DISSERTATION

QUANTIFYING AND MODELING VISITOR USE IN YOSEMITE NATIONAL PARK AND ROCKY MOUNTAIN NATIONAL PARK

Submitted by

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Human Dimensions of Natural Resources

In partial fulfillment of the requirements

For the degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Spring 2009

COLORADO STATE UNIVERSITY

February 6, 2009

WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY DAVID E. PETTBONE ENTITLED "QUANTIFYING AND MODELING VISITOR USE IN YOSEMITE NATIONAL PARK AND ROCKY MOUNTAIN NATIONAL PARK" BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

QUANTIFYING AND MODELING VISITOR USE IN YOSEMITE NATIONAL PARK AND ROCKY MOUNTAIN NATIONAL PARK

Three manuscripts are presented in this dissertation. The first entitled "Estimating Visitor Use at Attraction Sites and Trailheads Using Automated Visitor Counters in Yosemite National Park" is a methodological paper that examines the use of automated visitor counters, a commonly used device to estimate visitor use in parks and protected areas. This study was conducted in Yosemite National Park in the summer of 2007 and used automated visitor counters to estimate visitor use at several locations in Yosemite Valley. One hundred thirty five hours of direct observations were conducted among six study sites to estimate monitor counting errors. Methods to treat missing monitor data and methods to estimate accurate visitor use counts from automated monitors are discussed. Results show a very strong relationship between observed visitor counts and automated monitor counts ($R^2 > 0.95$) and visitor use estimates are presented for all study sites. This study shows that automated visitor use monitors produce consistent data from which reliable estimates of visitor use can be calculated.

The second paper entitled "Modeling Visitor Use at Recreation Sites from Vehicle Traffic Entrance Counts in Yosemite National Park" describes a study that uses the data from the previous paper in a statistical model to predict visitor use at attraction sites and trailheads in Yosemite National Park. Negative binomial regression was used to

model visitor use at Yosemite Falls as a function of inbound vehicle traffic counts from park entrance stations. Results show a strong statistical relationship between visitor use at the study site and inbound vehicle counts ($R^2 = 0.85$). Used in conjunction with previous crowding studies, the methods in this paper provide Yosemite National Park managers with new options to proactively manage high-use attraction sites.

The final paper entitled "Estimating Visitors' Travel Mode Choices along Bear Lake Road in Rocky Mountain National Park" examines the trade-offs park visitors consider when choosing among transportation options in Rocky Mountain National Park. A stated choice survey was administered at the Bear Lake trailhead in Rocky Mountain National Park during the summer of 2008. An aggregate model that considered all visitors responses equally and segmented models based on visitor demographics were estimated. Results indicate that a model based on three age groups (< 40 years, 40 – 59 years, and 60+ years) produced the best model fit. Crowding along the trail at Bear Lake was found to be the most influential factor related to visitors' choice of transportation mode. Moreover, visitors less than 40 years old were more sensitive to crowding along the trail than older visitors. These results suggest that younger visitors consider transportation to a trailhead as a means to access an activity (e.g. hiking) while older visitors may consider auto-touring an activity in itself.

ACKNOWLEDGEMENTS

This work is the result of the efforts and sacrifices of many people. First and foremost among this list is my wife Lani who has endured life with a graduate student for four and a half years. The duration of our married life together has been concurrent with my graduate school career. The completion of this challenging stage of life and our new opportunities in Yosemite National Park are a testament to our commitment together and the sacrifices we have both made.

I am also grateful to my adviser Peter Newman who has consistently challenged me with exciting new projects in some of the most beautiful places on earth. All of the projects I have been associated with at Colorado State University have been conducted in the Colorado high country and the Sierra Nevada mountain range. Both of these areas are dear to my heart and there are no other places I would rather be. The research that I have conducted over the last four years has provided me a new depth of understanding about the challenges to manage these popular areas and has allowed me the opportunity to help better protect these places that are so important to me.

I also owe a debt of gratitude to my committee members, Steve Lawson, Chris Monz, David Theobald, and Randy Swaim, who have provided me with guidance and support through my graduate career. It has been a great privilege to have such accomplished researchers take interest in my work. The advice and resources

provided by this group have been instrumental to the completion of these research efforts.

I would also like to recognize the national park managers who understood the value of the work presented in these papers and provided financial support for these projects. I would like to acknowledge Jim Bacon, Bret Meldrum, and Niki Nicholas for the support and opportunities to work in Yosemite National Park. I would also like to recognize Moose Mutlow from the Yosemite Institute for all of the logistical support he provided while we stayed in Yosemite Valley. Much thanks goes to Larry Gamble for all of the support he has provided for our research efforts in Rocky Mountain National Park. Larry secured funding for my Master's research and the work we conducted this last summer in the park. He has been a great supporter of recreation research in Rocky Mountain National Park and I owe much of my success as a researcher to his support.

Finally, I would like to thank my mother, Lorraine, who passed away in 2005. She was the most dedicated, loving person I knew and was taken from us far too soon. Not a day passes that I don't think about her and wish she could share these accomplishments with us.

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CHAPTER I

Dissertation Overview

This dissertation contains three manuscripts prepared for publication instead of the traditional dissertation format. Chapters II – IV contain the three manuscripts and conclusions from these studies are presented in Chapter V. The manuscript format follows the guidelines and requirements specified by the Department of Human Dimensions of Natural Resources and by the Colorado State University Graduate School.

The manuscripts presented in this dissertation describe visitor use research conducted in Yosemite National Park (YNP) and Rocky Mountain National Park (RMNP) during the 2007 and 2008 summer seasons. The primary focus of this work has been to identify trends in visitor use to aid park management decisions. Chapter II describes methodologies to estimate visitor use from infrared visitor monitors, a commonly used device used by recreation researchers and land managers to estimate visitor use levels. Chapter III builds on the findings from Chapter II by describing a study to predict visitor use at recreation sites using data from automated visitor monitors and inbound vehicle traffic counts at park entrances. Chapter IV examines RMNP visitors' preferences towards alternative transportation. A brief description of each chapter and how they contribute to the theme of this dissertation is provided in the following paragraphs.

Chapter II

The use of automated visitor counters is becoming a common method for estimating visitor use in parks and protected areas. While these devices are regularly used to estimate visitor use, the existing literature does not adequately address methods to correct monitor counting errors. In this study, 135 hours of direct observations were conducted at six locations in YNP where automated monitors were used to estimate visitor use. Results show a very strong correlation between observed counts and monitor counts. Unique correction factors were estimated for each monitor suggesting that monitor error is related to local conditions such as trail slope, trail width, and trail condition. Bootstrapping techniques were used to treat missing visitor counter data. These findings emphasize the need for direct observations to calculate accurate estimations of visitor use.

Chapter III

As described in Chapter II, automated visitor counters have become a popular method to estimate visitor use because they are a relatively easy and efficient way to track visitor use in parks and protected areas. However, these data simply identify trends that may or may not represent real time conditions at a location. Chapter III builds on the study described in Chapter II by using visitor monitor data in a regression model to predict visitor use. Inbound vehicle traffic counts from YNP entrance stations were used as a predictor of visitor use at Yosemite Falls. Specifically, negative binomial regression was used to predict uncalibrated visitor monitor counts at Yosemite Falls. Results from these models were used as inputs in an integrative visitor use monitoring program to proactively manage visitor use in Yosemite National Park as described by Lawson et al. (2008a).

Chapter IV

The National Park Service is turning to alternative transportation systems to manage traffic congestion and crowded conditions that have become commonplace in many national parks. Few studies have examined the components of a trip that affect visitor preferences towards transportation systems in national parks. The study described in Chapter IV uses stated choice analysis techniques to estimate trip attributes that influence visitors' transportation mode choices. First, an aggregated model was estimated that assumed all visitor preferences to be the same. Second, models based on segmentations of the study population were estimated based on demographics (e.g. age, sex, education) and response certainty. Log-ratio tests were used to determine if the segmented models were an improvement over the aggregated model. These tests show that a model based on three age groups produces the best model fit. The use of stated choice analysis in this study provides important insights into the trade-offs national park visitors are willing to make about transportation mode options in order to inform RMNP managers tasked with determining transportation policy.

Chapter V

This dissertation concludes with a discussion about the applications of the findings presented in the previous chapters. First, a brief historical background of carrying capacity in the national park system is presented. Second, a background on indicator-based, adaptive management is discussed. Finally, a summary of the applications from the findings in this dissertation is given.

CHAPTER II

Estimating Visitor Use at Attraction Sites and Trailheads using Automated Visitor Counters in Yosemite National Park

Introduction

Baseline data on visitor use is essential to the planning and management of national park units. Such information is fundamental to national park units in order to assess visitor impacts to the resource, estimate the quality of the visitor experience, and to inform facilities planning (Loomis, 2000). However, visitor use data are not always available. While all park units are required to track overall visitor use levels, more detailed information about the extent, duration, and impacts from visitor use are difficult to obtain. Lack of funding and personnel time, logistical problems, and lack of training about available methods to collect and analyze data have been identified as some reasons why wilderness use has not been examined more adequately (Watson, Cole, Turner, & Reynolds, 2000).

Recently, automated visitor counters have gained recognition as a convenient way for land managers to estimate visitor use in parks because they require little maintenance, can count continuously for periods of weeks or months, and cause minimal to no disturbance to visitors (Watson, Cole, Turner, & Reynolds, 2000). A survey of 169 state land managers and 175 federal land managers found 55.2% of state land managers and

73.3% of federal land managers use mechanical/electronic counting devices to gauge visitor use on trails (Lynch, Vogt, Cindrity, & Nelson, 2002). Managers participating in the study identified visitor use data as being beneficial for trail planning projects, justifying funding, and day to day trail management. Lynch et al. (2002) also indicated that most managers consider these devices ineffective because of the difficulties associated with installation and calibration. Previous studies have documented that there is some amount of error associated with all automated monitors. Each monitor location has unique physical aspects (i.e., trail slope and trail width) and monitor set-up characteristics that contribute to the amount and variation of monitor counting error. For example, on a wide trail, people walking side by side in groups increases the chances of not all visitors being detected by a mechanical counter. In contrast, narrow trails force people to walk single file and pass a counter one at a time increasing the chances of being detected by a monitor. Likewise, monitors placed in areas where visitors tend to pause, such as overlooks and trail junctions, will count an individual multiple times if they pause within the counter's range of detection. Thus, raw data from automated counters cannot be treated as reliable and accurate measures of visitor use. Rather, calibration through direct observation is required to estimate automated counter data error in order to produce reliable estimates of visitor use.

Many studies have used automated visitor monitors to estimate visitor use (Bates, Wallace, & Vaske, 2007; Dixon, 2004; Gimblett & Sharp, 2005; Gracia-Longares, 2005; Jacobi, 2003; Peters & Dawson, 2004; Takahashi, 2004; Vaske & Donnelly, 2007), however, few of theses studies have documented specific calibration methods. For example, Watson et al. (2000) provide the most thorough description of calibration methods, including discussion of sampling methods to calibrate monitors and basic statistical analyses to estimate visitor use from automated counter data. The authors describe observer-based counting techniques to correct automated monitor counting errors but do not suggest observation lengths (i.e., 30 minutes vs. one hour). Likewise, Bates et al. (2006) used infrared monitors to estimate visitor use in Rocky Mountain National Park and conducted observation-based counts over three days during the 2004 summer season. However, the authors do not identify how observation days were selected or the length of their observations. Both of these studies make strong cases for the need to calibrate automated visitor counters through direct observations in order to calculate accurate estimates of visitor use but lack detail in their methodological descriptions to replicate their efforts.

Other studies have reported strong correlations between observed counts and automated visitor counts. For example, Muhar, Arnberegr, and Brandenburg (2002) present results that show a very strong correlation between monitor counts and observed counts (R^2=0.94) but no details of observation methods to correct monitor counting errors are provided. Thus, there is no way for researchers to replicate this study. Lindsey, Han, Wilson, & Yang (2006) used automated visitor monitors to estimate visitor use on urban trails in Indianapolis, Indiana over a four year period. The authors conducted 442 hours of direct observation at 28 locations with infrared monitors and combined observation data from all locations. Regression analyses were conducted on these observation data to estimate a general correction factor for all counters in the study (r^2=0.99). However, the authors did not calculate standard errors associated with the correction factor. Estimating the uncertainty associated with statistical estimations is important to consider and has been overlooked by many researchers who use automated visitor monitors.

In an unpublished thesis, Gracia-Longares (2005) used automated monitors to estimate visitor use in Yellowstone National Park and examined the effect of observation length to estimate automated visitor monitor correction factors. To estimate monitor counting errors, the author randomly selected which monitor location to observe on a chosen day and conducted 4-hour observations to test the effect of observation length. The author calculated correlation coefficients for 4-hour, 1-hour, 30 minute, and 15 minute observation periods. The highest correlation coefficients were obtained from the longest observation period (4 hours). Correlation values decreased as the duration of the observation period decreased, with the largest decrease in correlation occurring between the 1 hour observations and the 30 minute observations. Moreover, data from all observation lengths produced similar correction factors but the precision of these estimations improved with longer observations. These results suggest that observation lengths should be at least one hour long. However, all of the study sites were relatively low use areas (< 75 people / day), thus, these results may not be applicable to high use areas.

Additional sources of error in automated counter data require systematic treatment to enhance the reliability and validity of visitor use estimates. For example, infrared monitors are subject to error from climatic conditions such as heavy snow, blowing vegetation, visitor tampering, or direct sunlight striking the monitor's "receiving eye" at sunrise or dusk (Vaske, Shelby, & Donnelly, 2008). Typically, erroneous counts of this nature are relatively easy to detect because the data will contain continuous counts suggesting levels of visitor use that far exceed anecdotal knowledge and expectations about visitor use of the area. These data cannot be considered for analysis and must be removed from the dataset. Error in use measurement with automated counters also occurs if data are not downloaded from the counter on a sufficiently regular basis as pass-by events may occur after the memory or data storage capacity of the counter has been reached. One method for treating erroneous data of this nature is to estimate counts for missing data from known counts with similar characteristics. For example, missing data from a given Tuesday can be estimated from the previous and following Tuesday counts (Lindsey & Nguyen 2004; Vaske et al., 2008). This method simplifies calculations of population parameters because all data from the population are accounted for and assumes no errors in parameter estimates. However, this method may not be appropriate for datasets missing more than a few data points because population parameter estimates may result in misleading estimates of statistical precision.

In summary, automated counters are subject to several sources of error. Consequently, raw counter data will always require some form of calibration to generate valid and reliable estimates of visitor use. However, few published studies of visitor use monitoring with automated visitor counters have thoroughly documented methodological procedures and/or empirical results for calibrating automated visitor monitors to produce reliable and accurate estimates of visitor use. Thus, standardized methods to calibrate automated visitor counters are yet to be established.

This paper addresses this limitation of the existing literature on visitor use monitoring by describing systematic sampling and statistical methods for collecting and calibrating visitor use monitoring data with automated counters. Specifically, this paper describes the collection and calibration of automated counter data to monitor current visitor use levels at popular attraction areas within the Merced Wild and Scenic River watershed in Yosemite National Park (NP).

Methods

Study Location

Yosemite NP is centrally located in the Sierra Nevada mountain range in California and protects 285,151 hectares of rugged mountain terrain. Yosemite NP has some of the most spectacular scenery in the National Park Service (NPS) and views of glacier carved valleys can be seen from many locations throughout the park. People from all over the world come to experience Yosemite NP and visitation reached 3.5 million visitors in 2007 (NPS, 2008).

Yosemite Valley (Figure 1) is the most popular destination area in the park, offering iconic views of glacial features, including El Capitan and Half Dome. The Merced River bisects the north and south sides of Yosemite Valley and is designated a Wild and Scenic River in order to protect its free-flowing condition and unique values (NPS, 2005). Vehicle access is along a one-way road that enters from the west end of Yosemite Valley and follows the south side of the Merced River. About 90% of visitors to Yosemite NP arrive by automobile and 87% of visitors cite "taking a scenic drive" as their favorite activity in the park (White & Aquino, 2008).

The design and layout of roads, parking, and facilities within Yosemite Valley were never meant to accommodate the intensive amount of vehicle traffic they receive today. Consequently, traffic congestion in Yosemite Valley is common during periods of peak visitation. For example, on a typical day between May and September, up to 1,900 day use vehicles at a time are in Yosemite Valley competing for approximately 1,200 designated day-use parking spaces. During the summer, the main day-use visitor parking area fills to capacity between 11:00 am and 1:00 pm (National Park Service, 2007). As a result, visitor use at attraction sites during peak hours is very high and causes resource degradation and diminishes the quality of visitors' experiences.

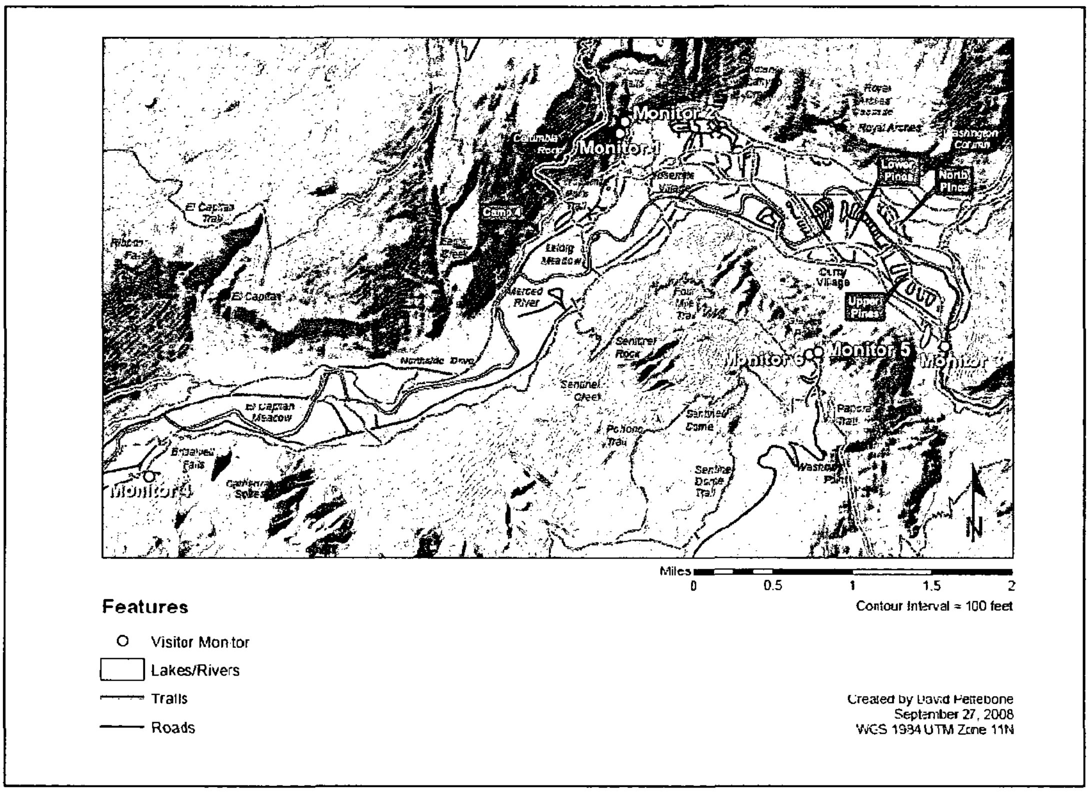


Figure 1. Locations of Yosemite Valley visitor monitors

Equipment

TrailMaster TM1550 active infrared monitors were employed to estimate visitor use at attraction sites and trailheads. These devices are designed to monitor and study wildlife, but have also been successfully applied to recreation use monitoring in protected natural areas (Bates et al., 2006; Gracia-Longares, 2005; Vaske & Donnelly, 2007). The TrailMaster TM1550 monitor system is comprised of a transmitter and a receiver placed on opposite sides of a trail. Infrared energy is emitted from the transmitter in short pulses and is detected by the receiver. The receiver registers a count when the infrared beam is interrupted by the presence of a physical object, such as a hiker. The TM1550 model used in this study stores up to 16,000 counts, with each recorded count containing a date and time stamp accurate to the minute. The study monitors stop registering counts when their memory reaches capacity (i.e., when 16,000 counter events are registered on a single unit). A TrailMaster DataCollector is used to download data from the monitor and to upload data to a personal computer. With each data download, the counter's memory is cleared by deleting the existing data and reset to its maximum storage capacity for the next monitoring period. The data download interval was scheduled for each counter based on the relative intensity of use at each counter location.

Data from TrailMaster monitors were uploaded to a personal computer using TrailMaster Stat Pack software. These data were in a format where each row represents one count. In order to aggregate the raw count data: 1) we exported the TrailMaster data as text files; 2) imported these text data into Microsoft Access; 3) queried these data using structured queried language (SQL) to examine seasonal (June 1-September 30) visitation totals and means, monthly visitation totals and means, mean visitation per day of the week by month, and mean hourly visitation; and 4) queried data were then exported into Microsoft Excel.

Monitor Locations

Monitors were purposively placed at attraction sites and trailheads of interest identified by researchers and Yosemite National Park staff (Table 1). The following criteria were considered when choosing a monitor location: 1) narrow trail sections where visitors were most likely to walk single file; 2) locations with a straight and clear line between transmitter and receiver to ensure a strong signal between the components; 3) sites where monitors could be hidden from trail users so as not to degrade the visitor experience; and 4) away from trail junctions or areas of interest where visitors tend to pause and could potentially be counted multiple times.

Table 1.

Monitor numbers and locations of visitor monitors

Monitor Number	Location	Use Level	Date Placed in Field
1	Yosemite Falls (West)	High	May 19, 2007
2	Yosemite Falls (East)	High	May 19, 2007
3	Vernal Falls Trailhead	High	May 23, 2007
4	Bridalveil Fall	High	May 24, 2007
5	Glacier Point (Main Trail)	High	June 2, 2007
6	Glacier Point (Handicap Accessible Trail)	Low	June 25, 2007

Monitor Calibration Pilot Study

Because of the paucity of information about calibration techniques within existing literature, a pilot study was conducted to estimate the number of sampling hours that would be required to collect the necessary amount of observation data needed to calibrate the visitor monitors. The pilot study was conducted on the Yosemite Falls trail because visitor use changes drastically throughout the day. Visitor use during early morning hours tends to be low while visitor use at midday is much busier. We speculated that visitor monitor correction factors would vary by the level of visitor use. In other words, we expected monitor correction factors to be larger during busy periods because the monitor would not capture individuals when continuous flows of visitors passed the monitor. In addition, the two trails that access the Yosemite Falls area have different widths which could affect how people align themselves as they pass the monitor.

Direction of travel also had to be accounted for because counts from automated counters estimate the total number of visitors passing a monitoring location, but do not account for the direction of travel of passing visitors. Direction of travel needs to be estimated by direct observation and raw counts need to be adjusted before calibrating the data. Additional procedures were needed to account for direction of travel to compute estimates of *arriving* visitors (i.e., site visitation). For the most part, visitors to the study sites arrive and depart at the same location. However, the Yosemite Falls study site offers visitors the opportunity to enter and exit the area at different locations. Consequently, it would be inaccurate to simply assume that the total number of *arriving* visitors at a given access point within these two study sites is equal to one half of all visitor pass-bys recorded at the monitoring location. Furthermore, the proportion of visitor arrivals and departures at the study site access points generally varies across the hours of the day, with a greater proportion of arrivals than departures during morning hours of the day, and the reverse during afternoon hours. To clarify the distinction between total visitor counts and counts of *arriving* visitors, the term "number of people" is used throughout the remainder of this paper to refer to the *total* number of visitors counted passing a monitoring location and the term "visitation" is used to refer to the number of *arriving* visitors counted at monitoring locations.

An automated monitor was placed on each of the two access points to Lower Yosemite Falls and nine one-hour observations of visitor use were conducted from May 20 to May 22, 2007 (Figure 2). Starting times for each of the nine observation periods were randomly selected, ranged from 7 am to 6 pm, and occurred on the hour. One observer was stationed next to each of the two automated monitors to assess each device's performance and collect calibration data. The observers recorded data in 15-minute intervals on a standardized form that included entries for: 1) observed visitor arrival and departure counts; and 2) automated monitor counts recorded at the beginning and end of each observation period.

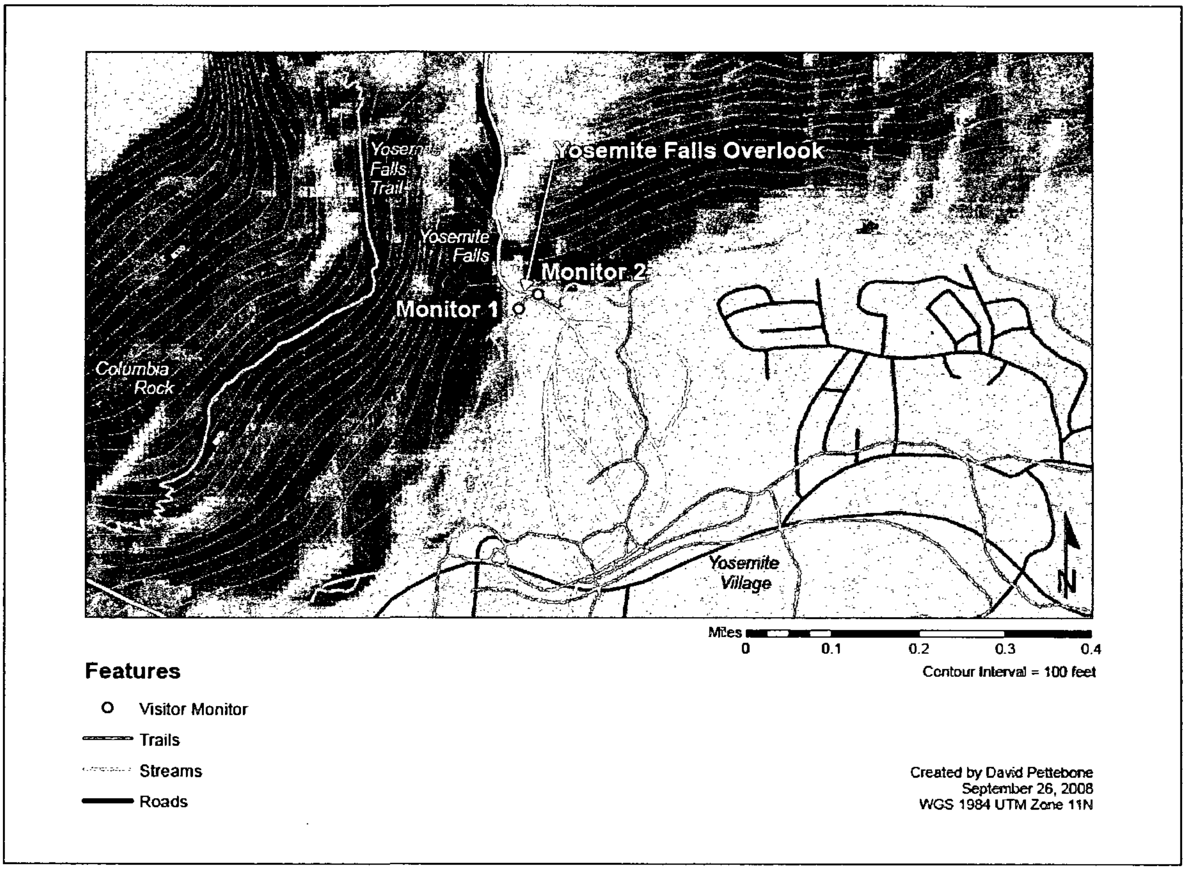


Figure 2. Location of automated counters on the trail to Yosemite Falls

For analysis purposes, observation-based and automated monitor counts of visitor use were each aggregated into single observations of hourly visitor use. Hourly visitor use counts, based on human observation and the automated counters, were entered into Microsoft Excel to calculate daily visitor use totals and means for the three-day sampling period. Plots of the data for each of the two automated monitors are depicted in Figure 3.

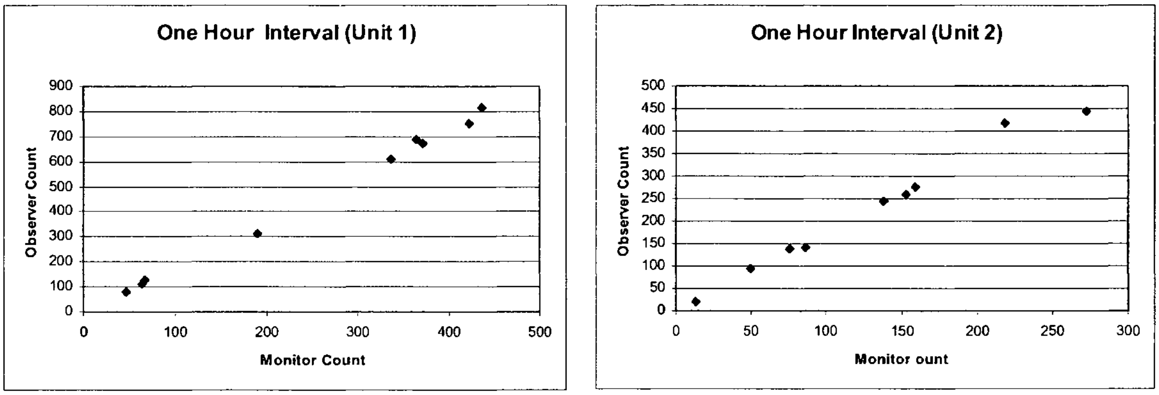


Figure 3. Plots of hourly visitor use counts, based on pilot test observer and automated counter data

The plots of these data showed that ratio estimation is an appropriate method to estimate visitor use at Yosemite Falls. Ratio estimation is a statistical method commonly used in government, business, and academic research to estimate population parameters from two highly correlated variables (Scheaffer, Mendanhall III, & Ott, 2006). Ratio estimation requires the measurement of two highly correlated variables for each observation in the sample (Scheaffer, et al., 2006). In addition, ratio estimation requires the data to pass through the origin and to have a "funnel" shape where the data closer to the origin is more correlated than data further from the origin. The plots in Figure 3 suggest the pilot study data have the necessary characteristics for ratio estimation, thus, we calculated the required observation sample size based on ratio estimation techniques.

Calculating Correction Factors

For all automated counters, linear regression models with the regression line forced through the origin were estimated with automated visitor monitor counts of hourly visitor use entered as the independent variable and observation-based counts of hourly visitor use specified as the dependent variable. Regression lines were forced through the origin in order to apply regression estimation techniques to calibrate monitor counts. The estimated regression coefficient for the independent variable serves as the correction factor (r) for converting raw counter data to estimates of site visitation.

Calibration procedures used for study sites with single monitors could not be used for the two sites with multiple monitors because each of the monitors at a multi-monitor site has a unique r and standard error of r (SE_r) value. Moreover, the relative amount of use varies at each access point within a multiple monitor site, thus, visitor use counts from each monitor have differently weighted contributions to estimates of mean and total visitor use. To address this, we adapted single-monitor site methods to estimate weighted values of r and the SE_r for each automated monitor within each multiple-monitor site, based on the relative number of raw counts recorded by each monitor. First, regression models were estimated separately for each monitoring location, with automated counter measures of hourly visitor use entered as the independent variable and observed-based counts of hourly visitor use specified as the dependent variable. Regression results provided calibration factors for each monitor, which were entered into a pair of equations to estimate composite calibration factors and standard errors, based on weighting regression results from each monitor. Study data from Yosemite Falls are used in the following set of equations to demonstrate the procedures used to estimate weighted calibration factors for monitors within multiple-monitor study sites:

$$r_{combined} = \frac{(r_{unit1} \cdot \hat{\tau}_{unit1}) + (r_{unit2} \cdot \hat{\tau}_{unit2})}{\hat{\tau}_{combined}} = \frac{(1.83125 \cdot 228{,}831) + (1.66902 \cdot 138{,}689)}{367{,}520} = 1.77003$$

$$SE_{r(combined)} = \frac{(SE_{r(unit1)} \cdot \hat{\tau}_{unit1}) + (SE_{r(unit2)} \cdot \hat{\tau}_{unit2})}{\hat{\tau}_{combined}} = \frac{(.01808 \cdot 228{,}831) + (.01704 \cdot 138{,}689)}{367{,}520} = .01769$$

Calculating Visitor Use from Monitor and Calibrations

Visitor use was monitored at the Vernal Falls trailhead and at Bridalveil Fall with a single automated counter at each site, while multiple devices were used to monitor use at Yosemite Falls and Glacier Point. Data from locations with multiple monitors needed to be combined to calculate estimates of visitor use. Raw count data from the automated monitors at sites with multiple devices were combined for all days when neither automated counter contained missing data. Data collected on days when one or both monitors contained missing data were excluded from analysis. In other words, we only considered days where data were available from both monitors.

Data was collected from the mechanical counters between June 1 and September 30, 2007. However, some counter data was lost during the season because the counter's memory occasionally reached capacity. Instead of substituting means for missing data, we chose to estimate the uncertainty associated with the missing data. Examination of the data revealed most of the data to be positively skewed, thus, classic statistical methods were not appropriate to estimate means and totals for raw monitor counts. Therefore, we used bootstrapping methods to estimate means for raw counts from monitors with incomplete data.

Bootstrapping is a resampling method to make statistical inferences from a distribution that approximates the distribution of a population (Crawley, 2005; Scheaffer et al., 2006). In this case, the approximating distribution is the incomplete dataset of monitor counts and the population distribution is the complete monitor counts. The approximating distribution is randomly sampled (of equal size to the original dataset) with replacement many times (i.e. 1,000+ times) to estimate statistical parameters (means in this case). A distribution of means is obtained from the 1,000+ samples and the mean of this distribution is the estimated mean for the population. A 95% confidence interval for the mean is obtained by identifying values for the 97.5% and 2.5% quantiles. Confidence intervals calculated from bootstrapping are typically asymmetric, reflecting the skewness in the data. In contrast, confidence intervals from classic statistical methods are symmetric, regardless of the distribution of the data.

We created a script using the 'R' statistical program to resample the data 10,000 times to obtain the mean and 95% confidence intervals of the mean. Based on these estimates, the following formulae were used to calibrate mean estimates of raw counts in order to estimate mean visitor use at each monitor:

$$\hat{X} = (r) \cdot (\hat{x}) \tag{1}$$

$$Var(r) = [SE(r)]^2 \tag{2}$$

$$Var(\hat{X}) = (\hat{x})^2 \cdot Var(r) \tag{3}$$

$$B(\hat{X}) = 2 \cdot \sqrt{Var(\hat{X})} \tag{4}$$

$$CI(\hat{X}) = \hat{X} \pm B \tag{5}$$

Where:

$\hat{X}$	=	calibrated mean monitor count
r	=	ratio factor
$\hat{x}$	=	estimated mean monitor count
Var	=	variance
SE	=	standard error
B	=	bounds of estimation
CI	=	confidence interval

Figure 4. Equations used to calibrate data from all study sites

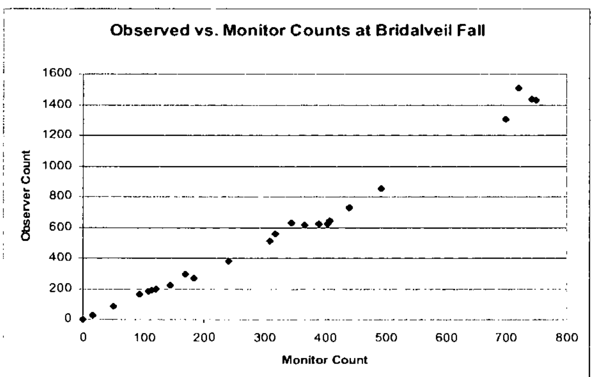
Equations 1 – 5 describe ratio estimation techniques to calibrate the mean raw monitor counts. These equations were also used to calibrate the 95% confidence intervals of the mean derived from the bootstrapping estimates. In addition, to estimate use at sites with multiple automated monitors, we modified the script in 'R' to calculate combined r and SE_r values for the amount of use contributed from each monitor. Combined r and SE_r values change slightly for each analysis (i.e., seasonal use estimation vs. monthly) because each monitor's contribution changes slightly for each time period.

Results

Monitor Calibration

Monitor errors were consistent at all times of the day for both weekend and weekdays based on our pilot study. Therefore, we used a simple random sampling scheme to select observation hours. We randomly selected six days between June 1 – August 31 and randomly selected four hours within each selected day between 7 am and 6 pm to observe monitor performance. Based on this sampling design, we collected 24 hours of observation data at monitors 1-5 and 15 hours at monitor 6.

All monitors performed consistently well and monitor counts were highly correlated with observed counts. Scatterplots of observed counts and monitor counts at Bridalveil Fall (Unit 4) and Glacier Point (Unit 5) demonstrate this strong relationship (Figure 5). The same strong relationship between observed and monitor counts was found at all of the other study sites.



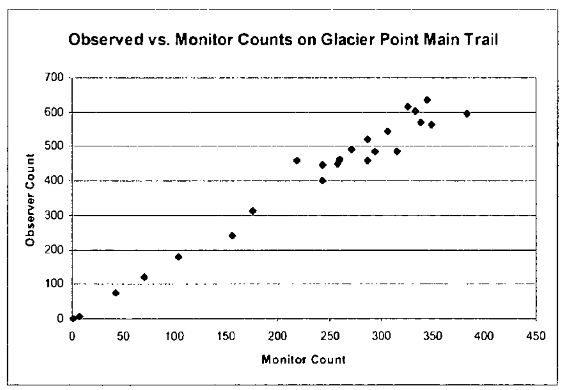


Figure 5. Scatterplots of observed versus monitor counts for the Bridalveil Fall trail and Glacier Point main trail

Direction of travel was estimated from our observation data at the daily time scale and found that arrivals were equal to departures. Thus, raw daily monitor counts were multiplied by 0.5 before calibrating raw monitor counts to estimate visitation. However, not enough data was collected during our direct observations to estimate visitation at the hourly time scale. Therefore, data from a concurrent study to model visitor use at Yosemite Falls was used to estimate arrival/departure proportions at the hourly time scale (Lawson et al., 2008b). Researchers working on this study collected arrival/departure data from 7 am through 9 pm over 5 days in July, 2007 and found that arrivals and departures were equal at the hourly time scale at Yosemite Falls. Thus, we multiplied raw hourly monitor count data by 0.5 to estimate hourly visitation at Yosemite Falls.

The scatterplots of observed counts versus monitor counts confirmed our choice to use regression estimation techniques to calibrate monitor data. Thus, simple linear regression models with the regression line forced through the origin were estimated and produced very strong model fits (Table 3).

Table 3.

Regression analysis results with regression line forced through origin for monitors 1-6.

Unit	β^*	*SE*	R^2	*df*	*F*	*p*
1	1.83125	.01808	.9977	1,23	10,025	<.001
2	1.66902	.01704	.9976	1,23	9,588	<.001
3	1.70400	.01900	.9973	1,22	8,036	<.001
4	1.82560	.03570	.9917	1,22	2,615	<.001
5	1.72431	.02707	.9944	1,23	4,057	<.001
6	1.56545	.08539	.9600	1,14	336	<.001

* The regression coefficient (β) was used to estimate monitor correction factors (*r*).

Estimated Use

This section of the paper presents estimates of total seasonal visitation for each study site. Calibrated seasonal visitor use totals estimated from bootstrapping are presented along with the calibrated lower and upper bounds of the bootstrap estimation. Data from units 1 and 2 were combined to estimate use at Yosemite Falls and data from units 5 and 6 were combined to estimate use at Glacier Point (Table 4).

Table 4.

Visitation at individual monitors (June 1-September 30)

Unit/ Location	Total Number of Days	Number of Days with Data	Total	Lower Bound of Bootstrap Estimation	Upper Bound of Bootstrap Estimation
1	122	118	233,335 ± 4,607	213,311 ± 4,212	253,809 ± 5,012
2	122	112	126,040 ± 2,574	116,071 ± 2,370	136,414 ± 2,785
3	122	92	246,606 ± 5,499	228,771 ± 5,102	265,752 ± 5,926
4	122	105	295,613 ± 11,561	276,514 ± 10,815	313,994 ± 12,280
5	122	99	331,862 ± 10,420	318,749 ± 10,008	345,065 ± 10,834
6	122	82	5,145 ± 561	4,721 ± 515	5,574 ± 608
Yosemite Falls	122	112	354,423 ± 7,083	324,316 ± 6,482	384,278 ± 7,680
Glacier Point	122	75	346,500 ± 11,273	330,631 ± 10,756	362,154 ± 11,782

Daily visitor use is presented in Table 5. Bootstrapping techniques were not used to estimate use for Tuesday, Wednesday, and Thursday because all data was collected for those days and population parameters did not need to be estimated.

Table 5.

Mean daily visitation at Yosemite Falls (Season)

Day	Total Number of Days	Number of Days with Data	Total	Lower Bound of Bootstrap Estimation	Upper Bound of Bootstrap Estimation
Monday	17	14	2,857 ± 57	2,218 ± 44	3,488 ± 70
Tuesday	17	17	2,693 ± 54	-	-
Wednesday	17	17	2,717 ± 54	-	-
Thursday	17	17	2,625 ± 52	-	-
Friday	18	17	2,827 ± 56	2,206 ± 44	3,442 ± 69
Saturday	18	15	3,633 ± 73	2,819 ± 56	4,481 ± 90
Sunday	18	15	3,075 ± 61	2,409 ± 48	3,787 ± 76

Daily and hourly visitation at Yosemite Falls are presented in Figure 6 to demonstrate how visitor use estimates for different time segments can be presented.

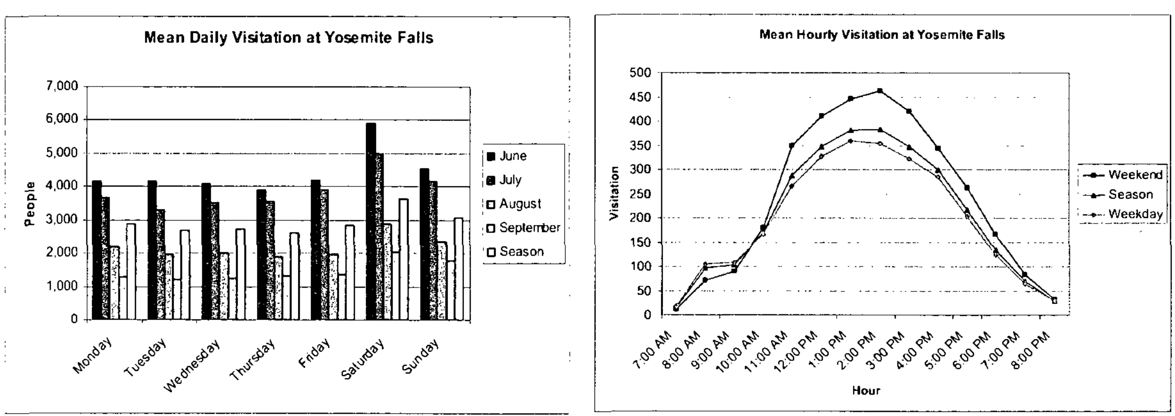


Figure 6. Seasonal estimates for mean daily and mean hourly visitation at Yosemite Falls

Discussion

This study shows that automated visitor counters produce consistent data from which reliable estimates of visitor use can be calculated. These results provide important insights for researchers and park managers using these devices to estimate visitor use in parks and protected areas. Moreover, the methods described in this paper provide a comprehensive system to collect observation data to calibrate automated visitor counters and produce accurate estimates of visitor use.

Monitor Calibration

At all study sites, automated monitor counts were highly correlated to observation based counts. Regression models calculated from these data produced R^2 values greater than 0.95 and significant p-values indicate that all regression coefficients (r) were statistically different than 1. These results show that automated visitor counters produce consistent estimations of visitor use but raw monitor counts need to be corrected to obtain accurate estimations of visitor use. Moreover, each automated visitor counter had a unique r and SE_r value suggesting that monitor error is related to local conditions such as slope, trail width, and trail condition and not related to amount of use because hikers tend to align their travel across a trail section according to a trail's immediate condition. For example, visitors will walk in a group formation on wide trail sections while narrow trail sections dictate that groups walk side by side or in single file.

Consistent with Gracia-Longares (2005), we found our correction factors became less variable as the observation period increased. Large amounts of visitor traffic were often under-counted during short periods of time (15 minutes or less), however, these errors were generally offset over the course of an hour by periods when individuals and small groups would be accurately captured by the monitor. Similarly, people walking side by side during low use periods only triggered a single count. Again, these errors tended to even out over the course of an hour.

Treatment of Missing Data

Bootstrapping was found to be an effective method for treating missing data and offers three advantages over replacing missing values with means. First, bootstrapping does not require a set of rules to determine how mean values are obtained. Typically, mean values to replace missing data are calculated from the same day of the week from the previous and following weeks of a missing count. However, there are potential shortcomings to replacing missing values with means. For example, holidays can affect the results of these calculations or force the researcher to modify the rules from which the mean is obtained (e.g., the Monday before or after Labor Day). In addition, replacing missing data with mean values may not be possible for datasets with more than a few missing points because days from which means are calculated may be missing. Second, bootstrapping is robust to the amount of missing data because population parameters can be estimated from datasets missing more than a few data points. Third, confidence intervals can be obtained to estimate the error of a population parameter using bootstrapping. In other words, bootstrapping provides a way to quantify the uncertainty from datasets with missing values.

Implications

These results show that automated visitor monitors can provide data to accurately estimate visitor use in parks and protected areas. All of the monitors used in this study were subject to counting errors. However, counting errors were consistent at each monitor for all times of day and all days of the week, and, correction factors calculated from observed counts and automated monitor counts resulted in accurate estimates of visitor use. Thus, researchers and managers who choose to use automated monitors to estimate visitor use need to provide personnel to collect direct visitor counts. The necessity of this step cannot be underestimated because counts from automated monitors that are not calibrated cannot be considered a proxy for visitor use estimates.

One hundred and thirty-five hours of direct observations were collected for the 6 monitors used in this study. Data were obtained during all of these hours because all of the study sites were high use areas. However, direct observations to calibrate automated monitors in low use areas may not produce counts during some observation periods. Nonetheless, it is necessary to obtain these data in order to accurately estimate visitor use. We suggest obtaining a minimum of 5 hours of usable observations (i.e. monitor counts and observation counts are greater than 0) to calibrate data from automated visitor counters. This will provide a reasonable estimation of r and SE_r from which estimations of visitor use can be derived. Estimations of visitor use derived from automated visitor counters without estimating these parameters should be considered suspect.

In summary, automated visitor counters are a useful tool to collect data about visitor use. These devices can collect data continually over long periods of time (i.e., months) and provide important insights into temporal patterns of visitor use. Moreover, the relatively low cost of these devices (approximately $400/ device) makes this an affordable tool for park managers to collect data about visitor use. However, these devices require calibration through direct observation in order to calculate accurate estimations of visitor use. Collecting visitor counts through direct observation can be time-consuming and managers and researchers who use automated visitor monitors must allocate personnel to collect these data.

Conclusion

Baseline data on visitor use is essential to the planning and management of national park units. Area administrators must be knowledgeable about the amount, types, locations, and behaviors of visitor use. Such information is fundamental to address a variety of visitor-use related issues, including visitor use capacity. Recently, automated visitor counters have become an accepted method for estimating visitor use in parks and protected areas. However, few studies provide thorough methodologies to correct raw monitor counts in order to calculate estimates of visitor use. This paper provides methodologies to obtain direct observation counts and calculate correction factors in order to estimate visitor use from automated visitor counters. Moreover, we found automated monitors performed consistently well at all study sites and during all time periods. The findings in this paper provide a methodological base for researchers and park managers interested in using automated visitor counters to estimate visitor use in parks and protected areas.

CHAPTER III

Modeling Visitor Use at Recreation Sites from Vehicle Traffic Entrance Counts in Yosemite National Park

Introduction

Understanding visitor use patterns and trends is crucial to visitor management planning in national parks. Knowing when and where visitor use tends to occur can help park managers determine if park/agency management objectives are being met and allocate resources where deficient conditions are found. The spatial and temporal distributions of visitor use have been examined by recreation researchers and findings show that visitor use is unevenly distributed across spatial and temporal scales (Cole, 1996; Glass & Walton, 1995; Lucas, 1980; Manning & Powers, 1984; Pettebone, Newman, Beaton, Gibson, & Stack, 2008; Roggenbuck & Lucas, 1987). For example, Lucas (1980) found that approximately 80% of all visitor use occurred on approximately 50% of the trails in the Spanish Peaks Wilderness. Likewise, Glass and Walton (1995) found that average daily recreation use on the Pemmigewasset and Swift river drainages was twice as high on weekends and holidays than on weekdays during parts of the year.

Although information about visitor use is useful for park planning, estimating the amount of visitor use in parks and protected areas is challenging because standardized methods and protocols to collect visitor use data are not well established and collecting these data can be costly (Loomis, 2000; Hollenhorst, Whisman, & Ewert, 1992). Land managers cite logistical problems, lack of personnel time, and the lack of quantitative analytical skills in agencies as barriers to collecting accurate visitor use data (Watson, Cole, Turner, & Reynolds, 2000). Due to these challenges, many land managers rely on "best guess" estimates or coarse measurements to quantify visitor use (Loomis 2000; Watson et al., 2000). For example, the National Park Service (NPS) collects inbound vehicle traffic counts at entrance stations using automated vehicle traffic counters. While these data provide general information about visitor use trends at a park-wide scale, they do not provide much information about visitor use levels at specific sites within a park. Thus, this level of information is not adequately precise to inform indicator-based adaptive management, the planning strategy adopted by the NPS to protect natural resources and visitor experiences.

Indicator-based adaptive management is a systematic planning framework to facilitate visitor use capacity decisions and has become widely used by park managers and recreation researchers (Manning, 1999). A number of indicator-based adaptive management planning frameworks have been developed and although the implementation of each differs slightly there are a number of commonalities among approaches (Manning, 1999): 1) formulation of specific management objectives or desired future conditions; 2) developing measurable indicators of natural resource or social condition change; 3) setting standards of quality that reflect minimum acceptable conditions; 4) active monitoring to determine if management objectives are being met. Development of indicators is the key element in this process that links desired natural resource and social conditions to active visitor use monitoring. Typically, indicators are defined as specific, measurable, and manageable variables that reflect the essence of management objectives

(Manning, 1999). Because the nature of indicators is specific and quantitative, indicators and related standards of quality need to be spatially and temporally explicit. Thus, visitor use needs to be measured at a site specific level (e.g. an attraction site or trailhead) to effectively implement an indicator-based adaptive management strategy.

Recently, automated visitor counters have become a widely used method to estimate visitor use at a recreation sites. These devices provide managers a relatively easy and efficient method to track visitor use in parks and protected areas and provide managers with important descriptive information that can be used to manage for desired conditions. However, these data simply identify trends that may or may not represent real time conditions at a location. Consequently, strategies developed from these data may be too general to effectively manage visitor use since visitor use is dynamic and can change from day to day or hour to hour.

Park managers need methods to estimate real time visitation at recreation sites in order to manage visitor use effectively. Furthermore, a visitor use monitoring program that included predictive estimations of visitation would offer park managers options to proactively manage visitor use. The purpose of this paper is to illustrate such a method using relatively easy-to-collect inbound traffic data to predict visitation at popular recreation sites in Yosemite National Park that are subject to crowding and natural resource impacts. The research described in this paper involved collection of inbound traffic counts at entrance stations, visitor use counts with automated visitor counters at popular recreation sites, and statistical analyses to model the relationships among the traffic and site visitation data. The outcome of this effort is a pragmatic monitoring tool that allows Yosemite National Park managers to estimate site specific visitation at an hourly temporal scale (Figure 1).

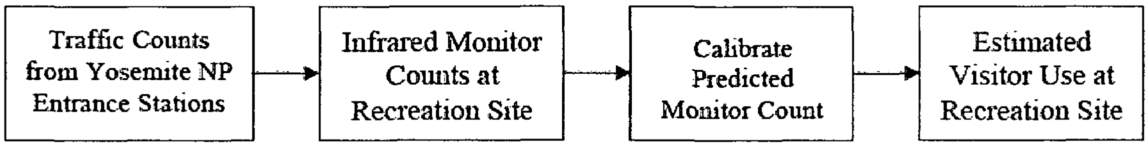


Figure 1. Conceptual model to estimate visitor counts at Yosemite Falls

Previous Work Modeling Visitor Use

Understanding the spatial and temporal variation in visitor use allows managers to answer important management questions. For example, are current visitor use patterns consistent with resource protection and visitor use experience objectives? Moreover, it is particularly important for agencies like the NPS with legal mandates to protect natural resource conditions and visitor experiences to base visitor use management decisions on scientifically credible information. To meet this need, recreation researchers and land managers are exploring ways to model visitor use in order to monitor baseline conditions, estimate appropriate levels of visitor use, describe the consequences of management alternatives, and communicate these consequences to the public (Cole, 2005).

Visitor use modeling has been of interest to park managers and recreation researchers for the last forty years (Hollenhorst et al., 1992; Cole, 2005). The earliest efforts attempted to estimate visitor use in campgrounds and recreation sites using vehicle traffic counts (James & Quinkert, 1972; Tombaugh & Love, 1964; Wagar & Thalheimer, 1969). These early efforts suggested strong statistical relationships between inbound vehicle traffic counts and recreation site visitation. For example, Tombaugh and Love (1964) examined the relationship between automated vehicle traffic counter estimates and total number of visitors in national forest campgrounds as estimated by field personnel. Results from correlation analyses showed strong relationships ($r = 0.807$). Similarly, Wagar and Thalheimer (1969) used vehicle traffic counts from automated vehicle counters to explain the variability in campground site visitation. Results suggested good model fits with errors ranging from 11.6% – 29.4%. However, Wagar and Thalheimer (1969) suggest that estimating visitor use solely from observations is time-consuming and inefficient and that future modeling efforts would benefit from automated methods to estimate visitor use.

More recently, technological advances, such as the personal computer and automated visitor counting devices, have allowed researchers to develop more sophisticated methods for modeling visitor use. For example, recreation researchers now use computer simulation modeling to estimate current visitor use patterns and test different hypothetical scenarios. There are two commonly used software packages used in visitor use simulation modeling: Extend (1996) and RBSim (Itami et al., 2002). Both of these programs use relatively easy-to-obtain visitor arrival and route data from visitors at trailheads to estimate use conditions throughout a dispersed geographic area. Computer simulation modeling of visitor use is becoming more commonplace in visitor use research and has been used in several national parks including Yosemite National Park (Lawson et al. 2008b), Grand Canyon National Park (Daniel & Gimblett, 2000), and Arches National Park (Lawson, Manning, Valliere,Wang, & Budruk, 2002).

Automated visitor monitors are also becoming a common tool for researchers to estimate visitor use. These devices are more efficient than direct observations and produce precise estimates of visitor use (Pettebone et al., 2008). Moreover, data from automated monitors have been used to further the statistical modeling techniques developed by early recreation researchers (Federal Highway Administration, 1999; Lindsey & Lindsey, 2004; Lindsey, Han, Wilson, & Yang, 2006, Lindsey, Wilson, Rubchinskaya, Yang, & Han, 2007). For example, Lindsey et al. (2006) used temporal, weather, demographic, and urban form as independent variables and estimates of visitor use from automated monitors as the dependent variable in a multiple linear regression model to predict urban trail use in Indiana (R^2=.7966). Our study extends the use of statistical modeling to explain visitor use at recreation sites by examining the effects of temporal variability on the relationship between the inbound vehicle traffic at vehicle entrance stations and visitation at recreation sites.

Methods

Study Location

Yosemite National Park is located in central California and protects 285,151 hectares of the central Sierra Nevada mountain range. Yosemite National Park has four entrance stations where vehicles can enter the park (Figure 3). The Big Oak Flat and Arch Rock entrances provide access to vehicles entering from the west side of the park, the Wawona entrance provides vehicle access from the south side of the park, and the Tioga Pass entrance provides vehicle access approaching from the east side of the park. About 90% of visitors to Yosemite National Park arrive by automobile and 87% of visitors cite "taking a scenic drive" as their favorite activity in the park (White & Aquino, 2008). The park offers visitors a wide range of activities including day hiking, rock climbing, and backcountry camping and hosts upwards of 3.5 million people annually (NPS, 2008).

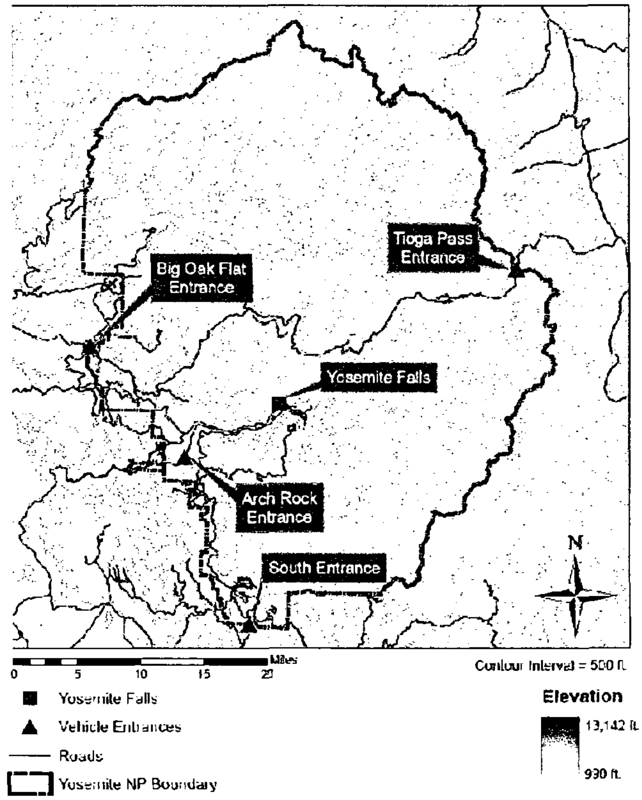


Figure 3. Locations of entrance stations in relation to Yosemite Falls in Yosemite National Park

Yosemite Valley is a very popular destination within the park and offers visitors spectacular views of iconic features such as Half Dome, El Capitan, and Yosemite Falls. Visitors flock to the valley to experience and photograph these areas, and, during busy times attraction sites and trails become very crowded. In particular, the lower Yosemite Falls viewing area offers visitors easy access to impressive views of this iconic 3,000 foot waterfall. High visitor use is common at the base of the falls, especially during peak use times. A loop trail with two entrance points provides visitors access to the base of the falls where a formal viewing area is provided by the NPS.

Inbound Vehicle Traffic Counts

Inbound vehicle traffic data for the season was provided by Yosemite National Park staff. Vehicle traffic counts were collected using the Pegasus Vehicle Traffic Counter (Diamond Traffic Products, Oakridge, OR) that uses inductive loop-magnetic field detection to count vehicles. An inductive loop is buried beneath the road surface and emits a magnetic field. A count is recorded when the magnetic field is disturbed by a passing vehicle and traffic counts can be aggregated at a specified time interval (e.g. by hour or day). Data are retrieved by a field technician using a laptop computer and stored in a Microsoft Excel format.

As a matter of protocol, the park collects hourly traffic counts at each of the four entrance stations. However, traffic counts were not available for the Wawona entrance station due to equipment malfunctions. Therefore, only vehicle traffic count data from the Big Oak Flat, Arch Rock, and Tioga Pass entrances were considered for the following analyses. Data from these three entrances were combined and used as an explanatory variable to estimate visitor use counts at Yosemite Falls.

Recreation Site Visitation Counts

National park units are required to gather information about visitor use. However, few parks have monitoring programs to collect such data (Watson et al., 2000). Recently, Yosemite National Park administrators and university researchers have put substantial effort towards quantifying and characterizing visitor use in Yosemite Valley (Pettebone et al., 2008). Visitor use was estimated at: 1) attraction sites in Yosemite Valley including Yosemite Falls, Bridalveil Fall, and Glacier Point; and 2) trailheads including Vernal Falls, Lyel Canyon, Cathedral Peaks, Glen Aulin, and Hetch Hetchy. Visitor use was estimated for different time scales (i.e. seasonally, monthly, daily, and hourly) to provide insights into typical visitor use patterns and results suggest that the amount of visitor use varies over the course of a day. Although the time of peak visitor use stayed the same between weekends and weekdays at each study site, the amount of visitor use during hours of peak use were higher on weekends than weekdays (Figure 1). These results suggest that the timing of visitor use at attraction spots and trailheads may be related to park infrastructure such as road networks and trailhead locations and is the basis for the study presented in this paper. For the purposes of demonstrating this methodology, the remainder of this paper focuses on Yosemite Falls.

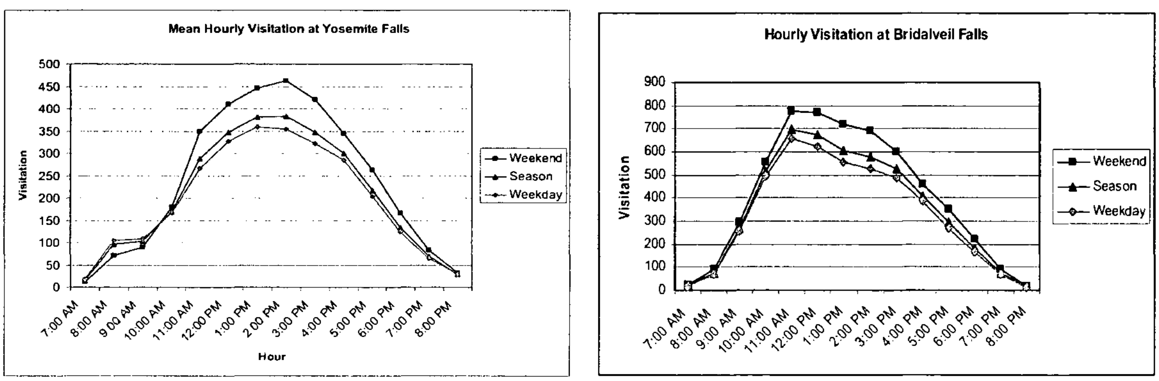


Figure 2. Mean visitation by hour at Yosemite Falls and Bridalveil Fall during 2007 summer season (June 1 – Sept. 30)

Visitor use was estimated at the Lower Yosemite Falls viewing area using TrailMaster TM1550 active infrared monitors. The TM1550 was originally designed to monitor wildlife but has become a commonly used device to monitor visitor use in parks and protected areas (Bates, Wallace, & Vaske, 2006; Gracia-Longares, 2005; Titre, Bates & Gumina, 2004; Vaske & Donnelly, 2007). The TrailMaster TM1550 monitor system is comprised of a transmitter and a receiver placed on opposite sides of a trail. The transmitter emits infrared energy in short pulses that are detected by the receiver. A count is registered by the receiver when the infrared energy is disrupted by a physical object (i.e. a hiker). The TM1550 monitor used in this study is able to store up to 16,000 counts with a date and time stamp included for each count. Monitors stop registering counts when memory capacity is reached (i.e. 16,000 counts are registered). A TrailMaster DataCollector is used to download data from each monitor and to upload data to a personal computer. With each data download, the counter's memory is reset to its maximum storage capacity for the next monitoring period by deleting the existing data. The data download interval was scheduled for each counter based on the relative intensity of use at each counter location.

Data from the TrailMaster DataCollector were uploaded to a personal computer using TrailMaster Stat Pack software. These data were in a format where each row represents one count. In order to aggregate the raw count data: 1) TrailMaster data were exported as text files; 2) these text files were then imported into Microsoft Access; 3) data were queried in Microsoft Access using structured queried language (SQL) to obtain aggregated hourly monitor counts; and 4) queried data were then exported into Microsoft Excel.

Because there are two points of access to the Lower Yosemite Falls viewing area, infrared monitors were installed at each access point. In order to estimate overall use at the Lower Yosemite Falls site, raw monitor count data were combined for all days when neither automated counter contained missing data. Data collected on days when one or both monitors contained missing data were excluded from analysis. These data were combined with Yosemite National Park entrance count data into a single table in Microsoft Excel and then imported into the statistical program 'R' for further analyses.

Calibrating Raw Infrared Monitor Counts

Previous research using infrared monitors to estimate visitor use at recreation sites show that monitor counts need to be calibrated in order to produce accurate estimates of visitor use (Bates, Wallace, & Vaske, 2006; Lindsey & Lindsey, 2004; Pettebone et al. 2008). Each monitor location has unique physical aspects (i.e. trail slope and trail width) and monitor set-up characteristics that contribute to monitor miscounts. For example, on a wide trail, people walking side by side in groups increases the chances of not all visitors being detected by an automated visitor counter. In contrast, narrow trails force people to walk single file and pass a counter one at a time increasing the chances of an individual being detected by a monitor. Likewise, monitors placed in areas where visitors tend to pause, such as overlooks and trail junctions, will count an individual multiple times if they pause within the counter's range of detection. Thus, raw monitor counts cannot be considered an accurate measure of visitor use and correction factors need to be derived for automated visitor monitors from direct observation.

Direction of travel also had to be accounted for because counts from automated counters estimate the total number of visitors passing a monitoring location but do not account for the direction of travel of passing visitors. Thus, direction of travel needs to be estimated by direct observation and raw counts need to be adjusted before calibrating the data to compute estimates of *arriving* visitors (i.e., site visitation). Typically, visitors arrive and depart at trailheads and attraction sites at the same location. However, there are two access points at the Lower Yosemite Falls viewing area where visitors can enter and exit. Thus, one cannot simply assume that the total number of *arriving* visitors at an access point is equal to one half of all visitor monitor counts recorded at that same access point. Furthermore, the proportion of visitor arrivals and departures at each access point tends to vary throughout the course of a day, with a greater proportion of visitors arriving during the morning and a greater number of visitors departing during the afternoon hours. To clarify the difference between total number of people and arriving visitors, we use "number of people" to describe the total number of people passing a visitor monitor (regardless of their direction of travel) and "visitation" to describe the number of visitor arrivals at a visitor monitor location.

Twenty-four hours of observations were conducted at each access point to estimate correction factors for each monitor. Six days were randomly selected between June 1 and August 31 for observations and four random hours between 7:00 am and 7:00 pm were chosen for observations during each selected day. All observations were conducted over a one hour period. These observations produced enough data to estimate correction factors for each monitor but not enough data to estimate direction of travel at an hourly rate. To address this limitation, data from a concurrent study at Yosemite Falls to model visitor use patterns was used to estimate direction of travel (Lawson et al., 2008b). Lawson et al. (2008b) collected visitor arrival/departure data at Yosemite Falls from 7 am through 9 pm over 5 days in July, 2007.

In order to estimate overall visitor use at Yosemite Falls, data from each visitor monitor needed to be combined. However, each monitor has a unique correction factor (r) and error associated with its correction factor (SE_r). Moreover, each access point contributes a different proportion to overall visitor use at Yosemite Falls. To address this, weighted values of r and the SE_r were calculated to estimate visitor use at Yosemite Falls from infrared visitor monitors. First, linear regression models were estimated for each single monitor with raw monitor counts of visitor use input as the independent variable and observed visitor counts input as the dependent variable. Regression coefficients estimated from each model provided correction factors (r) for each monitor. Next, we calculated a weighted estimate of r and SE_r based on the amount of use contributed by each single monitor location to overall use at Yosemite Falls (Figure 4).

$$r_{combined} = \frac{\left(r_{unit1} \cdot \hat{\tau}_{unit1}\right) + \left(r_{unit2} \cdot \hat{\tau}_{unit2}\right)}{\hat{\tau}_{combined}} \qquad (1)$$

$$SE(r)_{combined} = \frac{\left(SE(r)_{unit1} \cdot \hat{\tau}_{unit1}\right) + \left(SE(r)_{unit2} \cdot \hat{\tau}_{unit2}\right)}{\hat{\tau}_{combined}} \qquad (2)$$

Where: r = calibration regression coefficient

SE_r = Standard error of calibration regression coefficient

$\hat{\tau}$ = Uncalibrated monitor count

Figure 4. Equations to estimate r and SE_r at locations with two visitor monitors

Modeling Inbound Traffic to Site Visitation

There are a number of assumptions that need to be considered when developing multivariate statistical models. For example, discrete dependent variables, such as count data, sometimes respond like continuous variables and ordinary least squares (OLS) regression analyses produce unbiased estimations. However, OLS assumes the outcome variable to be a continuous value and using OLS to model count data can produce inconsistent and inefficient estimates (Indiana University, 2006). Consequently, there are four problems that can arise using OLS regression for modeling count data (Crawley, 2005): 1) linear regression models may produce negative counts; 2) the variance in the response may increase with the mean; 3) errors may not be distributed normally; and 4) zeros are difficult to deal with in transformations. To address these issues, nonlinear models such as Poisson and negative binomial regression have been developed to model count data (Indiana University, 2006). Both methods use a log-linear relationship between the mean and linear predictor (Zeilis, Kleiber, & Jackman, 2008). Predicted values from Poisson and negative binomial regression are expressed in logs and must be anti-logged for interpretation (Kutner, Nachtsheim, & Neter, 2004). The advantage of this method is that the log-linear relationship ensures predicted count values are positive.

The Poisson distribution is the simplest distribution used to model count data. Variance in the Poisson model is assumed to be equal to the mean and thus the dispersion parameter is equal to 1. Typically, Poisson models are useful for describing the mean of a distribution but underestimate variance (Zeilis et al., 2008). The negative binomial distribution makes no assumptions about variance and dispersion and it allows for more variability in the data (Dallal, 2008). Thus, negative binomial regression is a common method to model count data with large variances. In addition, negative binomial regression is an effective method for modeling temporally or spatially aggregated data (Damborenea, 1998; Koenraadt, Githeko, & Takken, 2004; Zimmer-Faust, Tyre, & Case, 1985).

Relationships between inbound vehicle counts and visitor use at Yosemite Falls were first explored by conducting Pearson correlations with aggregated vehicle traffic counts as the independent variable and visitor monitor data points as the dependent variable. Visitation was not used as the independent variable in any analyses because calibrated monitor data is an estimate and is subject to variability. This is important in subsequent analyses because regression analysis assumes no variability in the dependent variable (Kutner et al., 2004). The relationship between traffic counts and visitor monitor counts from 9 am to 5 pm were examined in order to inform a visitor use computer simulation model developed by Lawson et al. (2008a). Correlation analyses were conducted to determine the strength of the relationships between inbound traffic counts and monitor counts with time delays of 0, 1, 2, 3, and 4 hours to account for travel time from the entrance station to Yosemite Valley. In other words, vehicle traffic counts at 6 am would predict visitor monitor counts at 8 am with a delay of 2 hours. Subsequent regression models to predict visitor use at Yosemite Falls were based on the time delay with the strongest Pearson correlation.

Examination of our data showed that the mean of the dependent variable (visitor counts) was much smaller than its variance ($\bar{x} = 318.8258$, var=36,542.69). Therefore, negative binomial regression was used to model visitor use. "Dummy" coding was used to create variables for day of week, time of day, week during season, and interactions between the number of cars entering the entrance stations and "dummy" variables to examine the variability associated at different time periods. All statistical analyses were conducted using the 'R' statistical program. Table 1 presents the variables used in our regression analyses. For the sake of parsimony, only main effect variables are presented in Table 1, however, interaction effects between inbound traffic and all "dummy" variables were also estimated in our regression analyses.

Table 1.

Variables used to estimate visitor use at Yosemite Falls from inbound traffic counts

Variable	Description
Inbound Vehicles	Hourly inbound vehicle traffic at park entrance stations
Day of Week	
Saturday	1=Saturday, 0 otherwise
Sunday	1=Sunday, 0 otherwise
Monday	1=Monday, 0 otherwise
Tuesday	1=Tuesday, 0 otherwise
Wednesday	1=Wednesday, 0 otherwise
Thursday	1=Thursday, 0 otherwise
Time of Day	
6am	1=6 am hour, 0 otherwise
7am	1=7 am hour, 0 otherwise
8am	1=8 am hour, 0 otherwise
9am	1=9 am hour, 0 otherwise
10am	1=10 am hour, 0 otherwise
11am	1=11 am hour, 0 otherwise
12pm	1=12 pm hour, 0 otherwise
1pm	1=1 pm hour, 0 otherwise
Week During Season	
Week1	1=Friday 6/1-Saturday, 6/2; 0 otherwise
Week2	1=Sunday 6/3-Saturday 6/9; 0 otherwise[1]
Week3	1= Sunday 6/10-Saturday 6/16, 0 otherwise[1]
Week4	1= Sunday 6/17-Saturday 6/23, 0 otherwise[1]
Week5	1= Sunday 6/24-Saturday 6/30, 0 otherwise[1]
Week6	1= Sunday 7/1-Saturday 7/7, 0 otherwise[1]
Week7	1= Sunday 7/8-Saturday 7/14, 0 otherwise[1]
Week8	1= Sunday 7/15-Saturday 7/21, 0 otherwise[1]
Week9	1= Sunday 7/22-Saturday 7/28, 0 otherwise[1]
Week10	1= Sunday 7/29-Saturday 8/4, 0 otherwise[1]
Week11	1= Sunday 8/5-Saturday 8/11, 0 otherwise[1]
Week12	1= Sunday 8/12-Saturday 8/18, 0 otherwise[1]
Week13	1= Sunday 8/19-Saturday 8/25, 0 otherwise[1]
Week14	1= Sunday 8/26-Saturday 9/1, 0 otherwise[1]
Week15	1= Sunday 9/2-Saturday 9/8, 0 otherwise[1]
Week16	1= Sunday 9/9-Saturday 9/15, 0 otherwise[1]
Week17	1= Sunday 9/16-Saturday 9/22, 0 otherwise[1]

A two step approach was used to determine the best model fit. First, negative binomial regression was used to model visitor counts using only main effects for inbound vehicle traffic counts, day of week, time of day, and week during season as independent variables. Variance Inflation Factors (VIF) were calculated to determine the collinearity of the variables in this model. Second, all interactions with inbound traffic counts and "dummy" variables were included in a negative binomial model. Akaike's Information Criteria (AIC) and the log-likelihood ratio test were used to determine if the interaction variables improved model fit.

Results

Recreation Site Visitation Model

Results from the Pearson correlation analysis show the relationship between entrance station vehicle traffic counts and visitor monitor counts ranged from 0.324 for a 0-hour delay to 0.587 for a delay of 3 hours. Thus, a 3-hour delay between vehicle traffic counts and visitor monitor counts was used for our modeling efforts.

The negative binomial regression model using only main effects as independent variables was statistically significant at the 95% confidence level ($\chi^2 = 1977.6$, $df = 32$, $p<.001$). The null deviance for this model was 7163.2 (df=998) with a residual deviance of 1040.9 (df=966, R^2=.855) implying a good fit. All variables in this model were statistically significant and all VIF values were less than 10 indicating the independent variables in this model were not multi-collinear.

The negative binomial model including all interactions was also significant at the 95% confidence level ($\chi^2 = 2098.4$, $df = 63$, $p < .001$). The null deviance for this model was 8089.6 (df=998) with a residual deviance of 1040.9 (df=935, R^2=.871), once again indicating a good fit. The AIC for the model using only main effects was 11,211 and the

AIC for the model including interactions was 11,153 indicating that the addition of interactions produced an improved model fit. Furthermore, log-likelihood ratio tests indicate that the addition of interactions in the model was a statistically significant improvement over the model with only main effects ($\chi^2 = 120.80$, $df = 31$, $p < .001$).

Here we present results for the model that includes all interactions. The predictors for inbound vehicles and main effects for time of day, day of week, and week during season were all statistically significant (Table 2). Interaction effects for time of day were all significant except for the 10 am and 11 am hours. Only interaction effects for Saturday and Wednesday were statistically significant for the day of week variable. All interaction effects were statistically significant for week during season except weeks 1, 15, and16.

Table 2

Results for negative binomial regression model

Variable	β(std. error)	Variable	β(std. error)
Intercept	3.9855*** (0.1687)	**Week During Season**	
Inbound Vehicles	0.0025*** (0.0006)	Week1	1.2074*** (0.1895)
Time of Day		Week2	1.4994*** (0.1402)
6am	0.2891 (0.1976)	Week3	1.5563*** (0.1389)
7am	0.3992** (0.1907)	Week4	1.6475*** (0.1351)
8am	0.7964*** (0.1726)	Week5	1.6074*** (0.1422)
9am	0.7417*** (0.1795)	Week6	1.4715*** (0.1246)
10am	0.6682*** (0.1761)	Week7	1.3742*** (0.1258)
11am	0.5844*** (0.1593)	Week8	1.1145*** (0.1267)
12pm	0.7807*** (0.1605)	Week9	0.9624*** (0.1396)
1pm	0.6782*** (0.1662)	Week10	1.0320*** (0.1387)
Inbound Vehicles*6am	-0.0066*** (0.0014)	Week11	0.9442*** (0.1317)
Inbound Vehicles*7am	-0.0023** (0.0008)	Week12	0.9196*** (0.1287)
Inbound Vehicles*8am	-0.0016** (0.0006)	Week13	0.5936*** (0.1245)
Inbound Vehicles*9am	-0.0010** 0.0005)	Week14	0.2824*** (0.1199)
Inbound Vehicles*10am	-0.0007 (0.0005)	Week15	0.0769 (0.1231)
Inbound Vehicles*11am	-0.0005 (0.0005)	Week16	0.0605 (0.1303)
Inbound Vehicles*12pm	-0.0012** (0.0005)	Week17	0.3768** (0.1277)
Inbound Vehicles*1pm	-0.0013** (0.0005)	Inbound Vehicles*Week1	-0.0006 (0.0006)
Day of Week		Inbound Vehicles*Week2	-0.0018*** (0.0005)
Saturday	0.1184 (0.0814)	Inbound Vehicles*Week3	-0.0016*** (0.0004)
Sunday	0.0646 (0.0802)	Inbound Vehicles*Week4	-0.0016*** (0.0004)
Monday	0.2131** (0.0818)	Inbound Vehicles*Week5	-0.0017*** (0.0004)
Tuesday	-0.0172 (0.0785)	Inbound Vehicles*Week6	-0.0014*** (0.0004)
Wednesday	-0.2081** (0.0794)	Inbound Vehicles*Week7	-0.0013** (0.0004)
Thursday	0.1960** (0.0774)	Inbound Vehicles*Week8	-0.0011** (0.0004)
Inbound Vehicles*Saturday	0.0006** (0.0002)	Inbound Vehicles*Week9	-0.0013** (0.0004)
Inbound Vehicles*Sunday	0.0003 (0.0002)	Inbound Vehicles*Week10	-0.0017*** (0.0004)
Inbound Vehicles*Monday	-0.0003 (0.0002)	Inbound Vehicles*Week11	-0.0013*** (0.0004)
Inbound Vehicles*Tuesday	0.0002 (0.0002)	Inbound Vehicles*Week12	-0.0014*** (0.0004)
Inbound Vehicles*Wednesday	0.0010*** (0.0002)	Inbound Vehicles*Week13	-0.0012** (0.0004)
Inbound Vehicles*Thursday	-0.0004* 0.0002)	Inbound Vehicles*Week14	-0.0011*** (0.0004)
		Inbound Vehicles*Week15	-0.0007* (0.0004)
		Inbound Vehicles*Week16	-0.0004 (0.0004)
		Inbound Vehicles*Week17	-0.0008* (0.0004)

indicates $p < .10$; ** indicates $p < 0.05$; ***indicates $p < 0.001$

For these data, the expected log count for a one unit increase in inbound vehicles is 0.0025. This produces an exponential relationship that is best described using a specific example: 10 cars entering the park at 2 pm on a Friday during the 18th week results in a predicted monitor count of 55.17. A 10 car increase from 10 to 20 cars results in a 1.0253 times increase in monitor counts (55.17 * 1.0253 = 56.57). Another 10 car increase to 30 cars during the same time period results in another 1.0253 times increase in monitor counts (56.57 * 1.0253 = 58.00).

Figure 5 presents predicted visitor monitor counts versus observed monitor counts. The model does well predicting the cyclic pattern of visitor use but underestimates some monitor counts at time of peak use, particularly in September.

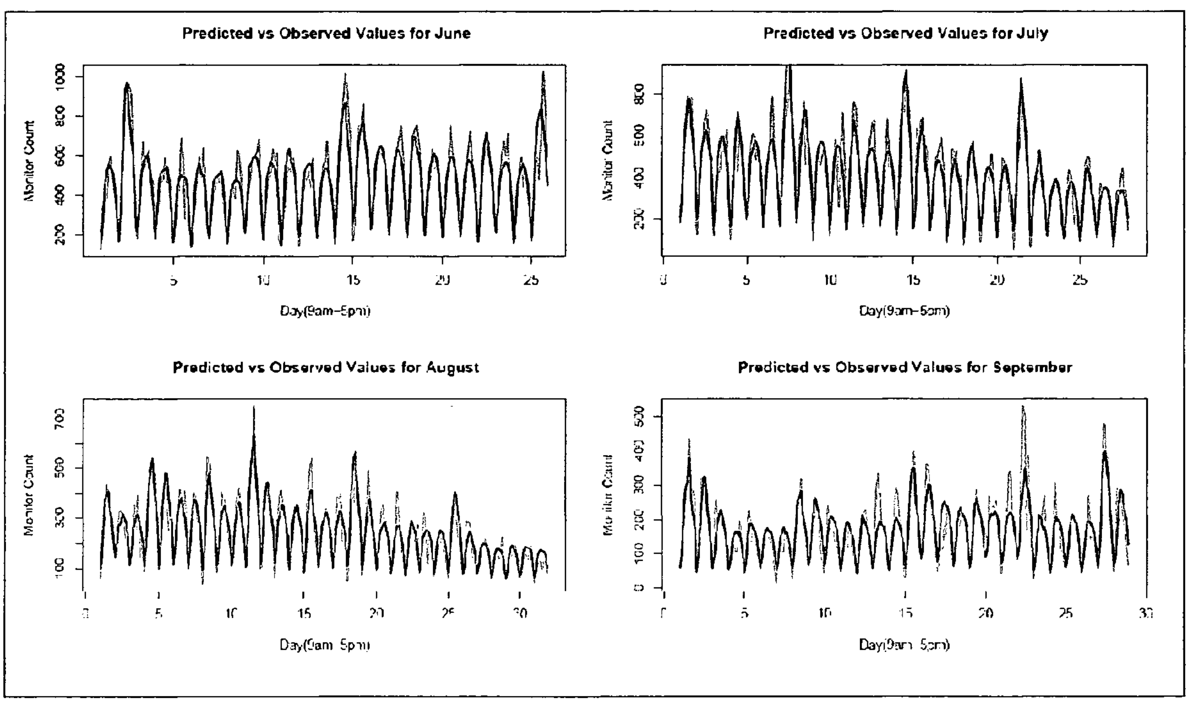


Figure 5. Predicted monitor counts versus observed monitor counts by month (black lines are predicted counts and grey lines are observed counts)

Visitor Counter Calibration

Results indicate a very high correlation between visitor monitor counts and observed counts at Yosemite Falls. Simple linear regression models with the regression line forced through the origin resulted in the best model fit for both monitors (Table 4). Combining calibration estimates from the two monitors results in $r = 1.7703$ and $SE_r = 0.01769$. Furthermore, results from Lawson et al. (2008b) indicate that the hourly proportion of arrivals and departures at Yosemite Falls was 0.5. Therefore, we multiplied predicted uncalibrated monitor counts by 0.5 to estimate the number of people per hour at Yosemite Falls.

Table 4.

Regression analysis results with regression line forced through origin for Yosemite Falls visitor monitors

Unit	β	*SE*	R^2	*df*	*F*	*p*
1	1.83125	.01808	.9977	1,23	10,025	<.001
2	1.66902	.01704	.9976	1,23	9,588	<.001

Estimating Site Visitation from Traffic Count-Visitor Monitor Count Model

The dependent variable in this model was automated visitor monitor data points. Thus, predicted values from this model need to be calibrated in order to estimate the number of people at Yosemite Falls. For example, a hypothetical predicted value of 700 visitor monitor counts first needs to be multiplied by 0.5 to account for the proportion of arrivals at Yosemite Falls and then multiplied by the calibration factor of 1.7703. This produces a predicted estimate of 620 people arriving at Yosemite Falls. Following these methods, visitor use can be estimated at recreation sites throughout the course of a day. To illustrate the utility of these methods, estimates of visitor use for the busiest, 7th busiest, and the 50th busiest days at the Yosemite National Park entrance stations are presented in Table 5.

Table 5.

Predicted visitor use at Yosemite Falls for the busiest, 7th busiest, and the 50th busiest days during the 2007 summer season

	Busiest Day- Sunday May 27, 2007		7th Busiest Day- Saturday July 28, 2007		50th Busiest Day- Tuesday July 31, 2007	
Time of Day	Traffic Count	Estimated Visitor Use	Traffic Count	Estimated Visitor Use	Traffic Count	Estimated Visitor Use
9:00 am	169	144	153	120	121	119
10:00 am	334	365	268	273	215	221
11:00 am	535	1,152	457	756	349	524
12:00 pm	690	1,714	557	966	509	579
1:00 pm	743	1,971	579	1,010	488	579
2:00 pm	852	2,328	578	958	449	529
3:00 pm	563	1,422	471	887	306	589
4:00 pm	443	983	450	682	327	462
5:00 pm	328	395	326	252	308	179

Discussion

This study was motivated by a need to develop a proactive strategy to manage visitor use. In order to manage user capacity, the NPS has adopted an indicator-based planning framework called Visitor Experience/Visitor Protection (VERP) (NPS, 1997) to identify the types and amounts of visitor use that can be accommodated by a park without causing negative impacts to natural resources or experiential qualities. However, there are some limitations associated with this approach as currently implemented. Specifically, management actions are not required until some level of impact has already occurred. The methodologies presented in this paper address this limitation and provide park managers with new options to proactively manage visitor use at recreation sites in Yosemite National Park.

Results from this study show a strong statistical relationship between inbound vehicle traffic counts and visitor use at Yosemite Falls and is consistent with early recreation research. However, the methodology presented in this paper furthers this early work by developing a predictive model between inbound vehicle traffic and recreation site visitation. Moreover, the variables used in this model are relatively easy-to-obtain, quantitative, temporally explicit, and spatially explicit making this a pragmatic tool to integrate into an indicator-based adaptive management monitoring program

To fully utilize the methods as a part of an indicator-based adaptive management monitoring program, data from automated vehicle traffic monitors need to be uploaded to a central system in real time. This will allow a park monitoring program to: 1) estimate the number of people at a site for a specific time; 2) determine how the estimated level of use affects social and/or physical conditions based on salient indicators; and 3) identify necessary management actions (such as diverting traffic, informing visitor centers, or posting signs) to maintain desired site conditions. Furthermore, the methods described in this paper can, and should be, applied to other sites in the park to avoid managing overall park visitation based on only one or a few sites.

While previous research has developed statistical models to estimate the relationship between inbound vehicle traffic counts and site visitation, OLS has typically been used. However, we found the use of negative binomial regression an effective method to model visitor monitor counts at Yosemite Falls that ensured predicted values were non-negative. Conceptually, this provides a more appropriate result than OLS where predicted values can be negative. The model described in this paper included only time related variables and explained over 87% of the variance in visitor monitor counts. However, peak visitor use was underestimated at certain times during the season. This is a study limitation because times of peak use are of particular concern to park managers. This may be related to using vehicle traffic counts from only three of the four entrance stations that provide access to Yosemite Valley. Inbound vehicle traffic data from the South entrance was not available because of equipment malfunction. The South entrance has been the busiest entrance station in recent years and exclusion of these data may have contributed to the unexplained variability associated with peak visitor use. In addition, future work should explore other explanatory variables in an effort to improve this model. For example, occupancy rates at Yosemite Lodge and Yosemite Valley campgrounds may have some influence over the variability in monitor counts because visitors staying overnight in Yosemite Valley are not accounted for at the entrance station in this model. Likewise, tour groups arriving in busses may influence the relationship between inbound vehicle traffic and visitor monitor counts because a single bus provides access to many people visiting Yosemite Valley. Finally, this model needs to be validated. The work described in this paper helps establish monitoring sites and protocols for future visitor use data collection and analysis in Yosemite National Park. Data collected from future efforts should be used to confirm and improve the model described in this paper in order to provide rigor and reliability to these findings. The use of temporal variables to model visitor use from inbound traffic should also be evaluated at other destination sites to determine the generalizability of this modeling strategy.

Conclusion

Understanding visitor use patterns in national parks is essential for park managers. As visitor use in parks continues to change and evolve managers need robust information about visitor use patterns to develop management strategies to address the dynamic conditions associated with visitor use. The work described in this paper makes use of data from two relatively easy to collect variables: 1) visitor counts from infrared monitors, a widely used technique to estimate visitor use in parks and protected areas; and 2) inbound vehicle traffic counts from park entrance stations. The model developed from this study can provide useful real time information to help parks proactively manage visitor use in order to meet park mandates to protect visitor experiences and natural resource conditions.

CHAPTER IV

Estimating Visitors' Travel Mode Choices along Bear Lake Road in Rocky Mountain National Park

Introduction

National parks host millions of visitors each year (National Park Service, 2008) and traffic congestion and crowding have become a common occurrence. During peak periods of use, park visitors often wait in traffic and compete for limited parking to access popular attraction sites. Visitors who do find parking during periods of high use can experience crowded conditions along trails and at attraction sites. This level of high use can negatively impact visitor experiences and lead to natural resource damage. To alleviate these conditions, the National Park Service is looking to alternative transportation systems to provide visitors access to the national parks in a manner that potentially reduces traffic congestion, enhances visitors' experiences, and more effectively protects park resources.

Rocky Mountain National Park (RMNP) was one of the first national parks to adopt an alternative transportation system, initiating a shuttle bus system in the Bear Lake Road corridor in 1978 that continues to operate during the peak visitor use season. In 1999, RMNP initiated a transportation study to assess existing visitor use, transportation-related problems, and potential solutions (Parsons, Brinkerhoff, Quade, & Douglas, 2000). This study concluded that the shortage of parking spaces was the most significant transportation problem in the park with 46% of summer visitors unable to find legal parking spaces. Furthermore, study findings suggest that when parking lots are full, visitors often park illegally in spaces designated for disabled visitors, on road shoulders, or on alpine tundra, which results in safety concerns and resource damage.

To address these issues, while accommodating for increasing visitation, RMNP implemented an improved 10-vehicle fleet of shuttle busses in 2001, which is based from the main shuttle parking lot (Park-and-Ride) along Bear Lake Road. The shuttle operates from early June through early October and provides service to the Bear Lake and Fern Lake trailheads and several points in between. Prior to 2001, approximately 156,000 people rode the Bear Lake and Fern Lake shuttles annually. Transit service has been incrementally improved every year since then and in 2006 ridership increased to around 270,000 passengers. In 2006, the park expanded the shuttle service into the town of Estes Park. Park visitors can now leave their cars at the Estes Park Visitor Center and ride a shuttle bus to the Beaver Meadows Visitor Center where they can then transfer to the Bear Lake shuttle.

With an increasing percentage of visitors accessing the Bear Lake area via the shuttle bus, rather than in private vehicles, the constraint to visitor use levels associated with parking lot capacities has been effectively eliminated. Thus, recreation sites and trails serviced by the park's shuttle bus system have witnessed increased visitor use levels and associated impacts to the quality of visitors' experiences and park resources.

Well-designed transportation systems can help to mitigate impacts to natural resources and visitor experiences caused by high levels of visitor use. Understanding visitor preferences, and the associated trade-offs visitors are willing to make about transportation mode choices, can provide important information to transportation planners. Much of the social science conducted in national parks has focused on the visitors' experiences related to natural, cultural, and social conditions. However, few studies have examined the role transportation systems play in the visitor experience or the factors that influence national park visitors' choice of transportation mode. Such research is needed to develop transportation management policies that effectively protect natural resources while satisfying the travel needs of park visitors.

The purpose of this study is to identify the trade-offs that visitors make about transportation modes along the Bear Lake Road in Rocky Mountain National Park. A stated choice survey was administered at the Bear Lake trailhead to explore the trade-offs park visitors were willing to make about transportation mode choice. For example, would visitors be more willing to use a shuttle bus system if it would provide greater opportunities for solitude? Likewise, does the level of traffic congestion influence the choice to use the shuttle bus service? This paper explores these questions and is organized as follows: 1) a review of previous research that examined national park visitors' perspectives towards alternative transportation systems; 2) a brief overview of stated choice modeling and how it has been applied in outdoor recreation research; 3) data collection methods; 4) results of the stated choice analysis; and 5) this paper concludes with a discussion of the implications of our findings for transportation planning in RMNP.

National Park Visitors' Perspectives towards Transportation Systems

Research that examines national park visitors' perspectives and attitudes about transportation systems is limited. Most previous social science about transportation in national parks has focused on visitor responses to transportation management policy change. These studies show that visitors are supportive of voluntary shuttle bus service but are less supportive of mandatory shuttle services because visitors perceive a loss of “freedom” when using shuttle bus services (Dilworth, 2003; Miller & Wright, 1999; Sims, Hodges, Fly, & Stevens 2005). Recently, White (2007) provides important new insights into national park visitor perspectives towards alternative transportation systems in a qualitative study conducted in Yosemite National Park. Situational factors in the park setting (i.e. convenience, access, flexibility of travel modes, type of visit, park use level) were found to influence how visitors perceived the Yosemite shuttle bus system. The author suggests that immediate needs such as transporting recreational gear, traveling with children, severe traffic congestion, and parking shortages may act as choice heuristics, or shortcuts, in the travel mode choice decision process. Likewise, individual psychological factors (i.e. perceived freedom, environmental values, perceived crowding) were found to influence visitors’ perceptions of the Yosemite shuttle bus service. When respondents were asked to discuss the benefits of using private vehicles, personal freedom to determine their travel schedule was frequently cited. Perceived crowding was another important factor influencing visitors’ perceptions of the Yosemite shuttle bus system. When asked about the benefits of using the shuttle bus service many respondents reported using the shuttle service in order to avoid traffic congestion. However, they also reported crowded conditions on the bus which reminded them of an urban experience.

These perspectives towards transportation systems show that park visitors consider a number of factors when choosing among transportation mode options. One method to explore visitors’ decision-making process about such trade-offs is stated choice modeling. Stated choice models provide a contextual approach to examine how visitors evaluate these factors in terms of transportation mode choice.

Stated Choice Analysis

Stated choice analysis was first developed in the field of economics to study urban travel demand (McFadden, 1974; Domenich & McFadden, 1974). Domenich and McFadden (1974) related travel choices to the theory of choice among discrete alternatives based on the following two assumptions: 1) travel is normally a "means to an end" for a consumer; and 2) the complexity of travel decisions (e.g. mode, frequency, destination, time of travel) require a simplification of the decision-making process. In the case of travel, stated choice analysis interrelates individual parts of travel through the attributes of a trip (i.e., time and cost variables).

In practice, stated choice surveys ask respondents to make a series of discrete choices among unique multi-attribute conditions. These multi-attribute conditions are commonly referred to as scenarios and are defined by varying levels of an attribute (Mackenzie, 1993). For example, respondents may be asked to choose among different modes of transportation options based on travel time, parking availability, and wait time at a bus stop. Respondents are asked to choose their preferred scenario based on the combination of attributes presented and statistical analysis reveals which attributes are most salient to respondents. Moreover, the effect each attribute has on respondents' choice is estimated.

Stated choice experiments have been applied by recreation researchers to examine visitor preferences towards a variety of recreation related issues in parks and protected areas. For example, stated choice experiments have been used to examine visitor preferences towards social, managerial, and resource conditions of campsite and trail conditions (Lawson & Manning, 2002; Lawson & Manning 2003; Newman, Manning, Dennis, & McKonly, 2005; Cahill, Marion, & Lawson, 2007), as well as, national park icon sites (Bullock & Lawson, 2008). In addition, these studies show a progression of sophistication in stated choice survey design for outdoor recreation management. For example, Newman et al. (2005) and Bullock and Lawson (2008) use a visual approach to portray campsite and trail conditions that are difficult to describe using short narrative descriptions (e.g., amount of bare ground or the number of people on a section of trail).

The study presented in this paper builds on previous outdoor recreation management research by examining visitor preferences towards transportation mode choice in national parks. Specifically, this study incorporates stated choice modeling techniques used in previous outdoor recreation management and transportation research to estimate trip attributes that influence visitors' transportation mode choices. The outcome of this research effort is an interactive, predictive model that allows RMNP managers to estimate park visitor support for multi-attribute decisions about transportation along the Bear Lake Road.

Methods

Study Area

Established in 1915, RMNP protects 265,873 acres of the southern Rocky Mountains of Colorado. The park is approximately 75 miles northwest of Denver, Colorado and ranges in elevation from 2,316 m near the town of Estes Park to the 4,345 m summit of Long's Peak. Some of the most spectacular scenery in the southern Rocky

Mountains is preserved in RMNP. Views of Long's Peak and the Continental Divide are visible from numerous locations throughout the park, wildlife is abundant, and many visitors come to see elk, moose, bighorn sheep, and bears. RMNP also provides many outdoor recreation opportunities such as hiking, rock climbing, camping, and fishing. RMNP is a very popular park hosting approximately 3.5 million people per year and borders the gateway community of Estes Park (National Park Service, 2008).

Auto-touring is a popular activity in the park. Trail Ridge Road is one of the main attractions in the park and connects the east and west sides of the park. At 3,670 m, Trail Ridge Road crosses the Continental Divide and is the highest continuous road in the continental United States. Bear Lake is another very popular location in the park that offers scenic views of the Continental Divide and easy access to a number of alpine lakes. The Bear Lake area is accessed via the Bear Lake Road, a 7 mile two-lane road that ends at Bear Lake.

Selection of Attributes and Levels

There are three different modes of transport visitors can choose to access Bear Lake: 1) drive your personal vehicle; 2) ride the Park-and-Ride shuttle bus; and 3) ride the shuttle bus from the town of Estes Park. Attributes to describe the trade-offs associated with each travel mode were chosen based on previous research related to transportation systems in national parks and consultation with outdoor recreation researchers, traffic planners, and RMNP park staff. In addition, attribute levels were chosen to describe real world conditions. For example, the Park-and-Ride shuttle bus currently picks up visitors every 15 minutes, therefore, options for shorter and longer intervals between visitor pick-ups were allowed. Likewise, the shuttle bus from Estes

Park departs from the Estes Park Visitor Center every hour. Thus, options for shorter and longer departure intervals were provided in these attribute levels.

Visitors were asked to choose among the three different transportation options given varying traffic and visitor use conditions. We grouped traffic and visitor use conditions into four multi-level attributes: 1) destination convenience (describes trailhead parking availability or how often a shuttle bus picks up passengers); 2) traffic volume (the number of cars on a section of the Bear Lake Road; 3) visitor volume (the amount of time to find a parking space at the trailhead or the availability of shuttle bus seating); and 4) the probability of obtaining solitude (visibility of other people along a section of trail) (Table 1). In addition, respondents were given the option of leaving the area if they would not choose any of the travel mode scenarios.

Table 1

RMNP transportation option attributes and level

Attributes	A)	Drive Personal Vehicle	B)	Drive to Park-and-Ride and use Bear Lake Shuttle	C)	Shuttle Bus from Estes Park
1. Destination Convenience (Freedom)	1.	You find a parking space at trailhead	1.	Bus arrives every 5 minutes	1.	Bus arrives every 30 minutes
	2.	You cannot find parking at trailhead	2.	Bus arrives every 15 minutes	2.	Bus arrives every 1 hour
	3.	Driving personal vehicle is not an option	3.	Bus arrives every 30 minutes	3.	Bus arrives every 1 ½ hours
2. Traffic Volume	1	Photo showing 2 cars on road	1.	Photo showing 2 cars on road	1.	Photo showing 2 cars on road
	2	Photo showing 10 cars on road	2.	Photo showing 10 cars on road	2.	Photo showing 10 cars on road
	3	Photo showing 20 cars on road	3.	Photo showing 20 cars on road	3.	Photo showing 20 cars on road
3. Visitor Volume (by transportation mode)	1.	Once at the trailhead, you find a parking space in less than 1 min.	1.	Seats are available for everyone in my group	1.	Seats are available for everyone in my group
	2.	Once at the trailhead, you find a parking space in approximately 5 min.	2.	Seats are available for half of the people in my group, half of my group has to stand	2.	Seats are available for half of the people in my group, half of my group has to stand
	3.	Once at the trailhead, you find a parking space in approximately 10 min.	3.	No seats are available for the people in my group, all of my group has to stand	3.	No seats are available for the people in my group, all of my group has to stand
4. Probability of Solitude (visibility of other visitors during hike)	1.	Photo showing 0 people on trail	1.	Photo showing 0 people on trail	1.	Photo showing 0 people on trail
	2.	Photo showing 8 people on trail	2.	Photo showing 8 people on trail	2.	Photo showing 8 people on trail
	3.	Photo showing 16 people on trail	3.	Photo showing 16 people on trail	3.	Photo showing 16 people on trail

The destination convenience and visitor volume attributes were described using the narrative statements shown in Table 1. Digitally edited photographs were used to describe the traffic volume and probability of solitude attributes (Figure 1). Mixing narrative statements and photographs to describe attribute levels was used successfully in stated choice surveys by Newman et al. (2005) and Bullock and Lawson (2008) to describe natural resource conditions and visitor use levels.

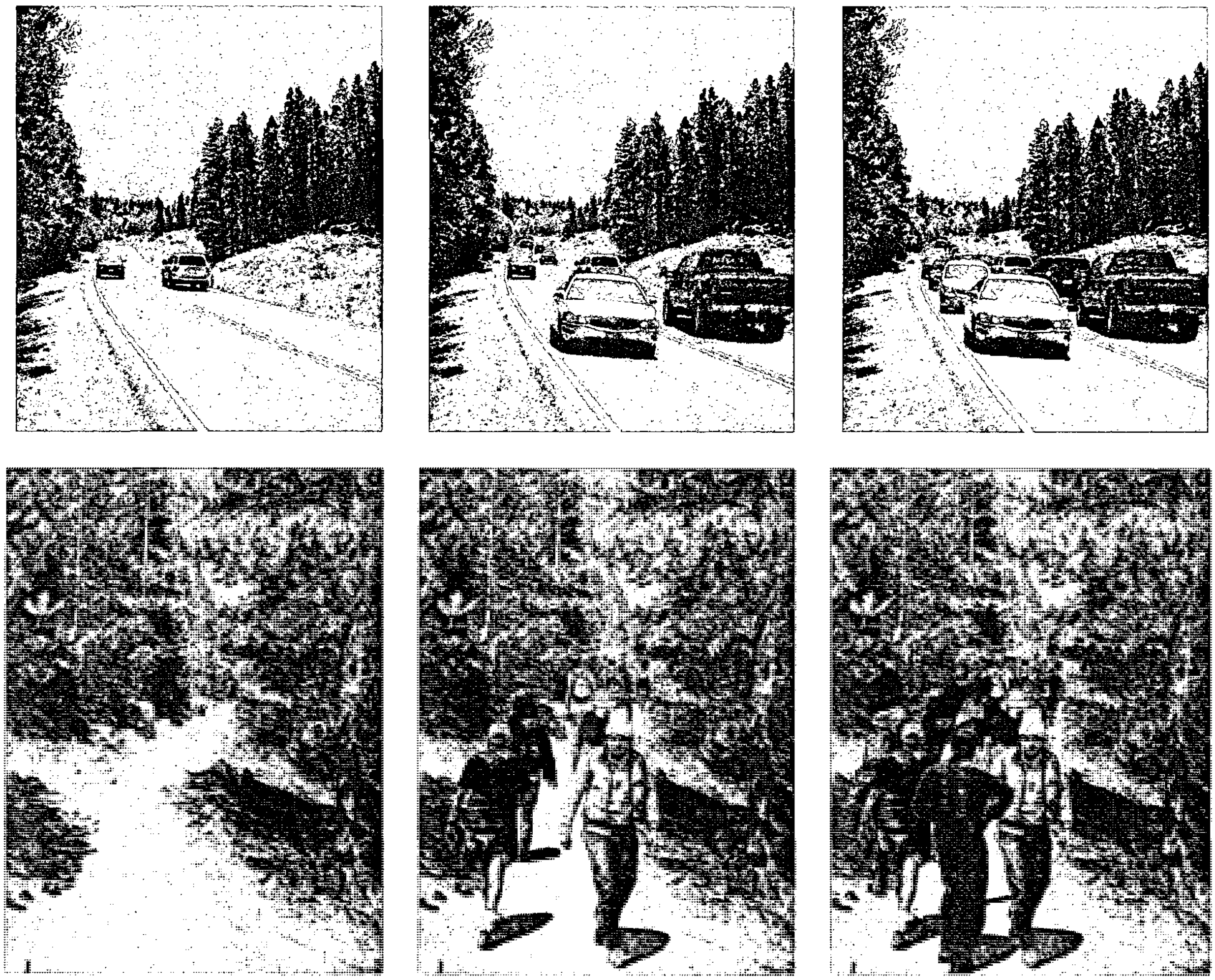


Figure 1. Digitally edited photos to describe traffic volume and probability of solitude attributes

Experimental Design

A fractional factorial design was used to combine the attributes and levels into 28 three-way comparisons blocked into four questionnaire versions, each containing seven three-way comparisons (Louviere, Hensher, & Swait, 2000). The three-way comparison included a choice of three scenarios each of which included the four attributes with different combinations of their levels. The design used in this study ensured scenarios included a balance of options where visitors could drive their personal vehicles along the Bear Lake Road because the destination convenience attribute for personal vehicles included two scenarios where visitors could not access Bear Lake in their own vehicles. In addition, the traffic volume attribute was held constant within each scenario. In other words, the traffic level was the same for each transportation mode option in a given scenario.

Statistical Analyses

Visitor responses were analyzed using stated choice analyses. Stated choice analysis is based on random utility theory (McFadden, 1981) which assumes that individuals select alternatives that maximize utility (e.g. latent measure of satisfaction). In this study, we used a multinomial logit model (MLN) to estimate the utility of a choice. The conditional indirect utility of an individual can be expressed as:

$$U_i = X_i \beta + \varepsilon_i \quad (1)$$

Where U_i is the utility of an individual choosing alternative i, X_i is a vector of observable attributes associated with alternative *i*, β is a vector of parameters, and ε_i is a random component of utility which represents unobserved attributes, random choice selections, or measurement error. For a given set of transportation mode alternatives, an individual will choose alternative *i* if:

$$X_i \beta + \varepsilon_i > X_j \beta + \varepsilon_j \quad (2)$$

If we assume that ε_i's are independent and identical (have the same variances), independence of irrelevant alternatives (IIA) holds for choices among transportation modes, and vector $\{\varepsilon_1, \ldots, \varepsilon_n\}$ is an independent identical type I extreme distribution (Hausman, Leonard, & McFadden, 1995; Habb & Hicks, 1997), the probability that alternative i will be selected is:

$$P_i = \frac{\exp(Xi\beta)}{\sum_{k=1}^{n} \exp(X_k \beta)} \tag{3}$$

The utility function used in this study was assumed to be linear and parameters were estimated using the form:

$$U_i = \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots\ldots + \beta_k X_{ik} \tag{4}$$

Where X_{ik} is the value of the kth attribute of alternative i and β_1 to β_k are estimated parameters. A conditional logistic regression model and maximum likelihood methods were used to estimate parameters of the stated choice analysis. The four attributes were entered into the model as independent variables using "dummy" coding for all variables except traffic volume which was entered as a continuous variable. A model was estimated for the entire population (aggregate model) and then separate models were calculated for different segments of the population based on gender, United States citizenship, past visitation, group size, age, education, and the certainty of a respondent's choice. Log-Ratio tests were used to determine the goodness of fit between the aggregate model and the segmented models.

Survey Administration

The survey was administered on laptop computers because it was the most effective way to present the combination of narrative statements and photographs that described attribute levels for each scenario. Custom forms were created in Microsoft Access and responses stored in an electronic database. The survey was pilot tested on Colorado State University students and professors to ensure that questions were clear and comprehensible, attributes accurately described each transportation mode option, response burden associated with completing the survey was reasonable, and that the electronic survey format was operating correctly and recording responses accurately. Responses from the pilot survey were positive and suggested that the electronic survey format was easy to navigate and understand.

Visitors were surveyed onsite at the Bear Lake trailhead after their visit to the area from July 28, 2008 – August 19, 2008. The survey was administered on 16 randomly selected days from this 23 day period. In addition, we randomly selected which survey of the four survey versions to administer on each selected sampling day. This ensured that each survey was administered over four days. Each survey version only differed in terms of stated choice model scenarios.

In the stated choice section of the survey, respondents were presented with instructions that included a brief discussion of the different transportation mode options to access the Bear Lake area. Respondents were then asked to evaluate seven scenarios. Descriptions of choice sets were presented on the following screens by clicking on the "Next Page" button. For each choice set, three scenarios were presented together on one screen. Respondents were asked to: 1) indicate the scenario they preferred; and 2) how sure they were of their response on a nine point scale with -4 indicating “Not Certain”, 0 indicating “Neutral”, and 4 indicating “Very Certain”. Figure 2 shows an example of a choice set from the survey. Brief narrative statements were used to describe destination convenience and visitor volume attributes. Each scenario included buttons that respondents were instructed to click on to view photos depicting different levels of traffic volume and number of people on a section of trail.

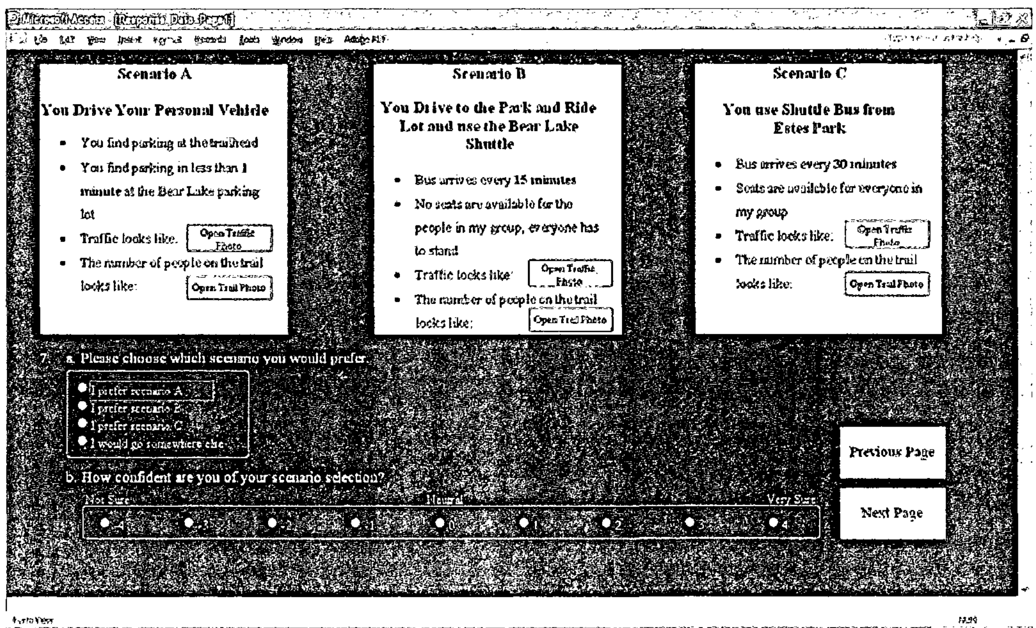


Figure 2. Example of choice set presented to respondents.

Lastly, respondents were presented with four hypothetical management actions related to transportation along the Bear Lake Road and asked to rate the acceptability of each management action on a nine-point scale with -4 indicating “Not Acceptable”, 0 indicating “Neutral”, and 4 indicating “Very Acceptable”. Respondents were asked to rate the following management actions: 1) “No private vehicles allowed along the Bear Lake Road. All access is by shuttle bus only”; 2) “Only visitors with backcountry permits and disabled persons are allowed to use private vehicles along the Bear Lake Road. All other visitors must use the shuttle bus"; 3) "Shuttle bus is voluntary and private vehicles are allowed along the Bear Lake Road"; and 4) "Shuttle bus service is not available on the Bear Lake Road. All access is by private vehicles".

Results

Response Rates

Of 870 people contacted, 514 completed the survey for a response rate of 59%. The number of surveys was balanced across all four versions of the survey resulting in 2,750 three-way comparisons. People most typically stated "no time" or "meeting people" for refusing to participate in the survey. Statistical tests suggest respondents were not different at the 95% confidence level regarding the type of transportation mode used to access Bear Lake ($\chi^2 = 3.013$ $p = 0.2217$).

Stated Choice Model Results

Results for the aggregate model are presented in Table 2. This model included 13 variables and the estimated intercepts for each alternative including the option of leaving the Bear Lake area and going somewhere else. In addition, traffic volume was centered at 11 for all statistical analyses.

Table 2

Coefficients for aggregate stated choice model

Variable	*B*	Std. Error
Intercept		
Go somewhere else	0.07	0.09
Drive Personal Vehicle	1.97**	0.08
Take shuttle bus from Park-and-Ride	1.63**	0.07
Destination Convenience		
Shuttle bus from Park-and-Ride		
Bus arrives every 5 minutes	0.00	0.06
Bus arrives every 15 minutes	0.05	0.06
Shuttle bus from Estes Park		
Bus arrives every 30 minutes	0.31**	0.09
Bus arrives every 60 minutes	0.22*	0.09
Traffic Volume		
Number of Cars	-0.05**	0.01
Number of Cars*Private Vehicle	-0.02*	0.01
Number of Cars*Shuttle Bus	0.00	0.01
Visitor Volume		
Drive Personal Vehicle		
1 min to find parking	0.35**	0.08
5 min to find parking	0.04	0.07
Shuttle Busses		
Seats available for all	0.19**	0.05
Seats available for half	-0.03	0.05
Probability of Solitude		
0 people	0.84**	0.05
8 people	-0.20	0.04

* indicates $p < .05$; ** indicates $p < .001$

Holding all variables constant, visitors prefer to drive their personal vehicle to Bear Lake. Visitors are also more likely to choose shuttle bus service from the Park-and-Ride over the shuttle bus from Estes Park. Similarly, they would choose the Park-and-Ride shuttle over the option of going somewhere else. The choice of going somewhere else and taking the shuttle bus from Estes Park are not statistically different indicating that visitors are as likely to go somewhere other than Bear Lake as they are to choose the shuttle bus service from Estes Park.

Probability of solitude is the most influential variable over a visitor's choice of transportation mode. Seeing no other people on the trail is more preferable to seeing many people on the trail. Similarly, traffic volume was negatively correlated with transportation mode choice. Furthermore, the interaction between type of transportation mode and traffic volume was significant for personal vehicles but not significant for shuttle busses. This suggests that the choice to drive a personal vehicle is more affected by the amount of traffic on the Bear Lake Road than the choice of either shuttle bus options. With respect to visitor volume, the availability of parking or seating on the shuttle bus is positively correlated to transportation mode choice. However, the shuttle bus pick-up interval is not statistically significant for the Park-and-Ride. This suggests that people are willing to wait for the shuttle bus at the Park-and-Ride if all individuals in their group are able to find seating. In contrast, the shuttle bus pick-up interval from Estes Park was statistically significant where intervals 60 minutes or less were preferred over intervals longer than 60 minutes.

Next, results from the segmented models are presented. Based on log-ratio tests, the model based on three age groups produced the most improved model fit over the aggregated model (Table 3).

Table 3

Log ratio test results comparing aggregated model to segmented models

Model	*k*	Log-Likelihood	Log Ratio Test
Aggregate Model	16	-	-
Aggregate Model*Gender	32	-2568.60	23.542
Aggregate Model*U.S. Citizenship	32	-2556.80	15.432
Aggregate Model*Past Visitation	32	-2560.90	8.414
Aggregate Model*Group Size(2 groups: 1-3, 4+)	32	-2564.40	7.702
Aggregate Model*Age(2 groups: <50 yrs, 50+ yrs.)	32	-2564.76	44.654**
Aggregate Model*Age(3 groups: <40 yrs, 40-59 yrs, 60+ yrs.)	48	-2531.48	74.258**
Aggregate Model*Education(2 groups: college education+, college grad)	32	-2531.48	20.478
Aggregate Model*Certainty(Interacted with parameters -4 to 4)	32	-2558.37	46.352**

* indicates $p < .05$; ** indicates $p < .001$

In addition, the model based on three age groups was found to be a statistically significant improvement over the model based on two age groups (Log Ratio = 29.604, p = .02). Results for the model based on three age groups are presented in Table 4.

Table 4

Coefficients for the stated choice model based on three age groups

Variable	β (std. error)	Variable	β (std. error)
Intercept		**Traffic Volume(continued)**	
Go somewhere else	0.28* (0.12)	Num. Cars*Private Vehicle	-0.01 (0.01)
Go somewhere else*<40 yrs	-0.28 (0.15)	Num. Cars*Private Vehicle*<40 yrs	-0.01 (0.02)
Go somewhere else*60+ yrs	0.54* (0.22)	Num. Cars*Private Vehicle*60+ yrs	0.02 (0.03)
Drive Personal Vehicle	2.19**(0.11)	Num. Cars*Shuttle Bus	<0.01 (0.01)
Drive Personal Vehicle*<40 yrs	-0.51**(0.14)	Num. Cars*Shuttle Bus*<40 yrs	-0.01 (0.02)
Drive Personal Vehicle*60+ yrs	0.67**(0.20)	Num. Cars*Shuttle Bus*60+ yrs	<0.01 (0.03)
Shuttle bus from Park-and-Ride	1.95**(0.11)	**Visitor Volume**	
Shuttle bus: Park-and-Ride*<40 yrs	-0.32* (0.13)	*Drive Personal Vehicle*	
Shuttle bus: Park-and-Ride*60+ yrs	0.82**(0.19)	1 min to find parking	0.34**(0.09)
Destination Convenience		1 min to find parking*<40 yrs	-0.14 (0.12)
Shuttle bus from Park- and-Ride		1 min to find parking*60+ yrs	0.12 (0.15)
Bus arrives every 5 minutes	0.03 (0.07)	5 min to find parking	0.01 (0.08)
Bus arrives every 5 minutes*<40 yrs	-0.10 (0.10)	5 min to find parking*<40 yrs	0.09 (0.11)
Bus arrives every 5 minutes*60+ yrs	0.14 (0.12)	5 min to find parking*60+ yrs	-0.16 (0.14)
Bus arrives every 15 minutes	0.08 (0.07)	*Shuttle Busses*	
Bus arrives every 15 minutes*<40 yrs	-0.07 (0.10)	Seats available for all	0.18* (0.06)
Bus arrives every 15 minutes*60+ yrs	0.09 (0.12)	Seats available for all*<40 yrs	-0.07 (0.08)
Shuttle bus from Estes Park		Seats available for all*60+ yrs	0.01 (0.11)
Bus arrives every 30 minutes	0.38*(0.13)	Seats available for half	0.02 (0.07)
Bus arrives every 30 minutes*<40 yrs	-0.04 (0.16)	Seats available for half*<40 yrs	-0.01 (0.09)
Bus arrives every 30 minutes	0.10 (0.23)	Seats available for half*60+ yrs	0.10 (0.11)
Bus arrives every 60 minutes	0.09 (0.15)	**Probability of Solitude**	
Bus arrives every 60 minutes*<40 yrs	0.09 (0.18)	0 people	0.82**(0.05)
Bus arrives every 60 minutes*60+ yrs	-0.30 (0.28)	0 people*<40 yrs	0.17* (0.07)
Traffic Volume		0 people*60+ yrs	-0.20*(0.09)
Num. Cars	-0.05* (0.02)	8 people	-0.22**(0.05)
Num. Cars*<40 yrs	0.02 (0.02)	8 people*<40 yrs	0.07 (0.07)
Num. Cars*60+ yrs	<-0.01 (0.03)	8 people*60+ yrs	-0.08 (0.09)

* indicates $p < .05$; ** indicates $p < .001$

Holding all variables constant, the 41-59 year-old age group is more likely than all other age groups to drive their own vehicle than to ride a shuttle bus. The driving personal vehicle intercept for the 40-59 year-old age group can be calculated by adding the negative sum of the <40 and 60+ year-old age group interactions to the intercept (i.e. 2.18 + (-1*(-0.51 + 0.67)) = 2.03). The intercept for riding the shuttle bus from the Park-and-Ride for the 40-59 year-old age group is 1.45, which is a larger difference between the 40-59 old age group and 60+ year old age group intercepts for driving a personal vehicle and riding the shuttle bus from the Park-and-Ride.

The probability of obtaining solitude attribute is more important to younger visitors than older visitors. This suggests that younger people are more willing to make trade-offs among transportation options to enhance their experience at Bear Lake. With regard to traffic volume, more vehicles on the road are negatively correlated to choosing to drive a personal vehicle and ride the shuttle bus from the Park-and-Ride but are positively correlated to choosing to ride the shuttle bus from Estes Park. The partworth utility for riding the shuttle bus from Estes Park is the reciprocal of the sum of the coefficients for driving a personal vehicle and riding the shuttle bus from the Park-and-Ride (i.e. -1*(-0.046 +-0.045) = 0.091). Visitor Volume (wait time for parking or seat availability on bus) had a negative effect on transportation mode choice, however, all interactions for this attribute were not statistically significant. Results for the destination convenience attribute were inconsistent. Wait time for the shuttle bus from the Park-and-Ride lot was not statistically significant and suggests this is not an important factor in visitors' choices of transportation mode. However, wait times were statistically significant and negatively correlated to using the shuttle bus from Estes Park.

Support for Hypothetical Management Actions

Visitor support for the hypothetical management actions related to transportation policy along the Bear Lake Road is presented in Table 5. There is disagreement about actions to limit personal vehicles along the Bear Lake Road. Mean values near 0 with large standard deviations show that visitors are divided about limiting personal vehicle use. In contrast, visitors show much more agreement about support for voluntary shuttle bus use and removal of the shuttle bus service from the Bear Lake area. A mean value of 2.07 and a smaller standard deviation than the previous management actions suggest that visitors support personal vehicle use along the Bear Lake Road with voluntary shuttle bus use. However, visitors show little support for removing the shuttle bus service from the Bear Lake area.

Table 5

Results for visitor support of hypothetical management actions related to transportation policy along the Bear Lake Road

Management Action	Mean	Standard Deviation
No personal vehicles	-0.11	2.85
Personal vehicles only for overnight user and disabled persons	-0.18	2.88
Shuttle bus use is voluntary and personal vehicles are allowed	2.07	2.05
No shuttle bus service, all access is by personal vehicles	-2.22	2.17

Discussion

As the NPS moves towards alternative transportation options to alleviate crowded conditions and traffic congestion, there is an increasing need for national park managers to understand visitor choices about transportation mode. Little previous research has examined the factors that influence how national park visitors choose among transportation mode options. The use of stated choice analysis described in this paper provides important insights into visitors' choice process of transportation mode in national parks.

First, we developed an aggregate model to estimate transportation choice behavior of all visitors to the Bear Lake area. Results indicate that visitors prefer to use their personal vehicle over the shuttle bus service. However, these results suggest that visitors are willing to trade the use of their personal vehicles for shuttle bus service to improve certain aspects of their trip. For example, crowding along the trail and traffic congestion on the roadway were found to be influential factors affecting transportation choice. In other words, visitors were willing to use the shuttle bus service to improve these aspects of their trip. In addition, visitor volume was a significant but less important factor influencing transportation mode choice. These findings are consistent with White (2007) where people cited traffic congestion and crowding as reasons to use shuttle bus service in national parks.

To further explore visitor choice behavior about transportation mode, we developed models based on different segments of the population. The model based on three age groups was found to be a statistically significant improvement over all other models. Results from this model show that the 40–59 year-old age group was more likely than the other age groups to choose to drive their personal vehicles rather than use the shuttle bus service. Similar to the aggregate model, crowding along the trail was found to be the most influential attribute affecting transportation mode choice. Moreover, results from the model based on three age groups indicate that crowding along the trail was more important to younger visitors than older visitors. In fact, the probability of obtaining solitude was the only attribute in the model based on three age groups with statistically significant differences among the interactions.

These results suggest that younger visitors put a stronger emphasis on their experience beyond the Bear Lake trailhead than older visitors. Thus, younger visitors may consider transportation mode simply as a means to achieve outdoor experiences and are willing to make transportation mode trade-offs in order to improve that experience. In contrast, older visitors may consider auto-touring a primary component of their park experience and put less emphasis on their experience beyond the trailhead. Auto-touring is a very popular activity in national parks and a recent study by White and Aquino (2008) found that 87% of visitors to Yosemite National Park cite "taking a scenic drive" as their favorite activity in the park.

Most previous recreation research has found little correlation between age and recreation participation. However, Kelly (1980) found a strong inverse relationship with age and recreation activities that required strength/endurance. This provides some evidence that the physical activity component of a trip is more important for younger visitors than older visitors. However, in terms of crowding, little research has examined the effects of age on perceptions of crowding (Manning, 1999). An examination of visitor perceptions of crowding was not the focus of this work, nonetheless, our results suggest that different age groups attribute different amounts of importance to perceived crowding.

Other than the probability of solitude, there was no statistically significant difference between age groups among the other attributes. All main effects, except destination convenience for the Park-and-Ride, were statistically significant indicating that visitors' transportation mode choices were influenced by these different trip components. Because none of the interactions between these attributes and age were statistically significant it is expected all visitors perceive these conditions similarly.

Decision Support System

A Decision Support System (DSS) was created in Microsoft Excel based on the coefficients from the model based on three age groups. A DSS allows managers to create and test different transportation scenarios and estimate the level of preference these scenarios would receive from park visitors (Figure 3).

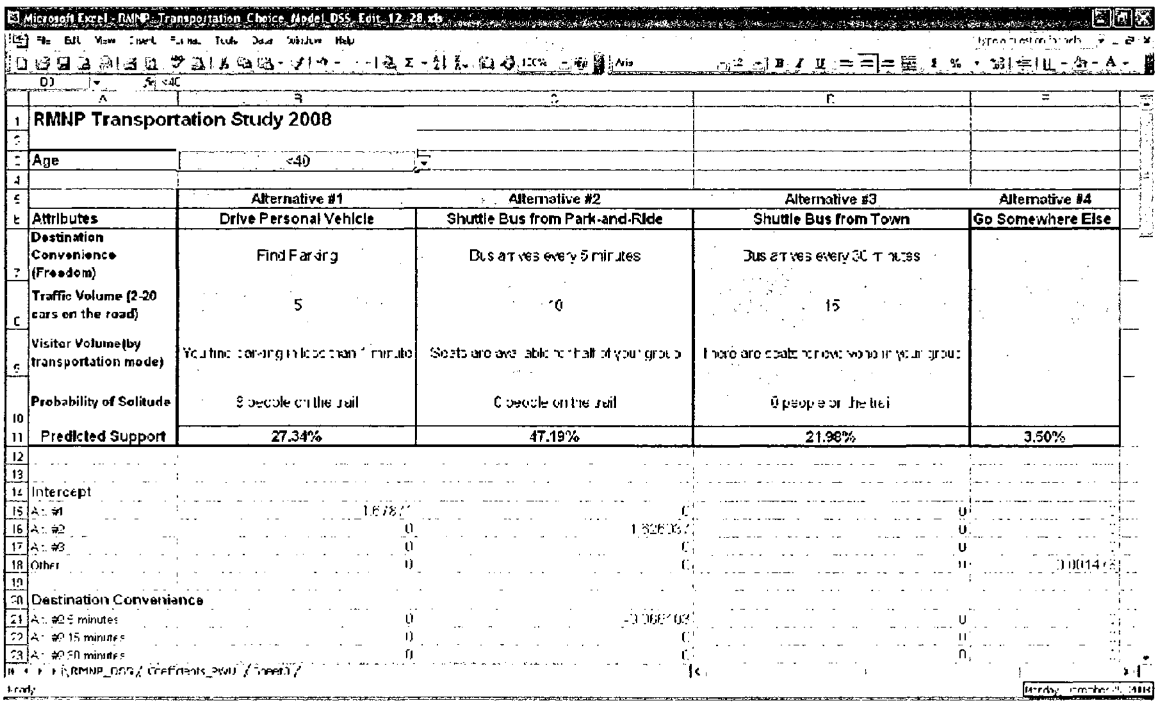


Figure 3. RMNP transportation Decision Support System

The scenario depicted in Figure 3 is used to describe the RMNP transportation DSS. Trip attributes are listed on the left side of the screen and users can select attribute levels from a drop down list under each transportation choice option. In addition, a drop down list on the top left-hand side of the screen allows users to specify which age group to examine. The scenario in Figure 3 examines the preferred choices for visitors less than 40 years of age. In this scenario, the destination convenience attribute is held constant at its lowest level across all transportation options; traffic volume is higher for the shuttle bus options than the drive a personal vehicle option; visitor volume is held at its lowest level for driving a personal vehicle and the shuttle bus from town but is at the intermediate level for riding the shuttle bus from the Park-and-Ride; and the probability of solitude attribute is at its intermediate level for driving a personal vehicle and its lowest level for both shuttle bus options. The model estimates that over 47% of visitors in this scenario would choose to use the shuttle bus from the Park-and-Ride lot, just over 27% would choose to drive their personal vehicle, and nearly 22% would take the shuttle bus from Estes Park. The results from this scenario suggest that many visitors would choose to use one of the shuttle bus services in order to gain a higher level of solitude.

The transportation DSS allows RMNP managers to test various combinations of the study attributes in order to gauge park visitor preferences towards Bear Lake Road transportation options and the trade-offs visitors make among transportation options. Insights provided by this tool will allow managers to make more informed decisions about transportation policy in order to alleviate traffic congestion and crowded conditions in the Bear Lake area.

Support for Hypothetical Management Scenarios

Results of support for the hypothetical management actions suggest RMNP visitors support voluntary shuttle bus service along the Bear Lake Road but not mandatory shuttle bus use. This is consistent with previous research and RMNP managers should consider indirect approaches to promote shuttle bus use. For example, managers can provide real time information about parking lot availability, vehicle traffic levels, and visitor use levels around the Bear Lake area to encourage visitors to use shuttle bus service during times of high visitor use.

Study Limitations

Although this study provides important insights about visitor use preferences towards alternative transportation, this study is not without limitations. First, it is common to examine differences in the study population by identifying groups of people with different preferences. In this study, we did not identify groups a priori, thus we examined differences between groups of visitors using empirical tests and found differences based on age. However, segmenting the population by age was not based on theoretical foundations, thus, further research is needed to test if these results are generalizable or simply limited to RMNP visitors.

Second, the use of photographs and narrative statements in combination to describe attribute levels has been used successfully in previous research using stated choice models. However, it is difficult to determine if photo-based attributes and narrative statements are evaluated equally by respondents. Results from this study suggest that respondents considered both methods to describe attributes equally. For example, all main effects in the model based on three age groups were statistically significant except for destination convenience for the shuttle bus from the Park-and-Ride option. However, only the interactions for the probability of solitude, an attribute described by a photo, were statistically significant. Traffic volume, the other attribute described by a photo, had no statistically significant interactions. Certainly, this is not definitive evidence that respondents did not evaluate attributes described by photographs and narratives differently, but there do not appear to be any trends in our results that suggest otherwise.

Conclusion

The choice process of national park visitors towards alternative transportation has received little attention. The results from this study provide insight into national park visitor preferences towards alternative transportation and the factors that influence their decision process about using alternative transportation. Our results show that visitors prefer to use personal vehicles to access the Bear Lake area but are willing to use the shuttle bus service to avoid traffic congestion and crowds of people on the trail. However, visitors indicate that they want this to be a voluntary choice and not a mandate by park administrators. Thus, RMNP managers should consider indirect approaches to promote shuttle bus use.

CHAPTER V

Conclusion

The papers presented in this dissertation examine temporal and spatial visitor use patterns in national parks. Land managers need to understand these trends because high levels of visitor use can overwhelm existing facilities, diminish visitor experiences, and impact natural resources. Managers who understand these trends can implement management actions to mitigate visitor use related impacts and develop long term plans to address high levels of visitor use.

Historically, the National Park Service (NPS) has responded to increasing use by building more facilities, such as roads and parking lots, to accommodate increasing use (Dilasver & Wykoff, 1999). However, there may be unintended consequences associated with infrastructure development without thoughtful planning. For example, infrastructural development may change the characteristics of an area by accommodating more people and may result in higher levels of sustained visitor use. As a result, visitors seeking experiences (e.g., solitude) that can no longer be obtained at an area with new facilities may be displaced. Therefore, visitor use capacity issues cannot be solved by simply accommodating increased use. Moreover, legal mandates, such as the Organic Act of 1916, require visitor use to be managed in a way that protects natural resources and visitor experiences. Thus, land managers need to determine the types of experiences and conditions that are appropriate for a recreation area.

To address this need, the NPS has adopted indicator-based adaptive management planning frameworks to facilitate decisions about the amounts and types of visitor use in parks and protected areas. The studies presented in this dissertation can be applied to an indicator-based adaptive management planning program and provide land managers with new, proactive options to manage visitor use. To provide a context for this discussion, a brief background on carrying capacity and planning frameworks to address recreational carrying capacity is presented followed by a summary of the findings from this dissertation and a discussion of the practical applications of this work.

Historical Background of Carrying Capacity in National Parks

Carrying capacity has been an issue for the NPS since its inception in 1916. Around this time, auto clubs and groups like the Sierra Club pressured the government for automobile access into national parks and in 1915 vehicles were allowed into Yellowstone National Park (Lillard, 1968). Moreover, Stephen Mather, the NPS's first director, championed the automobile in national parks because he believed that providing easy access to parks would increase support for parks and build a constituency for the newly established agency (Dilsaver & Wycoff, 1999). Within 20 years, major road projects were undertaken in Rocky Mountain National Park, Zion National Park, Grand Canyon National Park, and additional roads were built in Yosemite National Park, Grand Canyon National Park, and Mount Rainier National Park. As early as 1936, reports of traffic congestion were reported in many national parks (Dilsaver & Wycoff, 1999). To accommodate these high levels of use the NPS constructed more pullouts, parking lots, and facilities.

Around this same time, Sumner (1936) first suggested the idea of a visitor capacity in a NPS report on policy suggestions for parks in the Sierra Nevadas of California by asking, "How large a crowd can be turned loose in a wilderness without destroying its essential qualities?", and suggested that recreation use be kept, "within a carrying capacity". Carrying capacity is a concept developed in ecology and rangeland sciences to describe the relationship between wildlife populations and the available supply of resources to support a population. Early thought on this subject assumed that numerical recreation carrying capacity could be determined based solely on ecological deterioration of recreation areas. However, carrying capacity, as conceived by Sumner, describes a value-laden relationship that people experience with land. J.A. Wagar (1964) further expanded the concept of recreational carrying capacity to include the social environment that affects experiential conditions. At about the same time, Lucas (1964) attempted to estimate the recreational carrying capacity of the Boundary Waters Canoe Area, MN. He found that perceptions of crowding differed by user type: paddling canoeists were more sensitive to crowding than motor canoeists who in turn were more sensitive to crowding than motor-boaters. Thus, Lucas estimated a range of carrying capacities based on these relationships. These results suggested that a single number of visitors to define carrying capacity would not satisfy all users. The concept of carrying capacity was further expanded to include a managerial component when Wagar (1968) suggested that recreation experiences may be maintained or enhanced by management actions. These three dimensions of recreational use (natural resource, social, and managerial) have become the foundation for contemporary carrying capacity research.

To provide a systematic planning strategy to consider the ecological, social, and managerial components of visitor use, Stankey et al. (1985) developed Limits of Acceptable Change (LAC) which is widely regarded as the first carrying capacity planning framework. Today, carrying capacity planning frameworks are commonly referred to as indicator-based adaptive management. A number of alternatives to LAC, such as Visitor Impact Management (VIM) (Graefe et al.1990) and Visitor Experience/Resource Protection (VERP)(NPS, 1997) have been developed, but all share three core elements (Manning, 1999): 1) development of indicators and standards of quality that define recreation opportunities to be provided; 2) monitoring of indicators to determine if existing conditions meet standards of quality; and 3) management actions where standards of quality are not being met. Indicator-based adaptive management strategies do not require a specific number or range of visitors to determine a visitor capacity, but instead focus on desired conditions for a recreation area. Examples of successfully implemented indicator-based adaptive management programs include the Carriage Roads in Acadia National Park (Manning, Valliere, Wang, Ballinger, & Jacobi, 1998) and rafting on the Colorado River in Grand Canyon National Park (Daniel & Gimblett, 2000).

Indicator-based adaptive management has become the accepted conceptual planning framework for visitor use capacity decisions in parks and protected areas. However, the use of indicator-based adaptive management to determine visitor capacity on federally protected land has recently been challenged in federal court. In short, user groups sued the NPS over the use of VERP to determine visitor use capacity in Yosemite National Park. The court agreed with the plaintiffs and found VERP to be *reactive* to degradation and did not provide management actions that prevented degradation from occurring (United States Court of Appeals for the Ninth Circuit, 2008). The court's interpretation that indicator-based adaptive management was reactive to degradation of park conditions was a setback for land managers and recreation researchers. Some researchers have argued that standards can be set low enough to act as a warning signal to prevent degradation, similar to a traffic signal's "yellow light". The court specifically addressed this response in their ruling and interpreted this implementation as a reaction to degraded conditions. However, the court did not find VERP inherently reactive, only the way it is currently being implemented was determined to be reactive. Thus, recreation researchers are challenged to find proactive methods to address this issue. The research presented in this dissertation is a first step to address this need.

Summary of Research Presented in this Dissertation

The study in Chapter II describes specific methodologies to estimate visitor use from mechanical visitor counters at recreation sites. This paper contributes to the recreation research knowledge base because many land agencies and researchers use these devices to estimate visitor use levels but little work has examined or described methods to derive accurate estimates of visitor use. This is partially the result of many land agencies not considering accurate estimations of visitor use a priority and many land agencies are now being questioned about the legitimacy of their visitor use estimates (Loomis, 2000, English, Kocis, Arnold, Zarnoch, and Warren, 2003). The methods described in this paper address this current and practical need by providing researchers and land managers with reliable methods to calculate these fundamental measures of visitor use.

Chapter III builds on the work in Chapter II by providing a method to proactively manage visitor use in parks and protected areas. Park planners and recreation researchers are now recognizing that effective visitor use management must consider transportation infrastructure to develop effective visitor use planning strategies. Understanding spatial and temporal trends of vehicle traffic and visitor use is fundamental to traffic planning and visitor use capacity decisions. The study in Chapter III uses the temporal relationship between inbound vehicle traffic counts and visitor use at recreation sites to predict visitor use. The results from these analyses were used as inputs into a larger, integrative vehicle traffic/visitor use study as described by Lawson et al. (2008b) to predict crowding conditions at attraction sites and trailheads in Yosemite Valley. These visitor use monitoring strategies can be considered "proactive" because they forecast visitor use conditions before they occur. This provides land managers new options to manage visitor use such as diverting vehicle traffic before an area becomes overcrowded, or, providing real time information to visitors before they enter crowded areas of the park. These new options begin to provide managers ways to actively manage visitor use but require a commitment of park resources to continue consistent monitoring. In addition, these methods should be complimentary parts of a comprehensive visitor use management plan that includes management of transportation systems that deliver visitors to sites and trailheads.

As discussed earlier, the NPS is looking to alternative transportation systems to relieve traffic congestion and crowded conditions. However, little research has been conducted about visitor perceptions of alternative transportation in national parks. To address these limitations, Rocky Mountain National Park initiated visitor use studies that integrate traffic planning research, visitor use modeling, and social science to develop effective strategies to minimize social and resource impacts that result from high levels of visitor use. The work presented in Chapter IV examines the trade-offs RMNP visitors were willing to make about transportation mode choices and builds on recent work about national park visitor perceptions of alternative transportation (White, 2007). This research was conducted in conjunction with other recreation researchers and transportation planners as part of an integrative study to examine transportation along the Bear Lake Road. As part of this study, visitor use simulation models were created to estimate visitor use patterns and crowding along trails in the Bear Lake area. In addition, traffic simulation models were developed to determine the efficiency of the current transportation system. These models will allow researchers and park managers to test the timing of shuttle bus routes and their affect on trail use patterns. The DSS developed from the stated choice survey provides a way to estimate visitor support for alternative shuttle bus management options. This integrated approach allows managers to consider the different components of a trip that encompass visitors' experiences.

Each of the studies presented in this dissertation are part of larger, integrated visitor use studies. The results from the studies in this dissertation show specific relationships that exist within parks that can be used to better understand and manage the dynamic nature of visitor use. Each study provides important insights into the nature of visitor use, and, used in conjunction with crowding research and traffic monitoring, these studies provide relatively simple, pragmatic tools to manage real time visitor use. The findings presented in this dissertation provide a foundation for future recreation research and proactive implementations of visitor use capacity monitoring programs.

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APPENDIX A

Calibration Data for Yosemite Visitor Monitors

Table 1

Observed counts and monitor counts at Unit 1

Date	Time	Observed Count	Monitor Count
Friday, June 08, 2007	7:00 am	10	8
Friday, June 08, 2007	8:00 am	504	283
Friday, June 08, 2007	3:00 pm	719	373
Friday, June 08, 2007	4:00 pm	576	300
Sunday, June 10, 2007	9:00 pm	223	142
Sunday, June 10, 2007	11:00 pm	403	228
Sunday, June 10, 2007	2:00 pm	817	441
Sunday, June 10, 2007	5:00 pm	457	239
Sunday, June 17, 2007	9:00 am	174	104
Sunday, June 17, 2007	2:00 pm	1012	535
Sunday, June 17, 2007	5:00 pm	665	364
Sunday, June 17, 2007	6:00 pm	399	226
Sunday, July 08, 2007	1:00 pm	913	494
Sunday, July 08, 2007	3:00 pm	539	295
Sunday, July 08, 2007	4:00 pm	561	333
Sunday, July 08, 2007	5:00 pm	424	225
Thursday, August 09, 2007	1:00 pm	299	180
Thursday, August 09, 2007	2:00 pm	349	202
Thursday, August 09, 2007	3:00 pm	245	164
Thursday, August 09, 2007	6:00 pm	82	44
Friday, August 31, 2007	9:00 am	43	27
Friday, August 31, 2007	11:00 am	104	61
Friday, August 31, 2007	3:00 pm	122	65
Friday, August 31, 2007	4:00 pm	135	75

Table 2

Observed counts and monitor counts at Unit 2

Date	Time	Observed Count	Monitor Count
Tuesday, May 29, 2007	10:00 am	141	91
Tuesday, May 29, 2007	12:00 pm	329	190
Tuesday, May 29, 2007	1:00 pm	365	217
Tuesday, May 29, 2007	2:00 pm	481	287
Saturday, June 02, 2007	10:00 am	220	148
Saturday, June 02, 2007	12:00 pm	532	339
Saturday, June 02, 2007	1:00 pm	592	361
Saturday, June 02, 2007	4:00 pm	479	265
Wednesday, June 13, 2007	7:00 am	9	9
Wednesday, June 13, 2007	1:00 pm	295	176
Wednesday, June 13, 2007	2:00 pm	315	190
Wednesday, June 13, 2007	3:00 pm	396	226
Monday, June 18, 2007	11:00 am	289	173
Monday, June 18, 2007	12:00 pm	384	237
Monday, June 18, 2007	3:00 pm	371	225
Monday, June 18, 2007	6:00 pm	159	107
Thursday, July 19, 2007	7:00 am	19	7
Thursday, July 19, 2007	11:00 am	227	137
Thursday, July 19, 2007	12:00 pm	308	184
Thursday, July 19, 2007	5:00 pm	191	104
Wednesday, August 08, 2007	11:00 am	267	154
Wednesday, August 08, 2007	3:00 pm	260	146
Wednesday, August 08, 2007	4:00 pm	202	106
Wednesday, August 08, 2007	6:00 pm	86	45

Table 3

Observed counts and monitor counts at Unit 3

Date	Time	Observed Count	Monitor Count
Saturday, June 09, 2007	7:00 am	339	180
Saturday, June 09, 2007	8:00 am	341	195
Saturday, June 09, 2007	4:00 pm	618	367
Saturday, June 09, 2007	5:00 pm	598	360
Sunday, June 17, 2007	8:00 am	135	80
Sunday, June 17, 2007	12:00 pm	350	203
Sunday, June 17, 2007	2:00 pm	306	183
Sunday, June 17, 2007	5:00 pm	273	157
Sunday, July 01, 2007	10:00 am	396	208
Sunday, July 01, 2007	11:00 am	408	250
Sunday, July 01, 2007	1:00 pm	427	268
Sunday, July 01, 2007	2:00 pm	436	256
Tuesday, August 07, 2007	8:00 am	144	87
Tuesday, August 07, 2007	9:00 am	243	136
Tuesday, August 07, 2007	1:00 pm	693	396
Tuesday, August 07, 2007	3:00 pm	696	391
Friday, July 20, 2007	7:00 am	92	56
Friday, July 20, 2007	10:00 am	346	240
Friday, July 20, 2007	6:00 pm	202	125
Monday, August 20, 2007	7:00 pm	84	49
Monday, August 20, 2007	12:00 pm	434	243
Monday, August 20, 2007	2:00 pm	511	305
Monday, August 20, 2007	4:00 pm	413	247

Table 4

Observed counts and monitor counts at Unit 4

Date	Time	Observed Count	Monitor Count
Sunday, May 27, 2007	10:00 am	1432	749
Sunday, May 27, 2007	12:00 pm	1505	721
Sunday, May 27, 2007	1:00 pm	1437	743
Sunday, May 27, 2007	2:00 pm	1307	700
Monday, June 04, 2007	9:00 am	271	183
Monday, June 04, 2007	10:00 am	626	390
Monday, June 04, 2007	2:00 pm	623	405
Monday, June 04, 2007	3:00 pm	642	408
Friday, June 22, 2007	10:00 am	513	309
Friday, June 22, 2007	12:00 pm	727	441
Friday, June 22, 2007	1:00 pm	629	346
Friday, June 22, 2007	6:00 pm	226	143
Wednesday, July 18, 2007	7:00 am	23	17
Wednesday, July 18, 2007	10:00 am	558	318
Wednesday, July 18, 2007	4:00 pm	378	241
Wednesday, July 18, 2007	6:00 pm	164	94
Saturday, July 28, 2007	8:00 am	88	51
Saturday, July 28, 2007	9:00 am	295	169
Saturday, July 28, 2007	12:00 pm	853	493
Saturday, July 28, 2007	3:00 pm	615	366
Thursday, August 30, 2007	7:00 am	0	0
Thursday, August 30, 2007	10:00 am	198	120
Thursday, August 30, 2007	4:00 pm	184	108
Thursday, August 30, 2007	6:00 pm	188	114

Table 5

Observed counts and monitor counts at Unit 5

Date	Time	Observed Count	Monitor Count
Thursday, June 07, 2007	11:00 am	595	383
Thursday, June 07, 2007	1:00 am	459	287
Thursday, June 07, 2007	2:00 pm	449	258
Thursday, June 07, 2007	3:00 pm	484	316
Monday, June 11, 2007	7:00 am	8	7
Monday, June 11, 2007	9:00 am	178	104
Monday, June 11, 2007	12:00 pm	485	294
Monday, June 11, 2007	4:00 pm	402	243
Saturday, June 23, 2007	8:00 am	76	43
Saturday, June 23, 2007	12:00 pm	603	334
Saturday, June 23, 2007	1:00 pm	569	339
Saturday, June 23, 2007	5:00 pm	521	287
Monday, July 09, 2007	9:00 am	241	156
Monday, July 09, 2007	1:00 pm	460	218
Monday, July 09, 2007	2:00 pm	544	307
Monday, July 09, 2007	6:00 pm	312	176
Tuesday, July 31, 2007	7:00 am	1	1
Tuesday, July 31, 2007	2:00 pm	634	345
Tuesday, July 31, 2007	4:00 pm	614	326
Tuesday, July 31, 2007	6:00 pm	446	243
Monday, August 20, 2007	9:00 am	121	71
Monday, August 20, 2007	1:00 pm	562	349
Monday, August 20, 2007	4:00 pm	462	260
Monday, August 20, 2007	6:00 pm	491	271

Table 6

Observed counts and monitor counts at Unit 6

Date	Time	Observed Count	Monitor Count
Saturday, June 23, 2007	8:00 am	0	0
Saturday, June 23, 2007	12:00 pm	11	7
Saturday, June 23, 2007	3:00 pm	14	7
Saturday, June 23, 2007	5:00 pm	8	5
Monday, July 09, 2007	9:00 am	10	7
Monday, July 09, 2007	1:00 pm	8	6
Monday, July 09, 2007	6:00 pm	2	2
Tuesday, July 31, 2007	7:00 am	0	0
Tuesday, July 31, 2007	2:00 pm	16	11
Tuesday, July 31, 2007	4:00 pm	8	8
Tuesday, July 31, 2007	6:00 pm	5	4
Monday, August 20, 2007	9:00 am	2	1
Monday, August 20, 2007	1:00 pm	12	6
Monday, August 20, 2007	4:00 pm	19	10
Monday, August 20, 2007	6:00 pm	1	0

APPENDIX B

'R' Syntax for Visitor Use Estimates using Bootstrapping

```
Monitor.Bootstrap=function(x,n,N,r,p,s){

##########################################################
# NOTE:
# x = calibrated mean for monitor
# n = number of days with data (sample)
# N = number of days in the monitoring period
# r = calibration ratio of monitor
# p = proportion of arrivals
# s = standard error of r (SEr) for monitor
##########################################################

########################################################
# Create 1x2 plot for histogram and sample size plot
########################################################

par(mfrow=c(2,2))

############################
# Create histogram of data
############################

hist(x)

##############################################################################
# Bootstrap seasonal data
# Unit 2
##############################################################################

plot(c(0,n),c(0,max(x)),type="n",xlab="Sample Size",ylab="Confidence Interval")
for(k in seq(5,n,10)){
a=numeric(10000)
for(i in 1:10000){
 a[i]=mean(sample(x,k,replace=T))
}
points(c(k,k),quantile(a,c(.025,.975)),type="b")
}
```

```
hist(a)

##########################################################
# Estimate the number of people from the bootstrap method
# Find calibrated bootstrap mean divided by p.
##########################################################

a.cal=(mean(a)*r)*p
hist(a*r*p)

############################################################
# Calculate the variance associated with the calibration of
# the mean
############################################################

var.mean=((mean(a)*p)^2)*(s^2)

# Calculate the error associated with the mean

B.mean=2*(sqrt(var.mean))

# Lower and upper bounds of mean

lb.mean=a.cal-B.mean
ub.mean=a.cal+B.mean

####################
# Find 2.5% quantile
####################

q1=quantile(a,c(.025))

#########################################################################
# Calculate the calibrated 2.5% quantile of people from the bootstrap method
#########################################################################

q1.cal=(q1*r)*p

#####################
# Find 97.5% quantile
#####################

q2=quantile(a,c(.975))
```

```
#################################################################################
# Calculate the calibrated 97.5% quantile of people from the bootstrap method
#################################################################################

q2.cal=(q2*r)*p

#######################################
# Calculate the confidence interval
#######################################

CI.low=a.cal-q1.cal
CI.high=abs(a.cal-q2.cal)

##################################################################
# Calculate the variance associated with the calibration of
# 2.5% and 97.5% quantiles
##################################################################

var.q1.p=((q1*p)^2)*(s^2)
var.q2.p=((q2*p)^2)*(s^2)

#####################################################################
# Calculate the error associated with the calibration of 2.5%
# and 97.5% quantiles
#####################################################################

B.q1.p=2*(sqrt(var.q1.p))
B.q2.p=2*(sqrt(var.q2.p))

###################################################################
# Calculate the upper and lower bounds of the 2.5% quantiles
###################################################################

q1.lb.cal=q1.cal-B.q1.p
q1.ub.cal=q1.cal+B.q1.p

###################################################################
# Calculate the upper and lower bounds of the 97.5% quantiles
###################################################################

q2.lb.cal=q2.cal-B.q2.p
q2.ub.cal=q2.cal+B.q2.p
```

```
##########################################################
# Calculate percent difference between mean and CI's
##########################################################

PCT.low=CI.low/a.cal
PCT.high=CI.high/a.cal

###############################
# Calculate population total
###############################

total=a.cal*N

var.total=((mean(a)*N*p)^2)*(s^2)

# Calculate the error associated with the mean

B.total=2*(sqrt(var.total))

# Lower and upper bounds of mean

lb.total=total-B.total
ub.total=total+B.total

###############################################
#Calculate 2.5% Quantile of population total
###############################################

q1.total.cal=q1.cal*N

###############################################
#Calculate 97.5% Quantile of population total
###############################################

q2.total.cal=q2.cal*N

##################################################################
# Calculate the variance associated with the calibration of
# 2.5% and 97.5% quantiles
##################################################################

var.q1.total.p=((q1*N*p)^2)*(s^2)
var.q2.total.p=((q2*N*p)^2)*(s^2)
```

```
######################################################################
# Calculate the error associated with the calibration of 2.5%
# and 97.5% quantiles
######################################################################

B.q1.total.p=2*(sqrt(var.q1.total.p))
B.q2.total.p=2*(sqrt(var.q2.total.p))

####################################################################
# Calculate the upper and lower bounds of the 2.5% quantiles
####################################################################

q1.total.lb.cal=q1.total.cal-B.q1.total.p
q1.total.ub.cal=qI.total.cal+B.q1.total.p

####################################################################
# Calculate the upper and lower bounds of the 97.5% quantiles
####################################################################

q2.total.lb.cal=q2.total.cal-B.q2.total.p
q2.total.ub.cal=q2.total.cal+B.q2.total.p

####################################################################
# Calculate confidence interval for bootstrap estimation
####################################################################

CI.low.Total=total-q1.total.cal
CI.high.Total=q2.total.cal-total

##################
# Display results
##################

cat("\n MEAN RESULTS \n")
cat("\n Calibrated Mean Number of People          = ", a.cal)
cat("\n Calibration error associated with mean     = ", B.mean)
cat("\n Lower bound of mean                       = ", lb.mean)
cat("\n Upper bound of mean                       = ", ub.mean)
cat("\n Lower Cl Percent Difference                = ", PCT.low)
cat("\n Upper CI Percent Difference                = ", PCT.high)
cat("\n            \n")
cat("\n Lower Bound of mean \n")
cat("\n Calibrated 2.5% Quantile (People)          = ", q1.cal)
cat("\n Calibrated Lower CI (People)              = ", CI.low)
cat("\n Calibration error associated with lb of mean = ", B.q1.p)
cat("\n Lower Bound of 2.5% Quantile               = ", q1.lb.cal)
```

```
cat("\n Upper Bound of 2.5% Quantile              = ", q1.ub.cal)
cat("\n            \n")
cat("\n Upper Bound of mean \n")
cat("\n Calibrated 97.5% Quantile (People)        = ", q2.cal)
cat("\n Calibrated Upper CI (People)              = ", CI.high)
cat("\n Calibration error associated with ub of mean = ", B.q2.p)
cat("\n Lower Bound of 97.5% Quantile             = ", q2.lb.cal)
cat("\n Upper Bound of 97.5% Quantile             = ", q2.ub.cal)
cat("\n            \n")
cat("\n            \n")
cat("\n            \n")
cat("\n TOTAL RESULTS \n")
cat("\n TOTAL NUMBER OF PEOPLE                    = ", total)
cat("\n Calibration error associated with mean    = ", B.total)
cat("\n Lower bound of mean                       = ", lb.total)
cat("\n Upper bound of mean                       = ", ub.total)
cat("\n            \n")
cat("\n Lower Bound of total \n")
cat("\n Calibrated 2.5% Quantile (People)         = ", q1.total.cal)
cat("\n Calibrated Lower CI (People)              = ", CI.low.Total)
cat("\n Calibration error associated with lb of total= ", B.q1.total.p)
cat("\n Lower Bound of 2.5% Quantile              = ", q1.total.lb.cal)
cat("\n Upper Bound of 2.5% Quantile              = ", q1.total.ub.cal)
cat("\n            \n")
cat("\n Upper Bound of total \n")
cat("\n Calibrated 97.5% Quantile (People)        = ", q2.total.cal)
cat("\n Calibrated Upper CI (People)              = ", CI.high.Total)
cat("\n Calibration error associated with lb of total= ", B.q2.total.p)
cat("\n Lower Bound of 97.5% Quantile             = ", q2.total.lb.cal)
cat("\n Upper Bound of 97.5% Quantile             = ", q2.total.ub.cal)
}
```

APPENDIX C

Geographic Coordinates for Yosemite National Park Visitor Monitors

Table 1

Visitor monitor coordinates by location (UTM Zone 11N, North American Datum 1927)

Location	Unit Number	X-Coordinate	Y-Coordinate
Hetch Hetchy Trailhead	1	254946.913560	4204126.682478
Yosemite Falls – West	2	271270.461393	4181212.433338
Yosemite Falls – East	3	271334.607421	4181279.349893
Vernal Falls Trailhead	4	274586.197705	4179033.004823
Bridalveil Fall	5	266483.465941	4177714.494285
Glacier Point - Main Trail	6	273222.854729	4178978.022502
Hetch Hetchy - Beehive Trail	7	255107.582709	4204808.734977
Hetch Hetchy - Wapama Falls	8	256160.075913	4205069.981300
Tuolumne Meadows - Cathedral Lakes	9	290334.408123	4194273.797490
Tuolumne Meadows - Glen Aulin	10	291667.697530	4195087.519939
Tuolumne Meadows - Lyel Canyon	11	294656.543917	4194566.157278
Glacier Point – Handicap Accessible Trail	12	273132.443383	4178961.206604

APPENDIX D

Table 1

Inbound vehicle counts (Arch Rock, Big Oak Flat, and Wawona entrances) and Yosemite Falls monitor counts (Monitors 1 and 2)

Date	Hour (Inbound Vehicles)	Inbound Vehicle Count	Yosemite Falls Monitor Count
Friday, June 01, 2007	6:00 am	100	122
Friday, June 01, 2007	7:00 am	190	263
Friday, June 01, 2007	8:00 am	260	443
Friday, June 01, 2007	9:00 am	343	377
Friday, June 01, 2007	10:00 am	376	557
Friday, June 01, 2007	11:00 am	344	602
Friday, June 01, 2007	12:00 pm	343	499
Friday, June 01, 2007	1:00 pm	315	403
Friday, June 01, 2007	2:00 pm	247	347
Saturday, June 02, 2007	6:00 am	121	173
Saturday, June 02, 2007	7:00 am	252	353
Saturday, June 02, 2007	8:00 am	386	624
Saturday, June 02, 2007	9:00 am	518	839
Saturday, June 02, 2007	10:00 am	497	927
Saturday, June 02, 2007	11:00 am	391	965
Saturday, June 02, 2007	12:00 pm	316	912
Saturday, June 02, 2007	1:00 pm	326	612
Saturday, June 02, 2007	2:00 pm	231	283
Sunday, June 03, 2007	6:00 am	90	179
Sunday, June 03, 2007	7:00 am	171	260
Sunday, June 03, 2007	8:00 am	302	465
Sunday, June 03, 2007	9:00 am	431	673
Sunday, June 03, 2007	10:00 am	474	545
Sunday, June 03, 2007	11:00 am	433	600
Sunday, June 03, 2007	12:00 pm	382	629
Sunday, June 03, 2007	1:00 pm	327	462
Sunday, June 03, 2007	2:00 pm	293	478
Monday, June 04, 2007	6:00 am	134	287
Monday, June 04, 2007	7:00 am	172	251
Monday, June 04, 2007	8:00 am	304	369

Monday, June 04, 2007	9:00 am	358	465
Monday, June 04, 2007	10:00 am	394	478
Monday, June 04, 2007	11:00 am	303	594
Monday, June 04, 2007	12:00 pm	260	468
Monday, June 04, 2007	1:00 pm	268	477
Monday, June 04, 2007	2:00 pm	216	365
Tuesday, June 05, 2007	6:00 am	120	161
Tuesday, June 05, 2007	7:00 am	214	243
Tuesday, June 05, 2007	8:00 am	261	435
Tuesday, June 05, 2007	9:00 am	318	418
Tuesday, June 05, 2007	10:00 am	357	688
Tuesday, June 05, 2007	11:00 am	299	584
Tuesday, June 05, 2007	12:00 pm	257	278
Tuesday, June 05, 2007	1:00 pm	247	297
Tuesday, June 05, 2007	2:00 pm	215	268
Wednesday, June 06, 2007	6:00 am	130	146
Wednesday, June 06, 2007	7:00 am	214	301
Wednesday, June 06, 2007	8:00 am	284	337
Wednesday, June 06, 2007	9:00 am	361	493
Wednesday, June 06, 2007	10:00 am	389	596
Wednesday, June 06, 2007	11:00 am	296	486
Wednesday, June 06, 2007	12:00 pm	273	639
Wednesday, June 06, 2007	1:00 pm	205	498
Wednesday, June 06, 2007	2:00 pm	197	219
Thursday, June 07, 2007	6:00 am	127	177
Thursday, June 07, 2007	7:00 am	187	272
Thursday, June 07, 2007	8:00 am	276	376
Thursday, June 07, 2007	9:00 am	353	432
Thursday, June 07, 2007	10:00 am	371	492
Thursday, June 07, 2007	11:00 am	301	463
Thursday, June 07, 2007	12:00 pm	246	468
Thursday, June 07, 2007	1:00 pm	254	368
Thursday, June 07, 2007	2:00 pm	218	280
Friday, June 08, 2007	6:00 am	130	183
Friday, June 08, 2007	7:00 am	175	321
Friday, June 08, 2007	8:00 am	280	395
Friday, June 08, 2007	9:00 am	384	445
Friday, June 08, 2007	10:00 am	404	383
Friday, June 08, 2007	11:00 am	356	630
Friday, June 08, 2007	12:00 pm	305	598
Friday, June 08, 2007	1:00 pm	261	476
Friday, June 08, 2007	2:00 pm	271	366
Monday, June 11, 2007	6:00 am	121	226
Monday, June 11, 2007	7:00 am	186	321
Monday, June 11, 2007	8:00 am	276	432
Monday, June 11, 2007	9:00 am	401	518

Monday, June 11, 2007	10:00 am	420	588
Monday, June 11, 2007	11:00 am	337	597
Monday, June 11, 2007	12:00 pm	313	620
Monday, June 11, 2007	1:00 pm	264	684
Monday, June 11, 2007	2:00 pm	250	422
Tuesday, June 12, 2007	6:00 am	121	180
Tuesday, June 12, 2007	7:00 am	197	274
Tuesday, June 12, 2007	8:00 am	286	412
Tuesday, June 12, 2007	9:00 am	402	481
Tuesday, June 12, 2007	10:00 am	402	516
Tuesday, June 12, 2007	11:00 am	324	635
Tuesday, June 12, 2007	12:00 pm	278	575
Tuesday, June 12, 2007	1:00 pm	257	613
Tuesday, June 12, 2007	2:00 pm	236	173
Wednesday, June 13, 2007	6:00 am	129	139
Wednesday, June 13, 2007	7:00 am	208	238
Wednesday, June 13, 2007	8:00 am	357	328
Wednesday, June 13, 2007	9:00 am	392	489
Wednesday, June 13, 2007	10:00 am	399	555
Wednesday, June 13, 2007	11:00 am	296	520
Wednesday, June 13, 2007	12:00 pm	302	587
Wednesday, June 13, 2007	1:00 pm	273	526
Wednesday, June 13, 2007	2:00 pm	231	359
Thursday, June 14, 2007	6:00 am	131	141
Thursday, June 14, 2007	7:00 am	218	258
Thursday, June 14, 2007	8:00 am	352	386
Thursday, June 14, 2007	9:00 am	389	486
Thursday, June 14, 2007	10:00 am	395	478
Thursday, June 14, 2007	11:00 am	366	523
Thursday, June 14, 2007	12:00 pm	298	438
Thursday, June 14, 2007	1:00 pm	300	588
Thursday, June 14, 2007	2:00 pm	244	347
Friday, June 15, 2007	6:00 am	112	204
Friday, June 15, 2007	7:00 am	218	326
Friday, June 15, 2007	8:00 am	316	392
Friday, June 15, 2007	9:00 am	384	545
Friday, June 15, 2007	10:00 am	461	575
Friday, June 15, 2007	11:00 am	371	672
Friday, June 15, 2007	12:00 pm	360	460
Friday, June 15, 2007	1:00 pm	311	452
Friday, June 15, 2007	2:00 pm	285	395
Saturday, June 16, 2007	6:00 am	149	146
Saturday, June 16, 2007	7:00 am	281	403
Saturday, June 16, 2007	8:00 am	446	623
Saturday, June 16, 2007	9:00 am	529	649
Saturday, June 16, 2007	10:00 am	534	876

Saturday, June 16, 2007	11:00 am	520	1018
Saturday, June 16, 2007	12:00 pm	358	930
Saturday, June 16, 2007	1:00 pm	291	762
Saturday, June 16, 2007	2:00 pm	313	638
Sunday, June 17, 2007	6:00 am	78	166
Sunday, June 17, 2007	7:00 am	177	261
Sunday, June 17, 2007	8:00 am	344	550
Sunday, June 17, 2007	9:00 am	503	749
Sunday, June 17, 2007	10:00 am	504	708
Sunday, June 17, 2007	11:00 am	495	862
Sunday, June 17, 2007	12:00 pm	421	638
Sunday, June 17, 2007	1:00 pm	392	632
Sunday, June 17, 2007	2:00 pm	322	531
Monday, June 18, 2007	6:00 am	116	221
Monday, June 18, 2007	7:00 am	220	251
Monday, June 18, 2007	8:00 am	376	440
Monday, June 18, 2007	9:00 am	426	579
Monday, June 18, 2007	10:00 am	475	617
Monday, June 18, 2007	11:00 am	385	614
Monday, June 18, 2007	12:00 pm	355	594
Monday, June 18, 2007	1:00 pm	318	557
Monday, June 18, 2007	2:00 pm	294	346
Tuesday, June 19, 2007	6:00 am	113	277
Tuesday, June 19, 2007	7:00 am	260	302
Tuesday, June 19, 2007	8:00 am	333	464
Tuesday, June 19, 2007	9:00 am	422	557
Tuesday, June 19, 2007	10:00 am	474	636
Tuesday, June 19, 2007	11:00 am	384	691
Tuesday, June 19, 2007	12:00 pm	299	751
Tuesday, June 19, 2007	1:00 pm	322	609
Tuesday, June 19, 2007	2:00 pm	210	451
Wednesday, June 20, 2007	6:00 am	106	255
Wednesday, June 20, 2007	7:00 am	223	264
Wednesday, June 20, 2007	8:00 am	379	405
Wednesday, June 20, 2007	9:00 am	462	694
Wednesday, June 20, 2007	10:00 am	404	731
Wednesday, June 20, 2007	11:00 am	332	758
Wednesday, June 20, 2007	12:00 pm	276	679
Wednesday, June 20, 2007	1:00 pm	264	585
Wednesday, June 20, 2007	2:00 pm	246	405
Thursday, June 21, 2007	6:00 am	139	190
Thursday, June 21, 2007	7:00 am	194	263
Thursday, June 21, 2007	8:00 am	389	422
Thursday, June 21, 2007	9:00 am	462	499
Thursday, June 21, 2007	10:00 am	449	633
Thursday, June 21, 2007	11:00 am	397	535

Thursday, June 21, 2007	12:00 pm	370	599
Thursday, June 21, 2007	1:00 pm	339	553
Thursday, June 21, 2007	2:00 pm	263	382
Friday, June 22, 2007	6:00 am	125	224
Friday, June 22, 2007	7:00 am	209	254
Friday, June 22, 2007	8:00 am	345	414
Friday, June 22, 2007	9:00 am	442	541
Friday, June 22, 2007	10:00 am	495	752
Friday, June 22, 2007	11:00 am	429	616
Friday, June 22, 2007	12:00 pm	354	585
Friday, June 22, 2007	1:00 pm	307	444
Friday, June 22, 2007	2:00 pm	282	322
Tuesday, June 26, 2007	6:00 am	115	204
Tuesday, June 26, 2007	7:00 am	227	322
Tuesday, June 26, 2007	8:00 am	364	416
Tuesday, June 26, 2007	9:00 am	424	479
Tuesday, June 26, 2007	10:00 am	430	633
Tuesday, June 26, 2007	11:00 am	327	723
Tuesday, June 26, 2007	12:00 pm	306	573
Tuesday, June 26, 2007	1:00 pm	271	444
Tuesday, June 26, 2007	2:00 pm	233	384
Wednesday, June 27, 2007	6:00 am	120	162
Wednesday, June 27, 2007	7:00 am	203	268
Wednesday, June 27, 2007	8:00 am	364	516
Wednesday, June 27, 2007	9:00 am	461	607
Wednesday, June 27, 2007	10:00 am	498	629
Wednesday, June 27, 2007	11:00 am	401	678
Wednesday, June 27, 2007	12:00 pm	273	552
Wednesday, June 27, 2007	1:00 pm	253	505
Wednesday, June 27, 2007	2:00 pm	225	338
Thursday, June 28, 2007	6:00 am	121	219
Thursday, June 28, 2007	7:00 am	217	330
Thursday, June 28, 2007	8:00 am	351	460
Thursday, June 28, 2007	9:00 am	427	613
Thursday, June 28, 2007	10:00 am	479	671
Thursday, June 28, 2007	11:00 am	370	598
Thursday, June 28, 2007	12:00 pm	351	713
Thursday, June 28, 2007	1:00 pm	293	458
Thursday, June 28, 2007	2:00 pm	278	335
Friday, June 29, 2007	6:00 am	127	149
Friday, June 29, 2007	7:00 am	189	187
Friday, June 29, 2007	8:00 am	345	410
Friday, June 29, 2007	9:00 am	499	504
Friday, June 29, 2007	10:00 am	456	593
Friday, June 29, 2007	11:00 am	450	440
Friday, June 29, 2007	12:00 pm	328	535

Friday, June 29, 2007	1:00 pm	303	435
Friday, June 29, 2007	2:00 pm	302	338
Saturday, June 30, 2007	6:00 am	151	169
Saturday, June 30, 2007	7:00 am	276	363
Saturday, June 30, 2007	8:00 am	365	537
Saturday, June 30, 2007	9:00 am	503	586
Saturday, June 30, 2007	10:00 am	485	476
Saturday, June 30, 2007	11:00 am	489	752
Saturday, June 30, 2007	12:00 pm	453	1027
Saturday, June 30, 2007	1:00 pm	478	821
Saturday, June 30, 2007	2:00 pm	276	593
Sunday, July 01, 2007	6:00 am	94	181
Sunday, July 01, 2007	7:00 am	197	302
Sunday, July 01, 2007	8:00 am	394	638
Sunday, July 01, 2007	9:00 am	494	677
Sunday, July 01, 2007	10:00 am	599	792
Sunday, July 01, 2007	11:00 am	539	719
Sunday, July 01, 2007	12:00 pm	430	786
Sunday, July 01, 2007	1:00 pm	388	553
Sunday, July 01, 2007	2:00 pm	342	467
Monday, July 02, 2007	6:00 am	114	125
Monday, July 02, 2007	7:00 am	197	304
Monday, July 02, 2007	8:00 am	375	505
Monday, July 02, 2007	9:00 am	477	546
Monday, July 02, 2007	10:00 am	537	673
Monday, July 02, 2007	11:00 am	455	729
Monday, July 02, 2007	12:00 pm	357	634
Monday, July 02, 2007	1:00 pm	320	541
Monday, July 02, 2007	2:00 pm	250	493
Tuesday, July 03, 2007	6:00 am	115	118
Tuesday, July 03, 2007	7:00 am	196	294
Tuesday, July 03, 2007	8:00 am	343	401
Tuesday, July 03, 2007	9:00 am	430	426
Tuesday, July 03, 2007	10:00 am	454	522
Tuesday, July 03, 2007	11:00 am	424	525
Tuesday, July 03, 2007	12:00 pm	334	521
Tuesday, July 03, 2007	1:00 pm	279	634
Tuesday, July 03, 2007	2:00 pm	226	390
Wednesday, July 04, 2007	6:00 am	103	101
Wednesday, July 04, 2007	7:00 am	215	277
Wednesday, July 04, 2007	8:00 am	328	487
Wednesday, July 04, 2007	9:00 am	427	546
Wednesday, July 04, 2007	10:00 am	472	427
Wednesday, July 04, 2007	11:00 am	382	611
Wednesday, July 04, 2007	12:00 pm	313	559
Wednesday, July 04, 2007	1:00 pm	283	403

Wednesday, July 04, 2007	2:00 pm	224	320
Thursday, July 05, 2007	6:00 am	102	197
Thursday, July 05, 2007	7:00 am	234	381
Thursday, July 05, 2007	8:00 am	299	511
Thursday, July 05, 2007	9:00 am	478	608
Thursday, July 05, 2007	10:00 am	511	609
Thursday, July 05, 2007	11:00 am	443	486
Thursday, July 05, 2007	12:00 pm	384	553
Thursday, July 05, 2007	1:00 pm	340	471
Thursday, July 05, 2007	2:00 pm	323	449
Friday, July 06, 2007	6:00 am	127	159
Friday, July 06, 2007	7:00 am	203	308
Friday, July 06, 2007	8:00 am	371	454
Friday, July 06, 2007	9:00 am	530	503
Friday, July 06, 2007	10:00 am	536	611
Friday, July 06, 2007	11:00 am	490	791
Friday, July 06, 2007	12:00 pm	361	522
Friday, July 06, 2007	1:00 pm	341	452
Friday, July 06, 2007	2:00 pm	309	312
Saturday, July 07, 2007	6:00 am	144	159
Saturday, July 07, 2007	7:00 am	234	430
Saturday, July 07, 2007	8:00 am	410	616
Saturday, July 07, 2007	9:00 am	576	652
Saturday, July 07, 2007	10:00 am	640	727
Saturday, July 07, 2007	11:00 am	615	823
Saturday, July 07, 2007	12:00 pm	456	910
Saturday, July 07, 2007	1:00 pm	392	651
Saturday, July 07, 2007	2:00 pm	324	493
Sunday, July 08, 2007	6:00 am	80	180
Sunday, July 08, 2007	7:00 am	178	306
Sunday, July 08, 2007	8:00 am	312	609
Sunday, July 08, 2007	9:00 am	471	617
Sunday, July 08, 2007	10:00 am	530	768
Sunday, July 08, 2007	11:00 am	508	462
Sunday, July 08, 2007	12:00 pm	416	541
Sunday, July 08, 2007	1:00 pm	368	475
Sunday, July 08, 2007	2:00 pm	350	338
Monday, July 09, 2007	6:00 am	102	93
Monday, July 09, 2007	7:00 am	194	241
Monday, July 09, 2007	8:00 am	272	481
Monday, July 09, 2007	9:00 am	390	494
Monday, July 09, 2007	10:00 am	438	460
Monday, July 09, 2007	11:00 am	360	503
Monday, July 09, 2007	12:00 pm	314	548
Monday, July 09, 2007	1:00 pm	298	462
Monday, July 09, 2007	2:00 pm	235	371

Tuesday, July 10, 2007	6:00 am	107	119
Tuesday, July 10, 2007	7:00 am	183	244
Tuesday, July 10, 2007	8:00 am	309	416
Tuesday, July 10, 2007	9:00 am	404	586
Tuesday, July 10, 2007	10:00 am	418	502
Tuesday, July 10, 2007	11:00 am	388	258
Tuesday, July 10, 2007	12:00 pm	308	529
Tuesday, July 10, 2007	1:00 pm	240	713
Tuesday, July 10, 2007	2:00 pm	234	486
Wednesday, July 11, 2007	6:00 am	106	163
Wednesday, July 11, 2007	7:00 am	203	229
Wednesday, July 11, 2007	8:00 am	285	445
Wednesday, July 11, 2007	9:00 am	390	540
Wednesday, July 11, 2007	10:00 am	460	765
Wednesday, July 11, 2007	11:00 am	381	738
Wednesday, July 11, 2007	12:00 pm	314	563
Wednesday, July 11, 2007	1:00 pm	255	414
Wednesday, July 11, 2007	2:00 pm	253	344
Thursday, July 12, 2007	6:00 am	118	158
Thursday, July 12, 2007	7:00 am	191	243
Thursday, July 12, 2007	8:00 am	268	506
Thursday, July 12, 2007	9:00 am	426	536
Thursday, July 12, 2007	10:00 am	473	598
Thursday, July 12, 2007	11:00 am	387	665
Thursday, July 12, 2007	12:00 pm	371	673
Thursday, July 12, 2007	1:00 pm	290	393
Thursday, July 12, 2007	2:00 pm	260	392
Friday, July 13, 2007	6:00 am	109	245
Friday, July 13, 2007	7:00 am	196	200
Friday, July 13, 2007	8:00 am	348	456
Friday, July 13, 2007	9:00 am	442	482
Friday, July 13, 2007	10:00 am	417	684
Friday, July 13, 2007	11:00 am	408	446
Friday, July 13, 2007	12:00 pm	388	510
Friday, July 13, 2007	1:00 pm	348	429
Friday, July 13, 2007	2:00 pm	275	317
Saturday, July 14, 2007	6:00 am	160	120
Saturday, July 14, 2007	7:00 am	276	240
Saturday, July 14, 2007	8:00 am	402	488
Saturday, July 14, 2007	9:00 am	526	765
Saturday, July 14, 2007	10:00 am	532	716
Saturday, July 14, 2007	11:00 am	549	874
Saturday, July 14, 2007	12:00 pm	474	837
Saturday, July 14, 2007	1:00 pm	408	666
Saturday, July 14, 2007	2:00 pm	293	516
Sunday, July 15, 2007	6:00 am	88	184

Sunday, July 15, 2007	7:00 am	174	203
Sunday, July 15, 2007	8:00 am	381	637
Sunday, July 15, 2007	9:00 am	537	537
Sunday, July 15, 2007	10:00 am	556	678
Sunday, July 15, 2007	11:00 am	599	609
Sunday, July 15, 2007	12:00 pm	477	432
Sunday, July 15, 2007	1:00 pm	388	553
Sunday, July 15, 2007	2:00 pm	364	415
Monday, July 16, 2007	6:00 am	121	183
Monday, July 16, 2007	7:00 am	181	226
Monday, July 16, 2007	8:00 am	344	398
Monday, July 16, 2007	9:00 am	416	479
Monday, July 16, 2007	10:00 am	449	512
Monday, July 16, 2007	11:00 am	395	542
Monday, July 16, 2007	12:00 pm	378	590
Monday, July 16, 2007	1:00 pm	333	478
Monday, July 16, 2007	2:00 pm	332	346
Tuesday, July 17, 2007	6:00 am	131	83
Tuesday, July 17, 2007	7:00 am	184	185
Tuesday, July 17, 2007	8:00 am	315	289
Tuesday, July 17, 2007	9:00 am	403	538
Tuesday, July 17, 2007	10:00 am	478	478
Tuesday, July 17, 2007	11:00 am	398	530
Tuesday, July 17, 2007	12:00 pm	315	376
Tuesday, July 17, 2007	1:00 pm	282	415
Tuesday, July 17, 2007	2:00 pm	255	301
Wednesday, July 18, 2007	6:00 am	116	73
Wednesday, July 18, 2007	7:00 am	206	242
Wednesday, July 18, 2007	8:00 am	312	386
Wednesday, July 18, 2007	9:00 am	418	468
Wednesday, July 18, 2007	10:00 am	445	526
Wednesday, July 18, 2007	11:00 am	423	579
Wednesday, July 18, 2007	12:00 pm	312	473
Wednesday, July 18, 2007	1:00 pm	313	379
Wednesday, July 18, 2007	2:00 pm	311	271
Thursday, July 19, 2007	6:00 am	115	88
Thursday, July 19, 2007	7:00 am	204	190
Thursday, July 19, 2007	8:00 am	321	314
Thursday, July 19, 2007	9:00 am	475	430
Thursday, July 19, 2007	10:00 am	474	410
Thursday, July 19, 2007	11:00 am	393	383
Thursday, July 19, 2007	12:00 pm	406	513
Thursday, July 19, 2007	1:00 pm	355	419
Thursday, July 19, 2007	2:00 pm	297	294
Friday, July 20, 2007	6:00 am	138	191
Friday, July 20, 2007	7:00 am	220	176

Friday, July 20, 2007	8:00 am	348	312
Friday, July 20, 2007	9:00 am	464	493
Friday, July 20, 2007	10:00 am	494	473
Friday, July 20, 2007	11:00 am	468	406
Friday, July 20, 2007	12:00 pm	356	368
Friday, July 20, 2007	1:00 pm	358	241
Friday, July 20, 2007	2:00 pm	375	258
Saturday, July 21, 2007	6:00 am	123	52
Saturday, July 21, 2007	7:00 am	252	188
Saturday, July 21, 2007	8:00 am	418	437
Saturday, July 21, 2007	9:00 am	613	536
Saturday, July 21, 2007	10:00 am	679	628
Saturday, July 21, 2007	11:00 am	540	750
Saturday, July 21, 2007	12:00 pm	573	640
Saturday, July 21, 2007	1:00 pm	444	565
Saturday, July 21, 2007	2:00 pm	349	357
Sunday, July 22, 2007	6:00 am	109	59
Sunday, July 22, 2007	7:00 am	194	175
Sunday, July 22, 2007	8:00 am	374	365
Sunday, July 22, 2007	9:00 am	513	367
Sunday, July 22, 2007	10:00 am	520	456
Sunday, July 22, 2007	11:00 am	627	386
Sunday, July 22, 2007	12:00 pm	554	387
Sunday, July 22, 2007	1:00 pm	397	305
Sunday, July 22, 2007	2:00 pm	334	283
Monday, July 23, 2007	6:00 am	127	168
Monday, July 23, 2007	7:00 am	187	199
Monday, July 23, 2007	8:00 am	373	304
Monday, July 23, 2007	9:00 am	458	325
Monday, July 23, 2007	10:00 am	468	386
Monday, July 23, 2007	11:00 am	475	340
Monday, July 23, 2007	12:00 pm	326	380
Monday, July 23, 2007	1:00 pm	374	353
Monday, July 23, 2007	2:00 pm	307	178
Tuesday, July 24, 2007	6:00 am	113	140
Tuesday, July 24, 2007	7:00 am	204	107
Tuesday, July 24, 2007	8:00 am	363	332
Tuesday, July 24, 2007	9:00 am	498	435
Tuesday, July 24, 2007	10:00 am	508	413
Tuesday, July 24, 2007	11:00 am	429	365
Tuesday, July 24, 2007	12:00 pm	341	176
Tuesday, July 24, 2007	1:00 pm	288	324
Tuesday, July 24, 2007	2:00 pm	308	198
Wednesday, July 25, 2007	6:00 am	111	93
Wednesday, July 25, 2007	7:00 am	211	180
Wednesday, July 25, 2007	8:00 am	342	287

Wednesday, July 25, 2007	9:00 am	485	469
Wednesday, July 25, 2007	10:00 am	490	503
Wednesday, July 25, 2007	11:00 am	410	490
Wednesday, July 25, 2007	12:00 pm	318	330
Wednesday, July 25, 2007	1:00 pm	331	283
Wednesday, July 25, 2007	2:00 pm	292	236
Thursday, July 26, 2007	6:00 am	107	107
Thursday, July 26, 2007	7:00 am	215	176
Thursday, July 26, 2007	8:00 am	347	371
Thursday, July 26, 2007	9:00 am	495	351
Thursday, July 26, 2007	10:00 am	507	340
Thursday, July 26, 2007	11:00 am	407	347
Thursday, July 26, 2007	12:00 pm	352	349
Thursday, July 26, 2007	1:00 pm	361	327
Thursday, July 26, 2007	2:00 pm	299	237
Tuesday, July 31, 2007	6:00 am	121	66
Tuesday, July 31, 2007	7:00 am	215	133
Tuesday, July 31, 2007	8:00 am	349	331
Tuesday, July 31, 2007	9:00 am	509	336
Tuesday, July 31, 2007	10:00 am	488	383
Tuesday, July 31, 2007	11:00 am	449	447
Tuesday, July 31, 2007	12:00 pm	306	344
Tuesday, July 31, 2007	1:00 pm	327	334
Tuesday, July 31, 2007	2:00 pm	308	147
Wednesday, August 01, 2007	6:00 am	115	55
Wednesday, August 01, 2007	7:00 am	191	236
Wednesday, August 01, 2007	8:00 am	369	290
Wednesday, August 01, 2007	9:00 am	507	368
Wednesday, August 01, 2007	10:00 am	475	434
Wednesday, August 01, 2007	11:00 am	474	400
Wednesday, August 01, 2007	12:00 pm	377	292
Wednesday, August 01, 2007	1:00 pm	384	232
Wednesday, August 01, 2007	2:00 pm	302	214
Thursday, August 02, 2007	6:00 am	91	182
Thursday, August 02, 2007	7:00 am	203	197
Thursday, August 02, 2007	8:00 am	356	286
Thursday, August 02, 2007	9:00 am	546	328
Thursday, August 02, 2007	10:00 am	535	333
Thursday, August 02, 2007	11:00 am	458	294
Thursday, August 02, 2007	12:00 pm	418	258
Thursday, August 02, 2007	1:00 pm	322	207
Thursday, August 02, 2007	2:00 pm	345	149
Friday, August 03, 2007	6:00 am	104	153
Friday, August 03, 2007	7:00 am	211	200
Friday, August 03, 2007	8:00 am	395	288
Friday, August 03, 2007	9:00 am	539	356

Friday, August 03, 2007	10:00 am	581	255
Friday, August 03, 2007	11:00 am	455	398
Friday, August 03, 2007	12:00 pm	457	197
Friday, August 03, 2007	1:00 pm	395	140
Friday, August 03, 2007	2:00 pm	344	196
Saturday, August 04, 2007	6:00 am	147	83
Saturday, August 04, 2007	7:00 am	304	184
Saturday, August 04, 2007	8:00 am	491	317
Saturday, August 04, 2007	9:00 am	604	358
Saturday, August 04, 2007	10:00 am	613	472
Saturday, August 04, 2007	11:00 am	619	498
Saturday, August 04, 2007	12:00 pm	519	452
Saturday, August 04, 2007	1:00 pm	438	485
Saturday, August 04, 2007	2:00 pm	351	282
Sunday, August 05, 2007	6:00 am	114	90
Sunday, August 05, 2007	7:00 am	207	174
Sunday, August 05, 2007	8:00 am	398	332
Sunday, August 05, 2007	9:00 am	565	301
Sunday, August 05, 2007	10:00 am	659	366
Sunday, August 05, 2007	11:00 am	568	424
Sunday, August 05, 2007	12:00 pm	533	253
Sunday, August 05, 2007	1:00 pm	441	294
Sunday, August 05, 2007	2:00 pm	402	297
Monday, August 06, 2007	6:00 am	125	127
Monday, August 06, 2007	7:00 am	217	175
Monday, August 06, 2007	8:00 am	361	281
Monday, August 06, 2007	9:00 am	496	317
Monday, August 06, 2007	10:00 am	555	414
Monday, August 06, 2007	11:00 am	505	386
Monday, August 06, 2007	12:00 pm	439	346
Monday, August 06, 2007	1:00 pm	378	410
Monday, August 06, 2007	2:00 pm	324	283
Tuesday, August 07, 2007	6:00 am	125	119
Tuesday, August 07, 2007	7:00 am	213	162
Tuesday, August 07, 2007	8:00 am	389	222
Tuesday, August 07, 2007	9:00 am	527	312
Tuesday, August 07, 2007	10:00 am	520	400
Tuesday, August 07, 2007	11:00 am	456	364
Tuesday, August 07, 2007	12:00 pm	394	283
Tuesday, August 07, 2007	1:00 pm	376	316
Tuesday, August 07, 2007	2:00 pm	307	231
Wednesday, August 08, 2007	6:00 am	112	36
Wednesday, August 08, 2007	7:00 am	213	134
Wednesday, August 08, 2007	8:00 am	361	338
Wednesday, August 08, 2007	9:00 am	499	549
Wednesday, August 08, 2007	10:00 am	556	536

Wednesday, August 08, 2007	11:00 am	453	497
Wednesday, August 08, 2007	12:00 pm	403	389
Wednesday, August 08, 2007	1:00 pm	368	295
Wednesday, August 08, 2007	2:00 pm	324	212
Thursday, August 09, 2007	6:00 am	120	83
Thursday, August 09, 2007	7:00 am	232	173
Thursday, August 09, 2007	8:00 am	384	299
Thursday, August 09, 2007	9:00 am	465	403
Thursday, August 09, 2007	10:00 am	572	343
Thursday, August 09, 2007	11:00 am	477	373
Thursday, August 09, 2007	12:00 pm	452	270
Thursday, August 09, 2007	1:00 pm	395	227
Thursday, August 09, 2007	2:00 pm	345	183
Friday, August 10, 2007	6:00 am	102	202
Friday, August 10, 2007	7:00 am	229	125
Friday, August 10, 2007	8:00 am	339	235
Friday, August 10, 2007	9:00 am	481	361
Friday, August 10, 2007	10:00 am	606	392
Friday, August 10, 2007	11:00 am	548	422
Friday, August 10, 2007	12:00 pm	415	302
Friday, August 10, 2007	1:00 pm	458	223
Friday, August 10, 2007	2:00 pm	369	212
Saturday, August 11, 2007	6:00 am	144	102
Saturday, August 11, 2007	7:00 am	265	207
Saturday, August 11, 2007	8:00 am	436	386
Saturday, August 11, 2007	9:00 am	587	476
Saturday, August 11, 2007	10:00 am	599	521
Saturday, August 11, 2007	11:00 am	636	752
Saturday, August 11, 2007	12:00 pm	540	470
Saturday, August 11, 2007	1:00 pm	458	478
Saturday, August 11, 2007	2:00 pm	398	284
Sunday, August 12, 2007	6:00 am	102	100
Sunday, August 12, 2007	7:00 am	201	106
Sunday, August 12, 2007	8:00 am	408	378
Sunday, August 12, 2007	9:00 am	556	428
Sunday, August 12, 2007	10:00 am	656	433
Sunday, August 12, 2007	11:00 am	571	374
Sunday, August 12, 2007	12:00 pm	577	357
Sunday, August 12, 2007	1:00 pm	455	274
Sunday, August 12, 2007	2:00 pm	379	273
Monday, August 13, 2007	6:00 am	111	59
Monday, August 13, 2007	7:00 am	202	290
Monday, August 13, 2007	8:00 am	328	311
Monday, August 13, 2007	9:00 am	541	394
Monday, August 13, 2007	10:00 am	544	417
Monday, August 13, 2007	11:00 am	528	354

Monday, August 13, 2007	12:00 pm	430	316
Monday, August 13, 2007	1:00 pm	385	243
Monday, August 13, 2007	2:00 pm	339	215
Tuesday, August 14, 2007	6:00 am	125	100
Tuesday, August 14, 2007	7:00 am	202	132
Tuesday, August 14, 2007	8:00 am	331	255
Tuesday, August 14, 2007	9:00 am	518	346
Tuesday, August 14, 2007	10:00 am	502	333
Tuesday, August 14, 2007	11:00 am	504	347
Tuesday, August 14, 2007	12:00 pm	379	295
Tuesday, August 14, 2007	1:00 pm	385	280
Tuesday, August 14, 2007	2:00 pm	288	183
Wednesday, August 15, 2007	6:00 am	130	87
Wednesday, August 15, 2007	7:00 am	203	237
Wednesday, August 15, 2007	8:00 am	335	367
Wednesday, August 15, 2007	9:00 am	438	453
Wednesday, August 15, 2007	10:00 am	491	505
Wednesday, August 15, 2007	11:00 am	473	541
Wednesday, August 15, 2007	12:00 pm	341	306
Wednesday, August 15, 2007	1:00 pm	343	225
Wednesday, August 15, 2007	2:00 pm	335	170
Thursday, August 16, 2007	6:00 am	129	191
Thursday, August 16, 2007	7:00 am	251	228
Thursday, August 16, 2007	8:00 am	349	223
Thursday, August 16, 2007	9:00 am	498	271
Thursday, August 16, 2007	10:00 am	549	268
Thursday, August 16, 2007	11:00 am	439	338
Thursday, August 16, 2007	12:00 pm	419	310
Thursday, August 16, 2007	1:00 pm	374	237
Thursday, August 16, 2007	2:00 pm	365	156
Friday, August 17, 2007	6:00 am	112	122
Friday, August 17, 2007	7:00 am	200	147
Friday, August 17, 2007	8:00 am	332	262
Friday, August 17, 2007	9:00 am	483	384
Friday, August 17, 2007	10:00 am	622	364
Friday, August 17, 2007	11:00 am	509	399
Friday, August 17, 2007	12:00 pm	378	207
Friday, August 17, 2007	1:00 pm	324	214
Friday, August 17, 2007	2:00 pm	367	165
Saturday, August 18, 2007	6:00 am	128	46
Saturday, August 18, 2007	7:00 am	239	114
Saturday, August 18, 2007	8:00 am	448	325
Saturday, August 18, 2007	9:00 am	596	368
Saturday, August 18, 2007	10:00 am	644	361
Saturday, August 18, 2007	11:00 am	606	572
Saturday, August 18, 2007	12:00 pm	501	409

Saturday, August 18, 2007	1:00 pm	422	322
Saturday, August 18, 2007	2:00 pm	356	225
Sunday, August 19, 2007	6:00 am	83	65
Sunday, August 19, 2007	7:00 am	151	221
Sunday, August 19, 2007	8:00 am	340	267
Sunday, August 19, 2007	9:00 am	525	342
Sunday, August 19, 2007	10:00 am	607	494
Sunday, August 19, 2007	11:00 am	590	344
Sunday, August 19, 2007	12:00 pm	438	263
Sunday, August 19, 2007	1:00 pm	384	260
Sunday, August 19, 2007	2:00 pm	368	190
Monday, August 20, 2007	6:00 am	100	87
Monday, August 20, 2007	7:00 am	184	191
Monday, August 20, 2007	8:00 am	272	244
Monday, August 20, 2007	9:00 am	417	312
Monday, August 20, 2007	10:00 am	478	357
Monday, August 20, 2007	11:00 am	466	285
Monday, August 20, 2007	12:00 pm	390	285
Monday, August 20, 2007	1:00 pm	337	253
Monday, August 20, 2007	2:00 pm	276	185
Tuesday, August 21, 2007	6:00 am	99	80
Tuesday, August 21, 2007	7:00 am	178	141
Tuesday, August 21, 2007	8:00 am	283	193
Tuesday, August 21, 2007	9:00 am	399	246
Tuesday, August 21, 2007	10:00 am	460	407
Tuesday, August 21, 2007	11:00 am	430	308
Tuesday, August 21, 2007	12:00 pm	329	216
Tuesday, August 21, 2007	1:00 pm	300	145
Tuesday, August 21, 2007	2:00 pm	252	122
Wednesday, August 22, 2007	6:00 am	103	79
Wednesday, August 22, 2007	7:00 am	180	128
Wednesday, August 22, 2007	8:00 am	276	155
Wednesday, August 22, 2007	9:00 am	373	253
Wednesday, August 22, 2007	10:00 am	406	226
Wednesday, August 22, 2007	11:00 am	339	265
Wednesday, August 22, 2007	12:00 pm	323	214
Wednesday, August 22, 2007	1:00 pm	286	164
Wednesday, August 22, 2007	2:00 pm	277	274
Thursday, August 23, 2007	6:00 am	110	80
Thursday, August 23, 2007	7:00 am	179	127
Thursday, August 23, 2007	8:00 am	282	258
Thursday, August 23, 2007	9:00 am	431	321
Thursday, August 23, 2007	10:00 am	451	219
Thursday, August 23, 2007	11:00 am	353	117
Thursday, August 23, 2007	12:00 pm	327	233
Thursday, August 23, 2007	1:00 pm	299	207

Thursday, August 23, 2007	2:00 pm	254	161
Friday, August 24, 2007	6:00 am	109	66
Friday, August 24, 2007	7:00 am	183	144
Friday, August 24, 2007	8:00 am	261	225
Friday, August 24, 2007	9:00 am	409	153
Friday, August 24, 2007	10:00 am	477	206
Friday, August 24, 2007	11:00 am	397	222
Friday, August 24, 2007	12:00 pm	339	156
Friday, August 24, 2007	1:00 pm	291	145
Friday, August 24, 2007	2:00 pm	276	88
Saturday, August 25, 2007	6:00 am	120	61
Saturday, August 25, 2007	7:00 am	198	197
Saturday, August 25, 2007	8:00 am	330	307
Saturday, August 25, 2007	9:00 am	486	309
Saturday, August 25, 2007	10:00 am	538	389
Saturday, August 25, 2007	11:00 am	469	310
Saturday, August 25, 2007	12:00 pm	374	227
Saturday, August 25, 2007	1:00 pm	372	235
Saturday, August 25, 2007	2:00 pm	286	190
Sunday, August 26, 2007	6:00 am	71	84
Sunday, August 26, 2007	7:00 am	158	102
Sunday, August 26, 2007	8:00 am	282	290
Sunday, August 26, 2007	9:00 am	423	284
Sunday, August 26, 2007	10:00 am	510	279
Sunday, August 26, 2007	11:00 am	445	259
Sunday, August 26, 2007	12:00 pm	378	165
Sunday, August 26, 2007	1:00 pm	378	117
Sunday, August 26, 2007	2:00 pm	305	187
Monday, August 27, 2007	6:00 am	81	136
Monday, August 27, 2007	7:00 am	150	102
Monday, August 27, 2007	8:00 am	241	141
Monday, August 27, 2007	9:00 am	352	147
Monday, August 27, 2007	10:00 am	343	199
Monday, August 27, 2007	11:00 am	332	218
Monday, August 27, 2007	12:00 pm	271	159
Monday, August 27, 2007	1:00 pm	268	168
Monday, August 27, 2007	2:00 pm	231	118
Tuesday, August 28, 2007	6:00 am	86	60
Tuesday, August 28, 2007	7:00 am	146	107
Tuesday, August 28, 2007	8:00 am	230	150
Tuesday, August 28, 2007	9:00 am	284	180
Tuesday, August 28, 2007	10:00 am	342	151
Tuesday, August 28, 2007	11:00 am	278	135
Tuesday, August 28, 2007	12:00 pm	247	190
Tuesday, August 28, 2007	1:00 pm	188	233
Tuesday, August 28, 2007	2:00 pm	199	89

Wednesday, August 29, 2007	6:00 am	75	93
Wednesday, August 29, 2007	7:00 am	178	71
Wednesday, August 29, 2007	8:00 am	236	146
Wednesday, August 29, 2007	9:00 am	310	164
Wednesday, August 29, 2007	10:00 am	323	149
Wednesday, August 29, 2007	11:00 am	270	139
Wednesday, August 29, 2007	12:00 pm	250	190
Wednesday, August 29, 2007	1:00 pm	225	127
Wednesday, August 29, 2007	2:00 pm	179	93
Thursday, August 30, 2007	6:00 am	93	62
Thursday, August 30, 2007	7:00 am	138	87
Thursday, August 30, 2007	8:00 am	187	127
Thursday, August 30, 2007	9:00 am	270	191
Thursday, August 30, 2007	10:00 am	310	151
Thursday, August 30, 2007	11:00 am	287	133
Thursday, August 30, 2007	12:00 pm	268	172
Thursday, August 30, 2007	1:00 pm	255	188
Thursday, August 30, 2007	2:00 pm	223	93
Friday, August 31, 2007	6:00 am	83	41
Friday, August 31, 2007	7:00 am	142	82
Friday, August 31, 2007	8:00 am	248	121
Friday, August 31, 2007	9:00 am	328	125
Friday, August 31, 2007	10:00 am	348	128
Friday, August 31, 2007	11:00 am	302	93
Friday, August 31, 2007	12:00 pm	318	127
Friday, August 31, 2007	1:00 pm	302	116
Friday, August 31, 2007	2:00 pm	253	77
Saturday, September 01, 2007	6:00 am	131	58
Saturday, September 01, 2007	7:00 am	247	139
Saturday, September 01, 2007	8:00 am	423	287
Saturday, September 01, 2007	9:00 am	581	250
Saturday, September 01, 2007	10:00 am	546	319
Saturday, September 01, 2007	11:00 am	649	438
Saturday, September 01, 2007	12:00 pm	471	295
Saturday, September 01, 2007	1:00 pm	426	285
Saturday, September 01, 2007	2:00 pm	378	267
Sunday, September 02, 2007	6:00 am	136	68
Sunday, September 02, 2007	7:00 am	242	109
Sunday, September 02, 2007	8:00 am	394	227
Sunday, September 02, 2007	9:00 am	584	319
Sunday, September 02, 2007	10:00 am	697	296
Sunday, September 02, 2007	11:00 am	643	327
Sunday, September 02, 2007	12:00 pm	554	276
Sunday, September 02, 2007	1:00 pm	430	161
Sunday, September 02, 2007	2:00 pm	311	213
Monday, September 03, 2007	6:00 am	108	71

Monday, September 03, 2007	7:00 am	209	164
Monday, September 03, 2007	8:00 am	370	256
Monday, September 03, 2007	9:00 am	525	189
Monday, September 03, 2007	10:00 am	567	222
Monday, September 03, 2007	11:00 am	558	184
Monday, September 03, 2007	12:00 pm	466	183
Monday, September 03, 2007	1:00 pm	402	202
Monday, September 03, 2007	2:00 pm	364	72
Tuesday, September 04, 2007	6:00 am	87	58
Tuesday, September 04, 2007	7:00 am	156	70
Tuesday, September 04, 2007	8:00 am	242	123
Tuesday, September 04, 2007	9:00 am	259	122
Tuesday, September 04, 2007	10:00 am	304	104
Tuesday, September 04, 2007	11:00 am	276	105
Tuesday, September 04, 2007	12:00 pm	321	196
Tuesday, September 04, 2007	1:00 pm	251	168
Tuesday, September 04, 2007	2:00 pm	257	110
Wednesday, September 05, 2007	6:00 am	100	61
Wednesday, September 05, 2007	7:00 am	165	91
Wednesday, September 05, 2007	8:00 am	276	206
Wednesday, September 05, 2007	9:00 am	361	226
Wednesday, September 05, 2007	10:00 am	349	136
Wednesday, September 05, 2007	11:00 am	304	164
Wednesday, September 05, 2007	12:00 pm	295	153
Wednesday, September 05, 2007	1:00 pm	283	99
Wednesday, September 05, 2007	2:00 pm	252	92
Thursday, September 06, 2007	6:00 am	102	69
Thursday, September 06, 2007	7:00 am	167	84
Thursday, September 06, 2007	8:00 am	211	150
Thursday, September 06, 2007	9:00 am	312	154
Thursday, September 06, 2007	10:00 am	339	175
Thursday, September 06, 2007	11:00 am	273	144
Thursday, September 06, 2007	12:00 pm	255	144
Thursday, September 06, 2007	1:00 pm	258	110
Thursday, September 06, 2007	2:00 pm	250	53
Friday, September 07, 2007	6:00 am	84	11
Friday, September 07, 2007	7:00 am	168	67
Friday, September 07, 2007	8:00 am	264	151
Friday, September 07, 2007	9:00 am	340	131
Friday, September 07, 2007	10:00 am	408	102
Friday, September 07, 2007	11:00 am	306	179
Friday, September 07, 2007	12:00 pm	373	121
Friday, September 07, 2007	1:00 pm	327	114
Friday, September 07, 2007	2:00 pm	287	92
Saturday, September 08, 2007	6:00 am	112	24
Saturday, September 08, 2007	7:00 am	191	87

Saturday, September 08, 2007	8:00 am	288	197
Saturday, September 08, 2007	9:00 am	452	222
Saturday, September 08, 2007	10:00 am	439	252
Saturday, September 08, 2007	11:00 am	459	318
Saturday, September 08, 2007	12:00 pm	326	180
Saturday, September 08, 2007	1:00 pm	301	176
Saturday, September 08, 2007	2:00 pm	295	166
Sunday, September 09, 2007	6:00 am	59	69
Sunday, September 09, 2007	7:00 am	148	109
Sunday, September 09, 2007	8:00 am	288	151
Sunday, September 09, 2007	9:00 am	404	202
Sunday, September 09, 2007	10:00 am	460	211
Sunday, September 09, 2007	11:00 am	385	251
Sunday, September 09, 2007	12:00 pm	386	151
Sunday, September 09, 2007	1:00 pm	355	110
Sunday, September 09, 2007	2:00 pm	307	72
Monday, September 10, 2007	6:00 am	90	36
Monday, September 10, 2007	7:00 am	180	129
Monday, September 10, 2007	8:00 am	211	240
Monday, September 10, 2007	9:00 am	381	157
Monday, September 10, 2007	10:00 am	381	160
Monday, September 10, 2007	11:00 am	324	166
Monday, September 10, 2007	12:00 pm	288	121
Monday, September 10, 2007	1:00 pm	279	125
Monday, September 10, 2007	2:00 pm	244	97
Tuesday, September 11, 2007	6:00 am	103	56
Tuesday, September 11, 2007	7:00 am	210	85
Tuesday, September 11, 2007	8:00 am	258	105
Tuesday, September 11, 2007	9:00 am	367	144
Tuesday, September 11, 2007	10:00 am	360	116
Tuesday, September 11, 2007	11:00 am	302	186
Tuesday, September 11, 2007	12:00 pm	248	116
Tuesday, September 11, 2007	1:00 pm	240	133
Tuesday, September 11, 2007	2:00 pm	236	68
Wednesday, September 12, 2007	6:00 am	108	62
Wednesday, September 12, 2007	7:00 am	204	64
Wednesday, September 12, 2007	8:00 am	238	152
Wednesday, September 12, 2007	9:00 am	383	214
Wednesday, September 12, 2007	10:00 am	337	200
Wednesday, September 12, 2007	11:00 am	301	229
Wednesday, September 12, 2007	12:00 pm	264	179
Wednesday, September 12, 2007	1:00 pm	265	120
Wednesday, September 12, 2007	2:00 pm	251	86
Thursday, September 13, 2007	6:00 am	111	71
Thursday, September 13, 2007	7:00 am	204	137
Thursday, September 13, 2007	8:00 am	279	289

Thursday, September 13, 2007	9:00 am	342	334
Thursday, September 13, 2007	10:00 am	374	271
Thursday, September 13, 2007	11:00 am	305	182
Thursday, September 13, 2007	12:00 pm	294	179
Thursday, September 13, 2007	1:00 pm	264	157
Thursday, September 13, 2007	2:00 pm	244	75
Friday, September 14, 2007	6:00 am	100	54
Friday, September 14, 2007	7:00 am	205	87
Friday, September 14, 2007	8:00 am	288	142
Friday, September 14, 2007	9:00 am	396	213
Friday, September 14, 2007	10:00 am	442	293
Friday, September 14, 2007	11:00 am	385	274
Friday, September 14, 2007	12:00 pm	369	181
Friday, September 14, 2007	1:00 pm	334	197
Friday, September 14, 2007	2:00 pm	382	83
Saturday, September 15, 2007	6:00 am	109	27
Saturday, September 15, 2007	7:00 am	171	88
Saturday, September 15, 2007	8:00 am	306	196
Saturday, September 15, 2007	9:00 am	491	299
Saturday, September 15, 2007	10:00 am	516	369
Saturday, September 15, 2007	11:00 am	497	397
Saturday, September 15, 2007	12:00 pm	368	304
Saturday, September 15, 2007	1:00 pm	352	270
Saturday, September 15, 2007	2:00 pm	282	113
Sunday, September 16, 2007	6:00 am	67	90
Sunday, September 16, 2007	7:00 am	136	144
Sunday, September 16, 2007	8:00 am	303	235
Sunday, September 16, 2007	9:00 am	404	360
Sunday, September 16, 2007	10:00 am	472	358
Sunday, September 16, 2007	11:00 am	438	287
Sunday, September 16, 2007	12:00 pm	371	219
Sunday, September 16, 2007	1:00 pm	335	170
Sunday, September 16, 2007	2:00 pm	283	132
Monday, September 17, 2007	6:00 am	102	46
Monday, September 17, 2007	7:00 am	162	78
Monday, September 17, 2007	8:00 am	264	126
Monday, September 17, 2007	9:00 am	397	111
Monday, September 17, 2007	10:00 am	408	181
Monday, September 17, 2007	11:00 am	335	156
Monday, September 17, 2007	12:00 pm	306	239
Monday, September 17, 2007	1:00 pm	284	160
Monday, September 17, 2007	2:00 pm	295	87
Tuesday, September 18, 2007	6:00 am	110	61
Tuesday, September 18, 2007	7:00 am	184	104
Tuesday, September 18, 2007	8:00 am	289	152
Tuesday, September 18, 2007	9:00 am	357	174

Tuesday, September 18, 2007	10:00 am	377	221
Tuesday, September 18, 2007	11:00 am	308	214
Tuesday, September 18, 2007	12:00 pm	250	218
Tuesday, September 18, 2007	1:00 pm	264	195
Tuesday, September 18, 2007	2:00 pm	221	111
Wednesday, September 19, 2007	6:00 am	103	64
Wednesday, September 19, 2007	7:00 am	168	87
Wednesday, September 19, 2007	8:00 am	290	143
Wednesday, September 19, 2007	9:00 am	354	253
Wednesday, September 19, 2007	10:00 am	382	287
Wednesday, September 19, 2007	11:00 am	323	245
Wednesday, September 19, 2007	12:00 pm	286	202
Wednesday, September 19, 2007	1:00 pm	238	171
Wednesday, September 19, 2007	2:00 pm	209	154
Thursday, September 20, 2007	6:00 am	73	174
Thursday, September 20, 2007	7:00 am	123	124
Thursday, September 20, 2007	8:00 am	216	271
Thursday, September 20, 2007	9:00 am	268	210
Thursday, September 20, 2007	10:00 am	215	240
Thursday, September 20, 2007	11:00 am	322	209
Thursday, September 20, 2007	12:00 pm	256	258
Thursday, September 20, 2007	1:00 pm	228	187
Thursday, September 20, 2007	2:00 pm	238	51
Friday, September 21, 2007	6:00 am	74	40
Friday, September 21, 2007	7:00 am	145	140
Friday, September 21, 2007	8:00 am	246	143
Friday, September 21, 2007	9:00 am	348	205
Friday, September 21, 2007	10:00 am	351	329
Friday, September 21, 2007	11:00 am	367	345
Friday, September 21, 2007	12:00 pm	351	217
Friday, September 21, 2007	1:00 pm	314	157
Friday, September 21, 2007	2:00 pm	270	143
Saturday, September 22, 2007	6:00 am	56	80
Saturday, September 22, 2007	7:00 am	118	166
Saturday, September 22, 2007	8:00 am	234	344
Saturday, September 22, 2007	9:00 am	341	533
Saturday, September 22, 2007	10:00 am	443	506
Saturday, September 22, 2007	11:00 am	343	163
Saturday, September 22, 2007	12:00 pm	324	389
Saturday, September 22, 2007	1:00 pm	274	183
Saturday, September 22, 2007	2:00 pm	238	64
Tuesday, September 25, 2007	6:00 am	90	26
Tuesday, September 25, 2007	7:00 am	172	126
Tuesday, September 25, 2007	8:00 am	268	153
Tuesday, September 25, 2007	9:00 am	385	173
Tuesday, September 25, 2007	10:00 am	339	189

Tuesday, September 25, 2007	11:00 am	254	222
Tuesday, September 25, 2007	12:00 pm	268	271
Tuesday, September 25, 2007	1:00 pm	224	154
Tuesday, September 25, 2007	2:00 pm	214	84
Wednesday, September 26, 2007	6:00 am	105	39
Wednesday, September 26, 2007	7:00 am	175	59
Wednesday, September 26, 2007	8:00 am	262	176
Wednesday, September 26, 2007	9:00 am	335	308
Wednesday, September 26, 2007	10:00 am	296	197
Wednesday, September 26, 2007	11:00 am	311	195
Wednesday, September 26, 2007	12:00 pm	278	117
Wednesday, September 26, 2007	1:00 pm	249	107
Wednesday, September 26, 2007	2:00 pm	205	60
Thursday, September 27, 2007	6:00 am	99	106
Thursday, September 27, 2007	7:00 am	170	67
Thursday, September 27, 2007	8:00 am	244	121
Thursday, September 27, 2007	9:00 am	353	163
Thursday, September 27, 2007	10:00 am	375	191
Thursday, September 27, 2007	11:00 am	303	175
Thursday, September 27, 2007	12:00 pm	286	181
Thursday, September 27, 2007	1:00 pm	223	128
Thursday, September 27, 2007	2:00 pm	205	70
Friday, September 28, 2007	6:00 am	113	49
Friday, September 28, 2007	7:00 am	192	107
Friday, September 28, 2007	8:00 am	269	120
Friday, September 28, 2007	9:00 am	358	170
Friday, September 28, 2007	10:00 am	346	268
Friday, September 28, 2007	11:00 am	318	141
Friday, September 28, 2007	12:00 pm	299	193
Friday, September 28, 2007	1:00 pm	321	158
Friday, September 28, 2007	2:00 pm	285	92
Saturday, September 29, 2007	6:00 am	110	67
Saturday, September 29, 2007	7:00 am	193	129
Saturday, September 29, 2007	8:00 am	322	242
Saturday, September 29, 2007	9:00 am	506	437
Saturday, September 29, 2007	10:00 am	513	481
Saturday, September 29, 2007	11:00 am	446	329
Saturday, September 29, 2007	12:00 pm	435	383
Saturday, September 29, 2007	1:00 pm	309	263
Saturday, September 29, 2007	2:00 pm	239	179
Sunday, September 30, 2007	6:00 am	56	45
Sunday, September 30, 2007	7:00 am	130	85
Sunday, September 30, 2007	8:00 am	231	292
Sunday, September 30, 2007	9:00 am	401	245
Sunday, September 30, 2007	10:00 am	439	278
Sunday, September 30, 2007	11:00 am	408	222

Sunday, September 30, 2007	12:00 pm	348	170
Sunday, September 30, 2007	1:00 pm	345	132
Sunday, September 30, 2007	2:00 pm	270	66

APPENDIX E

Attribute Levels for all Scenarios

Table 1

Scenarios for Version 1

Scenario (Version.Scenario)	Drive Personal Vehicle	Park and Ride	Shuttle from Town
1.1	- You find a parking space - Parking space in 1 minute - Traffic Photo: 10 cars - Trail Photo: 16 people	- Bus arrives every 15 minutes - No seats - Traffic Photo: 10 cars - Trail Photo: 0 people	- Bus arrives every 30 minutes - Seats for everyone - Traffic Photo: 10 cars - Trail Photo: 0 people
1.2	- You find a parking space - Parking space in 10 minutes - Traffic Photo: 2 cars - Trail Photo: 8 people	- Bus arrives every 30 minutes - Seats for everyone - Traffic Photo: 2 cars - Trail Photo: 0 people	- Bus arrives every 1 ½ hours - Seats for half - Traffic Photo: 2 cars - Trail Photo: 0 people
1.3	- You find a parking space - Parking space in 1 minute - Traffic Photo: 20 cars - Trail Photo: 8 people	- Bus arrives every 5 minutes - No seats - Traffic Photo: 20 cars - Trail Photo: 8 people	- Bus arrives every 1 ½ hours - No seats - Traffic Photo: 20 cars - Trail Photo: 16 people
1.4	Parking is not available, must use shuttle	- Bus arrives every 5 minutes - No seats - Traffic Photo: 10 cars - Trail Photo: 8 people	- Bus arrives every 30 minutes - Seats for half - Traffic Photo: 10 cars - Trail Photo: 8 people
1.5	- You find a parking space - Parking space in 1 minute - Traffic Photo: 10 cars - Trail Photo: 16 people	- Bus arrives every 5 minutes - Seats for half - Traffic Photo: 10 cars - Trail Photo: 0 people	- Bus arrives every 1 ½ hours - Seats for half - Traffic Photo: 10 cars - Trail Photo: 16 people
1.6	Personal vehicles are not allowed on the Bear Lake Road, must use shuttle	- Bus arrives every 30 minutes - Seats for half - Traffic Photo: 2 cars - Trail Photo: 8 people	- Bus arrives every 30 minutes - Seats for half - Traffic Photo: 2 cars - Trail Photo: 16 people
1.7	- You find a parking space - Parking space in 10 minutes - Traffic Photo: 10 cars - Trail Photo: 0 people	- Bus arrives every 15 minutes - Seats for everyone - Traffic Photo: 10 cars - Trail Photo: 8 people	- Bus arrives every 1 hour - Seats for everyone - Traffic Photo: 10 cars - Trail Photo: 16 people

Table 2

Scenarios for Version 2

Scenario (Version.Scenario)	Drive Personal Vehicle	Park and Ride	Shuttle from Town
2.1	- You find a parking space - Parking space in 10 minutes - Traffic Photo: 10 cars - Trail Photo: 0 people	- Bus arrives every 30 minutes - Seats for half - Traffic Photo: 10 cars - Trail Photo: 8 people	- Bus arrives every 1 ½ hours - No seats - Traffic Photo: 10 cars - Trail Photo: 0 people
2.2	- You find a parking space - Parking space in 1 minute - Traffic Photo: 2 cars - Trail Photo: 0 people	- Bus arrives every 30 minutes - No seats - Traffic Photo: 2 cars - Trail Photo: 16 people	- Bus arrives every 1 hour - Seats for half - Traffic Photo: 2 cars - Trail Photo: 8 people
2.3	- You find a parking space - Parking space in 5 minutes - Traffic Photo: 20 cars - Trail Photo: 0 people	- Bus arrives every 30 minutes - Seats for everyone - Traffic Photo: 20 cars - Trail Photo: 0 people	- Bus arrives every 30 minutes - Seats for everyone - Traffic Photo: 20 cars - Trail Photo: 16 people
2.4	Parking is not available, must use shuttle	- Bus arrives every 15 minutes - Seats for half - Traffic Photo: 10 cars - Trail Photo: 16 people	- Bus arrives every 1 ½ hours - Seats for everyone - Traffic Photo: 10 cars - Trail Photo: 8 people
2.5	- You find a parking space - Parking space in 1 minute - Traffic Photo: 2 cars - Trail Photo: 0 people	- Bus arrives every 15 minutes - Seats for half - Traffic Photo: 2 cars - Trail Photo: 16 people	- Bus arrives every 30 minutes - No seats - Traffic Photo: 2 cars - Trail Photo: 0 people
2.6	Personal vehicles are not allowed on the Bear Lake Road, must use shuttle	- Bus arrives every 15 minutes - Seats for everyone - Traffic Photo: 20 cars - Trail Photo: 8 people	- Bus arrives every 30 minutes - Seats for half - Traffic Photo: 20 cars - Trail Photo: 0 people
2.7	- You find a parking space - Parking space in 1 minute - Traffic Photo: 20 cars - Trail Photo: 8 people	- Bus arrives every 30 minutes - Seats for half - Traffic Photo: 20 cars - Trail Photo: 8 people	- Bus arrives every 1 hour - Seats for everyone - Traffic Photo: 20 cars - Trail Photo: 8 people

Table 3

Scenarios for Version 3

Scenario (Version.scenario)	Drive Personal Vehicle	Park and Ride	Shuttle from Town
3.1	- You find a parking space - Parking space in 5 minutes - Traffic Photo: 10 cars - Trail Photo: 8 people	- Bus arrives every 5 minutes - Seats for everyone - Traffic Photo: 10 cars - Trail Photo: 16 people	- Bus arrives every 1 hour - Seats for half - Traffic Photo: 10 cars - Trail Photo: 0 people
3.2	- You find a parking space - Parking space in 5 minutes - Traffic Photo: 2 cars - Trail Photo: 16 people	- Bus arrives every 15 minutes - Seats for everyone - Traffic Photo: 2 cars - Trail Photo: 8 people	- Bus arrives every 1 ½ hours - No seats - Traffic Photo: 2 cars - Trail Photo: 8 people
3.3	Parking is not available, must use shuttle	- Bus arrives every 5 minutes - Seats for everyone - Traffic Photo: 2 cars - Trail Photo: 16 people	- Bus arrives every 1 ½ hours - Seats for everyone - Traffic Photo: 2 cars - Trail Photo: 16 people
3.4	- You find a parking space - Parking space in 10 minutes - Traffic Photo: 2 cars - Trail Photo: 8 people	- Bus arrives every 5 minutes - Seats for half - Traffic Photo: 2 cars - Trail Photo: 0 people	- Bus arrives every 30 minutes - Seats for everyone - Traffic Photo: 2 cars - Trail Photo: 8 people
3.5	Parking is not available, must use shuttle	- Bus arrives every 5 minutes - Seats for half - Traffic Photo: 20 cars - Trail Photo: 0 people	- Bus arrives every 1 hour - No seats - Traffic Photo: 20 cars - Trail Photo: 0 people
3.6	- You find a parking space - Parking space in 10 minutes - Traffic Photo: 20 cars - Trail Photo: 16 people	- Bus arrives every 15 minutes - Seats for half - Traffic Photo: 20 cars - Trail Photo: 16 people	- Bus arrives every 1 hour - Seats for half - Traffic Photo: 20 cars - Trail Photo: 16 people
3.7	Personal vehicles are not allowed on the Bear Lake Road, must use shuttle	- Bus arrives every 30 minutes - No seats - Traffic Photo: 20 cars - Trail Photo: 16 people	- Bus arrives every 1 ½ hours - Seats for everyone - Traffic Photo: 20 cars - Trail Photo: 0 people

Table 4

Scenarios for Version 4

Scenario (Version.scenario)	Drive Personal Vehicle	Park and Ride	Shuttle from Town
4.1	- You find a parking space - Parking space in 5 minutes - Traffic Photo: 10 cars - Trail Photo: 8 people	- Bus arrives every 30 minutes - No seats - Traffic Photo: 10 cars - Trail Photo: 16 people	- Bus arrives every 30 minutes - No seats - Traffic Photo: 10 cars - Trail Photo: 16 people
4.2	Parking is not available, must use shuttle	- Bus arrives every 30 minutes - Seats for everyone - Traffic Photo: 10 cars - Trail Photo: 0 people	- Bus arrives every 1 hour - No seats - Traffic Photo: 10 cars - Trail Photo: 8 people
4.3	- You find a parking space - Parking space in 5 minutes - Traffic Photo: 2 cars - Trail Photo: 16 people	- Bus arrives every 5 minutes - No seats - Traffic Photo: 2 cars - Trail Photo: 8 people	- Bus arrives every 1 hour - Seats for everyone - Traffic Photo: 2 cars - Trail Photo: 0 people
4.4	Personal vehicles are not allowed on the Bear Lake Road, must use shuttle	- Bus arrives every 15 minutes - No seats - Traffic Photo: 2 cars - Trail Photo: 0 people	- Bus arrives every 1 hours - No seats - Traffic Photo: 2 cars - Trail Photo: 16 people
4.5	- You find a parking space - Parking space in 5 minutes - Traffic Photo: 20 cars - Trail Photo: 0 people	- Bus arrives every 15 minutes - No seats - Traffic Photo: 20 cars - Trail Photo: 0 people	- Bus arrives every 1 ½ hours - Seats for half - Traffic Photo: 20 cars - Trail Photo: 8 people
4.6	- You find a parking space - Parking space in 10 minutes - Traffic Photo: 20 cars - Trail Photo: 16 people	- Bus arrives every 5 minutes - Seats for everyone - Traffic Photo: 20 cars - Trail Photo: 16 people	- Bus arrives every 30 minutes - No seats - Traffic Photo: 20 cars - Trail Photo: 8 people
4.7	- You find a parking space - Parking space in 1 minutes - Traffic Photo: 10 cars - Trail Photo: 0 people	- Bus arrives every 15 minutes - Seats for half - Traffic Photo: 10 cars - Trail Photo: 8 people	- Bus arrives every 1 hour - Seats for everyone - Traffic Photo: 10 cars - Trail Photo: 0 people