of access and crowding conditions at Delicate Arch. For each respondent, a hyperbolic, semi-log, and quadratic curve was fit to the data points. The functional form for each individual indifference curve was selected based on the goodness of fit (R-square) of the regression equation, and the explanatory significance of the access variable (chance of receiving a permit) on the number of people at Delicate Arch.

Budget Constraint
A simulation model of visitor use at Arches National Park was used to estimate points along the budget constraint representing the possible combinations of visitor use levels and accessibility at Delicate Arch. Computer simulation models have been successfully applied to a variety of park and outdoor recreation areas (e.g., Potter & Manning 1984; Wang & Manning 1999; Schechter & Lucas 1978). Additional information about the inputs used to develop the simulation model can be found in Lawson and Manning (2000).

The simulation model was run at three levels of daily visitor use. The first level of use represented the Park's average daily use in the summer, which was used as a proxy for a 100 percent chance of receiving a permit to hike to Delicate Arch. The second level of use was 50 percent of the Park's average daily use, which was used as a proxy for a 50 percent chance of receiving a permit to hike to Delicate Arch. The third level of use was 25 percent of the Park's average daily use, which was used as a proxy for a 25 percent chance of receiving a permit to hike to Delicate Arch.

For each use level, the model was run 12 times to account for variability in model parameters. The outputs from the simulation model runs were used to estimate the maximum number of people seen at Delicate Arch at one time by at least one visitor per day, for each of the three accessibility conditions. A linear budget constraint was estimated from the three data points. Given the scope of this paper, a linear budget constraint was assumed for the purposes of simplification. Subsequent research should investigate the validity of this assumption.

Indifference Curve Analysis
Lastly, each individual's indifference curve was mathematically adjusted by adding a constant term to the equation for the indifference curve, to find the point where the indifference curve is tangent to the budget constraint. The point of tangency between the adjusted indifference curve and the budget constraint reveals the respondent's preferred combination of visitor use and accessibility, given the possible conditions at Delicate Arch.

Visitor Survey
Two versions of the indifference curve questionnaire were administered to visitors during the summer of 1999 as they returned from their hike to Delicate Arch. One version of the questionnaire included photographs depicting the number of visitors at Delicate Arch associated with each pair of conditions that respondents were asked to evaluate. The second version of the questionnaire included narratives describing each pair of conditions that respondents were asked to evaluate. Photographs of the number of visitors at Delicate Arch were not included in the second version of the questionnaire. Both versions of the questionnaire were administered on laptop computers. A total of 124 individuals responded to the questionnaire with photographs and 113 individuals responded to the questionnaire with narratives.

Results

For those individuals who responded to the questionnaire with photographs, results are presented for the estimation of each respondent's indifference curve. The budget constraint, constructed from the output of the simulation model of visitor use at Arches National Park is reported. Additionally, the preferred combinations of access and visitor use at Delicate Arch derived from the indifference curve analysis are presented for respondents to the questionnaire with photographs. Finally, the results of three chi-square tests are reported. The first test examined differences in the evaluation of tradeoffs between access and crowding for first time visitors versus repeat visitors. The second test examined differences in the evaluation of tradeoffs between access and crowding for local visitors to Arches National Park versus non-local visitors. The third test examined differences in the evaluation of tradeoffs between access and crowding for respondents to the questionnaire using photographs versus respondents to the questionnaire using narratives.

Indifference Curves
Indifference curves were derived for 123 respondents to the questionnaire with photographs, based on their evaluation of the tradeoffs between access and visitor use levels at Delicate Arch. Data from one respondent were excluded from the analysis because the data did not conform to the expected properties of indifference curves.

Analysis of sample data revealed 16 unique indifference curves. Respondents were categorized into one of three groups based on the characteristics of the preferences they revealed. The first group includes individuals whose preferences are "access oriented". In other words, these respondents would tolerate seeing relatively large numbers of people at Delicate Arch to help ensure they would be granted access to the Arch. The second group includes individuals whose preferences are "low use oriented". These respondents would tolerate a lower chance of being granted access to Delicate Arch to help ensure that if they received access to the Arch they would see relatively few people. The third group includes individuals whose preferences are "tradeoff oriented". In other words, these respondents would be more likely to negotiate or make tradeoffs between accessibility and visitor use levels than respondents in the other two groups.

Figure 2 illustrates indifference curves representative of individuals with "access oriented" , "low use oriented", and "tradeoff oriented" preferences. The values on the y-axis represent the maximum number of people seen at Delicate Arch at one time by at least one visitor per day. The values along the y-axis are inverted to represent increasingly desirable "crowding" conditions, based on the assumption that respondents would prefer to see fewer people at Delicate Arch. The values on the x-axis represent the percentage chance of receiving a permit to hike to Delicate Arch. The percentage chance of receiving a permit to hike to Delicate Arch serves as a proxy for total use at Delicate Arch. Current total use at Delicate Arch is represented as a 100% chance of receiving a permit to hike to Delicate Arch. The values along the x-axis extend beyond a 100% chance of receiving a permit to hike to Delicate Arch to represent total use levels that are greater than current total use levels. However, respondents were not asked to evaluate any conditions in which the percent choice of receiving a permit to hike to Delicate Arch was greater than 100%.

Nearly half of all respondents revealed preferences characterized as "low use oriented" (48.8%), compared with just one-fifth of respondents having preferences characterized as "access oriented" (20.3%). Just under one-third of respondents had preferences that were characterized as being "tradeoff oriented" (30.9%).

Budget Constraint
The budget constraint defining the possible combinations of accessibility and visitor use for Delicate Arch was derived from output generated by a simulation model of visitor use at Arches National Park. Output from the simulation model resulted in three data points for the budget constraint. Regression analysis was used to estimate a linear budget constraint based on the three data points. Figure 3 presents the budget constraint defining the possible combinations of access and visitor use levels at Delicate Arch.

Indifference Curve Analysis
An indifference curve was estimated for each respondent to the questionnaire with photographs. Each respondents' indifference curve was then adjusted to find the point of tangency with the budget constraint. Figure 4 presents the percent of respondents with each of the preferred combinations of access and visitor use at Delicate Arch. The budget constraint for Delicate Arch is represented by the line labeled BC. Each point noted along the budget constraint represents a preferred combination of access and crowding at Delicate Arch for at least one respondent. The number beside each point indicates the percent of respondents with the corresponding preferred combination of access and crowding.

Comparisons of Tradeoff Evaluations by Visitor Type and Questionnaire Format
An analysis was conducted to determine the potential effect of visitor type and questionnaire format on the findings from the indifference curve analysis. The first chi-square test examined differences in the evaluation of tradeoffs between access and crowding at Delicate Arch for first time visitors versus repeat visitors. Repeat visitors were defined as any individual who reported that they had visited Arches National Park on a previous trip. The results of the statistical test indicate that the distribution of first time visitors among the three preference categories ("access oriented", "low use oriented" and "tradeoff oriented") is not significantly different than that of repeat visitors (χ^2 = 0.361, p = 0.84).

The second chi-square test examined differences in the evaluation of tradeoffs between access and crowding at Delicate Arch for local visitors versus non-local visitors. Local visitors were defined as residents of any of the "four-corners" states (i.e., Colorado, New Mexico, Arizona and Utah). Non-local visitors were defined as residents of any state other than one of the "four-corners" states. The results of the statistical test indicate that the distribution of local visitors among the three preference categories is significantly different than that of non-local visitors (χ^2 = 5.864, p = 0.05). About half of both local visitors (49.2%) and non-local visitors (48.4%) revealed preferences characterized as "low use oriented". However, local visitors (27.9%) are more likely to be "access oriented" than non-local visitors (12.9%). Additionally, more than one-third of non-local visitors (38.7%) indicated "tradeoff oriented" preferences, compared with just under one-quarter of local visitors (23.0%).

The third test examined differences in the evaluation of tradeoffs between access and crowding at Delicate Arch for respondents to the questionnaire using photographs versus respondents to the questionnaire using narratives. The statistical test revealed significant differences between the preferences of respondents to the two questionnaire formats (χ^2 = 11.246, p = 0.00). Specifically, nearly half of all

Figure 1. Theoretical Indifference Curves and Budget Constraint

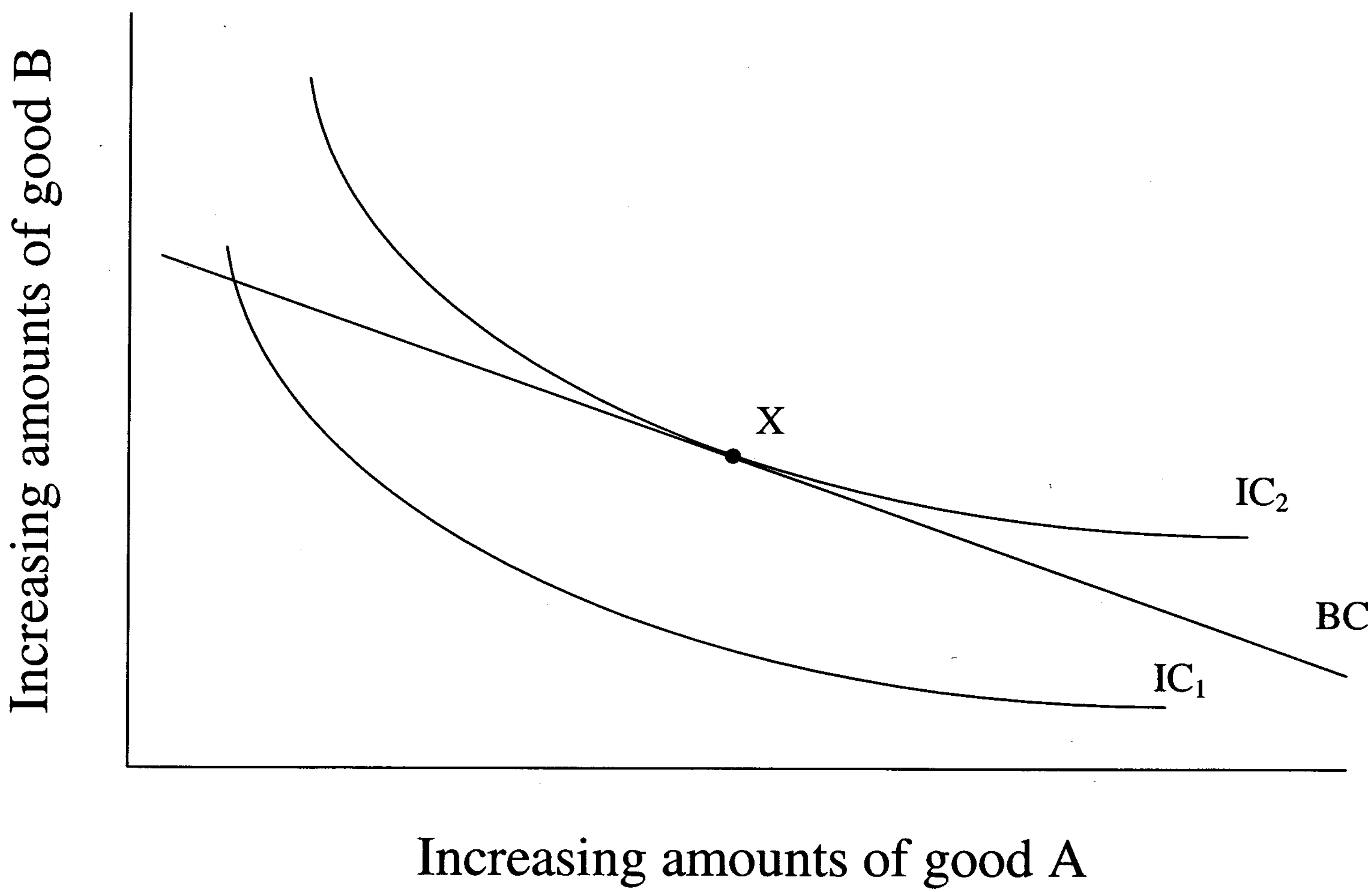


Figure 2. Indifference Curves – Access, Low Use, and Tradeoff Oriented Visitors

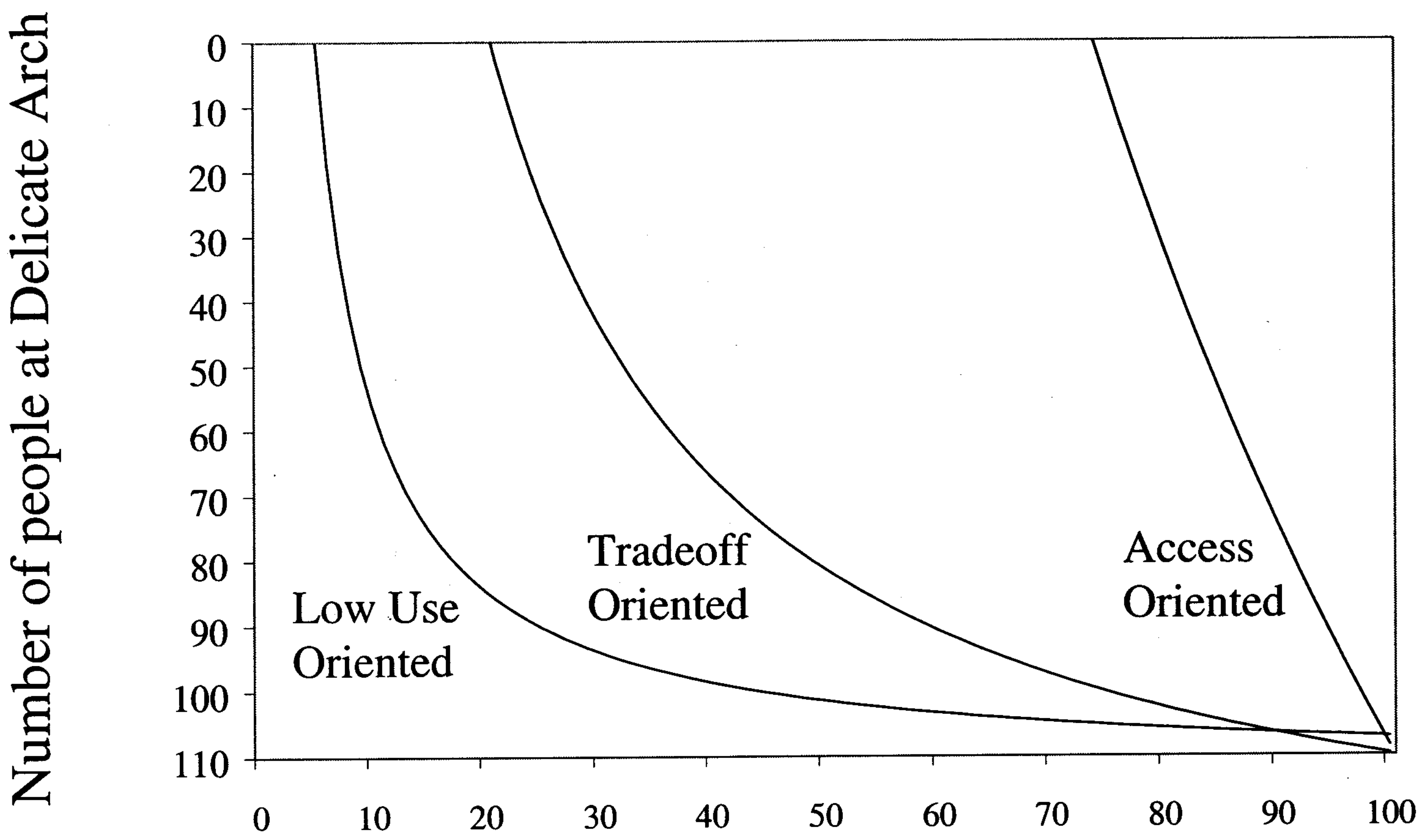


Figure 3. Budget Constraint for Delicate Arch

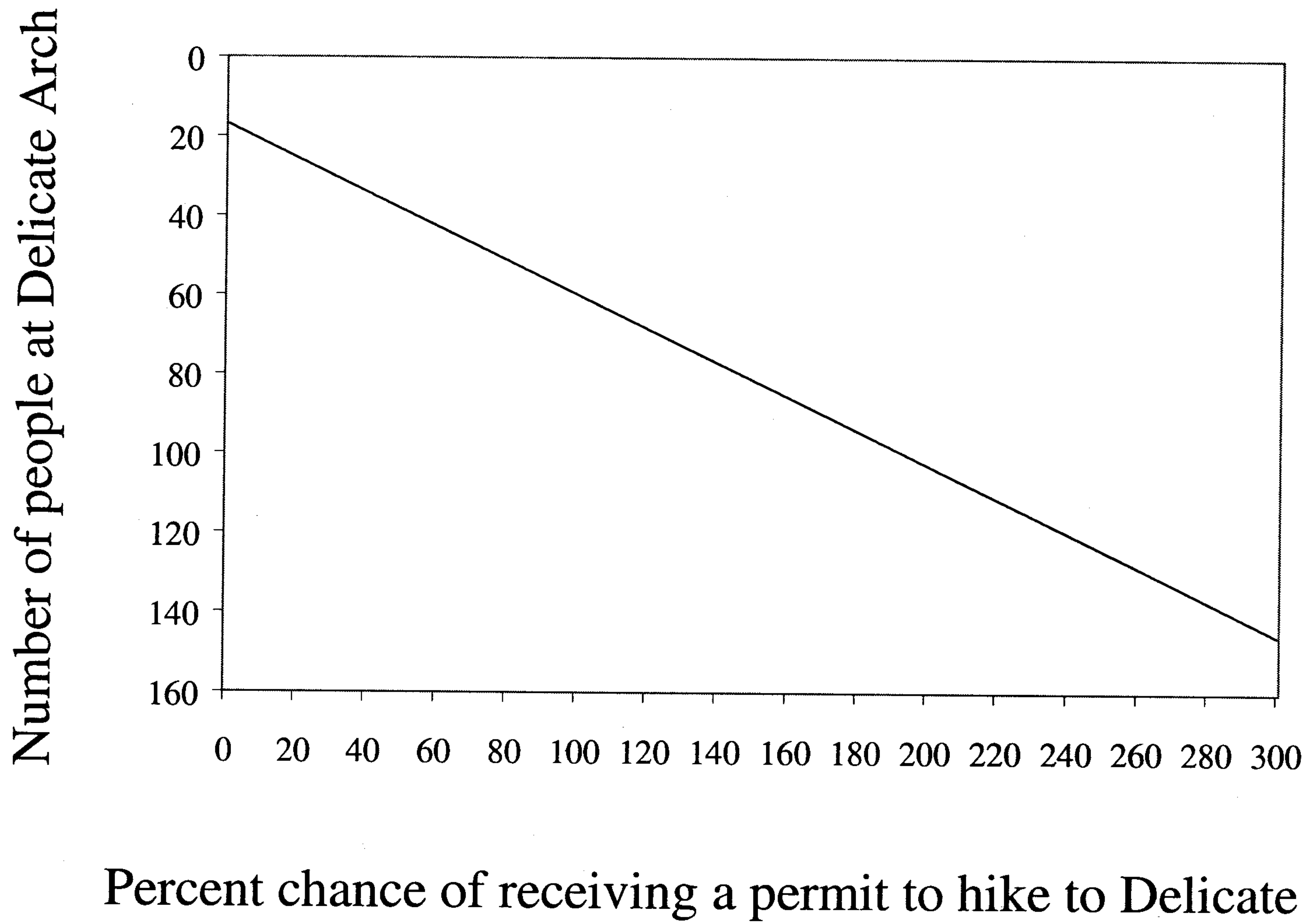
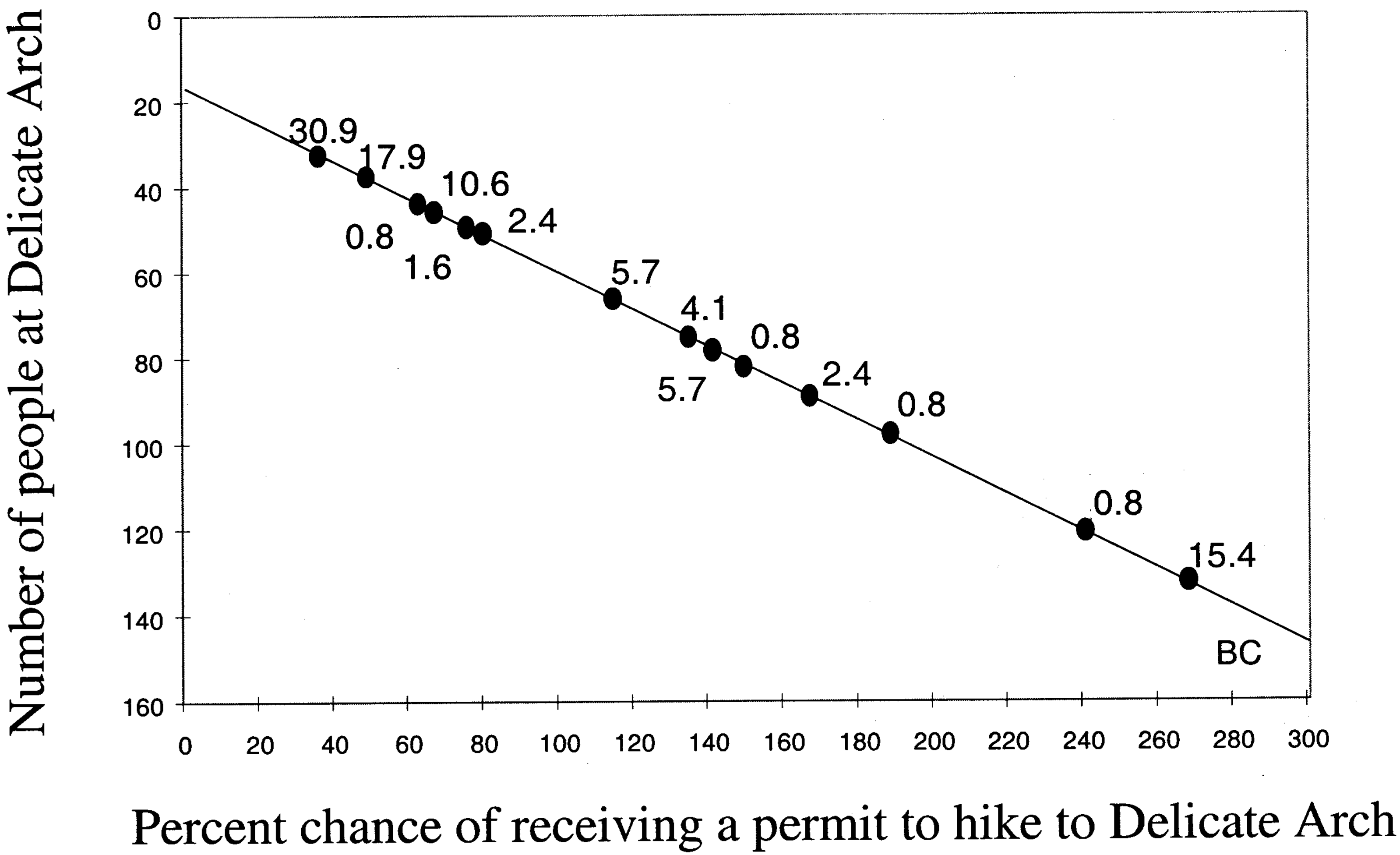


Figure 4. Preferred Combinations of Access and Visitor Use at Delicate Arch



respondents to the questionnaire using photographs (48.8%) revealed preferences characterized as "low use oriented", compared with just under one-third of respondents to the questionnaire using narratives (32.0%). Respondents to the questionnaire using narratives (40.0%) were more likely to reveal preferences characterized as "access oriented" than respondents to the questionnaire using photographs (20.3%). Just under one-third of respondents, regardless of questionnaire format, revealed preferences characterized as "tradeoff oriented" – 30.9% of respondents to the questionnaire using photographs and 28.0% of respondents to the questionnaire using narratives.

Conclusions

The results of this study suggest that indifference curve analysis provides a useful tool for park managers to evaluate the tradeoffs inherent in decisions about appropriate levels of visitor use at popular attraction sites. Indifference curve analysis allows managers at Arches National Park to make more informed evaluations of alternative management options for visitor use at Delicate Arch.

One of the management alternatives Arches National Park managers have is to freeze visitor use at Delicate Arch at current levels. The budget constraint indicates that if park managers continue to manage Delicate Arch at current use levels, visitors would see no more than 62 people at one time at the Arch. The results of the indifference curve analysis suggest that rather than allowing current use levels at Delicate Arch to persist, about two-thirds of the sample (64.2%) would prefer park managers to reduce visitors' chances of hiking to Delicate Arch to ensure that those who do go to the Arch see fewer than 62 people at one time. About one-third of the sample (35.7%) would prefer that park managers increase visitors' chances of seeing Delicate Arch, rather than maintaining current visitor use levels at the Arch.

A second alternative is to manage Delicate Arch in a manner that reflects the preferences of "low use oriented" visitors or "access oriented" visitors. Management actions taken to reduce the number of visitors seen at one time at Delicate Arch would be favored by about half of all respondents (48.8%). For example, these "low use oriented" visitors would prefer to see park managers initiate a permitting system to reduce the number of visitors seen at one time at Delicate Arch. About one-fifth of respondents (20.3%) have preferences characterized as "access oriented". Management actions that increase visitors' chances of seeing Delicate Arch (e.g. increasing the number of parking spaces at the Delicate Arch trailhead) would be favored by these "access oriented" visitors. Just under one-third (30.9%) of the sample have preferences characterized as "tradeoff oriented". These visitors would not necessarily favor management actions that reflect the preferences of either "low use oriented" visitors or "access oriented" visitors.

As the indifference curve data indicate, there are a substantial number of visitors with preferences characterized by each of the three preference categories. In light of these findings, Arches National Park managers might choose to manage visitor use levels by zones. Certain zones within the park could be managed to meet the preferences of "low use oriented" visitors. Visitors' access to these zones would be restricted through the use of a permitting system, or some other mechanism, in order to ensure a relatively "uncrowded" visitor experience. Other zones could be managed to meet the preferences of "access oriented" visitors. Visitors' chances of seeing attractions in these zones would not be restricted or limited by a permitting system. Virtually anyone who wanted to visit these zones would be able to. "Tradeoff oriented" visitors could choose among the various zones to meet their preferences for accessibility and visitor use levels at park attractions. Indifference curve data can help quantify choices about managing the park by zones.

Managers at Arches National Park may want to provide a visitor experience that targets the preferences of local visitors or non-local visitors. The results of this research inform Park managers about how various visitor use management alternatives will serve local and non-local visitors' preferences for access and crowding conditions. For example, management actions that increase visitors' chances of seeing Delicate Arch would be more consistent with the preferences of local visitors than non-local visitors. Additionally, Park managers can use these study results to make more informed decisions about how to designate management zones within Arches National Park that target local visitors or non-local visitors based on the chance of receiving access to the attractions in the zone and the number of other people visitors would see while visiting the attractions.

The results of this study suggest that the type of questionnaire format used to elicit evaluations of tradeoffs between access and crowding at Delicate Arch may influence study results. Further research should be conducted to investigate the effect of questionnaire format on the indifference curve analysis of tradeoffs in outdoor recreation management. Generating larger sample sizes for alternative questionnaire formats and controlling for the access and crowding conditions experienced by respondents to the indifference curve questionnaires would provide more insight into this issue.

Additional research might investigate the temporal consistency of individuals' preferences for access and lack of crowding. For example, respondents to an on-site survey like the one in this study could be recruited to participate in a follow-up mail survey. The mail survey would ask respondents to evaluate the same combinations of access and crowding conditions that they were asked to evaluate in the on-site questionnaire. Each individual's responses to the mail survey could be compared to his/her responses to the on-site survey to examine if preferences for tradeoffs between access and lack of crowding change over the full duration of the recreation experience.

Further research might focus on the effect on social carrying capacity of shifting the budget constraint associated with an attraction site. Shifting the budget constraint might be accomplished through visitor management or site design. For example, the budget constraint representing possible combinations of accessibility and visitor use levels at Delicate Arch could be shifted by scheduling the departure times of visitors hiking to Delicate Arch (Manning and Potter 1984). By scheduling visitors' hiking trips to Delicate Arch, park managers could potentially lower the number of people seen at one time at Delicate Arch while holding total use levels constant. Such a shift in the budget constraint would influence the outcome of the indifference curve analysis.

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EFFECTIVE SURVEY AUTOMATION

John Weisberg

Director, Techneos Systems Inc.
13 Woodhill Crescent, Ottawa, ON Canada K1B 3B7

Jay Beaman

Director, Auctor Consulting Associates, Ltd.
465 Andra Ct., Cheyenne, WY 82009

Abstract: Progress in the options for survey data collection and its effective processing continues. This paper focuses on the rapidly evolving capabilities of handheld computers, and their effective exploitation including links to data captured from scanned questionnaires (OMR and barcodes). The paper describes events in Parks Canada that led to the creation of survey software for handhelds. A current commercial Mobile Computer Assisted Personal Interviewing (MCAPI) application that grew out of the work at Parks Canada is used to demonstrate the current state of the art, and future applications are discussed. Basic decision making criteria for selecting a survey data collection method are provided.

Introduction

From the 1960s to 2000 we have experienced a technology revolution. This revolution has been associated with increasing options for cost-effective data collection and analysis (Beaman 1969, Wintrob 1987). As part of this revolution, an integrated framework for data automation was introduced into Parks Canada, yielding participation in discussions on technology and data at professional meetings such as NERR (Parks Canada 1988; Grim and Beaman 1989a and 1989b; Thomson, Cotter and Beaman 1992; Jaro, Stanley and Beaman 1992). Parks Canada was examining various options that produced electronic data such as traffic counters, data capturing cash registers, push-button questionnaires (Cadotte 1979) and "automated kiosks" (Cotter 1991).

As part of the revolution personal computers became "readily" available so that dependency on support groups that controlled access to mainframe computers was broken. Use of modems for transmission of data from field to a location where analysis could be done became feasible. Transportable computers evolved from luggable to laptop, and finally to truly portable handhelds. Software was also progressing, so that executing a complicated survey on a handheld computer became feasible (Sainsbury, Ditch and Hutton 1993; papers in Westlake, Martin, Rigg and Skinner 1999).

Surveys have been an important data collection method for Parks Canada since the 1960s or earlier (see references in Girt 1981, Parks Canada 1983, Canadian Parks Service 1992). In the early seventies Parks Canada began to collect survey data directly rather than relying on contractors. By the mid eighties concerns about the effort that went into planning for surveys, executing them and getting clean data for use in the analysis had risen. Planning for a summer survey could begin one fall, and not until well after the survey planning cycle had begun again the next year would data even be back from keyboarding. Cleaning of data files, analysis and report writing would then commence. With luck results would be presented in January or February, more than a year after a project was planned.

One option to make the collection of survey data more effective became clear. It was reducing the time and labor in going from an interview to clean files for analysis. By the late 1980s changing technology offered several option. Scanners and "image processing" was one. Also, durable and reliable handheld computers were becoming available. Parks Canada's headquarters saw a great potential for handheld computers and purchased two units for Atlantic Region to try. The idea to be tested with these was that by collecting survey data on a handheld, when an interview was over one had clean data ready to be sent by modem to be "added" to an analysis file. In theory analysis could begin during the survey season and next year's planning could be completed soon after the end of the survey. For most surveys ending after Labor Day, in principle, reports could be ready in early fall. Note that while scannable paper questionnaires can offer rapid turnaround as well, scanning is an extra step, the forms may need to be shipped from the survey site, and control of questionnaire navigation and data input values during the interview are not possible.

Discoveries from the experiment

The Atlantic Region handheld experiment basically went well. A lot of effort went into programming the handhelds and much of that was repetitive and tedious. Similar codelists and editing code had to go into different questions and questionnaires to get them properly displayed on a handheld. Furthermore there was variation in coding because of the differences in machines that were being tested. There was typing, retyping, cutting, pasting and formatting.

What became clear was that:

1. Future gains could certainly be made by automation of much of the programming involved in getting questionnaires into handhelds and displaying properly, branching as required and storing responses. But getting questions setup and running so valid responses were captured was only part of the battle. The structure of output data files to be produced by the handhelds had to be programmed and a program had to exist to "collect" data from a particular survey from multiple handhelds and produce a valid aggregate analysis file. Conditional branches based on a person's responses created some tricky details in producing these files. Because output from the handheld was just input to a program to produce analysis files, even though one had defined codes for asking questions, these values had to be linked into output analysis programs so that, at some point, one could create an analysis file (e.g., SPSS or SAS file).

2. Gains could be made by having questions and responses in a data base so that:
   - they could be easily accessed and formatted into program code producing proper display on a handheld;
   - the responses could be incorporate into response editing code; and
   - questions, codes and their description could be used in defining variable labels and value labels in an analysis file.

   Unfortunately, it was often discovered after questionnaires went into the field that they were not perfect. Making adjustments for this required a great deal of careful programming. Not only was it necessary that code for collecting the data be modified, code for output had to be modified to accommodate the inclusion of new variables and the elimination of any removed. This resulted in a problem in "linking together" data produced with different versions of a questionnaire. When questionnaire revisions occur during the course of a survey, major savings can result from programming that performs data consolidation while automatically accommodating all the modifications.
3. Another problem area was managing the data collected, particularly when the same computer was used for more than one questionnaire. When one is getting data from a computer, particularly datasets for different questionnaires, and bringing each together with other data files previously obtained from the same and other handhelds, errors could arise. Some data were overwritten, some were included two or three times. This meant that, where possible, some files from handhelds had to be recovered and properly added to cumulative files. Where extra records were in data they had to be found and removed.
4. Problems could be avoided and gains made by building standards and rigorous integrity controls into data files produced by the handhelds and supporting these in routines that received and aggregated them to produce the analysis files.

Even if the comments above suggest that there were lots of problems, the experiment was judged to be a success. Atlantic Region acquired more handheld computers and used them in numerous surveys. Other regions adopted the technology. Along with acquisitions went a commitment to addressing the areas in which the effectiveness of handheld based surveys could be improved. By 1992 Parks Canada's Western Region had enough handheld survey activity that they took over responsibility for innovation and development. In 1995, with a change in philosophy and management in Parks Canada, staff responsible for the handheld technology and some other survey work in Parks Canada made the decision to leave, in order to push forward with development of the concept on a commercial basis. The software used in the following examples is the result of the efforts by this group.

The fact that handhelds became a key development area and, say, scanning of paper questionnaires was not a thrust, reflects circumstance. In fact, handhelds are being used with paper questionnaires to improve data collection efficiency for particular surveys. Choosing the appropriate cost-effective data collection technology for a given situation should always be a goal (for more information on scannable forms see LoPresti and Maphtali 1996; Acumen Systems 2000; and Principia Products 2000).

Some Examples of Applications

Prior to discussing what has been achieved and what is seen as important, some examples of Mobile Computer Assisted Personal Interviewing (MCAPI) applications will give an insight in the nature and complexity of what can be done.

Yukon Tour Bus Study

In 1999 Parks Canada conducted a survey of tour bus visitors to sites in the Yukon (Weisberg and Thomlinson 1999). The short tour bus season and tight schedule for each tour group meant that rapid data collection was imperative. An easy to use and reliable solution was critical, as the project manager was located over 1,000 miles away, making on-site supervision impractical.

The project utilized handheld computers with built-in bar code scanners, running the Mobile Interviewer™ software from Techneos™ Systems Inc, and OMR (Optical Mark Reading) mailback questionnaires. An interviewer used the handheld to collect information about each tour group from the bus driver. A mailback post-card sized questionnaire was then handed out to each passenger on the bus, after scanning the form's unique bar coded serial number into the interview record. This enabled individual responses to be linked to group information with a very high degree of accuracy. The overall approach substantially decreased respondent burden, as each passenger was only required to provide personal views, without having to describe the entire group's itinerary—information that the driver provided with greater accuracy. The method met the goals of the project manager. Interviewers liked it as well, considering the opportunity to use the handhelds to be the "fun part" of the job.

Liquor Control Board of Ontario (LCBO) Study

In November 1999, the LCBO used the Mobile Interviewer software to conduct in-store research at its new flagship retail location in Toronto. The questionnaire used branching extensively, first screening respondents based on a series of demographic characteristics. Qualifying respondents were then asked a set of 13 attitudinal questions. The software performed a series of calculations based on mean scores derived from previous research, and identified which of five customer types best fit the respondent—all in real time. Based on the customer type, further in-depth research was conducted in the store.

The alternative, using paper questionnaires, would have required the respondent to wait while data was entered into a laptop and the calculations performed. Using the handhelds made the experience a better one for both respondent and interviewer, according to the LCBO's director of customer insights, who said: "It was easy, instant, and looked cool."

The State of the Art

These examples indicate that the state of the art has advanced quickly. Progress has occurred in both hardware and software.

Hardware

Most papers examining Computer Assisted Personal Interviewing (CAPI) have looked at the use of laptop computers (Sainsbury, Ditch and Hutton, 1993; deLeeuw and Nicholls 1996). There are many problems with the use of laptops in the field:

- Unacceptable battery life (e.g., 1-5 hours);
- Easily damaged (by dropping, or from dust and moisture);
- Poor ergonomics (heavy, difficult to use while standing, and tends to come between respondent and interviewer);
- Cost;
- Operating system (reliability, time to start up/shut down).

Parks Canada pioneered the use of ruggedized industrial handhelds for survey research in the late 1980s in order to address many of these problems. Battery life was 8-10 hours, the units were designed for outdoor use, and were smaller and lighter than a laptop (though at about two pounds, still no picnic for the interviewer to carry for eight hours). Cost remained very high however, and because the units were specialized, only a few vendors existed.

In 1993 Apple Computer's Newton MessagePad created the concept of a powerful yet inexpensive mobile computer. The device didn't catch on, but in 1996 Palm Computing released a smaller and less expensive device, and the market for consumer handhelds took off. Today almost every computer, electronics, and office supply store carries Palm devices. The base model weighs 6 ounces, uses common AAA batteries which provide 40-50 hours of run-time, features an exceptionally easy to use and reliable operating system designed for mobile computing—and costs only US$150.

Palm Computing is the clear leader with over 75% market share at present. Palm has also licensed its technology to other manufacturers, including Handspring, Symbol, Sony and TRG. All Palm devices come with built in programs that can be used to manage project-related information, and third party developers have developed an amazing assortment of add-on programs. Hardware accessory manufacturers have produced data acquisition devices including GPS receivers, digital voice recorders, and temperature and altitude sensing modules. These could be combined with survey software to provide new research approaches.

Current handheld hardware is an excellent alternative to standard paper-based interviewing. Future enhancements will come in the areas of wireless connectivity, which will enable functions such as real-time quota control; larger colour screens with adequate battery life, which will allow the incorporation of multimedia in the survey instrument; and more powerful processors, which will make voice recognition the main input method.

Software

Handheld survey software has also been advancing as the hardware improves. Techneos appears to be the only developer with Mobile Computer Assisted Personal Interviewing (MCAPI) software for Palm OS devices. Some companies had developed for Microsoft Windows CE, but changes in the operating system orphaned the products. Products from additional vendors are likely in the future as the popularity of handhelds continues to grow. Other companies offer custom survey programming. This can be an alternative for very large, ongoing surveys that require a custom interface design, but it is expensive, time-consuming and risky when dealing with numerous ad-hoc research projects.

The issues with the use of handhelds for survey data collection that Parks Canada identified led to the development of a meta-data model. This work established the concepts on which Techneos's software is based. Meta-data is "information about information." Normally interview data is stored as a value (e.g., "1") for a particular variable (e.g., "SATISFAC"). A survey system capable of handling meta-data can also store information about the value: "1" means "Very Satisfied" and was recorded in response to the question "How satisfied were you with the quality of papers presented at the symposium?" Information about which questionnaire was used to collect that value, and on which handheld, in what language, and at what time, is also meta-data.

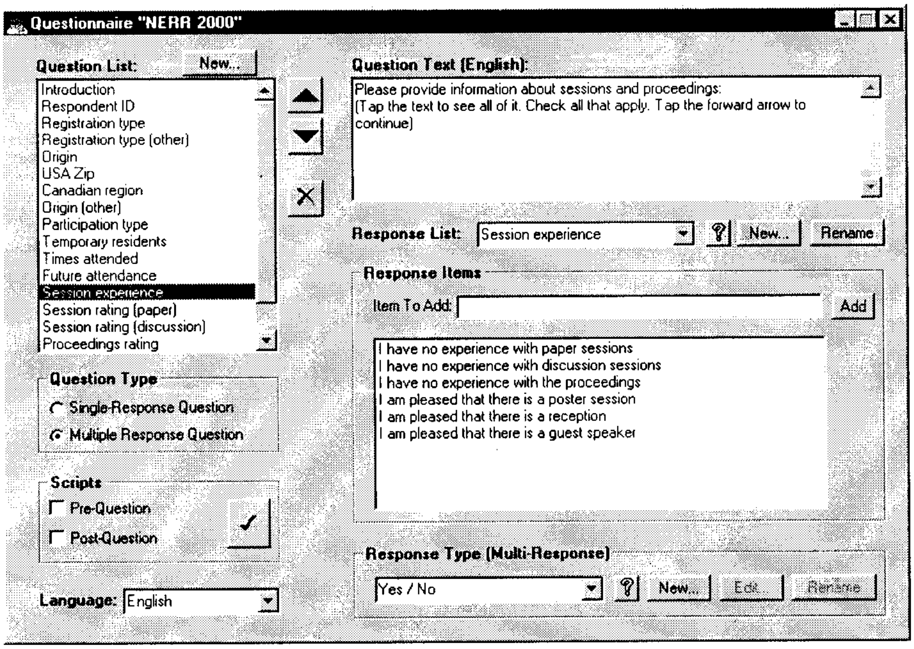
Meta-data is an extremely powerful tool for survey data. Techneos's software is built from the ground up with meta-data in mind, giving it capabilities that are otherwise impossible. Although very few survey software packages currently use meta-data, a new survey interchange standard called Triple-S XML has been developed which will promote its use (Hughes, Jenkins, and Wright 1999). According to the authors, Triple-S XML is "a language for describing survey metadata – that is, data about the survey data: question and response texts, the location of individual data items within the record, valid ranges for responses, and so on." The standard will enable survey designs to be exchanged between any Triple-S XML compliant software packages, eliminating the need for developers to write import and export routines for every other vendor's program. Questionnaires will be more portable, enabling rapidly deployment of the same survey across multiple systems. Triple-S XML is built using XML (eXtensible Markup Language), which is designed to describe what data is—in other words, it is a language for meta-data. XML has applications in many areas, for example to describe the location and possible values for every field on a scannable form. We believe that XML will be rapidly adopted by the survey research industry and will have a profound effect on survey software development.

An MCAPI System

How well does a current state of the art MCAPI system address the issues first identified by Parks Canada a decade ago? We will examine a system consisting of the Techneos Survey Workbench™ for Windows 95/98/NT, and Techneos Mobile Interviewer software running on a Palm OS handheld (all current and most out-of-production models are usable).

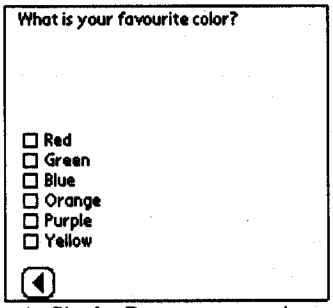
The functions of the Survey Workbench software include questionnaire design, and data communications and management. The program is used to create a questionnaire, download it to. one or more handhelds, upload and consolidate response data from the handhelds, and export the response data for analysis.

A researcher uses the graphical user interface to create and name a question, which appears in the Question List. A choice is then made between Single and Multiple Response Question Type—this can be changed at any time with one click. Question Text is added, then a Response Type is selected or a new one created. Nothing more is required to create a questionnaire, unless branching, data integrity checks, or calculations are required. The contention that MCAPI has a high overhead for setup compared to PAPI (deLeewun and Nicholls 96) is no longer valid.

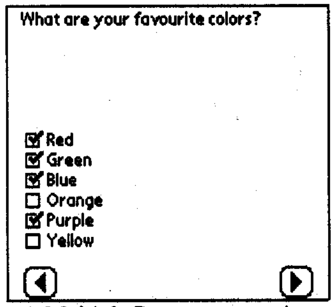


Sophisticated questionnaires can be created using pre- and post-question scripts to initiate actions. Conditional and unconditional branches will vary the path through the questionnaire based on responses obtained. Messages can be conditionally presented to the interviewer. Range and logic checks can be added to improve the quality of data collected, and new values can be calculated on the fly. The questionnaire designer must deal with variables and expressions to use scripts, but no programming is required.

When the questionnaire file is downloaded to the handheld computer, it includes data that describes each question, response set, and script. The Mobile Interviewer software on the handheld interprets this and displays each question in an appropriate manner. The Mobile Interviewer interface is extremely simple, yet the software offers full non-response tracking, the ability to switch interview languages at any time, and automatic recording of information such as respondent number and interview timestamp.



A Single Response question on the handheld. Tapping a checkbox selects that response and advances the survey to the next question



A Multiple Response question allows more than one response to be checked. Responses can be unchecked. After selecting all appropriate responses, the forward arrow is tapped to advance to the next question

Questionnaires may also be printed. The paper version can supplement use of the handheld, or be used instead. Returned forms can be data entered using the handhelds. This is not the fastest data entry technique, but it tends to reduce data entry errors. Once the data is entered, the Survey Workbench software saves time by directly creating a labeled SPSS data set.

The desktop and handheld programs are both very easy to use because of all the work they do behind the scenes. For example, the Survey Workbench software automatically creates and labels the variables required when creating a question, or when switching between single and multiple response. Proper response labels and values are associated with each question. Questions and response items can be deleted and restored at any time just by clicking a button. Entire questionnaires or individual response lists can be copied for use in multiple questionnaires, assuring consistency across an organization's surveys.

A project mode property provides exceptional control over data integrity. In Draft Mode, any changes can be made to the questionnaire, but response data can not be saved on the handheld. Switching to Pre-test Mode activates warnings when certain changes are attempted that can affect data integrity. It also enables modification logging, where every change is recorded in detail. Live mode maintains this high level of data integrity checking, and sets the Mode variable included in every interview record to a different value, so that Pre-test and Live data can be easily separated if required. Each interview record also contains a variable allowing precise identification of the questionnaire version that was used to complete that interview.

The high degree of tracking simplifies the consolidation and export of response data. The software assigns each questionnaire a unique identification number, so response data files from different questionnaires are easily distinguished. Changes such as a switch between single and multiple response for a question are resolved automatically when processing the response data for export. Some export formats allow meta-data such as variable and response labels, and question text, to be included with the response values. This makes it possible to create a ready to use SPSS data set, for example, with just a few mouse clicks.

Cost Comparison with Pencil and Paper

Mobile Computer Assisted Personal Interviewing (MCAPI) competes directly with Pencil and Paper Interviewing (PAPI) in situations where data must be collected on site. The two approaches have opposite cost structures:

	MCAPI	PAPI
Initial cost	**High** - capital investment	**Low** - existing infrastructure
Incremental cost per interview	**Low** - interviewer wages	**High**- interviewer wages plus printing, distribution, data entry, cleaning, data set labeling and formatting

The difference in cost structure means that PAPI is cost-effective for infrequent use and low volumes. MCAPI offers increasing cost efficiencies as the number of projects and interviews rises. The crossover point where MCAPI becomes a better value depends on a number of factors that vary by organization and project. This table shows key items to consider, and indicates which approach is more cost-effective (+). Costs are *fixed* (F) if they do not change based on the number of projects undertaken; *variable* (V) if they vary by project but not by number of interviews; and *incremental* (I) if related to the number of interviews.

Phase and Cost Type	MCAPI	PAPI
System Purchase (F)	- Software, hardware, training	+ Existing infrastructure
Questionnaire Design (V)	+ Reuse elements (response lists, standard questionnaires) + Faster revisions, with tracking + Complex questionnaires possible	- Poor control over standard elements + Faster for very simple, one-time surveys with few revisions - Complex designs unworkable
Printing and Distribution (V, I)	+ No layout, print, storage. Electronic distribution. + Automatic tracking of modifications and distribution + Unlimited inventory at no cost to produce or store + No waste, no delays	- Layout, print, ship, and store forms. Changes cost the same again. - Tracking is difficult and time-consuming - Time and shipping to get forms where needed; lost interview time - Changes produce waste, take time
Interviewing (I)	+ More efficient for complex or long questionnaires + Better response rates; interviewers and respondents enjoy more + Data integrity checks ensure more usable interviews + Automated data capture e.g. date and time stamp + Handles multiple questionnaires	+ More efficient for long open-ended and roster question types - Paper & clipboard is less efficient and attractive - No response checking results in lost due to bad data - Everything must be manually recorded, and done so accurately - Multiple questionnaires difficult
Data Entry Setup (V)	+ Not required	- Must reproduce questionnaire error free; redo if questionnaire changes
Data Entry (I)	+ Not required (done by interviewer) Saves time, avoids introduction of errors	- Additional wages, equipment use. Introduction of errors reduces data quality, may lose some interviews
Data Cleanup (V, I)	+ Minimized by designing questionnaire to ensure entry of clean data + Identify errors during interview and get correct data; more usable records	- Proper data entry not enforced, so varying amounts of cleaning required - Can identify errors, but too late to get good data; lost interviews
Data Set Creation (V)	+ Create formatted, labeled SPSS data set, or export to ASCII (no labels). Saves time, eliminates errors	- Need to reproduce questionnaire design again, error free; redo if questionnaire changes

Some rules of thumb for determining when to use MCAPI instead of paper:

- Use MCAPI for complex questionnaire designs, or when scripting can reduce the interview length for respondents;
- Use paper for many people in a very short time (i.e., to get an adequate sample in the available time, at reasonable cost).

Mobility is the characteristic that distinguishes MCAPI from other data collection methodologies such as phone interviews, mail-out surveys, or web surveys. Mobility is highly desirable in two common situations:

- When the population of interest is most easily reached on site, because they are widely dispersed the rest of the time or have a low incidence in the general population. Park trail users are a good example of this situation.
- When the setting matters. Instead of dealing with anticipation or recollection, you can research an experience while the respondent is in it. Participation tends to be high in this situation. Observational studies are also an excellent option.

It can be seen from this brief overview that the issues with Computer-Assisted Personal Interviewing that have been raised in the past are generally resolved by current Mobile CAPI systems. The use of handhelds with appropriate software is a viable replacement for Pencil and Paper Interviewing (PAPI) in terms of its capabilities; in fact, it is in many ways superior in terms of data quality, time, and cost. However, like every other survey data collection methodology, the suitability of MCAPI must be evaluated based on the overall requirements of each research project.

(A limited number of screenshots were included in the paper to save space. A free evaluation copy of the software can be downloaded from www.techneos.com).

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WEIGHTING ISSUES IN RECREATION RESEARCH AND IN IDENTIFYING SUPPORT FOR RESOURCE CONSERVATION MANAGEMENT ALTERNATIVES

Amy L. Sheaffer

Ph.D. Candidate in Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907-1200

Jay Beaman

Auctor Consulting, Cheyenne, WY 82009

Joseph T. O'Leary

Professor of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907-1200

Rebecca L. Williams

Superintendent, Delaware and Raritan Canal State Park, Somerset, NJ 08873

Doran M. Mason

Ecologist, National Oceanic and Atmospheric Administration
Great Lakes Environmental Research Laboratory
Ann Arbor, MI 48105-2945

Abstract: Sampling for research in recreation settings in an ongoing challenge. Often certain groups of users are more likely to be sampled. It is important in measuring public support for resource conservation and in understanding use of natural resources for recreation to evaluate issues of bias in survey methodologies. Important methodological issues emerged from a statewide project assessing sport fish consumption patterns of state anglers. The objective of the project was to determine an average consumption rate for fish obtained through recreational fishing. Although two methods were used to reach anglers, a mail survey and an onsite survey, the latter method was subject to participation bias among anglers interviewed in the on-site locations. The most active anglers were more likely to be encountered and interviewed by the survey team. As higher participation levels in fishing are likely associated with more opportunities for catching fish, more active anglers are likely to have higher consumption rates. More active anglers' consumption data would contribute to an estimate of average consumption rate calculation that was too high among anglers interviewed in the on-site locations. Weighting data based on the inverse of fishing participation was necessary to address the participation bias, and sport fish consumption was calculated with weights assigned. Comparison of weighted data with unweighted data is provided. Average consumption rate for active consumers assessed using weighted on-site data was similar to the rate observed for active consumers in the mail survey. Weighting was necessary to calculate an estimate of average sport fish consumption among on-site anglers and to provide information to the funding agency for policy decisions.

Introduction

Sport fish consumption is an issue of importance in human dimensions research based on health and safety issues associated with consuming potentially contaminated fish. Substances that accumulate in fish, such as polychlorinated biphenyls (PCBs), pose a risk for people who eat fish. The risk increases with larger or specific species of fish (Hutchison and Kraft, 1994). Fish consumption patterns are particularly of concern when sport fish form a substantial portion of angler diets and household meals.

Many states have issued fish consumption advisories for specific water bodies. These advisories help anglers choose between site alternatives (Jakus, Downing, Bevelhimer, and Fly, 1997). To set the levels of consumption for advisories, state agency personnel assess patterns of fish consumption by anglers who consume sport fish; this definition does not include fish purchased at a store or restaurant. Certain angler groups are of particular concern if they consume sport fish at higher levels than the general public and are therefore at higher risk from consuming contaminants in fish.

Methodologies can be chosen to reach different segments of the angling population to collect consumption data. Approaches to statewide surveys have varied. Mail surveys targeting licensed anglers may reach a majority of the angling public. Yet subpopulations of anglers, such as anglers who do not purchase licenses, may not be represented in survey data. For example, a statewide survey in Wisconsin had indicated a general compliance with the consumption advisory, but potentially overlooked ethnic minorities (Hutchison and Kraft, 1994). Diaries have been used to assess awareness of advisories and fish consumption behaviors (Connelly, Knuth, and Brown, 1996). In the Great Lakes region, several states, such as Michigan (West, Fly, Marans, Larkin, and Rosenblatt, 1995) and New York (Connelly et al., 1996) as well as the province of Ontario have collected fish consumption data; however as of 1997, no comprehensive data had been collected of consumption of fish from Indiana state waters. For this reason, the Indiana state Departments of Environmental Management, Health, and Natural Resources initiated efforts through researchers at Purdue University to conduct a statewide fish consumption project.

When measuring fish consumption levels, it is important to address variation in the estimates based on use of different methods and variables (Cavan, Gibson, Cole, and Riedel, 1996). Biases inherent in a particular methodology need to be considered. In on-site interviews, participation bias will affect fish consumption calculations, because highly active anglers are more likely to be interviewed. Weighting is used to address this bias and correct the data for a more accurate estimate of the measure of interest, namely average consumption rate by sport anglers in a region.

Need for Weighting On-site Interview Data

The use of weighting must be considered carefully. This has been noted for making inferences from recreation research (Christensen, 1979). Often the reason for using weighting is to correct for selection bias (Whitehead, Groothuis, Hoban, and Clifford, 1994). Weighting has been identified previously as an issue in food consumption research (Tucker, Bianchi, Maras, and Bermudez, 1998) and in nutrition surveys (Osler and Schroll, 1992). It has been used to avoid bias in certain estimates resulting from those of higher social status, such as higher-income groups participating at a different rate (e.g. times per year) than others in the population (Harou, 1982). Among those interviewed onsite it may be necessary to correct for a 'travel time bias' in making particular estimates of use (Wna, 1989). Weighting may also be employed to correct for differing variability in observations. In one case of using weighted least squares estimation the issue is getting more reliable estimates not removing bias (Beaman, Knetsch and Cheung, 1977).

In recreation research, the selection of a respondent often depends on the level of participation in a recreational activity at a location. Onsite survey methods must be designed with due consideration of how respondents are selected and how this should impact on their contribution to getting unbiased estimates of a particular measure of interest. How respondents are selected can result in unweighted averages of expenditure and person days of site use both being biased. Getting unbiased estimates requires 2 different weighting schemes.

If different respondents exhibit a different level of participation based on some measure, e.g., visits, and respondents are selected for interview on final exit, one must consider what measures to estimate to meet various survey objectives. Some people visit a site only 1 or 2 times a year but may stay for 2 weeks one of those times. Others make repeated visits to a place (every nice weekend for 15 or 20 weekend and day-visits). This is an issue when measuring use at national parks, at forest areas or at specific fishing sites (Beaman and Redkop, 1990; Price, 1991; Roeder, 1973).

Methods

The 1997-1998 Indiana sport fishing consumption survey questionnaire and administration methodology was designed based on past fish consumption research. A literature review was conducted focusing on past work on fish consumption patterns among anglers. A variety of survey methodologies have been used in the past, such as mail questionnaires, diaries and personal interviews. Calculations of consumption rate, specific wording of questions for variables to be measured, and visual aids were particularly noted within these methodologies. Based on discussions with the state agency and respective committees, two methodologies were selected: a mail survey of licensed anglers, and an onsite survey of anglers fishing in lakes and/or rivers near urban regions. It was deemed important to develop an on-site survey to reach angler segments potentially overlooked in the mail survey, such as non-licensed anglers, retirees who are not required to buy a license and minority groups fishing for subsistence purposes. An attempt was made to reach minority and lower income anglers by focusing on urban areas where the proportion of the population in these groups was higher than in non-urban areas. Survey locations were fishing places easily accessible to East Chicago, Hammond, and Fort Wayne in the north, Indianapolis in the central region, and Jeffersonville and Evansville in the southern part of the state. It is the on-site project that is the focus of this discussion. Weighting was necessary to correct for participation bias from highly active anglers who were more likely to be sampled in the on-site locations.

Variables

Two variables needed to calculate consumption rates are typical portion size and how often a respondent ate fish for a meal based on a specified recall period, such as number of meals per week in the past month. Recall periods found in the literature range from weeks to years. A three-month recall period was chosen for the Indiana project, and within that time frame respondents chose meal frequencies, e.g., once a week. In addition, a third variable, fishing frequency, was also measured in the Indiana project to determine level of fishing participation. Questions used for measuring consumption rate and fishing activity were:

1) "In the last three months, how often did you go fishing in Indiana waters?" (A six-point scale ranged from less than once/month to 5-7 days/week.)
2) "In the last three months, how often did you eat Indiana sport fish?" (A six-point scale ranged from less than one meal/month to 5-7 meals/week.)
3) What portion size would you say that you normally consume in a typical meal (An eight point scale ranged from less than 4 oz. to 16 oz., and respondents were given four photographs of 6, 8, 10, and 12 oz. fish portions as visual aids).

Respondents who noted both a typical portion size and a meal frequency during the three month recall period were defined as active consumers. Respondents who indicated a typical portion size but selected "never" as the response for how often they ate fish in the last three months were defined as potential consumers. These potential consumers were assumed to eat fish at other times of the year.

Calculating Consumption Rate

Calculation of consumption rate was based on the method used by Meredith and Malvestuto (1996). The result is presented as grams per day (GPD). The calculation used to determine an angler's gpd was:

$$C_{daily} = \frac{(ps)\ (m)\ (28.35\ grams/oz)}{30}$$

Where: C_{daily} = daily consumption of sport fish (ounce)
ps = portion size (ounces)
m = number of meals per month

less than once a month m = 0.5

Once a month	m = 1
2-3 days a month	m = 2.5
Once a week	m = 4
2-4 days a week	m = 12
5-7 days a week	m = 24
Not at all	m = 0

Weighting Consumption Data

It was important to correct for the bias from highly active anglers when calculating the consumption rate for sport fish among Indiana anglers interviewed in the on-site survey. Those who fish frequently were more likely to be selected by personal interview of people actively fishing in an on-site survey than those who fish infrequently. Computing an unweighted average of consumption rates across all respondents would have resulted in an artificially high consumption rate value. For this reason, it was necessary to weight consumption rates to correct for this frequency bias. This is achieved by weighting each respondent by the inverse of some fishing activity rate. Table 1 shows the weights that were assigned to each case by using the inverse of the fishing frequency measure obtained for the recall period.

Table 1. Weights assigned to on-site respondent data.

Variable Response	Code for fishing frequency/month	Weight Assigned
< Once/month	0.5	1/0.5 = 2
Once/month	1	1
2-3 times/month	2.5	0.4
Once/week	4	0.25
2-4 times/week	12	0.0833
5-7 times/week	24	0.0417

Findings

Average consumption rates for respondents of the Indiana on-site and mail surveys are given in Table 2. By our definition, active consumers had recently eaten fish (in the last three months). Potential consumers had not eaten fish in the last three months, so their consumption rate value was zero; however they indicated a typical portion size suggesting that they do consume fish. Therefore their zero consumption rates were incorporated into the average. When weights were assigned to the on-site data, the on-site active consumers (22.9 gpd) showed an average consumption rate that is very similar to that observed in the mail survey (19.8). In contrast, presenting the data without assigning weights would have led to the conclusion that on-site anglers are consuming fish at a higher rate than respondents to the mail survey. Such an estimate would have been too high as a result of the bias introduced by interviewing too many active anglers at the on-site survey locations.

Table 2. Average consumption rates by respondent type.

	Active Consumers		Potential and Active Consumers	
Survey Method	Onsite	Mail	Onsite	Mail
GPD Weights Assigned	22.9	19.8	9.8	16.4
GPD Not Weighted	32.3	19.8	17.9	16.4

Weighting was necessary to eliminate bias and thus get reasonably accurate estimates of the grams per day calculation average across income levels of interest. Four income categories were compared to assess potential differences in average consumption rates by anglers in each group and determine if anglers with lower incomes are consuming higher levels of sport fish. Data in Table 3 show that those with incomes less than $25,000 are consuming on average the same amount of fish (18.9 gpd) as those in the second category (18.8 gpd), and are actually consuming less than anglers in the highest income category (48.9 gpd). Getting weighted estimates shows that the difference in consumption rate between the highest and lowest income groups is greater than would have been concluded using data presented without weights assigned.

Table 3. Consumption rate by income among active consumers.

Income Level	<$25,000	$25,000-34,999	$35,000-49,999	$50,000 or more
GPD Weights Assigned	18.9	18.8	15.2	48.9
GPD Not Weighted	30.4	26.9	29.3	41.3

Consumption rates were compared across racial groups using the categories of white and minority active consumers. When weights were assigned to the data, findings showed that minority anglers were consuming significantly higher levels of sport fish (Table 4). A significant difference would not have been recognized using unweighted data (Table 5).

Table 4. GPD for active consumers by race, weights assigned.

Race	N	Mean	Std. Dev.
White	177	20.0	33.0
Minority	143	27.2	45.7
Significance (p-value): 0.000			

Table 5. GPD for active consumers by race, weights not assigned.

Race	N	Mean	Std. Dev.
White	177	27.8	39.5
Minority	143	38.3	55.9
Significance (p-value): >0.05			

Discussion and Implications

This research provides an example of the potential impact of biases in research conducted in recreation settings. On-site interviews have a frequency of participation or length of stay bias that can be corrected by weighting techniques to provide unbiased or less biased estimates of the measure of interest. Considerations of bias should be made at the outset, before the research project begins. Having collected data one may find that they can only produce biased estimates with no idea of the magnitude. Preplanning will hopefully result in collection of appropriate data for bias correction or selection of a method for which bias correction is not necessary for estimates of concern. Whether or not to use weighting depends on the measure of interest. In the fish consumption project the objective of the agency was an average measure for on-site anglers statewide. Selection of the weighting method and other methodological issues depends on the sample, and what is to be estimated which, of course, depends on the purpose of the study. Continued discussion of weighting can help promote its use where necessary.

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INTERVENTION FOR THE COLLABORATIVE USE OF GEOGRAPHIC INFORMATION SYSTEMS BY PRIVATE FOREST LANDOWNERS: A MEANING-CENTERED PERSPECTIVE

Kirk D. Sinclair

Graduate Student; Human Dimensions Research Unit; Department of Natural Resources; Cornell University; Ithaca, NY 14853

Barbara A. Knuth

Associate Professor; Human Dimensions Research Unit; Department of Natural Resources; Cornell University; Ithaca, NY 14853

Abstract: Private forest landowners support the stewardship objectives that can be achieved through ecosystems-based management. However, ecosystems-based management is a data intensive approach that focuses upon the broad forest landscape. Intervention by forestry agents or agencies could help neighboring landowners to collaborate with an ecosystems-based approach in pursuit of their stewardship objectives, using Geographic Information Systems as a tool. A typical means of intervention is the information-based approach, but this runs the risk of imposing a tyranny of the elite, where the information is presented as a means of technocratic or political control. Favoring empowerment over control as the preferred intent of intervention, we used a meaning-centered perspective to evaluate the impact of a workshop for private forest landowners featuring GIS collaboration in a role-playing simulation. Surveys and interviews assessed the ingredients for meaningful learning—conceptual background of the learner, motivation, and meaningful materials—and subsequent thinking, feeling, and acting by workshop participants. Meaningful learning occurred as participants understood the conceptual principles used in the role-playing simulation, yet the relevancy of the simulation was in question because landowners did not envision a high likelihood of collaborating with neighboring landowners. Motivations of the learner had the most impact upon the subsequent thinking, feeling, and acting indicative of the empowerment to pursue their objectives. Forestry agents or agencies should ensure that private forest landowners are motivated to learn about GIS, and that a venue for collaboration is set, before assisting with an ecosystems-based management approach.

Ecosystems-based Management for Private Forest Landowners

Ecosystems-based management targets the mosaic of ecosystems within a broad landscape as the appropriate scale for resource management decisions (Franklin 1992; Salwasser, MacCleery et al. 1992; Sample 1994). This scale of management fits well with the mission of resource agencies that manage large tracts of land, such as the Forest Service (Robertson 1992). In contrast, much of the forested Northeast consists of numerous small woodland parcels separately managed by private landowners (Birch 1996). Studies indicate that small private landowners support the stewardship objectives that ecosystems-based management could promote (Birch 1989; Jones, Luloff et al. 1995; Sinclair and Knuth In press). However, the advantages of scale for large agencies turn into problems of scale for private landowners whose management concerns correspond to just a small piece of the broader forested landscape.

An ecosystems-based approach places a large demand upon data that can be used to monitor, model, and map a variety of natural resource and land cover features spatially. A Geographic Information System (GIS) is viewed as an important tool for processing data at the landscape scale to meet this demand (Prevedel, Winn et al. 1993). Among the attributes of GIS suited to the demands of ecosystems-based management are:

- the inventory and classification of natural resources, the ability to use these data to devise management plans, and the ability to monitor management effects (Heit and Shortreid 1991; Franklin 1994);
- combining layers in various ways to generate new layers of data, integrating input into comprehensive output (Flamm and Turner 1994); and
- incorporating scales affecting any size area, projected over any length of time, and reflecting various multiple uses (Bailey and Avers 1993).

Small private forest landowners lack the resources available to large agencies; expecting every landowner to possess and use GIS is unrealistic. Collaboration among landowners would be a practical solution, both in terms of shared resources and the larger area affected by their decision-making. However, one study done in Connecticut (Sinclair and Knuth In press) indicates that landowners have little previous experience collaborating at the landscape scale.

During the Plainfield, Massachusetts Pilot Project GIS was used for collaboration among multiple forest landowners with reported success (Campbell and Kittredge 1996). With assistance through the intervention of university-supported training, participants realized benefits such as sharing ideas, minimizing forest impacts, and minimizing conflicts of objectives. Without this type of intervention private forest landowners will find it hard to collaborate using GIS, and may not be able to best pursue the stewardship objectives they support. Outside intervention, however, is not always welcomed in matters concerning private land ownership. Our study examined the effects of intervention in the collaborative use of GIS from a meaning-centered perspective.

Approaches to Intervention

Sample (1993) reported the results of a workshop which gathered together forest agencies, industries, academics, consultants, and landowners to explore effective means of mixed ownership collaboration towards ecosystems-based management. Three approaches to intervention were discussed. Landowners resented the regulatory-based approach and were skeptical of the incentives-based approach. Favored by landowners was the information-based approach, regarding which Sample (Sample 1994, pg. 43) concluded, "Providing education and technical assistance to private landowners offers a major opportunity for achieving ecosystem management objectives at low cost."

Information-based approaches are implemented with varying intent and varying effects, not all of which benefit the receiver of information. Unfortunately, approaches involving technology have a history of dubious intent. Other studies have revealed that what we call a tyranny of the elite often accompanied the introduction of sophisticated computer technology for tax assessments and other municipal functions (Danziger, Dutton et al. 1982; Kraemer 1985). These black boxes carried a mysterious aura of technical neutrality, yet the elite managers and/or technocrats that controlled the technology manipulated inputs fed into the black box to achieve outputs of information that fit their agenda. Regarding private forest landowners, GIS represents the black box that could be used by a political or technocratic elite to control a forest management agenda.

Education theories acknowledge intervention as part of the educative act, with the educator serving as intervener, but do not promote control as the motive for intervention. Earlier theories of education this century such as behavioral learning (Skinner 1954) and developmental learning (Piaget 1970) placed an emphasis on processes of learning that were external to the idiosyncrasies of the learner. This way of thinking calls upon experts to develop curriculum and instruction based upon external considerations such as a stimulus-response interaction. The intent of such an approach, driven by the educator in consideration of what is best for the learner, can be viewed as enlightenment.

To what extent does enlightenment differ from control? In the minds of those educators known as critical theorists (Apple 1979), there is little difference. According to their concerns the intent of most educative acts by political institutions, such as the state-sponsored public school system, is to create a citizenry that will support the current political structure and behave in certain ways. Intent to enlighten becomes the same as intent to control. As long as educative acts are designed independently from the idiosyncrasies of the targeted learners, this danger exists.
Neither enlightenment nor control has to be the intent of outside intervention in an educative act. Ausubel formulated an assimilation theory of learning which claimed that an educative process starts with what the learner already knows and introduces meaningful materials that can be linked to this knowledge, providing that the learner is motivated to create these linkages (Ausubel, Novak et al. 1978). This idiosyncratic, meaning-centered approach contrasts with the behavioral and developmental approaches to learning.

The internal role of meaning and the idiosyncrasies of a learner's cognitive structure influenced Novak's work on conceptual learning (Novak 1977). Novak claimed that the goal of education was not enlightenment but to empower learners with the ability to link new concepts into their unique cognitive structures, according to their own motivation. An educative event helps learners learn how to learn what they want to learn.

With this view, successful outside intervention with the collaborative use of GIS towards forest management would educate by empowering private forest landowners with how to learn what they need to meet their stewardship objectives. Any forestry agent or agency facilitating collaboration with GIS needs to understand the educative ingredients that lead to empowerment rather than enlightenment.

Study Rationale

What kind of guide can forestry agents or agencies use to determine the educative ingredients necessary for empowering private forest landowners with "learning how to learn?"

Gowin's theory of educating, which draws upon Ausubel's and Novak's work, emphasizes that the intervention of an educative act affects thinking, feeling, and acting in the learner (Gowin 1981). While these three educative outputs together (as opposed to the one output of affecting thinking) provide evidence that an educative act has empowered the learner, we still need to consider the inputs. For example, one could be induced into action through forced rote repetition of a doctrine (i.e., brainwashing). Determining whether learners have "learned how to learn" requires that their cognitive background and motivation allowed for the assimilation of meaningful intervention affecting the three outputs of thinking, feeling, and acting.

In the spring of 1998 a workshop provided to private forest landowners in Connecticut featured the use of GIS towards forest management, including a collaborative role-playing simulation. We examined the effects of this intervention from a meaning-centered perspective, to determine whether such workshops hold the potential for private forest landowners learning how to learn what they need to meet their forest stewardship objectives.

Methods

We conducted a workshop titled "The Use of GIS for Private Forest Management" at the Housatonic Valley Association office in Cornwall Bridge, CT, in April 1998. Invitations were sent to landowners on the mailing lists of the University of Connecticut Cooperative Extension with 25 acres or more of woodlands, and to members of the Housatonic Valley Association residing in Connecticut.

Twenty people were present, including three presenters and seventeen attendees. The first presentation, by a forester from the Cooperative Extension, demonstrated how GIS can be utilized to generate maps for forest management plans. The second presentation, led by a GIS consultant, reported on the use of GIS to classify forest types from satellite imagery. The third presentation, led by a graduate student in the field of Natural Resources, involved a simulation where participants role-played neighboring forest landowners using GIS to generate forest management zones. In addition to the presentations, attendees received an overview regarding the status of GIS in the state of Connecticut and information regarding how to access digital spatial data over the Internet.

During the role-playing simulation participants used ArcView 3.0a (ESRI 1996) software with a laptop, LCD panel, and 48-inch screen to examine a wooded geographic area in Connecticut. Roads, hydrography, and tax parcel boundaries formed the base map for the area. Other datalayers included critical species, wetlands, trails, scenic roads, and streams, representing a variety of ecological and social interests affected by forest management.

Participants were split into eight groups, each one corresponding to a different forest landowner with a woodland parcel located in the simulation area. Roles were evenly divided between owners of parcels 100 acres or larger and 50 acres or smaller, and between those with mainly an economic interest in their woodland and those with mainly an ecological interest. The groups had to weight the importance of the different natural resource features used in the simulation, and had to assign percentages to how much of the landscape should be placed in each of three zones:

1. preservation;
2. multiple-use with emphasis upon social and ecological interests; and
3. multiple-use with emphasis upon sustainable harvest.

One module prepared for the simulation used the weights assigned to the natural resource features to generate a map of high values in close proximity to highly weighted features, with values decreasing in proportion to the distance away from these features. Another module used these values to generate three management zones, based upon the percentages provided, with the highest value areas of the landscape falling within the preservation zone. Participants witnessed the effect of sample feature weightings and management zone percentages on the resulting value landscape. They subsequently collaborated to generate their own unique landscape of forest management zones.

Fifteen attendees (four of the seventeen attendees were couples) filled out a survey at the beginning of the workshop that assessed their prior knowledge and experience with maps, GIS, forest plans, and collaboration. At the end of the workshop ten attendees filled out an evaluation of the value landscape simulation; some attrition resulted from the workshop lasting longer than advertised.

Three months after the workshop, interviews were conducted with six of the attendees to explore in depth the impact of the workshop, using as a framework Ausubel's theory of meaningful learning and Gowin's theory of educating. Transcripted interview responses were fitted to a matrix with categories generated from the framework theories. Conceptual Background, Motivation, and Meaningful Materials were categories generated from Ausubel's assimilation theory of meaningful learning. Thinking, Feeling, and Acting were categories generated from Gowin's theory of educating. This matrix was analyzed to determine which steps in the educational process were key for empowering the workshop participants towards meeting their forest stewardship objectives (Table 1).

Table 1: Matrix used for analyzing responses to questions assessing the impacts of a GIS workshop upon meaningful learning and educating.

General Background	Conceptual Background	Motivation	Meaningful Materials	Thinking	Feeling	Acting
Landowner 1 Acres Years Owned Land Trust?	Forest plans? Computers? Maps? Collaboration ?	Stewardship? GIS? Other?	Understanding? Relevancy?	Plan maps? Classifying? Simulation? Data? Technology?	GIS? Collaboration?	GIS? Collaboration?

Results

General Background: Survey Respondents

Attendees at the workshop owned an average of 50 acres, with a range of 10-140 acres, for an average of 19 years, with a range of 4-67 years. Twelve of the fifteen survey respondents were familiar with the term GIS, though only seven had worked with maps and/or images of their woodland and only four had ever considered using GIS for forest management. Eleven respondents had never collaborated with other landowners but might if they had the opportunity; the remaining four had collaborated with other landowners in the past and would do so again. Only three respondents had ever obtained information regarding how the management of other woodlands affected theirs, and only two had obtained information regarding how the management of their woodland affected the surrounding landscape.

Conceptual Background: Interviewees

Of the six interviewees, half owned woodland of 90 acres or more and half owned woodland of 35 acres or less. Interviewees had some experience with at least two of the following categories: forest management plans, computers, maps, or collaboration with other landowners. All had previous experience with maps, while only one had previous experience with collaboration.

Motivation: Interviewees
Regarding motivation for attending the workshop, five interviewees referred to their stewardship values and a desire to seek out any information that might help them manage their woodlands better, while four specifically referred to their interest in the technological and/or cartographic aspect of the workshop. These four interviewees will be referred to as the "GIS-motivated." One interviewee confided he attended mainly to gather whatever "freebies," including free consultations, might be made available.

Meaningful Materials: Survey Respondents
Out of the ten respondents completing the evaluation of the role-playing simulation, eight agreed somewhat or strongly that GIS displays information in a manner that they could easily understand, whereas two disagreed somewhat. Eight of the ten agreed somewhat or strongly that they understood how ecological and social features were used to determine forest value in the simulation, and how landowner preferences for different forest management goals were used to determine forest management zones from a landscape of forest values. Seven respondents agreed somewhat or strongly that GIS is a tool that can help landowners collaborate regarding forest management. Only four agreed somewhat or strongly that GIS could provide information relevant to their forest management goals. Four also agreed somewhat or strongly that their willingness to collaborate with others would increase if GIS was used as a tool.

Meaningful Materials: Interviewees
All the interviewees found the information presented at the workshop understandable. Three of the GIS-motivated found the information relevant to their forest management interests, while the fourth stipulated that his woodland was too small and his neighbors not interested enough to make the information relevant at his scale. The other two did not find the GIS presentations relevant to their forest management goals.

Thinking: Interviewees
When prompted for their thinking regarding the workshop presentations, all the interviewees recalled something they found of interest at the workshop. Everyone was interested in the use of GIS to make maps of their woodlands, and all but one was interested in how GIS could be used to make forest classifications based upon satellite imagery. Only the four GIS-motivated recalled with interest the use of GIS for forest management collaboration. Three of these four also suggested forest management objectives for GIS use that were not emphasized at the workshop. These objectives included establishing wildlife corridors, plotting trails, managing witch hazel, and modeling defoliation.

Feeling: Interviewees
Three of the GIS-motivated interviewees indicated personal felt-significance to the use of GIS; one thought it would be valuable for mapping his woodland (including orchards), one thought it could assist him in expressing his forest management objectives succinctly; and one cited personal objectives for his woodland that he thought would benefit from the use of GIS. The rest felt that GIS would be valuable for objectives encompassing a large forested landscape, as might be the purview of a Land Trust or large landowner, but that their own woodland parcels were too small and their neighbors too disinterested to warrant the use of GIS in their own situations.

Acting: Interviewees
Three of the four GIS motivated had taken some subsequent action regarding GIS. Two of these three visited the Internet to access GIS-related sites. One mentioned that GIS now enters into his conversation with others regarding forest management. The fourth GIS-motivated interviewee indicated he needed more time before subsequent action. The remaining two interviewees had taken no subsequent GIS actions, nor had they any intention of doing so.

GIS Concerns: Interviewees
All interviewees were asked about their possible fear that the use of GIS for forest management could come under the control of an agent or agency that would use it to impose their agenda and subvert the forest management objectives of the interviewees. All six responded that the use of GIS could only be a positive, with four countering that GIS would more likely prevent anyone from being able to impose their agenda upon others.

Discussion

Meaningful learning occurs if learners have the conceptual background necessary to assimilate new concepts, and the motivation to do so. Pre-workshop surveys indicated a minority of private forest landowners had previous experience working with maps or images, but almost all were familiar with the term GIS before the workshop, and all had experience working with computers. Though only a small minority had obtained data regarding the effects of forest management across ownership boundaries, all were receptive to collaborating with other forest landowners. Thus, the conceptual background and motivation existed for meaningful learning to occur regarding GIS collaboration.

Educational materials become meaningful if they are understandable and relevant to the learner. The role-playing simulation at the workshop was our strategy for making the use of GIS for private forest landowner collaboration understandable. Our post-simulation survey indicated that most participants understood the process of how GIS was used to generate forest value and forest management zones, which implies that the use of GIS for forest management collaboration escapes the enigma of the black box.
The maps produced from an input of spatial data are less mysterious than, for example, assessment values produced from an input of numeric data.

However, the post-simulation results also indicated that the use of GIS would not be relevant to the participants in the pursuit of their own forest management goals. The lack of relevancy may relate to the perceived value of GIS for private forest management, the value of collaboration, or both. This became a question that the post-workshop interviews helped to address.

All six of the people interviewed found the materials presented at the workshop understandable, and all thought GIS could only be a positive tool if brought into a forest management situation that involved collaboration. However, all indicated little prior experience and slim future prospects of collaborating with others across a larger forest landscape, even though they were willing to do so. Two interviewees mentioned that collaboration might be a possibility only if an agency such as a local Land Trust was involved. GIS appears to be a legitimate tool for ecosystem-based management in the eyes of private forest landowners, but its relevancy is diminished because of limited opportunities for collaboration.

The six people interviewed all had the potential for meaningful learning to occur, based upon their previous background with forest management plans, maps, computers, and/or collaboration. All indicated that meaningful learning did occur. However, motivations differed regarding attendance at the workshop, which had a distinct effect upon their subsequent thinking, feeling, and acting. Those interviewed who were motivated to attend because of the technological aspects of the workshop had thought about the unique applications of GIS relevant to their own particular interest, felt that GIS could assist them with their own small woodland parcels, and had taken GIS-related action subsequent to the workshop.

The workshop educated the GIS-motivated as evidenced by the positive effects upon thinking, feeling, and acting. Intervention led to empowerment, in the sense that those motivated to learn more about GIS came away with an enhanced ability to pursue and benefit from the use of GIS. Such empowerment did not occur for those whose attendance was not motivated by learning more about GIS.

Implications

At the time that the Forest Service proclaimed Ecosystem Management to be their new operating philosophy (Robertson 1992) many thought that a Unix workstation was needed to accommodate the data storage and processing associated with GIS. The software was expensive and required the knowledge of hundreds of commands. If private forest landowners wanted to pursue stewardship objectives through the data intensive practice of ecosystems-based management, they might have easily succumbed to the tyranny of the elite. Even an information-based approach to intervention could be a means to control the decisions of landowners wholly dependent upon the resources of those with a technocratic or political agenda.

Since then, readily available PC hardware has become sufficiently powerful, and GIS software sufficiently user-friendly, to make GIS accessible for use by small private forest landowners. Our findings indicate that the conceptual background of private forest landowners, their motivations, and their ability to understand GIS output all contribute to meaningful learning that could empower their use of GIS as a tool for their objectives.

However, private forest landowners find little motivation or relevancy in determining how their woodland relates to the larger forested landscape, or in collaborating with others. Without this ingredient for meaningful learning GIS becomes an impractical tool for ecosystem-based management regardless of its accessibility. Rectifying this problem still calls for some form of information-based intervention.

In order that GIS intervention escapes the tyranny of the elite and empowers private forest landowners to meet their own objectives, our findings suggest the following:

- the motivation for learning how to apply GIS to forest management situations must be established prior to providing hands-on experience; and
- the relevancy of GIS collaboration must be evident, mainly in regards to feasibility, for pursuit of objectives.

These suggestions result from evaluating the impact of intervention from a meaning-centered perspective, applying theories of meaningful learning and educating to determine the potential for information-based intervention to empower rather than control. We recommend this approach for agents and agencies responsible for the guidance of stakeholders in natural resource management.

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ESTIMATING SOCIAL CARRYING CAPACITY THROUGH COMPUTER SIMULATION MODELING: AN APPLICATION TO ARCHES NATIONAL PARK, UTAH

Benjamin Wang

Research Data Specialist, School of Natural Resources, University of Vermont, Burlington, VT 05405

Robert E. Manning

Professor, School of Natural Resources, University of Vermont, Burlington, VT 05405

Steven R. Lawson

Graduate Research Assistant, School of Natural Resources, University of Vermont, Burlington, VT 05405

William A. Valliere

Research Data Specialist, School of Natural Resources, University of Vermont, Burlington, VT 05405

Abstract: Recent research and management experience has led to several frameworks for defining and managing carrying capacity of national parks and related areas. These frameworks rely on monitoring indicator variables to ensure that standards of quality are maintained. The objective of this study was to develop a computer simulation model to estimate the relationships between total park use and the condition of indicator variables. In this way, the social carrying capacity of parks might be estimated more proactively.

Introduction

Carrying capacity is a perennial issue in parks and outdoor recreation. Recreation can cause impacts to park resources (e.g., compaction and erosion of soil, destruction of groundcover vegetation) and the quality of the visitor experience (e.g., crowding and conflicting uses). Carrying capacity addresses the amount of recreation-related impact and associated visitor use that can ultimately be accommodated in parks and outdoor recreation areas. Carrying capacity is becoming increasingly important in the national park system where annual visits will soon surpass 300 million.

This study addresses application of carrying capacity to Arches National Park, Utah. Previous research has led to establishment of selected indicators and standards of quality for major attractions within the park (National Park Service 1995; Manning et al. 1996a). For example, to avoid unacceptable levels of crowding, the number of people-at-one-time (PAOT) at Delicate Arch should not exceed 30 more than 10 percent of the time. But how many visitors can be allowed to hike to Delicate Arch before this standard of quality is violated? Moreover, how many visitors can be allowed in the park before standards of quality are violated at this and other attraction sites? Computer simulation models of visitor use were developed to help answer these and related questions.

Background for the Study

Overview of carrying capacity

In studying the effects of increasing recreation use, researchers and managers were initially concerned about environmental impacts as measured by such variables as soil compaction, vegetation decline, and change in wildlife behavior. Using a well-known concept in natural science, recreation researchers started to think of these impacts in terms of carrying capacity. The central idea of carrying capacity is that there is a limit to the amount of use a resource such as a park can accommodate. As researchers explored the issue further, it soon became obvious that there were impacts to the visitors' experience as well as environmental impacts (Wagar 1964). The intuitive idea is that the presence of increasing numbers of visitors affects the quality of the outdoor recreation experience, and this is often referred to in the literature as social carrying capacity.

Contemporary carrying capacity frameworks in outdoor recreation have taken a management by objectives approach to defining and managing this issue. Management objectives are formulated for the degree of resource protection and the type of recreation experience desired. These management objectives are made operational through a set of indicators and standards of quality (Manning 1999). Indicators of quality are defined as measurable, manageable variables that reflect the essence or meaning of management objectives. Standards of quality are defined as the minimum acceptable condition of indicator variables. Indicator variables are monitored over time, and management action is required to ensure that standards of quality are maintained. Frameworks that use this approach to defining and managing carrying capacity include Limits of Acceptable Change (LAC) (Stankey et al. 1985), Visitor Impact Management (VIM) (Graefe et al. 1990), and Visitor Experience and Resource Protection (VERP) (National Park Service 1997).

While these carrying capacity frameworks have been successfully applied in a number of park and recreation areas, a potential weakness of this approach to carrying capacity is its arguably reactive nature. That is, it relies on a monitoring program to determine when standards of quality are violated, or are in danger of being violated. A more proactive approach to mananging carrying capacity would be to estimate the level of visitor use that will cause standards of quality to be violated, and to ensure that such levels of visitor use are not allowed. Computer simulation modeling has the potential to facilitate a more proactive approach to defining and managing social carrying capacity.

Overview of simulation modeling and applications to outdoor recreation

Simulation modeling is the imitation of the operation of a real-world process or system over time. It involves the generation of an artificial history of a system, and the observation of that artificial history to draw inferences concerning the operating characteristics of the real system. Simulation modeling enables the study of, and experimentation with, the internal interactions of a complex system. The approach is especially suited to those tasks that are too complex for direct observation, manipulation, or even analytical mathematical analysis (Banks and Carson 1984, Law and Kelton 1991, Pidd 1992).

The most appropriate approach for simulating outdoor recreation is dynamic, stochastic, and discrete-event, since most recreation systems share these traits. Models that represent systems as they change over time are *dynamic* models, differing from static models that represent a system at a particular point in time. Complex and highly variable systems are often modeled using *stochastic* simulation. A stochastic simulation model contains probabilistic components and takes into account the random variation of systems over time. *Discrete-event* simulation models are dynamic models that imitate systems where the variables change instantaneously at separated points in time. This contrasts with continuous systems where variables change continuously over time. A mountain stream is usually modeled as a continuous system, where variables such as stream flow change continuously over time. An example of a discrete-event system is a campground: variables, such as the number of campers, change only when there are campers arriving or departing.

From the mid-1970's to the early-1980's, researchers explored computer simulation modeling as a tool to assist recreation managers and researchers (Manning and Potter 1984, McCool et al. 1977, Potter and Manning 1984, Schechter and Lucas 1978, Smith and Headly 1975, Smith and Krutilla 1976). The main goal of the Wilderness Travel Simulation Model, as it came to be known, was to estimate the number of encounters that occurred between recreation parties in a park or wilderness area. The model required input variables such as typical travel routes and times, arrival patterns, and total use levels. Outputs included the number of encounters between visitor parties of various types and the date and location of encounters. Initial tests established the validity of the model, but the model soon fell into disuse. Computers were relatively inaccessible at the time, and the evaluative component of carrying capacity research had not yet produced defensible numerical standards of quality.

Recent changes in computing power complemented advances in evaluative research to provide the context and impetus for the present study to revisit computer simulation for recreation research and management. Simulation-capable computers have become "smaller, cheaper, more powerful and easier to use by non-specialists" (Pidd 1992, p. 3). Exponential growth in the power of personal computers has facilitated the use of graphic user interface and visual interactive modeling technologies to make the simulation process accessible to non-specialists (Pidd 1992). These advances have led to the wide proliferation of simulation in the fields of business management and manufacturing.

In the 1990's there was renewed interest in applying simulation approaches to outdoor recreation management. Studies at Acadia National Park (Wang and Manning 1999), Yosemite National Park (Manning et al. 1998a, Manning et al. 1999), Yellowstone National Park (Borrie et al. 1999), and on Alcatraz Island (Manning et al. 1998b) used a simulation approach similar to the Wilderness Travel Simulation Model. These studies involved building models of specific sites or specific activities to determine social carrying capacities within these National Park areas.

The following section describes carrying capacity research at Arches National Park. This ongoing planning and research process provided the opportunity for this study.

Visitor Experience and Resource Protection (VERP) research at Arches National Park

The VERP framework described above was first applied to Arches National Park, Utah (National Park Service 1995). A program of social science research was conducted to help managers formulate indicators and standards of quality (Manning et al. 1995; Manning et al. 1996a; Manning et al. 1996b). The first phase of research addressed potential indicators of quality. Using open- and close-ended questions, visitors were asked to identify variables that contributed to or detracted from the quality of their experience in the park. Several indicators of quality were identified, including the number of visitors at prime attraction sites, including Delicate Arch, The Windows, and Devils Garden.

The second phase of research addressed standards of quality. As part of this study, visitors to Delicate Arch, The Windows, and Devils Garden were asked to rate the acceptability of a series of photographs showing a range of visitors at these sites. These photographs were developed using photo editing computer software (Manning et al. 1996a). Based on study findings, park managers established crowding-related standards of quality at these sites. For Delicate Arch, the standard of quality was no more than 30 PAOT more than 10 percent of the time. For The Windows, the standard of quality was no more than 20 PAOT more than 10 percent of the time. For Devils Garden, the standard of quality was no more than twelve PAOT along a 100 meter section of trail more than 10 percent of the time. Once these standards of quality were established, park staff began a program of monitoring these sites to determine if standards of quality were being maintained.

Given these indicators and standards of quality, information was needed on the relationships between PAOTs and total use levels of the Park. The literature described above suggests that computer simulation may have special applications to the dynamic and descriptive aspects of park use and carrying capacity. The overall purposes of this study were to 1) develop a computer simulation model of total park use that could estimate the relationships between total park use and PAOTs at attraction sites, and 2) test the validity of this computer simulation model.

Methods

Data collection
A variety of methods were employed to gather the baseline data necessary for building a model of visitor travel in Arches. These were vehicle counts with traffic counters, on-site visitor surveys, field visits, and map analysis. In addition, parking lot counts and PAOT counts were conducted to validate model outputs. These are described in more detail below.

Data on how many and what time visitors entered the Park were gathered using a traffic counter at the Park entrance. Data were gathered for a seven-day period in the summer of 1997, from August 19 through August 25. Total daily vehicle entries for these seven days averaged to 1346 per day.

Information on visitor characteristics and travel patterns were gathered with on-site survey instruments in the summers of 1997 and 1998. In 1997 426 vehicle travel questionnaires were administered to visitors exiting the Park on August 14, 16, 20, 25, 26 and 30. These were administered from 7:00 a.m. to dusk. Safety concerns preempted surveying after dark. In the same year 180 hiking questionnaires were administered to visitors returning from their hikes to Delicate Arch on August 15, 18, and 24. In 1998 160 questionnaires were administered to tour bus drivers on 42 days between July 9 and October 22. Also in 1998 245 hiking questionnaires were administered to hikers returning from their hikes around The Windows on July 18, 19, 27, and August 2 and 3. Likewise in 1998 320 questionnaires were administered to hikers returning from their hikes in the Devil's Garden section on July 5, 6, 8, and August 3 and 6. In all of these surveys one visitor from each group was asked about their group size, the total amount of time they had spent on the roads or trails (depending on the survey), and where and how long they paused during the visit. Finally, with the aid of the interviewer, they were asked to retrace the route of their trip on a map of the Park.

The lengths of road and trail sections between intersections were calculated from Park maps.

For model validation purposes the number of vehicles in the Wolf Ranch (Delicate Arch), The Windows, and Devil's Garden parking lots were counted 11 times a day between 6:00 a.m. and 10:00 p.m. on August 19, 21, 23, and 25 1997. In addition, PAOT counts were conducted at Delicate Arch every minute for several hours each day on twelve days between August 24 and September 26, 1999. The total numbers of vehicles entering the park was recorded with traffic counters on each of the parking lot count and PAOT count days.

Model algorithm and programming
The simulation model was built using the object-oriented dynamic simulation package, Extend (1996). The structure of the model was built with hierarchical *blocks* that represented specific parts of the Park's road and trail systems. The three main types of hierarchical blocks that comprised the model were entrance/exit blocks, intersection blocks, and road and trail section blocks.

The entrance/exit blocks were built to generate the simulated visitor parties. Visitor parties were generated using an exponential distribution varying around mean values from the entrance counts. The exponential distribution has been demonstrated to accurately simulate arrival rates at park areas with random arrival patterns (Wang and Manning 1999). The parties were then randomly assigned travel modes (automobile or bus) and group size, both according to probability distributions derived from the visitor surveys. Simulated visitor parties were then randomly assigned travel speeds according to a lognormal distribution, which has been demonstrated to accurately simulate different travel speeds in parks (Wang and Manning 1999). The means and standard deviations were calculated from the travel times reported by survey respondents and the lengths of their travel routes. Lastly, the visitor parties were randomly assigned a route identification number according to frequencies of actual routes reported by survey respondents.

The intersection blocks were built to direct simulated visitor parties in the right direction when they arrive at road and trail intersections. Lookup tables unique for each intersection direct each party toward the correct next intersection as indicated by their route identification numbers and how many times, if any, they have been through that intersection.

The road section blocks were built to simulate travel through the road section by delaying simulated visitor parties for the appropriate period of time, according to their assigned travel speeds. The parking lot and attraction blocks also held simulated visitor parties for periods of time. In addition, they were designed to output the numbers of visitors in those areas throughout the simulated day.

Model runs
The model was run with three total use levels: current average total use level, half of the current average, and double the current average. Twelve runs were made for each use level to capture stochastic variation. The average PAOT conditions at Delicate Arch were recorded from these runs.

Figure 1. Relationship Between PAOT at Delicate Arch and Park Total Use Levels

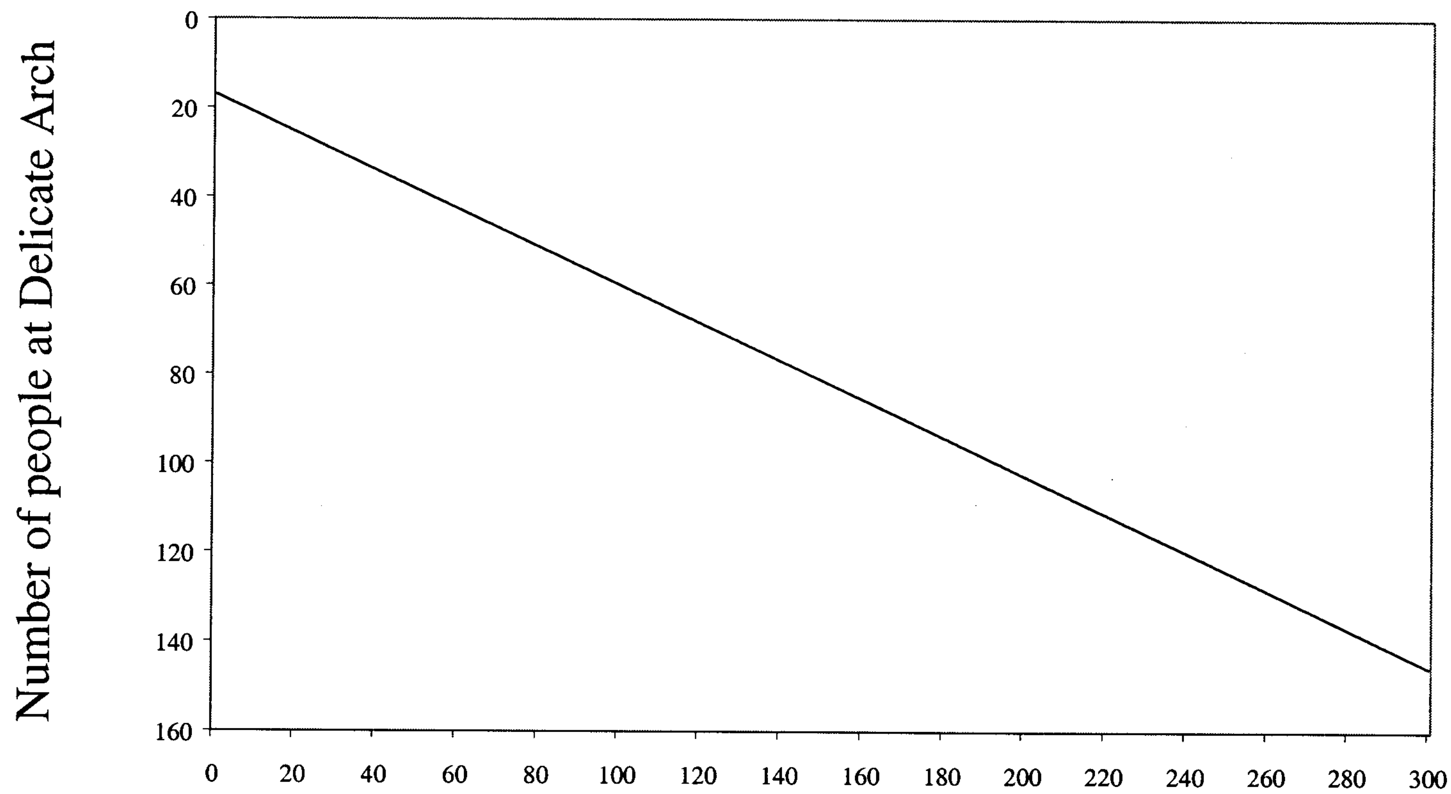


Figure 2. PAOT Comparisons at Delicate Arch

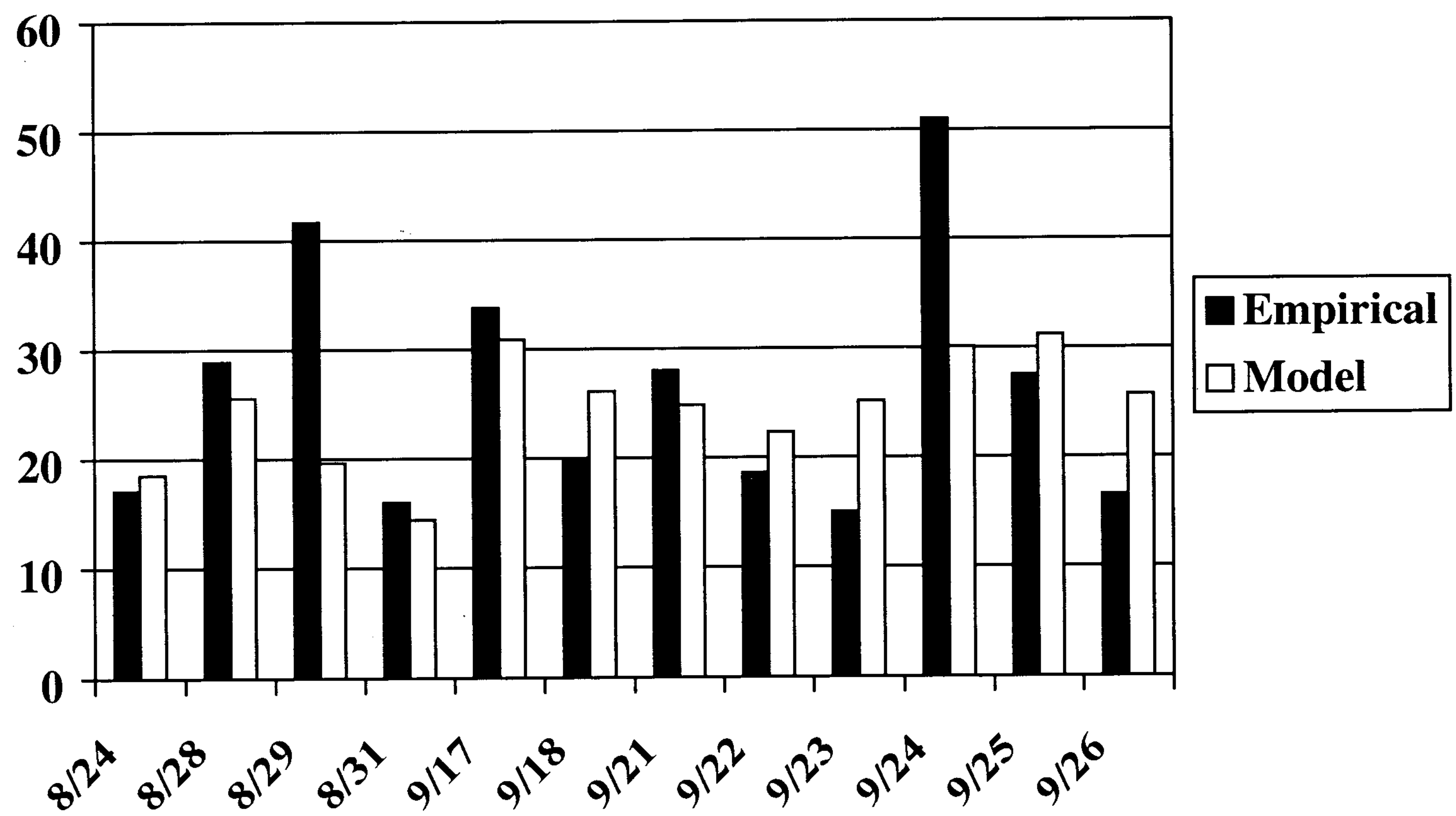
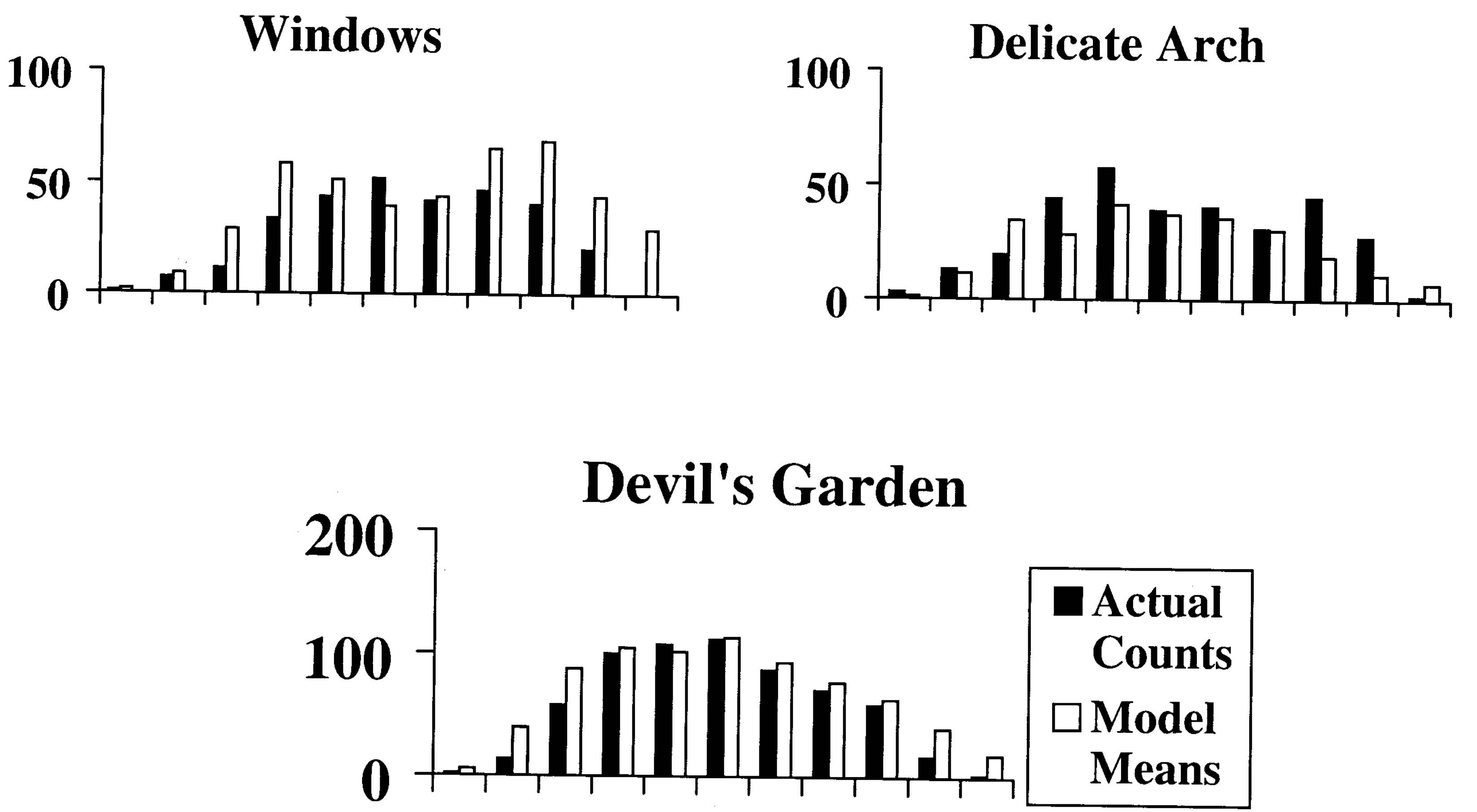


Figure 3. Parking Lot Count Comparisons Through the day on 8/23/98



The model was run a total of 32 times to compare with the empirical parking lot counts for validation purposes. Each run simulated Park use from 5:00 a.m. to 10:00 p.m., but only recorded output from 6:00 a.m. to 10:00 p.m. Output from the first hour was considered unreliable because people who would have entered the Park before 5:00 a.m. were not simulated. The model was run based on the total use levels of the four days on which the parking lot counts were done. The model runs were repeated eight times for each of the four simulated days to capture stochastic variation. The number of vehicles in each parking lot was tracked through each simulated day.

The model was also run for comparison against the PAOT counts at Delicate Arch. The model runs were repeated four times for each of the twelve simulated days to capture stochastic variation. The number of visitors at Delicate Arch was tracked through each simulated day.

Results

Figure 1 shows the relationship between the number of vehicles entering the Park each day and the highest PAOT at Delicate Arch. This relationship allows estimates of the maximum number of vehicles that can be accommodated in the Park without violating selected standards of quality.

Figure 2 shows comparisons between average observed PAOT and model outputs for estimated PAOT for twelve days at Delicate Arch. A visual inspection shows that the results match closely except for August 29 and September 24. Chi-square tests showed significant differences between the distributions.

Figure 3 shows representative output validation results for parking lot counts. Results are shown for comparisons of observed data and model outputs at the three parking lots on August 23. A visual inspection shows that the model matches empirical data closely except for the evening hours at each site. The model underestimates the number of visitors at Delicate Arch and overestimates the number of visitors at the other two sites. Chi-square tests showed significant differences between the distributions.

Conclusions and Implications

Study findings suggest that it is feasible to develop a park wide model of visitor use encompassing both vehicle and pedestrian travel. Moreover, such a model can be used to develop relationships between total park use (e.g., the number of vehicles entering the park each day) and the condition of indicators variables (e.g., PAOT at Delicate Arch). Such a model can be used to estimate the social carrying capacity of a park. While continued monitoring of indicator variables is warranted, modeling can more proactively estimate the point at which standards of quality will be violated, and can reduce needed intensity of monitoring activity.

Discrepancies between model output and field observations designed to validate the model are due primarily to the lack of visitor surveys conducted in the later hours of study days. As noted above, safety concerns (stopping vehicles after sunset) did not allow surveys to be conducted after dark. In the case of PAOT at Delicate Arch, the August 29 and September 24 field counts were conducted during the evening hours. The parking lot counts also showed the greatest discrepancies in the evenings. This problem will be rectified in the summer of 2000 when additional visitor surveys will be conducted during the evening hours at Delicate Arch, The Windows, and Devils Garden.

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DOES THE SUGGESTION THAT RESPONDENTS RECALL EVENTS CHRONOLOGICALLY SIGNIFICANTLY INFLUENCE THE DATA COLLECTED?

Andrew Hill

Research Assistant
Masters of Science student
Purdue University
1200 Forest Product Building
West Lafayette IN. 47506-1200

Jay Beaman, Ph.D

Director
Auctor Consulting Associates, Ltd.
676 Highland ave.
Ottawa Ontario, kla2k4

Joseph O'Leary, Ph.D

Professor of Outdoor Recreation and Tourism
Purdue University
1200 Forest Product Building
West Lafayette IN. 47506-1200

Abstract: This paper is about estimating a salience scale for trip reporting. The measurement project began as a way of establishing the affects of methodological changes between 1994 and 1997 in the Canadian Travel Survey. This is a survey that Canada uses to study the travel of its residents. There were several changes in methodology that could be expected to influence how trips are recalled. A key change was that in 1994 the interviewers were encouraged to suggest to the respondents that they report chronologically but in 1996 and 1997 they were told not to use the prompt during interviews. It is likely that other changes resulted in response burden being higher in 1996 and 1997 than in 1994. For people reporting two or more trips, chronological reporting should result in trips being reported in random order. It was found that the order in which trips were reported changed with the change in memory cue. The change may have been exacerbated by some trips not being reported because of response burden. The data were analyzed using paired-comparison. The effect of the methodology change is found to be significant. The implications for future research as well as general implications for survey methodology are reported.

Introduction

In 1998, Auctor Consulting Associates (Auctor 1998) examined the processes and products of the 1994, 1996 and 1997 Canadian Travel Surveys. This was done to determine if there where are any issues relating to the surveys that should be of concern to the Canadian Tourism Commission, CTC. A key issue was encouraging interviewers to prompt respondents to report trips chronologically. Prompting occurred in 1994 and was discouraged in 1996 and 1997.

Recognizing that prompting influenced recall salience for trips suggested the value of measuring trip-recall-salience. Chronological reporting does not follow salience order for trip reports so confirming that 1994 reporting is not ordered as in 1996 and 1997 would provide proof that responses in 1994 were different from those of the other years.

In order to understand the research done it is necessary to establish common definitions of concepts used in the analysis and to convey some background about the information used. The concept that underlies this research is salience. The critical analysis technique is scale development using paired comparisons. The data sets are the Canadian Travel Survey (CTS) for 1994, 1996 and 1999.

Salience

Salience is a property of an event that indicates how much it sticks out or serves as a focal point (Rotello, 1999; Metha, Starmer, and Sugden, 1994; Shlechter, Herrmann, and Toglia, 1990). In the context of this study trip-recall-salience (TRS) refers to the tendency to recall trips of a certain type more readily than trips of a different type. Therefore, a TRS scale is a scale such that if the value for trip type x is greater than that for trip type y then x tends to be reported ahead of y in reporting trips taken when there are no cues that disrupt recall.

Measuring salience by Paired Comparisons

In conventional paired comparison analysis a set of alternatives, or a subset of a set of alternatives, is presented a pair at a time to a subject who is then asked to specify the correct order for each pair (Tritchler and Lockwood, 1991; David 1988).

Formally, let the set of alternatives be A={x,y,z}. For the possible unordered pairs *[{x,y}, {x,z}, {y,z}J* one wants ordering information from the respondents. When one asks a number of respondents whether x should be "ahead of' y, one gets a number *r (x,y)*, 0_ *r* _ 1, for each pair, *(x,y)* such that this number is an estimate of the probability of x being ranked ahead of y. For this study we did not have respondents compare trips but rather the order in which trips were reported defined the ordered pairs. If a person reports a trip of type x first, then a trip oftypey, and last, a trip of type *z*, then the pairs *(x,y)*, *(x,z)*, and *(y,z)* become the pairs used for analysis. It is important to note that if on average x is 'ahead,' then S >.5.

There is an extensive literature on computing scales from paired comparison data (David, 1988). However, a very simple way to define a scale is S= mean(r(x,y) , for all y). This mean value is the average proportion of all alternatives that x is ahead of. It provides a scale on which the salience of every x is defined.

The CTS and Methodology changes behveen 94', 96 'and 97.'

The Canadian Travel Survey (CTS) is a survey by the Canadian Government in which individuals from randomly selected households report on their trips (Statistics Canada 1994, 1996, 1997). The data are used to estimate travel volume and expenditures by Canadian residents. The surveys results are an input to planning and in determining some provincial and national policies. They are also used to measure tourism performance.

In this research we are concerned with the 1994, 1996 and 1997 CTS. A key methodology change in collecting data for the CTS was a change in a prompt given to respondents. In 1994, the CTS interviewers were encouraged to prompt respondents to report trips chronologically. In 1996 and 1997 the interviewers were discouraged from using a chronological prompt during interviews for the CTS (Statistics Canada, 1994.
1996, 1997).

The other methodological changes from the 94 to the 96-97 *CTS* noted by Auctor are:

1) Computers were used in 96-97 that in part drove the interview process.
2) In 96-97, more elaborate information was asked of the respondents; this increased response burden.
3) In 96, the odds of a person being asked to respond to the CTS were twice as great as in 94; this is correlated with a decrease in the number of trips reported.
4) In 94, the CTS respondents were not asked to complet other labour force survey components; in 96 there were add-ons and in 97 there were even more add-ons. This could increase the burden felt by the respondents.

A Research Hypothesis, Corollary, and their Justification.

The primary reason to focus on the lack of a prompt in the 96-97 CTS is that the literature states that the mechanism used to prompt recall affects which events are remembered (Huttenlocher, Hedges, and Bradburn, 1990). This indicates that a change in the recall prompt used in the survey will impact the trips that the respondents remember and then report to the interviewer. This leads us to our hypothesis which is that the order in which trips are reported is influenced by the switch from chronological to 'off the top' reporting.

Hypotheses and Corollary
In formal language the null hypotheses is:
H_0: Prompting respondents to report events chronologically causes no differences in trip reporting from simply asking that trips be reported.

If H_0 is rejected we have:

Ha: Prompting respondents to report events chronologically causes differences from data obtained without prompting.

If Ha is accepted it leads to the following corollary:

Corollary: CTS estimates will be biased because 1994 and 1996-1997 differ in the way respondents were asked to recall travel.

What the corollary means if accepted will be addressed up in the discussion.

Consider that when respondents are interviewed, a particular type of event may appear to be reported prior to an event of another type. This tendency may depend on the socioeconomic attributes of a respondent and other factors. However, here we are concerned with this being a consequence of trip salience. The propensity to mention one event, ea, ahead of another, eb, can be attributed to a psychological process establishing a salience level designated by 0(e). When two trips are to be reported, salience 'disrupted' by other factors defines the reporting order.

If O(ea)>0(eb), then ea tends to be reported ahead of eb.

Because in the CTS one has only some of the data needed to determine 0(e), this research is built on the assumption that:

O(e)=F(A)=F(duration, distance, expenditure, trip type, mode)+~.

where 2~ is considered to be a random variable expressing the factors including special circumstances (e.g., important family event), response disposition (e.g., something mentioned by the interviewer or respondent influencing what is recalled), socioeconomic factors, and recall factors (e.g., different response burden).

Based on variables in the data, 288 distinct types of trips were created (288 4x3x3x4x2): The variables used were; duration (recoded to 4 levels), distance (recoded to 3 levels), expenditure (recoded to 3 levels), trip type (recoded to 4 levels), and mode of travel (recoded to 2 levels).

Analysis, Results, and Discussion

Steps in Analysis
The first step was to determine the 288 trip types used. The second step in the analysis was to compare the possible parings. The third step was to separate the trips into the years that they were taken. The forth step was to compare the years and see if there was a difference in how trips were reported.

The initial SAS program produced estimates of salience. A second program was used to determine the implications of the scale. For every trip type pair *(x,y)* the program determined if S(x)> S(y). If the response order was (x,y)then the pair was judged a success and if the order was (y,x) the pair was a failure. These scores were used to produce the summary results.

When the SAS program was run it was found that there were 55,000 trips for comparison. Table 1 shows some characteristics of CTS data. First, the number of trip report records are indicated for 94', 96' and 97.' The second line shows the number of individuals reporting two or more trips. The third line shows the number of 'comparison pairs' generated from all the trip data for persons reporting two or more trips.

Table 1. Description of 1994, 1996, and 1997 Canadian Travel Surveys.

	Year		
	1994	1996	1997
Trip Report Records	59242	79873	51598
Number of Individuals Reporting Two or More Trips	12723	16226	8480
Number of'Comparison Pairs.'	28866	37876	15550

Results

We reject H_0. The data show that at a *95%* confidence level, the '94 data differs from the '96 and '97 data, while the '96 and !97 data are not significantly different.

Table 2.

	Success	Total	Success Ratio	STC	95% LCI	95% UCI
94	18899	28866	0.65471	0.0052	0.64452	0.6649
96	27084	37876	0.71507	0.00469	0.70587	0.7227
97	11223	15550	0.72174	0.00583	0.71031	0.73317

Discussion

Table 2 shows is that when the chronological cue was used in the 94 data more low salience trips were reported ahead of higher salience trips. This supports the idea that 'off-the-top' reporting creates a disposition to report more salient trips first. This confirms that the TRS is effected by the chronological prompt. In contrast the 96' and 97' data collected without the chronological prompt shows no significant difference.

The corollary introduced above is readily interpreted as indicating that accepting Ha implies that CTS estimates will be biased in the sense that there will be a difference between Total trip estimates for 1994 and 1996 that can be attributed to the change in the way that trips are reported. However, proof that reporting differs between 1994 and 1996-97 does not provide proof that this has a consequence on estimated values. It only encourages one to believe that this is likely.

Providing proof that the methodological changes that influenced trip-recall-salience actually result in a bias in estimates of total numbers of trips, total expenditures or other estimates, requires building a link between salience and such estimates.

So what[2]

If estimates are biased and the influence on accuracy of bias is unknown, the usefulness of the data is limited. For example, in Canada the external indicators of travel increased from 1994 to 1996-97, but the CTS showed a drop in travel. Given the fact that these two sources of information contradicted each other how do we sort out which is giving an accurate picture if we do not know the impact of changes made in the instrument? A salience scale will help to address this issue by helping to show the direction that estimates tend to be off under changing conditions.

Practical Implications

Deriving this understanding of the impacts on recall of prompts is a first step in understanding how trip attributes relate to salience and how respondent attributes influence salience. Though this is not proof that estimates such as total trips will be biased, it gives good reason for concern. This is a step in determining if estimates are biased and if these biases can be corrected.

Future Research

It would seem to be wise to conduct an experiment with a chronological prompt, a neutral prompt, and other factors such as disposition prompts. This would allow an understanding to develop of how prompts work in the travel and recreation recall context.

Conclusions

It is possible to construct a TRS scale using paired comparisons for the '94, '96, and '97 CTS data. Using the TRS scale it is possible to show that suggesting to respondents that they report chronologically has a highly significant effect on the order in which they reported trips. This is indirect evidence that estimates of numbers such as total trips will be biased.

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Marketing & Management in Outdoor Recreation & Tourism

IMPORTANCE-PERFORMANCE ANALYSIS: AN APPLICATION TO MICHIGAN'S NATURAL RESOURCES

Gloria Sanders

Graduate Research Assistant, University of Florida, 325 Florida Gym, P.O. Box 118209, Gainesville, FL 32611

Erin White

Graduate Research Assistant, University of Florida, 325 Florida Gym, P.O. Box 118209, Gainesville, FL 32611

Lori Pennington-Gray

Assistant Professor, University of Florida, 325 Florida Gym, P.O. Box 118209, Gainesville, FL 32611

Abstract: In the state of Michigan, the nature-based tourist is becoming an increasingly important target market for providers of natural resources. To meet the demands of this growing market segment, evaluation strategies for nature-based sites are needed to maintain and improve customer satisfaction and loyalty. Evaluation strategies that incorporate consumer input can help to determine whether the needs of the tourists are being met. By using Importance-Performance Analysis, a marketing tool that emphasizes consumer input, the purpose of this study was to determine the satisfaction of the nature-based tourist who has visited Michigan's natural resources. The IP Analysis was used to examine attributes of the experience and to assess whether the state of Michigan is providing adequately for these attributes.

Introduction

Participation in outdoor recreation is one of the largest components of travel in Michigan. Of travelers to Michigan, seventy-two percent say they have participated in some form of outdoor recreation while traveling in Michigan (Holecek, 1995). The enormous amount of public land in the state of Michigan and the growth in tourism make nature-based tourism an increasingly important target market for providers of natural resources. In order to meet the demand of this growing market segment, evaluation strategies for nature-based sites are needed to maintain and improve customer satisfaction and loyalty. By embracing a marketing approach emphasizing consumer input, Michigan tourism officials can determine if the needs of nature-based travelers are being met and determine those areas that are currently considered deficient by those visiting Michigan's natural resources.

Purpose of the Study

The purpose of this study was to determine nature-based tourist satisfaction with the providers of Michigan's natural resources. The Importance-Performance Analysis (IPA) approach was used as the evaluation tool to assist in determining visitor's satisfaction. First developed as a marketing tool by Martilla & James (1977) to assess consumer satisfaction, the IP analysis in recent years has been used by leisure professionals to assist in the evaluation of customer satisfaction (Guadagnolo, 1985; Hollenhorst, Olson Fortney, 1992; Hudson & Shephard, 1998). The IP analysis works first by determining what attributes or features are important to the consumer. Then information is solicited from the consumers regarding the relative importance of the various attributes and asks how well the agency under study provides for these attributes. The results of the IPA, which are displayed in an easy to interpret two dimensional graph, indicate areas of strength and weakness in the services provided for each attribute presented. The graph is divided into four sections providing an easy guide for management's focus. Decision makers are then able to identify attributes where concentration is needed in order to improve services deemed important by the consumer. The attributes used in IP analysis are generally developed as a result of information gained from previous studies or from focus groups.

The four quadrants on the IP graph are labeled according to the level of importance and performance of each feature or attribute. The quadrant in the upper right section is titled "Keep up the Good Work", indicating the attribute has high importance and high performance. The quadrant in the lower right section is titled "Possible Overkill" indicating the attribute has low importance but showing high performance. The third quadrant in the lower left section titled "Low Priority" indicates that the attribute has low importance and low performance. The fourth quadrant located in the upper left titled "Concentrate Here" includes features or attributes with high importance but rated low in performance. The quadrants "Keep up the Good Work" and "Low Priority" indicate to managers that expectations are being met for these attributes as relative importance is equal to the performance rating. Focus still needs to be given to these attributes to maintain satisfaction levels. The quadrant "Concentrate Here" indicates to managers that the attribute is important to consumers but the agency's performance is not achieving a satisfactory level of the importance. The quadrant "Possible Overkill" rates attributes low in importance while consumers feel the agency is providing high performance on these attributes. Two solutions that might arise from the findings in this quadrant of an IP analysis are that the provider of the resources can redirect attention to the attributes that are performing better than expected or the provider might be able to "position" negative attributes positively in the minds of the traveler or potential traveler.

The Sample

The sampling frame for this study was generated from telephone lists purchased from Survey Sampling, Incorporated of Detroit, Michigan. Data was collected by means of a telephone survey. A random sample of adults aged 18 and older who permanently resided in Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin, and Ontario, Canada were chosen to participate in the study. These geographic areas were chosen because they represent the target areas which Travel Michigan, the state tourism bureau, identified as areas which tourist to Michigan originate. Adults, age 18 and older, were chosen because they represented those people who make the primary decisions to travel. A total of 350 completed interviews were conducted from May 1997 to August 1997. This number was deemed appropriate for a 95% confidence interval +/- 5%. Interviewing occurred on weekday evenings and weekend evenings and up to three callbacks were made for each contact. This calling procedure has proven to be effective in past studies performed by Travel, Tourism, Recreation, Resources Center at Michigan State University. Of the 350 interviews, a total of 185 people responded "yes" when asked if they "had traveled to Michigan for the purpose of outdoor recreation." These respondents were then asked to complete the importance-performance section of the interview.

Important-Performance Analysis

During questionnaire development, various IP attributes were derived from previous studies conducted about travel to Michigan and from the literature. A total of ten importance statements and ten performance statements where then chosen for the IP section of the interview. These attributes were found to be consistent throughout the previous studies and the literature. The ten attributes under study were scenic appeal, predicable weather, variety of places for water-based activities, variety of trails, scenic waterfalls, undisturbed nature, access to Great Lake coastlines, wildlife viewing, availability of public beaches and clean water. Respondents were asked to indicate the importance of each statement using a 5-point Likert scale, ranging from 1=not at all important to 5=very important and the performance of each statement was measured similarly using the same scale, however worded "strongly disagree" to "strongly agree".

Mean and median scores were computed for each importance and performance feature (see Table 1). Overall mean and scores were computed for all attributes. According to several researchers (Guadagnolo, 1985; Hollenhorst, Olson and Fortney, 1992), using the overall mean scores as the positioning points for the mid-point of the graph allowed for a more critical appraisal than using the middle point of the scale. As mean and median scores were fairly close and mean scores provided more information, mean scores were used for plotting. The central positions or cross hairs for overall performance and importance were plotted. The axes were 3.53 and 3.71 respectively. The mean of each importance feature was matched with the mean of each performance feature and plotted on the I-P matrix.

Importance-Performance Findings

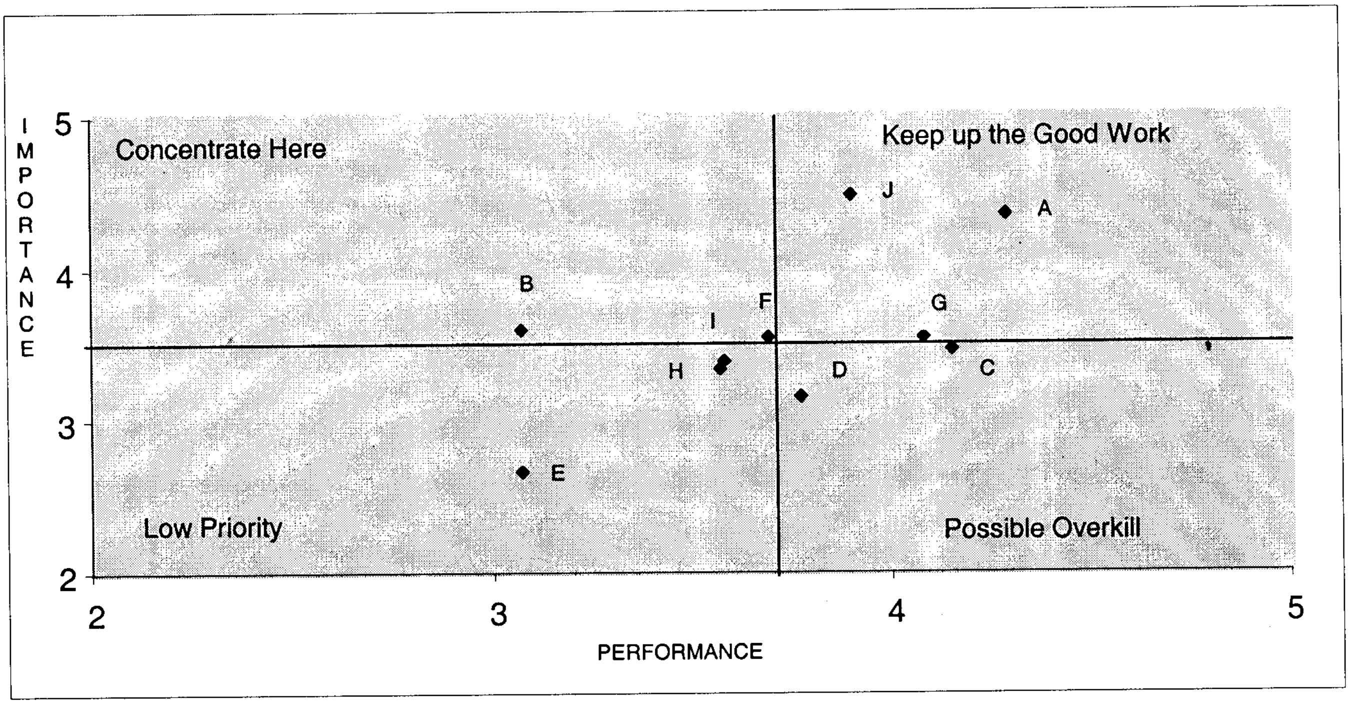
The findings indicate that clean water and scenic appeal were the two most important natural resource attributes while scenic appeal and variety of places for water-based activities performed the best (see Table 1). In addition, scenic waterfalls and variety of trails were the least important attributes when traveling for the purpose of outdoor recreation. According to travelers, the state did not do a good job of meeting the expectations of nature based travelers regarding the predictability of weather and the availability of scenic waterfalls. The area of high importance relative to low performance was seen in the attributes undisturbed nature and predictable weather. In the IPA graph, this quadrant signifies the features in which managers need to concentrate on higher performance to achieve customer satisfaction (see Figure 1).

Table 1. Importance and Performance Attributes of Natural Resources

Code	Attributes	Importance[a]			Performance[b]		
		N	Mean	SD	N	Mean	SD
A	Scenic appeal	186	4.26	0.88	185	4.31	0.86
B	Predictable weather	186	3.60	1.34	185	3.07	1.13
C	Variety of places for water-based activities	186	3.48	1.19	182	4.15	0.99
D	Variety of trails	182	3.16	1.22	175	3.77	1.16
E	Scenic waterfalls	182	2.67	1.40	171	3.07	1.37
F	Undisturbed nature	184	3.55	1.29	181	3.69	1.12
G	Access to Great Lake coastlines	183	3.55	1.24	177	4.08	1.15
H	Wildlife viewing	185	3.34	1.27	177	3.57	1.08
I	Availability of public beaches	185	3.39	1.26	178	3.58	1.11
J	Clean water	185	4.32	1.01	183	3.82	0.94
	Overall Means	184	3.53	1.21	179	3.71	1.09

[a] Mean values based on a 5 point Likert-type scale, ranging from 1=not at all important and 5=very important.
[b] Mean values based on a 5 point Likert-type scale, ranging from 1=strongly disagree and 5=strongly agree.

Figure 1. Importance Performance Matrix of Natural Resource Attributes



Discussion

While undisturbed nature can be assessed and eventually managed, predictable weather cannot. One idea that the State might consider is to look at changing the perception of weather in the minds of the traveler. Advertisements might look to include weather as part of their image. For example, an advertisement could show a group around the campfire enjoying the experience despite a light rain shower. Positioning weather in the minds of the traveler as part of the experience might help to reduce negative perceptions. The attributes receiving low priority (i.e. low importance, low performance) were wildlife viewing, scenic waterfalls and availability of public beaches. While the agency is meeting visitor's expectations on these attributes, these attributes are some of Michigan's finest resources which suggests to managers that this is an area that can be improved by shifting the public's perceptions of the importance of these attributes. By concentrating in these areas, managers can focus on the unique settings that are particular to the Michigan outdoors. In the quadrant that IPA categorized as "possible overkill" were the attributes of variety of trails and a variety of places for water-based activities. The participants rated these areas low in importance, but high in performance. The IPA suggests that more effort is being put in these areas than is needed. Although, this could suggest that variety may be relatively unimportant to these respondents because they have specific ideas of what they wanted to do while visiting Michigan. Variety may possibly be attracting a diverse group of visitors to the area and refocusing efforts may be to the disadvantage of the agency. Prior to making decisions based on the IP matrix, providers should look at the attributes in each of the quadrants and understand their meaning within the overall study before recommending or making changes.

Limitations and Future Research

One limitation to this study is the relatively small sample size. Further research needs to be conducted to see if this sample is representative of the study population. Another limitation of this study may be the conceptualization of the attributes tested. Future research might use focus groups to better understand the meaning of the attributes. The telephone survey used single item indicators and further questions were prohibitive allowing for multiple interpretations of the attributes. For example, focus groups might provide a more clear explanation of the attribute "undisturbed nature", does this mean lack of pollution or lack of uncharted areas? Focus groups could not only help clarify existing attributes but also assist in developing new attributes. Previous studies utilizing IP analysis used focus groups to create the features or attributes under consideration.

Participants in this study were not asked about their actual visitation patterns and the activities which were pursued. In future studies, visitation patterns and participation in specific activities could be tied into the IP analysis. This might allow for greater depth in the evaluation of the responses. In fact, it may be that traveler's responses vary with primary activity.

This study shows that the Importance-Performance Analysis is definitely one tool which can be used to evaluate customer satisfaction in a nature-based setting. The IPA provides managers with an easily understood marketing analysis of data collected. These results provide useful information in understanding the nature-based tourist who uses Michigan's natural resources.

References

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