National Park Service
U.S. Department of the Interior

Yosemite National Park
Resources Management and Science

Devils Postpile National Monument

2010 Visitor Use Monitoring Assessment



ON THE COVER
The basaltic columns that form the Devils Postpile volcanic feature.
Photograph by: Courtesy of Devils Postpile National Monument

Devils Postpile National Monument

2010 Visitor Use Monitoring Assessment

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September 2011

U.S. Department of the Interior
National Park Service
Yosemite National Park
Resources Management and Science
El Portal, California

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1 PREFACE

Devils Postpile National Monument (DEPO) General Management Plan (GMP) efforts have initiated the process of formalizing the approach of addressing user capacity and related long-term monitoring. The National Parks and Recreation Act (1978), requires the National Park Service (NPS) to address (user) carrying capacity as a part of any park unit GMP. A visitor capacity management program is an integral framework that land management agencies can apply to better understand existing resource conditions and develop justifiable decisions if management action is deemed necessary (National Park Service, 1997; Manning, Leung & Budrek, 2005). Monitoring formalized indicators, with clearly understood standards, is one way to ensure that the capacity determinations made in the GMP are effective in maintaining healthy resource conditions and quality visitor experiences. In addition, data collected prior to the final Environmental Impact Statement (EIS) will be utilized to inform the visitor experience and capacity sections of the document.

Visitor carrying capacity is defined as the type and level of visitor use that can be accommodated while sustaining the desired resource and visitor experience conditions in the park (National Park Service, 1997). At an operational level, user, carrying, or visitor capacity has taken on a wide variety of forms and meanings across both academic forums and protected area management. Recent court decisions, however, have directed the NPS to address capacity issues through a numerical capacity of visitors by describing the kinds and amounts of uses that are acceptable. Monitoring alone is not an adequate manner in which capacity is addressed; variations in the level of visitor use should be considered and discussed across the range of management alternatives (Friends of Yosemite Valley & Mariposans for Environmentally Responsible Growth v. Kempthorne, Jarvis, & Tollefson, 2008).

This project, acknowledged as a step in addressing capacity, informs management determination of capacity-related issues by establishing potential indicators and suggesting possible standards of experiential and resource-related metrics. These pilot indicators, initiated in the 2009 field season, have been proven in other locations in the Sierra Nevada and are known to be impacted by various types and amounts of visitor use (Yosemite National Park, 2009). Pilot indicators include:

Experiential/Social Indicators

- People at one time at attraction sites
- Daily visitation on trails (using trail use estimation)

Natural Resource/Biological Indicators

- Informal trails in meadows and along the river
- Water quality
- Riverbank erosion

These pilot indicators seek to assess visitor patterns and any associated impacts (positive and negative) on exemplary resources at the monument. DEPO is currently consulting with multiple subject matter experts to professionally and selectively establish a long term monitoring program.

Results may vary in the effectiveness of some of the proposed indicators due to technological constraints experienced in DEPO. The identification of indicators is essential for making informed decisions as to which conditions the plan will maintain in the final EIS. Scientifically sound indicators are necessary to establish capacity. Ongoing litigation at nearby NPS sites, such as Yosemite National Park, illustrates the need of a legally defensible basis for user capacity issues (Friends of Yosemite Valley & Mariposans for Environmentally Responsible Growth v. Kempthorne, Jarvis, & Tollefson, 2008).

Overcrowding in parks degrades the visitor experience as well as natural and cultural resources (Hammitt & Cole, 1998; Manning, 1999; Manning, 2007). Several high density visitation areas exist within DEPO, including Rainbow Falls and the Postpile itself. Vital information is needed, such as the identification, inventory, and assessment of key resources, prior to the GMP which is estimated to begin 2009-2010. The planning of visitor capacity management program standards and indicators will contribute to a time and cost efficient process that will provide baseline data needed for the GMP. This project will establish a program to assess impacts on essential resources, as well as identify and document current visitor use patterns at DEPO.

Application of a visitor capacity management monitoring program will provide specific data necessary to make informed decisions about desired conditions and how they may be balanced with growth and development in the adjacent resort community of Mammoth Lakes. Having a systematic approach for implementing this program in future planning efforts will make management activities and decisions more defensible than they would be if they were based on previously existing data alone. A proactive approach to protection requires identification and inventory of natural resource conditions to provide park management with the information necessary to effectively manage monument use for the benefit of the park and the visitor (Manning, Lawson, Newman, Laven, & Valliere, 2002). The Visitor Experience and Resource Protection (VERP) Framework has been used as the foundation for this NPS two-year study to identify and recommend the most relevant suite of monitoring indicators to gauge the success of the GMP in protecting natural and cultural resources while providing for quality visitor experiences. Deliverables that will come from this project include: (a) an analysis of current inventory and resource data, (b) the identification and inventory of undocumented sensitive habitats, (c) identification and documentation of current use patterns, (d) selection of visitor experience and resource protection indicators, (e) provision of indicator baseline data, and (f) establishment of protocols for routine indicator monitoring. Additionally, this project will produce a summary of resource analysis, recommendations for further monitoring and study, indicators for DEPO, baseline data on present use conditions, and a field manual for routine monitoring of indicators.

1.1 REVIEW OF EXISTING DEPO RESEARCH AND DATA

Given the relatively small size of Devils Postpile National Monument, there is a wealth of scientific research associated with it; however, limited information is available regarding the interaction of visitor and natural landscapes. The following section provides a review of potentially relevant existing and proposed studies in Devils Postpile National Monument. Brief summaries of reviewed research are provided (Table 1.1.1).

Table 1.1.1. Current and Proposed DEPO Research, Organized by Year of Initiation

PROJECT	YEAR	CONTACT	ORGANIZATION
Reds Meadow Shuttle Report	2004	Inyo NF DEPO staff	USDA Forest Service National Park Service
Invertebrates as indicators of wetland change	2004-present	Jeff Holmquist	University of California
Devils Postpile National Monument Acoustic Monitoring Report	2005 & 2006	DEPO Staff	National Park Service
Stream gage & mini-meteorological station	2005-present	Dan Cayan Douglas Alden Frank Gehrke	Scripps Institute Scripps Institute CADWR
Wetland Inventory & Condition Assessment	2006	Marie Denn	National Park Service, Pacific Northwest Region
Visitor Experience Survey	2006	Marc Manni, Bret Meldrum et al.	University of Idaho, Park Studies Unit
Transportation Study	2007	Vanasse Hangen Brustlin, Inc.	Vanasse Hangen Brustlin, Inc.
Preliminary Water Chemistry Investigations	2007-present	Snow Survey Associates	University of Nevada, Reno
Upper San Joaquin River Watershed Assessment	June 2008-October 2011 (on hold as of Fall 2009)	Erin Lutrick	USDA Forest Service, Inyo National Forest
Operational Hydrologic Monitoring	Ongoing	Frank Gehrke	California Department of Water Resources
Wetlands Ecological Integrity Monitoring for Sierra Nevada Network Parks	DEPO site established in 2009; full implementation in 2011	Linda Mutch	Inventory & Monitoring, Sierra Nevada Network (I & M, SIEN)
Surface-water/groundwater modeling of the upper middle fork of the San Joaquin River basin	Regional studies ongoing; in the proposal stage for DEPO applications (as of Fall 2009)	Lorrie Flint Alan Flint	United States Geological Survey (USGS)
San Joaquin River Gauging Station at DEPO	Uncertain (as of Fall 2009)	Paul Honeywell Chris Farrar	USGS
Monitoring and Analysis of Ground water-Surface water interaction	Uncertain (as of Fall 2009)	Chris Farrar	USGS

1.2 PAST AND CURRENT RESEARCH

Throughout the last decade, numerous studies have been proposed and completed within DEPO, ranging from wetland inventories to transportation investigations, all with the goal of providing a wealth of baseline data that will inform future research and management plans. The majority of this research has focused on the biotic and physical characteristics of the monument and surrounding areas, though a few studies have directed questions at transportation and visitor experience.

Beginning in 2004, research targeting NPS sites in the Sierra Nevada network (including DEPO) aimed to look at the use of invertebrates as indicators of wetland change. An inventory of invertebrate fauna was completed for DEPO (Holmquist &Schmidt-Gengenbach, 2005), and subsequent research was designed to look at the potential response of invertebrates to biological and physical variables and stressors (Holmquist & Schmidt-Gengenbach, 2008). During the same year as the initial invertebrate survey, a complete inventory of vascular plants was conducted within DEPO by the Sierra Nevada Network Inventory & Monitoring Program (SIEN) (Arnett & Haultrain, 2005). In 2006, a comprehensive wetland inventory and condition assessment for the monument was completed, which provided data on forty-three wetlands within six different classes, covering nearly sixty acres in area. The California Rapid Assessment Method (CRAM) was used to assess the condition of mapped wetlands (Denn & Shorrock, 2009). Currently, SIEN is working on a project that will monitor wet meadow and fen sites for ecological integrity in Sierra Nevada Network parks. The monitoring site within DEPO was established in July of 2009, and full implementation was achieved in 2010, with repeat monitoring recommended thereafter. This monitoring program aims to quantify and compare the status of fen and wet meadow wetlands, compare rates of change in wetland community characteristics between fen and wet meadow sites, and estimate temporal changes in a multitude of environmental attributes, such as hydrology, bare ground, and the composition and abundance of both aquatic and terrestrial plant and macro invertebrate species (Gage, Chow, Cooper, Haultain, Holmquist, Jones, McKinney, Moore, Mutch, Starcevich, & Werner, 2009.).

Investigations concerning the hydrologic attributes of Devils Postpile comprise the vast majority of completed and ongoing research in the monument. A stream gauge and mini-meteorological station was installed in Soda Springs Meadow in 2005 to provide hydro-climate data for the upper Middle Fork of the San Joaquin River and surrounding drainage area. The meteorological station is linked to a network of monitoring sites throughout the Sierra Nevada and provides data like air temperature, precipitation, wind speed and direction, barometric pressure, relative humidity, shortwave solar radiation, net radiation, and photosynthetic radiation. Snow pack depth and weight are also recorded by snow pillows installed at the base of the tower (Denn & Shorrock, 2009). The monitoring sites provide an opportunity to collect data for the prediction of summer and spring runoff, provide infrastructure for monitoring hydro parameters, address such issues as water supply, contribute to the climate change data set, and combine enhanced water supply and flood control. These operational hydrologic monitoring surveys are carried out by California Coop Snow Surveys staff of the California Department of Water Resources (Bulaon.; Burak; Bytnerowicz; Caprio; Cayan, Alden, & Gehrke;… & Scott, D., 2009).

Preliminary water chemistry investigations by researchers at the University of Nevada-Reno began in 2007 and are ongoing. The primary objectives of the project are to characterize the water chemistry for waters affecting DEPO and to determine if there is connectivity between the east/west side of Mammoth Mountain and/or San Joaquin Ridge. Protocol (inclusive of methodology) was submitted to DEPO staff for future inventory of sites sampled (Burak, 2009). A watershed assessment of the Upper Middle Fork of the San Joaquin River was initiated by the USDA Forest Service and the Calfed Bay Delta Program, California Department of Water Resources in June of 2008, but was put on hold as of October 2009 due to budget issues. Initial field research was focused on meadow condition and shallow groundwater storage and future work is to include measuring soil depth, permeability, and specific yield in meadows (Lutrick, 2008; Bulaon et. al., 2009).

Experiential/Social research includes a 2006 study dedicated exclusively to documenting visitor experience in the monument. The comprehensive survey aimed to answer questions regarding the visitors' trip characteristics, preferences, satisfaction levels, and demographics (Manni, Meldrum, Lackey, & Hollenhorst, 2007). Prior to the visitor use study, a general report was submitted on the background and context of the Reds Meadow Shuttle system as it relates to the Reds Meadow Valley Recreation Area, including DEPO (Smith, 2004). A more focused transportation study followed in 2007, addressing questions concerning funding for the shuttle service, visitor experience, and shuttle operator safety (Vanasse, Hangen & Brustlin, 2007). The initiation of transportation, flora, and fauna research in 2004, was followed by an acoustic monitoring study in 2005 and 2006. The primary goal of the report was to quantify existing acoustic conditions in the monument using two years' worth of data from four sites located in a variety of vegetation zones with the intention of providing results that could be used to inform park management (Formichella, Fristrup, Joyce, Emma Lynch, & Pilcher, 2006).

Though much of this research is not directly related to visitor use monitoring, it may still provide valuable background information on the historical and current status of a variety of the monument's natural, cultural and social resources.

1.3 PROPOSED RESEARCH

Monitoring and analysis of groundwater/surface-water interactions by the USGS is in the planning stages for DEPO, though the implementation timeline is still uncertain. This particular project will look at the exchanges between groundwater and surface-water by the establishment of a network of piezometers in meadows and in the streambed of the river (Bulaon et. al., 2009). Another proposal from the USGS aims to include the Upper Middle Fork of the San Joaquin River in a surface and groundwater modeling program. This regional project involves the development of a Basin Characterization Model for the Southwestern United States at 270-m for the years 1895-2100. The model development is an ongoing effort to support several studies interested in downscaling future climate scenarios and developing the associated hydrologic parameters, generally for monthly water availability assessment. The project also includes the development of a Basin Characterization Model for the State of California at 90-m for ecological applications under future climates. This endeavor focuses on finer scale applications with attention to parameters of

interest to ecologists (species distribution/diversity, wetlands, etc.), including soil water and climatic water deficits, snowpack, and evapotranspiration, as well as runoff and recharge.

The U.S. Geological Survey (USGS) has begun long-term monitoring of the upper middle fork of the San Joaquin River discharge by installing a river gauging station in the San Joaquin River near the DEPO campground; the station serves as a control point for understanding discharge variations at various scales, including days, annual, and interannual periods. It also helps identify and quantify flow variations caused by processes related to climate change, as well as serving as a key gauging station for collecting water quality data to be analyzed in terms of loads. Potential sites and potential difficulties for the project were identified as of the fall of 2009 (Bulaon et. al., 2009). Data from the river gauging station, which began collection on July 15, 2009, can be found on-line at: http://waterdata.usgs.gov/nwis/measurements/?site_no=11224000 (U. S. Geological Survey, 2011).

2 VISITOR USE

2.1 INTRODUCTION TO EXPERIENTIAL/SOCIAL INDICATORS

Understanding visitor use patterns and trends is crucial to visitor management and planning in national parks. Knowing when and where visitor use tends to occur can help park managers: A) determine if park/agency management objectives are being met, and B) allocate resources where deficient conditions are found. Previous research has examined the spatio-temporal distributions of visitor use, 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, Stack & Gibson, 2008; Roggenbuck & Lucas, 1987). For example, Lucas (1980) found that approximately 80% of all visitor use occurs on roughly 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 weekdays during the majority of the year.

Although information about visitor use has been important for previous park planning efforts, estimating the amount of visitor use in parks and protected areas was challenging in the past; in part because standardized methods and protocols to collect visitor use data had not yet been well established, and also because collecting these data could be costly (Hollenhorst, Whisman & Ewert,1992; Loomis 2000). Land managers used to 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), and relied on "best guess" estimates or coarse measurements to quantify visitor use (Loomis, 2000; Watson et al., 2000).

Today, many of those barriers have been overcome, and although challenges do still exist, land managers can find that acquiring visitor use data is far less costly than the alternative, which may include expensive and time consuming legal battles. One of the remaining challenges to estimating visitor use in natural areas is the dispersed, expansive and unique nature of recreation areas. Estimating dispersed recreational use involves defining and selecting applicable visitor use areas as study sites to sample. Typically, the number of people-at-one-time (PAOT) is sampled in clearly defined discrete plots. PAOT is a measure that is used as a proxy for overall visitor use and conditions of crowding, and has been used successfully in previous studies (Lawson, Newman, Choi, Pettebone & Meldrum, 2008; Pettebone, Meldrum & Ackerman, 2009; Pettebone, Newman & Lawson, 2010). PAOT is not a measure of the total number of people who visit a recreation site, but rather a repeated snapshot, measuring use levels across time, that can be applied to understand social conditions related to the visitor experience (Manning 1999; Manning 2007).

In the case of Devils Postpile National Monument (DEPO), previous work examining different aspects of visitor use has been conducted, including two studies in 2007 and one in 2009. The Reds Meadow/Devils Postpile National Monument Case Study (Vanasse, Hangen, & Brustlin, 2007), examined transportation related concerns including traffic congestion and parking conditions, while the Devils Postpile National Monument visitor survey (Manni, Meldrum, Lackey & Hollenhorst, 2007), was conducted to understand various aspects of the visitor experience; results from 2007 that are relevant to this study include:

- 83% of visitors hiked to the bottom of the Postpile viewing area; 50% of visitors hiked to the top of the Postpile; and 76% of visitors hiked to Rainbow Falls.
- 92% of visitors came to sightsee; 82% of visitors came to hike; 49% of visitors came to experience solitude; and 4% of visitors came to swim.
- 75% of DEPO visitors rode the shuttle bus.
- 97% of DEPO visitors were non-residents (people who live more than 75 miles from DEPO).

While the 2007 research provided important information for DEPO managers, no work had been conducted to quantify visitor use at key attraction sites until research for the Devils Postpile National Monument Visitor Use Report began in 2009. The 2009-2010 study addressed this initially by estimating the amount of visitor use throughout DEPO with an emphasis at two key attraction sites, the Devils Postpile viewing area and Rainbow Falls. Descriptive visitor use data was collected during the summer of 2009 through the use of PAOT counts, automated visitor counters on trails, and vehicle volume data; regression analyses were then conducted to examine the relationships between vehicle traffic and visitors arriving at DEPO trailheads and attraction sites. These analyses provided insights into the spatio-temporal trends of visitor use in DEPO to inform visitor use related management decisions; however, evaluative data, information pertaining to visitor experience, preferences and perceptions of crowding were still un-documented.

In the summer of 2010, visitor use data was collected at DEPO using several approaches concurrently: A) people at one time (PAOT) was again documented at the Postpile and Rainbow Falls viewing areas; B) automated trail counters were placed at three locations; C) vehicle counts were collected by NPS staff at the entrance station to the park; and D) visitor surveys were distributed to a random sample of DEPO visitors at both attraction sites. Regression analyses were conducted to examine the relationships between all variables, descriptive and evaluative; for example, to determine the relationships among: vehicle traffic, visitor use on the trails, PAOT counts at attraction sites, and visitors' reported experiences, preferences and perceptions of crowding.

While DEPO currently accommodates approximately 110,000 visitors annually during the months of June – September when the park is open (NPS Stats, 2010), high levels of visitor use (i.e., at attractions sites or areas of sensitive habitat), can pose a threat to natural resources, park infrastructure, and visitor experience. This research is intended to inform management decision making by providing quantitative data on visitor use, information necessary for determining the implications of current use levels on natural resources, and on visitor experience.

2.2 METHODS

Study Sites

Established in 1911, DEPO protects 800 acres of the eastern Sierra Nevada Mountain range. Completely surrounded by Inyo National Forest land, the Reds Meadow/Devils Postpile area is managed cooperatively by both the U.S. National Forest Service (USFS) and the National Park Service (NPS). One aspect of this management is the use of a "closed" transportation system;

during the summer months (mid-June – September) all day use visitors are required to use the Red's Meadow shuttle bus system. This bus service, which runs from 7:00 AM – 7:00 PM, originates at the Adventure Center at Mammoth Mountain Ski Resort and stops at ten destinations in Inyo National Forest and DEPO (Figure 2.2.1). The two main attractions within the monument, selected as the predominate study sites in this research, are the Devils Postpile rock formation and Rainbow Falls (Figure 2.2.2).

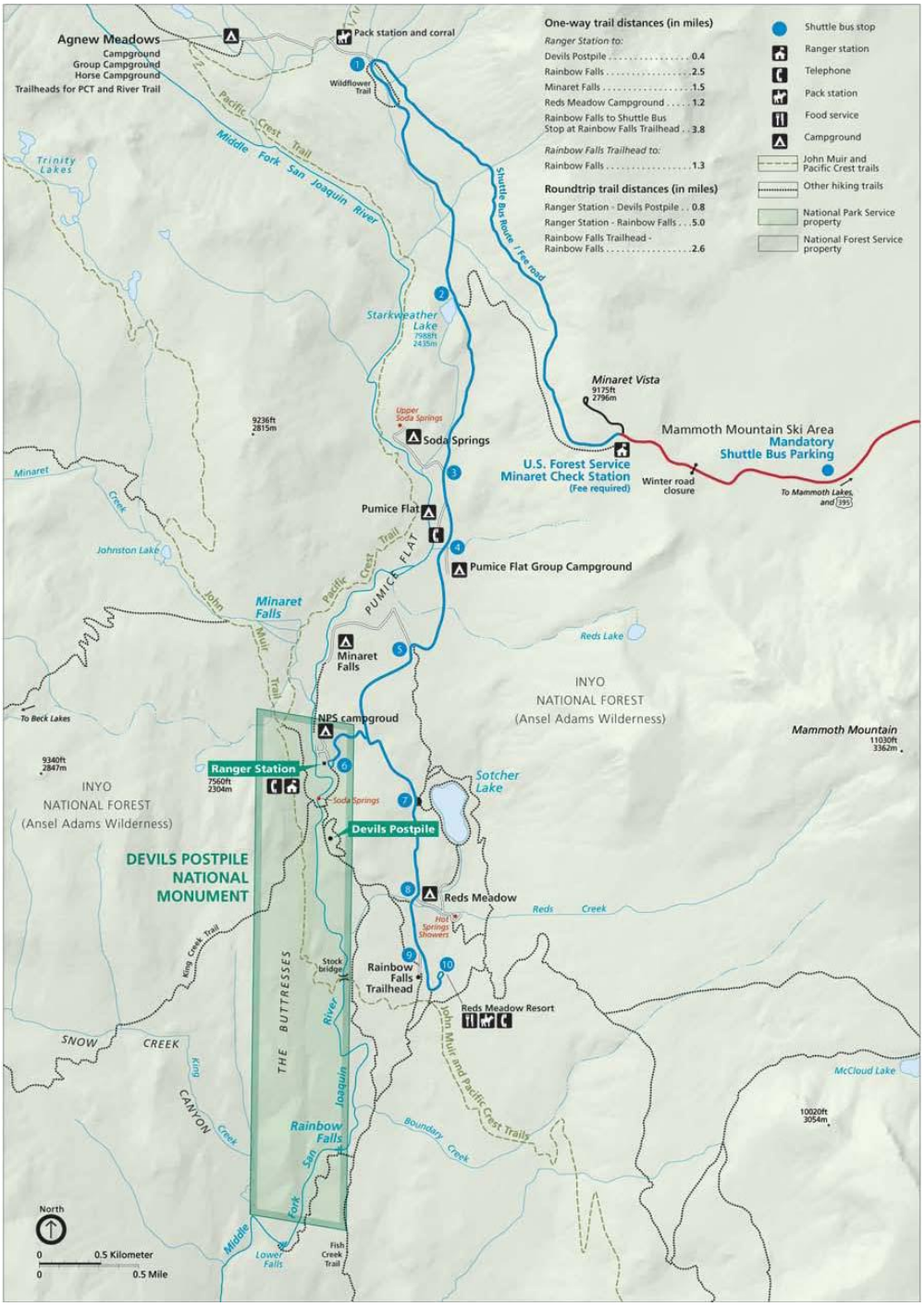


Figure 2.2.1. Devils Postpile National Monument and the Surrounding Area



Figure 2.2.2. Devils Postpile (left) and Rainbow Falls (right)

Sampling Design

The numbers of people-at-one-time (PAOT) at the Postpile and Rainbow Falls viewing areas were observed at each site concurrently by trained observers on 10 randomly selected days in 2009, from July 23rd through August 12th, and 15 days in 2010, from July 8th through 27th. Sample days for data collection were stratified by weekdays (Monday through Friday) and weekend days (Saturday and Sunday). Six weekdays and four weekend days were selected in 2009, with 10 weekdays and 6 weekend days observed in 2010, with the exception of one less weekday at Rainbow falls (Monday July 26th, 2010 when the Rainbow Falls viewing area was closed due to a lightning strike that started a forest fire).

On each sample day, observers documented the number of people at the Postpile and Rainbow Falls viewing areas from 9:00 am until 5:00 pm using a systematic sampling design. Observations began at 9:00 am and were repeated every 15 minutes in 2009, and every 20 minutes in 2010, until 5:00 pm. This resulted in between 24 and 32 observations per day for each study site. Visitor use areas were clearly defined at each site and observers documented the total number of people within each visitor use area by walking through the study site at the prescribed intervals.

In 2010, only a portion of the Postpile viewing area, one that could be clearly delineated in the survey photos, was used for the collection of PAOT counts; while in 2009, the Postpile study site included all of the lower viewing area from the junction of the main trail/loop trail above the Postpile to the beginning of the steps on the south end of the lower Postpile viewing area and the picnic area directly west of the Postpile viewing area (Figure 2.2.3). In 2009 overall PAOT was calculated by combining the observations from the Postpile viewing area and the picnic area. Animals (dogs and horses), which were documented in 2009, were not included in the 2010 study.

The Rainbow Falls study site (Figure 2.2.3), consisted of five distinct areas in 2009: 1) the first overlook, from its junctions with the main trail to the landing; 2) the second overlook, from its junctions with the main trail to the landing; 3) the hitching rack; 4) the main area, which includes all people in the upper Rainbow Falls area beyond the junction of the first overlook, but excludes

the hitching rack and overlooks; and 5) the lower falls, which includes all areas along the trail or shoreline below the stairs to the base of the falls. The number of people and dogs were documented at the overlooks, main area, and lower falls area while the number of horses was documented at the hitching rack. In addition, the number of people in the water at the base of the falls was documented. Overall PAOT was calculated by combining the observations from all of the discrete study sites described in this paragraph. In 2010, only the first overlook, which was utilized in the crowding photos, was included in PAOT counts at the Rainbow Falls viewing area.

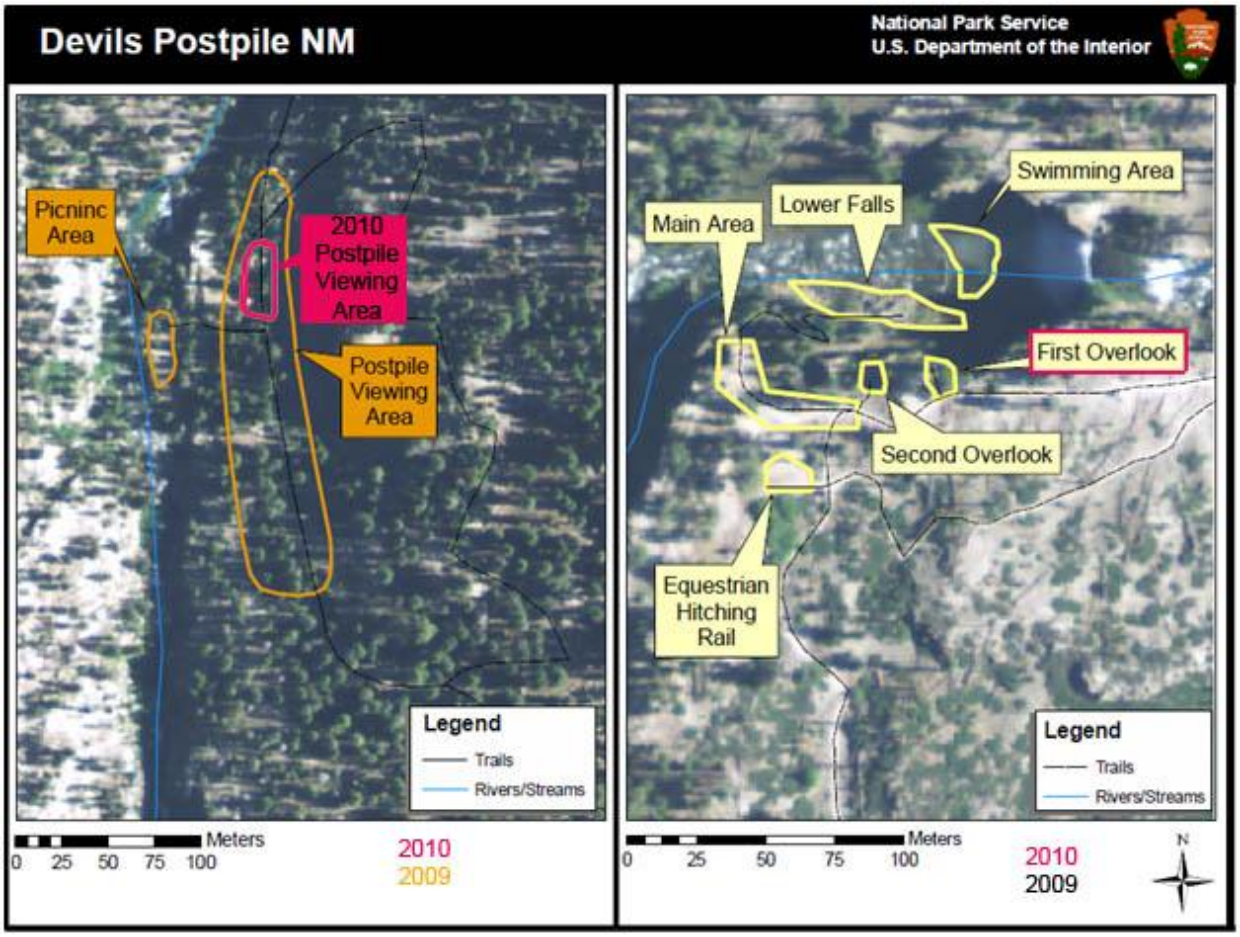


Figure 2.2.3. The 2009/2010 Devils' Postpile National Monument Visitor Use Study Sites including the Postpile and Rainbow Falls

In 2010, visitor surveys were distributed by trained surveyors to a randomly selected sample of visitors at the viewing area of each study site. Visitor surveys were distributed on the same 15 days, July 8 – 27 that PAOT counts were undertaken. Sample size was calculated to determine how many people needed to be surveyed in order to get results that statistically reflect the target population of 110,000 annual visitors to DEPO. The number 110,000 represents the average annual visitation over the past 5 years, 2006-2010; actual visitation was reported to be 110,212 in 2009 when the park was open to the public for 135 days, and 80,349 in 2010 when the park was only open for 108 days. In total, 584 surveys were collected providing a 95% confidence level with a confidence interval of 4% (also known as the margin of error).

In addition to PAOT counts and visitor surveys, trail data was collected with the use of automated visitor counters at various locations associated with the study sites from July through mid-September during both years. While trail data primarily provided counts of visitor use, a variety of vehicle data were also collected, including the number of personal vehicles, buses, and their passengers. Personal vehicle data were collected by the use of an automatic traffic counter located at the USFS Minaret entrance station throughout both the 2009 and 2010 seasons. The vehicle counter collected volume data only and passengers were estimated using a multiplier; data pertaining to the number of buses, and bus passengers, was obtained by the Eastern Sierra Transit Authority (ESTA), the company providing shuttle bus service to the park.

On-Trail Visitor Use

Visitor trail use data was collected via TRAFx automated visitor counters at nine locations in 2009 and three in 2010 (Figure 2.2.4): the Devils Postpile Trailhead, Reds Meadow, and at the entrance to Rainbow Falls.

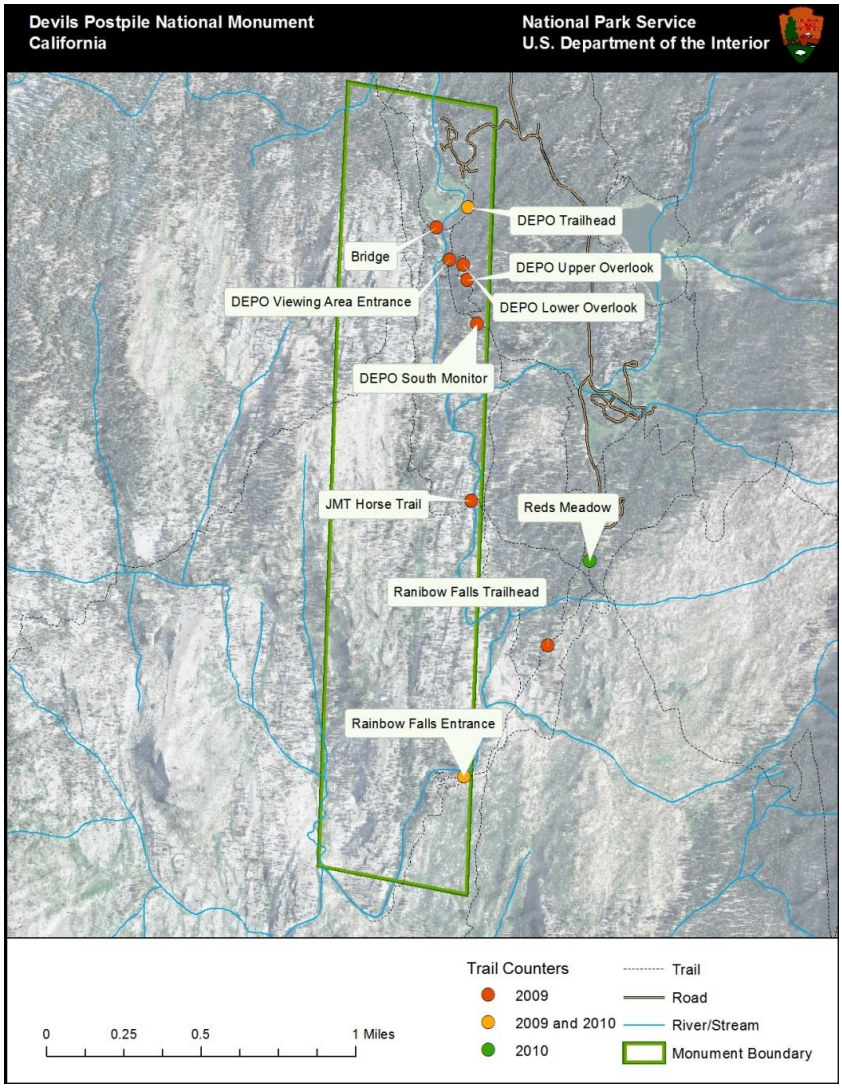


Figure 2.2.4. Trail Locations for the 2009 & 2010 Automatic Visitor Counters

Equipment

The automatic trail counter TRAFx monitor system is comprised of a single infrared scope connected to a small memory unit. The monitor registers a count when the scope detects the infrared signature of a warm moving object. For security, TRAFx units were secured inside steel boxes and mounted to trees, adjacent to trail sections of interest, with ¾ inch steel strapping (Figure 2.2.5).



Figure 2.2.5. TRAFx Automatic Visitor Counter Lock-Box (left) and a Conceptual Example of the Counter in Operation (right)

Data Management

The TRAFx monitors used in this study store up to 14,000 hourly counts. Data from the TRAFx counters were downloaded directly to a personal computer on a regular basis.

Monitor Calibration

Without calibration, raw data from automated counters cannot be treated as reliable and accurate measures of visitor use. Calibration through direct observation is required to estimate automated counter data error (Pettebone 2009). 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. Monitor counts are also subject to error from different types of environmental conditions, such as heavy snow or blowing vegetation (Vaske & Donnelly, 2007).

The automatic TRAFx monitors used in DEPO were each calibrated via direct observation and unique correction factors were calculated. Observations were obtained using a convenience based sampling design, and were conducted throughout the course of the day to ensure that the variability of daily visitor use was captured. A randomly selected sampling design was forgone, because previous work using automated visitor monitors found that monitor counting errors are

consistent regardless of the amount of visitor use passing a monitor (Pettebone et al. 2008; Pettebone 2009).

Direction of Travel

Direction of travel also had to be accounted for because counts from most 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 was calibrated by direct observation, and raw counts were adjusted, allowing the data to estimate the number of visitor arrivals to a location.

Vehicle Traffic

Vehicle traffic data, representing visitation to the Red's Meadow/DEPO area, were collected by the both the Eastern Sierra Transit Authority (data on shuttle buses), and by automatic traffic counter during both the 2009 and 2010 seasons. Because this area is a "closed" system of access (i.e., visitor access is limited to one entrance and most visitors are required to use the bus shuttle system), this data was explored to help document and explain visitor use levels specific to DEPO. A variety of data were collected at this entrance station including: 1) total daily inbound vehicles; 2) total daily inbound shuttle busses; 3) total bus passengers; 4) total daily inbound personal vehicles; 5) total personal vehicle passengers; and 6) total passengers.

Vehicle transportation data was used to explore statistical relationships between descriptive measures of visitor use (i.e., visitor use collected via automated visitor counters and PAOT collected by direct observation), and evaluative data from visitor surveys. Regression model results are reported for a variety of relationships (e.g., inbound vehicles to inbound visitors at trailheads; inbound visitors at trailheads to PAOT at attraction sites, inbound vehicles to visitors' preferences and perceptions of crowding).

2.3 RESULTS

Survey Results

Results from the visitor surveys collected at the Devils Postpile viewing area and Rainbow Falls are reported using tables, graphs, and in some cases charts, to facilitate a broader understanding of the data. The surveys elicited descriptive data, including experience use history and demographics, as well as evaluative data, such as visitors' preferences and perceptions of crowding. Most survey items are quantitative in design; however, two open-ended qualitative items were included, asking visitors to described what they liked best, and least, about their visit. Results of all responses are summarized below and qualitative responses are reported in full in the appendices (Appendix A – Open Ended Responses to Survey Questions 12 & 13).

Date of Survey

Visitor surveys were distributed on fifteen strategically selected days during the summer of 2010, beginning on July 8 and continuing through July 27, resulting in the collection of 584 surveys: 287 from the Devils Postpile viewing area and 297 from the Rainbow Falls viewing area (Table 2.3.1).

Table 2.3.1. Date of Survey by Location

Date of the Survey by Location

	Date	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (15 days)	7/08/2010	37	12.9	12.9
	7/09/2010	31	10.8	23.7
	7/10/2010	32	11.1	34.8
	7/11/2010	22	7.7	42.5
	7/12/2010	22	7.7	50.2
	7/13/2010	1	.3	50.5
	7/16/2010	12	4.2	54.7
	7/17/2010	15	5.2	59.9
	7/18/2010	42	14.6	74.6
	7/19/2010	3	1.0	75.6
	7/23/2010	22	7.7	83.3
	7/24/2010	11	3.8	87.1
	7/25/2010	18	6.3	93.4
	7/26/2010	18	6.3	99.7
	7/27/2010	1	.3	100.0
	Total	287	100.0	
Rainbow Falls Viewing Area (14 days)	7/08/2010	24	8.1	8.1
	7/09/2010	41	13.8	21.9
	7/10/2010	36	12.1	34.0
	7/11/2010	31	10.4	44.4
	7/12/2010	22	7.4	51.9
	7/15/2010	1	.3	52.2
	7/16/2010	25	8.4	60.6
	7/17/2010	18	6.1	66.7
	7/18/2010	21	7.1	73.7
	7/19/2010	7	2.4	76.1
	7/23/2010	24	8.1	84.2
	7/24/2010	23	7.7	91.9
	7/25/2010	20	6.7	98.7
	7/27/2010	4	1.3	100.0
	Total	297	100.0	

NOTE: Detail may not sum to totals because of rounding.

Number of Visits to Devils Postpile National Monument

Half of the visitors surveyed were on their first visit to DEPO; 19% had visited the park on one other occasion; 22% had visited the park between three and ten times; and 5% of the visitors surveyed had been there more than ten times, with some visitors reporting having visited the park on as many as 100 previous occasions (Table 2.3.2). Visitors to the Postpile viewing area had visited the park an average of 3.5 times, while visitors to Rainbow Falls had visited the park slightly more often, reporting an average of 4 visits.

Table 2.3.2. Number of Visits to Devils Postpile National Monument

How many times have you visited Devils Postpile National Monument?				
	Number of Visits	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 3.46; Std. Deviation = 8.47)	0	4	1.4	1.4
	1	162	56.6	58.0
	2	53	18.5	76.6
	3	21	7.3	83.9
	4	7	2.4	86.4
	5	8	2.8	89.2
	6	6	2.1	91.3
	7	2	.7	92.0
	8	2	.7	92.7
	10	6	2.1	94.8
	12	2	.7	95.5
	15	3	1.0	96.5
	20	2	.7	97.2
	25	1	.3	97.6
	30	3	1.0	98.6
	33	1	.3	99.0
	50	1	.3	99.3
	57	1	.3	99.7
	100	1	.3	100.0
	Total	286	100.0	
Rainbow Falls Viewing Area (Mean = 3.95; Std. Deviation = 7.97)	0	3	1.0	1.0
	1	136	45.8	46.8
	2	61	20.5	67.3
	3	20	6.7	74.1
	4	22	7.4	81.5
	5	12	4.0	85.5
	6	7	2.4	87.9
	8	5	1.7	89.6
	9	1	.3	89.9
	10	12	4.0	93.9
	11	1	.3	94.3
	15	5	1.7	96.0
	20	4	1.3	97.3
	25	1	.3	97.6
	30	4	1.3	99.0
	40	1	.3	99.3
	50	1	.3	99.7
	96	1	.3	100.0
	Total	297	100.0	

NOTE: Detail may not sum to totals because of rounding.

Familiarity with Devils Postpile National Monument

It is possible that visitors who have only been to a park once may become very familiar with the area during their visit, and conversely, visitors that frequent a park often may not become familiar with the park as a whole. Consequently, respondents were asked to rate how familiar they were with DEPO on a scale of 1 (Not at all familiar) to 9 (Extremely familiar). Visitors to Rainbow Falls reported being slightly more familiar with the park (mean = 4.9), than visitors to the Postpile viewing area (mean = 4.2). Approximately half (49.1%) of the surveyed visitors responded that they were relatively unfamiliar with the park, 39.2 % reported being familiar with the park to one degree or another, with less than 7% claiming to be extremely familiar with it (Table 2.3.3).

Table 2.3.3. Familiarity with Devils Postpile National Monument

How familiar are you with Devils Postpile National Monument?				
	Scale	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 4.2; Std. Deviation = 2.48)	1 Not at all Familiar	49	17.1	17.1
	2	40	14.0	31.1
	3	46	16.1	47.2
	4	27	9.4	56.6
	5 Neutral	32	11.2	67.8
	6	29	10.1	78.0
	7	29	10.1	88.1
	8	16	5.6	93.7
	9 Extremely Familiar	18	6.3	100.0
	Total	286	100.0	
Rainbow Falls Viewing Area (Mean = 4.94; Std. Deviation = 2.5)	1 Not at all Familiar	39	13.2	13.2
	2	22	7.4	20.6
	3	35	11.8	32.4
	4	27	9.1	41.6
	5 Neutral	36	12.2	53.7
	6	39	13.2	66.9
	7	53	17.9	84.8
	8	25	8.4	93.2
	9 Extremely Familiar	20	6.8	100.0
	Total	296	100.0	

NOTE: Detail may not sum to totals because of rounding.

Previous Attraction Viewing Area Visitation

When asked if they had previously visited their particular attraction viewing area, 57.2% of the Devils Postpile visitors, and 58.1% of the Rainbow Falls visitors, replied "No" they had not. In total, 42.4% of all respondents replied that "Yes" they had visited on at least one prior occasion (Table 2.3.4).

Table 2.3.4. Previously Visited the Attraction Viewing Area

Have you visited this viewing area before?				
Response		Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	No	163	57.2	57.2
	Yes	122	42.8	100.0
	Total	285	100.0	
Rainbow Falls Viewing Area	No	172	58.1	58.1
	Yes	124	41.9	100.0
	Total	296	100.0	

NOTE: Detail may not sum to totals because of rounding.

Number of Visits to the Attraction Site Viewing Areas

The 246 people (42.4%) that replied "Yes," they had visited on at least one prior occasion, were posed an additional question: "Including this time, approximately how many times have you visited [attraction site]." Most visitors responded to this additional question; of the 120 people that responded to this question at the Postpile viewing area, 43.3% reported visiting twice, 41.6% between three and ten times, and 11.7% more than ten times, with one person reporting having visited the Postpile on 100 separate occasions (Table 2.3.5). Out of the 121 people responding at the Rainbow Falls viewing area, 34.7% had been there twice, 53.7% between three and ten times,

and 8.3% reported having visited more than 10 times, with one person reporting having visited 50 times.

Table 2.3.5. Number of Visits to the Attraction Site Viewing Area

How many times have you visited this viewing area?				
Number of Visits (Including this visit)		Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 6.07; Std. Deviation = 11.16)	1	4	3.3	3.3
	2	52	43.3	46.7
	3	21	17.5	64.2
	4	6	5.0	69.2
	5	10	8.3	77.5
	6	4	3.3	80.8
	7	1	.8	81.7
	8	2	1.7	83.3
	10	6	5.0	88.3
	12	2	1.7	90.0
	15	4	3.3	93.3
	20	4	3.3	96.7
	25	1	.8	97.5
	30	1	.8	98.3
	57	1	.8	99.2
	100	1	.8	100.0
	Total	120	100.0	
Rainbow Falls Viewing Area (Mean = 5.69; Std. Deviation = 6.99)	1	4	3.3	3.3
	2	42	34.7	38.0
	3	17	14.0	52.1
	4	13	10.7	62.8
	5	10	8.3	71.1
	6	6	5.0	76.0
	7	3	2.5	78.5
	8	6	5.0	83.5
	9	1	.8	84.3
	10	9	7.4	91.7
	15	4	3.3	95.0
	20	2	1.7	96.7
	24	1	.8	97.5
	30	1	.8	98.3
	40	1	.8	99.2
	50	1	.8	100.0
	Total	121	100.0	

NOTE: Detail may not sum to totals because of rounding.

Hike Start Location

Survey respondents were asked where they began their hike that day; options included: A) Devils Postpile Visitor Center; B) Rainbow Falls Trailhead; C) Overnight camping in Wilderness area; D) Don't know; and E) Other. Results show that 84.6% of the Postpile surveyed visitors, and 61% of the Rainbow Falls visitors, started their hike at the Devils Postpile Visitor Center. Of the Rainbow Falls respondents, 30.8% started their hike at the Rainbow Falls Trailhead. (Table 2.3.6).

Table 2.3.6. The Day' s Hike Start Location

On your trip today, where did you begin your hike?				
	Hike Start Location	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	Devils Postpile Visitor Center	241	84.6	84.6
	Rainbow Falls Trailhead	11	3.9	88.4
	Overnight camping in Wilderness area	11	3.9	92.3
	Don't know	1	.4	92.6
	Other	21	7.4	100.0
	Total	285	100.0	
Rainbow Falls Viewing Area	Devils Postpile Visitor Center	180	61.0	61.0
	Rainbow Falls Trailhead	91	30.8	91.9
	Overnight camping in Wilderness area	4	1.4	93.2
	Other	20	6.8	100.0
	Total	295	100.0	

NOTE: Detail may not sum to totals because of rounding.

Responses to "Other" Hike Start Locations

There were 21 people at the Postpile viewing area, and 20 people at Rainbow Falls, that provided "Other" start locations for their hike than the ones provided in the survey. Red's Meadow was the most frequently mentioned, with 13 people (7 at the Postpile and 6 at Rainbow Falls) starting their hikes from that location (Table 2.3.7).

Table 2.3.7. Frequency of Other Hike Start Locations from Survey Respondents at the Postpile & Rainbow Falls Viewing Areas

Location	Devi's Postpile Frequency &(Valid Percent)	Rainbow Falls Frequency &(Valid Percent)
Agnew Meadow	1 (0.3%)	
Agnew Meadow shuttle stop San Joaquin River Trail	1 (0.3%)	
CCC trail crew camp ediza/Garnet Junction	1 (0.3%)	
Convict Lake Camping Resort	1 (0.3%)	
Lake Mary	1 (0.3%)	
Minaret Falls	2 (0.7%)	1 (0.3%)
Minaret Falls Campground	3 (1.0%)	
Pumice campground	1 (0.3%)	
Red's Meadow	7 (2.4%)	6 (2.0%)
Rosalie Lake, JMT Tuolumne Meadows -> Reds Meadow	1 (0.3%)	
Soda Springs Campground	1 (0.3%)	
Top of Starkweather trail	1 (0.3%)	
Backpackers Camp	1 (0.3%)	
Backpackers Camp-Tuolumne Meadows		1 (0.3%)
Biked from Mammoth Mountain Inn.		1 (0.3%)
Bus-Postpile then bus to rainbow falls trailhead		1 (0.3%)
Devils Postpile Campground		2 (0.7%)
Fish Valley		1 (0.3%)
Guard Station (Main Lodge)		1 (0.3%)
Horseshoe Lake		4 (1.3%)
Mexico (Up of Deer Creek)		1 (0.3%)

Hike Start Time

Respondents reported hike start times ranging from 7:00 am - 11:00 pm, although one Rainbow Falls respondent started their hike at 6:00 am (Figure 2.3.1). Hike start times for visitors at both viewing sites peaked at 11:00 am. Average hike start times were 11:52 am, reported by Postpile viewing area visitors, and 10:59 am, reported by Rainbow Falls visitors. For many visitors, hike start times were dependent upon shuttle bus times; the earliest bus departed from the Village at Mammoth Lakes at 7:00 am, with buses then departing hourly until 11:00 am.

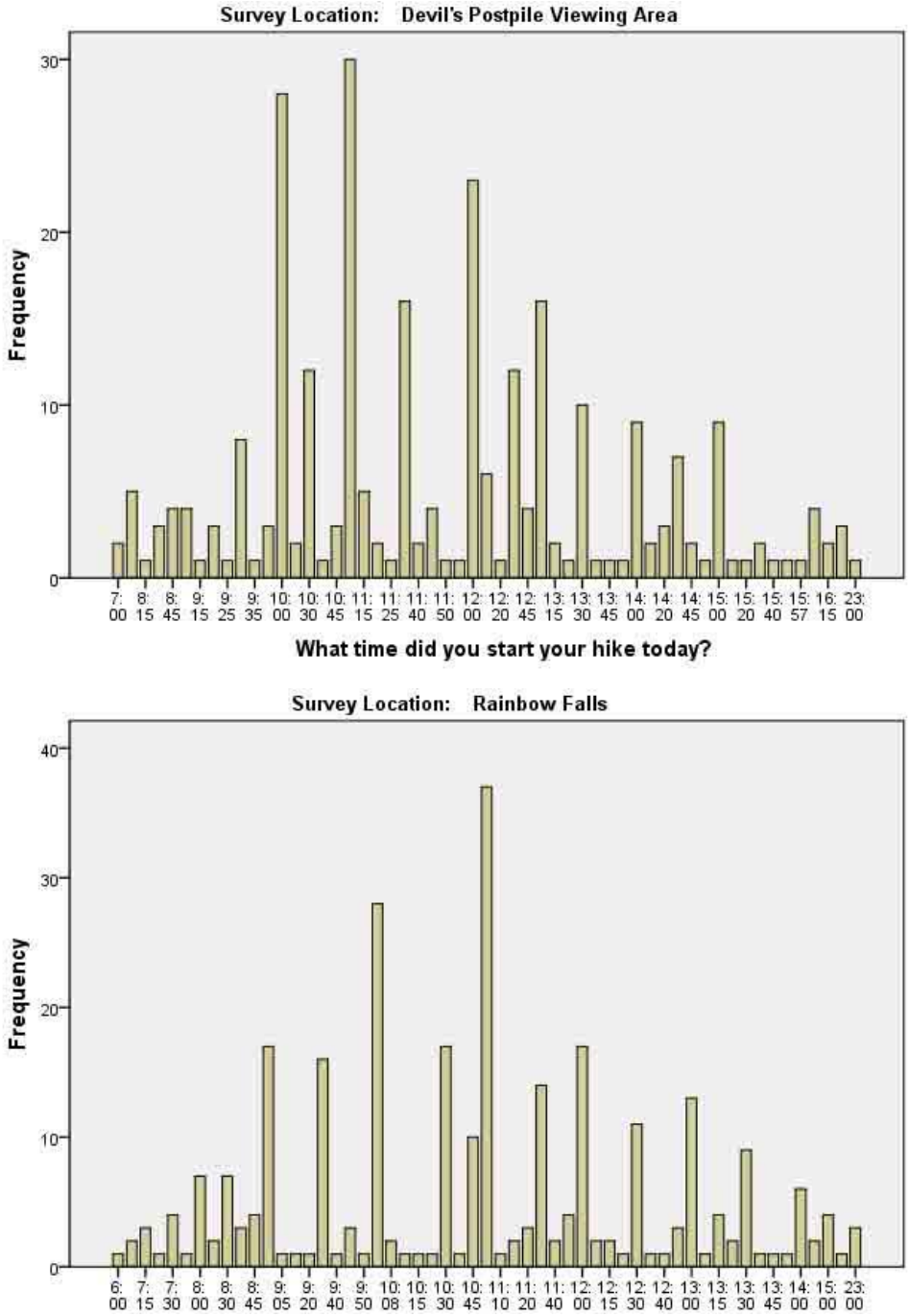


Figure 2.3.1. Charts Representing Reported Hike Start Times for Visitors to Postpile and Rainbow Falls Viewing Areas

Perceptions of Crowding

A series of survey questions pertaining to visitors' perceptions of crowding utilized photos of both the Postpile viewing area (Figure 2.3.2; Figure 2.3.3; Figure 2.3.4; Figure 2.3.5; Figure 2.3.6) and the Rainbow Falls viewing area (Figure 2.3.7; Figure 2.3.8; Figure 2.3.9; Figure 2.3.10; Figure 2.3.11), which had progressively greater numbers of people populating the same viewing location. Visitors were shown the photographs and were asked to rate the photos on a scale of -4 "Very Unacceptable" to +4 "Very Acceptable."



Figure 2.3.2. Postpile Photo 1 with No Other People



Figure 2.3.3. Postpile Photo 2 with 5 Other People



Figure 2.3.4. Postpile Photo 3 with 15 Other People



Figure 2.3.5. Postpile Photo 4 with 35 Other People



Figure 2.3.6. Postpile Photo 5 with 50 Other People



Figure 2.3.7. Rainbow Falls Photo 1 with No Other People



Figure 2.3.8. Rainbow Falls Photo 2 with 10 Other People



Figure 2.3.9. Rainbow Falls Photo 3 with 20 Other People



Figure 2.3.10. Rainbow Falls Photo 4 with 30 Other People



Figure 2.3.11. Rainbow Falls Photo 5 with 40 Other People

Effect of Encounters with Other People on the Overall Enjoyment of the Hiking Experience

When asked: "In general, how did the encounters you had with other people at [viewing area] today affect your overall enjoyment of your hiking experience?" visitors expressed a wide range of responses. This question did not refer to the photos, but instead, visitors were asked to rate their overall enjoyment on a scale of 1 - 5, with 1 equaling "Greatly added to my enjoyment" and 5 equaling "Greatly reduced my enjoyment" (Table 2.3.8).

Table 2.3.8. Effect of Encounters with Other People on the Overall Enjoyment of the Hiking Experience

How did the encounters you had with other people affect your overall enjoyment of your hiking experience?				
	Scale	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 2.31; Std. Deviation = .91)	1 Greatly added to my enjoyment	68	24.0	24.0
	2 Somewhat added to my enjoyment	74	26.1	50.2
	3 Had no effect	126	44.5	94.7
	4 Somewhat reduced my enjoyment	14	4.9	99.6
	5 Greatly reduced my enjoyment	1	.4	100.0
	Total	283	100.0	
Rainbow Falls Viewing Area (Mean = 2.16; Std. Deviation = .91)	1 Greatly added to my enjoyment	83	28.2	28.2
	2 Somewhat added to my enjoyment	100	34.0	62.2
	3 Had no effect	95	32.3	94.6
	4 Somewhat reduced my enjoyment	14	4.8	99.3
	5 Greatly reduced my enjoyment	2	.7	100.0
	Total	294	100.0	

NOTE: Detail may not sum to totals because of rounding.

Some respondents, 44.5% from the Postpile viewing area and 32.3% from the Rainbow Falls viewing area, reported that the number of other people had no effect on their overall enjoyment of their hiking experience; however, 50.2% of the Postpile respondents and 62.2% of the Rainbow Falls respondents reported that the encounters with other people at their viewing area added to their enjoyment, while 5.3% of the Postpile, and 5.5% of the Rainbow Falls, respondents reported that it reduced their enjoyment to some degree (Table 2.3.8).

Acceptable Number of People One Time

Visitors were then asked to determine the acceptable number of people at their respective viewing area at one time. Postpile viewing area results showed that the number of people, less than or equal to those represented in photo 3 (15 people), were acceptable to 73.7% of survey participants (with mean scores greater than zero (the neutral point), and that 54.1% of the Rainbow Falls respondents also found the number of people, less than or equal to those represented in Photos 3 (20 people), to be acceptable (Table 2.3.9).

For the number of people found to be unacceptable, the largest percentage of the survey participants at both the Postpile viewing area (59.4%), and the Rainbow Falls viewing area (68.4%), found the number of people represented in Photo 5 to be unacceptable, with mean scores of less than -2.5, on a 9 point scale, ranging from -4.0 to +4.0 (Table 2.3.9). A "norm curve" graphically illustrates the mean acceptability evaluations of different numbers of people at

each of the DEPO viewing areas (Figure 2.3.12, Figure 2.3.13). The norm curve in the case of the Postpile viewing area crosses the zero acceptability threshold at approximately 26 PAOT, suggesting that when there are more than 26 people at one time at this viewing area, it begins to affect visitor experience (Figure 2.3.12).

Table 2.3.9. Acceptable Number of People in the Viewing Area at One Time

Acceptable Number of People in the Viewing Area One Time										
Devils Postpile Viewing Area Mean Score (Std. Deviation)	Photo 1 (0 people) 3.6 (1.29)		Photo 2 (5 people) 3.21 (1.42)		Photo 3(15 people) 1.70 (1.88)		Photo 4 (35 people) -1.23 (2.38)		Photo 5(50 people) -2.59 (2.17)	
Scale	Freq.	Valid %	Freq.	Valid %	Freq.	Valid %	Freq.	Valid %	Freq.	Valid %
-4 Very Unacceptable	4	1.5	3	1.1	5	1.9	53	20.3	158	59.4
-3	1	.4	3	1.1	4	1.5	41	15.7	24	9.0
-2	1	.4	2	.7	8	3.0	54	20.7	19	7.1
-1	2	.7	3	1.1	16	5.9	25	9.6	15	5.6
0 Neutral	1	.4	2	.7	38	14.1	23	8.8	19	7.1
1	2	.7	2	.7	29	10.8	19	7.3	11	4.1
2	13	4.8	22	8.2	57	21.2	20	7.7	8	3.0
3	17	6.3	83	30.9	69	25.7	15	5.7	6	2.3
4 Very Acceptable	231	84.9	149	55.4	43	16.0	11	4.2	6	2.3
Total	272	100.0	269	100.0	269	100.0	261	100.0	266	100.0
% Acceptable (+1 - +4)	263	96.7.	256	95.2	198	73.6	65	24.9	31	11.7
Rainbow Falls Viewing Area Mean Score (Std. Deviation)	Photo 1 (0 people) 3.44 (1.58)		Photo 2 (10 people) 2.82 (1.72)		Photo 3(20 people) .59 (2.30)		Photo 4 (30 people) -1.43 (2.42)		Photo 5(40 people) -2.80 (2.21)	
Scale	Freq.	Valid %	Freq.	Valid %	Freq.	Valid %	Freq.	Valid %	Freq.	Valid %
-4 Very Unacceptable	7	2.5	3	1.1	15	5.4	74	27.0	188	68.4
-3	1	.4	5	1.8	21	7.5	43	15.7	18	6.5
-2	1	.4	2	.7	22	7.9	45	16.4	14	5.1
-1	2	.7	7	2.5	28	10.0	21	7.7	12	4.4
0 Neutral	7	2.5	14	5.1	42	15.1	24	8.8	14	5.1
1	5	1.8	12	4.3	36	12.9	27	9.9	10	3.6
2	10	3.5	30	10.8	51	18.3	17	6.2	3	1.1
3	16	5.6	70	25.3	35	12.5	10	3.6	4	1.5
4 Very Acceptable	235	82.7	134	48.4	29	10.4	13	4.7	12	4.4
Total	284	100.0	277	100.0	279	100.0	274	100.0	275	100.0
% Acceptable (+1 - +4)	266	93.7	246	88.8	151	54.1	67	24.5	29	10.5

NOTE: Detail may not sum to totals because of rounding.

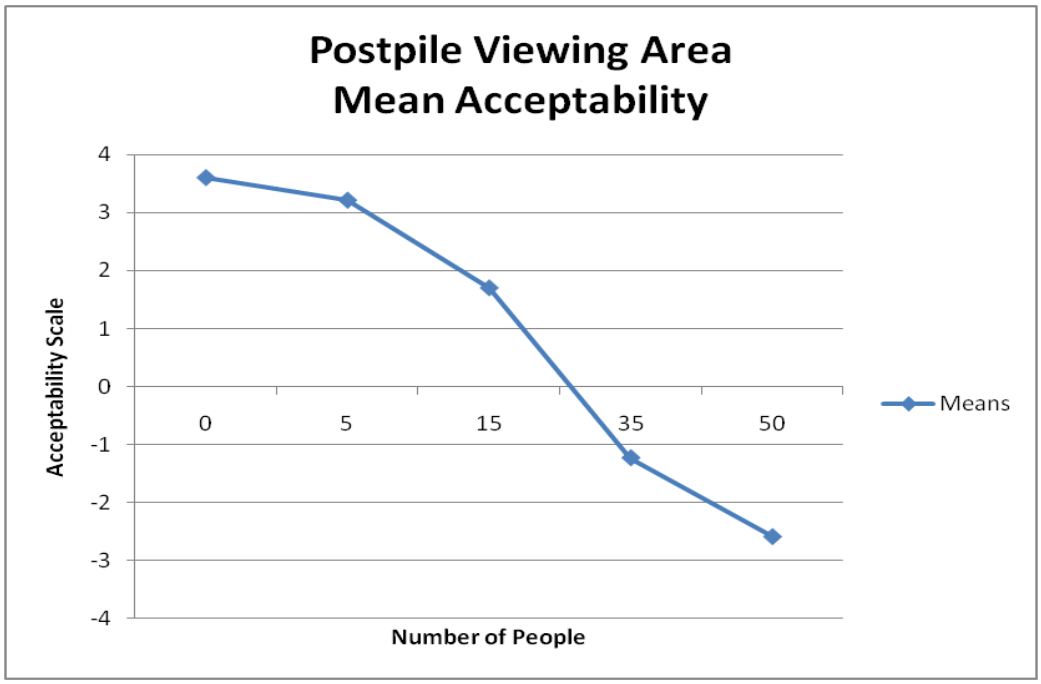


Figure 2.3.12. Norm Curve Illustrating the Mean Acceptability for the Numbers of People at the Postpile Viewing Area at One Time

The norm curve in the case of the Rainbow Falls viewing area crosses the zero acceptability threshold at approximately 23 people at one time, suggesting that when there are more than 23 people at one time at this viewing area, it begins to affect visitor experience (Figure 2.3.13).

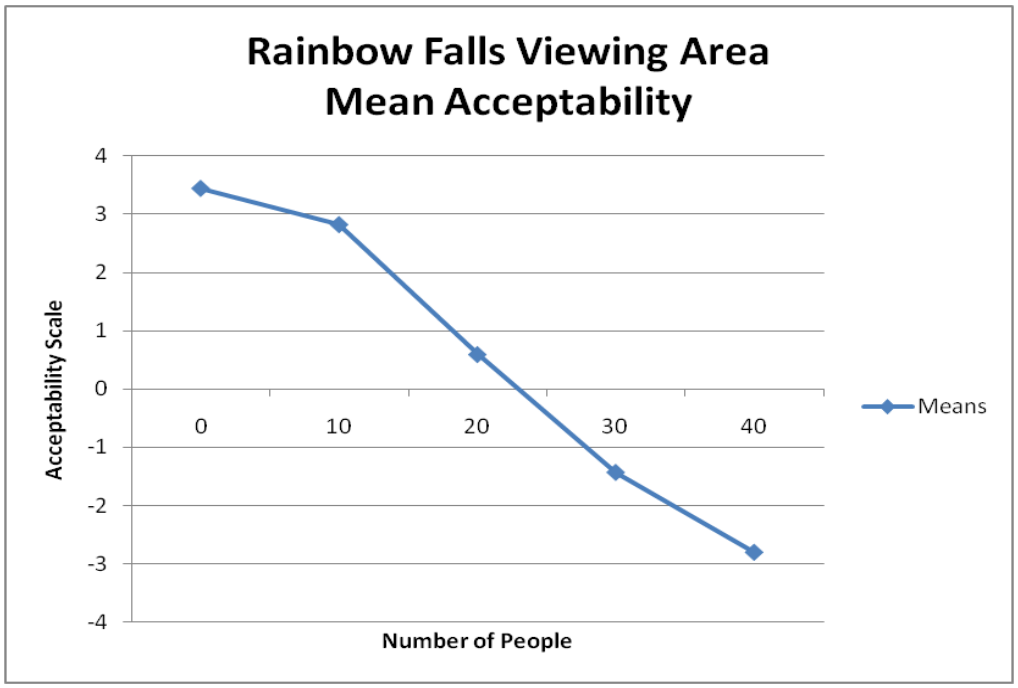


Figure 2.3.13. Norm Curve Illustrating the Mean Acceptability for the Numbers of People at the Rainbow Falls Viewing Area at One Time

Maximum Number of People the NPS Should Allow in the Viewing Area at One Time

Using the same five photos, visitors were next asked "Which photograph shows the maximum number of people the National Park Service should allow in this viewing area at one time?" While a small percentage of people did say that visitor use should not be limited at any point represented in the photos, or not be limited at all, the largest percentage of people surveyed at the Postpile viewing area, 51.7%, selected Photo 3 (with 15 people) as most representative of the maximum number of people the National Park Service should allow at any one time; the largest percentage of people surveyed at the Rainbow Falls viewing area, 47.4%, also selected Photo 3 (with 20 people) as most representative of the maximum number of people the National Park Service should allow at that viewing area any one time (Table 2.3.10). The overall mean was 3.2, equating to approximately 21 people at either viewing area.

Table 2.3.10. The Maximum Number of People the NPS should allow in the Viewing Area at One Time

Which photograph shows the maximum number of people the NPS should allow at this viewing area at one time?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 3.33; Std. Deviation = 0.83)	1 Photo (0 People)	4	1.7	1.7
	2 Photo (5 People)	23	9.7	11.3
	3 Photo (15 People)	123	51.7	63.0
	4 Photo (35 People)	67	28.2	91.2
	5 Photo (50 People)	21	8.8	100.0
	Total	238	100.0	83.8
	Should not be limited at any point shown in the photos	16	2.1	89.4
	Should not be limited at all	30	10.6	100.0
	Total	284	100.0	
Rainbow Falls Viewing Area (Mean = 3.14; Std. Deviation = 0.88)	1 Photo (0 People)	2	.9	.9
	2 Photo (10 People)	51	22.0	22.8
	3 Photo (20 People)	110	47.4	70.3
	4 Photo (30 People)	50	21.6	91.8
	5 Photo (40 People)	19	8.2	100.0
	Total	232	100.0	80.3
	Should not be limited at any point shown in the photos	20	6.9	87.2
	Should not be limited at all	37	12.8	100.0
	Total	289	100.0	

NOTE: Detail may not sum to totals because of rounding.

Number of People Preferred on a the Viewing Area

Visitors were then asked to select the photograph which represented the number of people in the viewing area that they would *prefer* to see. The mean score for this question at the Postpile viewing area was 2.15, which equates to approximately five people; the mean score at the Rainbow Falls viewing area was 2.1, equaling approximately ten people (Table 2.3.11). Ten visitors (3.5% of respondents), at each of the viewing areas selected "I don't know" as their response to this question; although 96.5% of the survey respondents were quite clear that they prefer to see lower numbers of visitors than were represented during their visit that day, which on average equaled 10 at the Postpile viewing area, and 14 at Rainbow Falls (Table 2.3.11).

Table 2.3.11. The Preferred Number of People at a Viewing Area

Which photograph shows the number of people at this viewing area that you would prefer to see?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 2.15; Std. Deviation = 0.78)	1 Photo 0 People	51	18.7	18.7
	2_ Photo 5People	143	52.4	71.1
	3_ Photo 15 People	68	24.9	96.0
	4 Photo 35 People	9	3.3	99.3
	5_Photo 50 People	2	.7	100.0
	Total	273	100.0	96.5
	I don't know	10	3.5	100.0
	Total	283	100.0	
Rainbow Falls Viewing Area (Mean = 2.10; Std. Deviation = 0.84)	1 Photo 0 People	58	20.9	20.9
	2 Photo 10 People	154	55.4	76.3
	3 Photo 20 People	51	18.3	94.6
	4 Photo 30 People	9	3.2	97.8
	5 Photo 40 People	6	2.2	100.0
	Total	278	100.0	96.5
	I don't know	10	3.5	100.0
	Total	288	100.0	

NOTE: Detail may not sum to totals because of rounding.

Number of People at the Viewing Area that would Prohibit Return Visits

When asked which photograph showed the number of people at the viewing area that would cause them never to want to return, 62.1% of the visitors at the Postpile viewing area selected photo 5 with 50 people; their mean score for this question was 4.6, which equates to approximately 42 people (Table 2.3.12).

Table 2.3.12. The Number of People at the Viewing Area that would Prohibit Return Visits

Which photograph shows the number of people at this viewing area that would cause you to never want to return?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 4.55; Std. Deviation = 0.67)	1 Photo 0 People	1	.5	.5
	2 Photo 5 People	3	1.5	2.0
	3 Photo 15 People	5	2.5	4.4
	4 Photo 35 People	68	33.5	37.9
	5 Photo 50 People	126	62.1	100.0
	Total	203	100.0	71.7
	I would return regardless of the number of people	68	24.0	95.8
	I don't know	12	4.2	100.0
	Total	283	100.0	
Rainbow Falls Viewing Area (Mean = 4.51; Std. Deviation = 0.76)	1 Photo 0 People	2	1.0	1.0
	2 Photo 10 People	2	1.0	2.1
	3 Photo 20 People	13	6.7	8.8
	4 Photo 30 People	55	28.4	37.1
	5 Photo 40 People	122	62.9	100.0
	Total	194	100.0	67.8
	I would return regardless of the number of people	83	29.0	96.85
	I don't know	9	3.15	100.0
	Total	286	100.0	

NOTE: Detail may not sum to totals because of rounding.

The largest percentage of visitors, 62.9%, at the Rainbow Falls viewing area selected photo 5 with 40 people as representative of the number of people that would cause them to never want to return; their mean score was 4.5, which equates to 35 people. There were, however, people at both viewing areas (24% of the Postpile respondents and 29% of Rainbow Falls respondents) that reported they would return regardless of the number of people in the viewing area (Table 2.3.12).

Number of People at the Viewing Area during Today's Visit

Visitors were asked to select the photo that best represented the number of visitors they saw at the viewing area that day. The visitors at the Postpile viewing area were nearly split between Photos 2 and 3; Photo 2, with 5 people, was selected by 45.8% of the respondents, and 45.1% selected photo 3 with 15 people (Table 2.3.13). The Postpile mean score for this question was 2.5, which equates to 10 people. Visitors at the Rainbow Falls viewing area selected Photo 2, with 10 people, as representative of the number of people present during their visit that day; although the mean score was 2.4, which equates to approximately 14 people. In relation, the mean number of people that survey respondents identified as the maximum the National Park Service should allow at either of the viewing areas at any one time was on average 21 people (Table 2.3.10).

Table 2.3.13. The Number of People at the Viewing Area during Today's Visit

Which photograph looks most like the number of visitors you saw at this viewing area today?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 2.52; Std. Deviation = 0.69)	1 Photo 0 People	11	4.0	4.0
	2 Photo 5 People	127	45.8	49.8
	3 Photo 15 People	125	45.1	94.9
	4 Photo 35 People	11	4.0	98.9
	5 Photo 50 People	3	1.1	100.0
	Total	277	100.0	97.9
	I don't know	6	2.1	100.0
	Total	283	100.0	
Rainbow Falls Viewing Area (Mean = 2.43; Std. Deviation = 0.77)	1 Photo 0 People	16	5.6	5.6
	2 Photo 10 People	159	55.8	61.4
	3 Photo 20 People	87	30.5	91.9
	4 Photo 30 People	18	6.3	98.2
	5 Photo 40 People	5	1.8	100.0
	Total	285	100.0	98.6
	I don't know	4	1.4	100.0
	Total	289	100.0	

NOTE: Detail may not sum to totals because of rounding.

Perceptions of Crowding at the Viewing Areas

The last question that pertained to visitor's perceptions of crowding asked visitors to describe how crowded they felt while they were at the survey viewing area that day. This question did not refer to the photos; instead, visitors were asked to rate their perception of crowding on a scale from 1 – 9, with 1-2 being "Not at all Crowded" and 8-9 being "Extremely Crowded." The mean score for this question from Postpile respondents was 2.5 (slightly crowded), with 64.1% of visitors reporting being not at all crowded, and only 2.7% of the Postpile viewing area visitors reporting feeling extremely crowded (Table 2.3.14). Rainbow Falls survey participants reported a mean score of 2.8

(slightly crowded), with 55.3% of visitors reporting feeling not at all crowded, and only 1.0% of visitors to the Rainbow Falls viewing area reporting feeling extremely crowded.

Table 2.3.14. Perceptions of Crowding at the Viewing Areas

How crowded did you feel while you were at this viewing area today?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 2.46; Std. Deviation = 1.55)	1 Not at all crowded	87	30.3	30.3
	2 Not at all crowded	97	33.8	64.1
	3 Slightly crowded	50	17.4	81.5
	4 Slightly crowded	20	7.0	88.5
	5	12	4.2	92.7
	6 Moderately crowded	13	4.5	97.2
	7 Moderately crowded	7	2.4	99.7
	8 Extremely crowded	1	.3	100.0
	9 Extremely crowded	0	.0	
	Total	287	100.0	
Rainbow Falls Viewing Area (Mean = 2.82; Std. Deviation = 1.77)	1 Not at all crowded	76	26.1	26.1
	2 Not at all crowded	85	29.2	55.3
	3 Slightly crowded	46	15.8	71.1
	4 Slightly crowded	34	11.7	82.8
	5	16	5.5	88.3
	6 Moderately crowded	21	7.2	95.5
	7 Moderately crowded	10	3.4	99.0
	8 Extremely crowded	2	.7	99.7
	9 Extremely crowded	1	.3	100.0
	Total	291	98.0	100.0

NOTE: Detail may not sum to totals because of rounding.

Logistical Issues Pertaining to Trails

A series of six questions in the surveys had to do with logistical issues pertaining to trails. These questions utilized a 4 point scale: 0) Don't Know/No Opinion, 1) Not a Problem, 2) Small Problem, and 3) Big Problem.

Difficulty Locating Trailheads

When asked about the difficulty of locating trailheads, 98.9% of Postpile survey participants, and 97.5% of those from Rainbow Falls, reported that it was not a problem; (Postpile means = 1.0, Rainbow Falls = 1.02); however, eight people, two from Postpile (0.7%) and six from Rainbow Falls (2.1%) felt that locating trailheads was a small problem (Table 2.3.15).

Table 2.3.15. Difficulty Locating Trailheads

Difficulty locating the trailhead				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.00; Std. Deviation = 0.10)	0 Don't Know/No Opinion	1	.4	.4
	1 Not a Problem	276	98.9	99.3
	2 Small Problem	2	.7	100.0
	Total	279	100.0	
Rainbow Falls Viewing Area (Mean = 1.02; Std. Deviation = 0.16)	0 Don't Know/No Opinion	1	.4	.4
	1 Not a Problem	274	97.5	97.9
	2 Small Problem	6	2.1	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Transportation to the Trailhead

Visitors were asked to report on what method of transportation they used to get to the trailhead that day; survey response options included: 1) personal vehicle, 2) shuttle bus, and 3) other, which included a space to describe other means of transportation. Shuttle bus use was the primary means of transportation reported by both Postpile (79.2%) and Rainbow Falls (69.7%) survey respondents (Table 2.3.16). Personal vehicles were used by 14.3% of Postpile, and 24.9% of Rainbow Falls, respondents, with eighteen Postpile visitors (6.5%), and fifteen Rainbow Falls visitors (5.4%), selecting the "other" response.

Table 2.3.16. Method of Transportation to Trailheads

How did you get to the trailhead today?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	1 Personal vehicle	40	14.3	14.3
	2 Shuttle bus	221	79.2	93.5
	3 Other	18	6.5	100.0
	Total	279	100.0	
Rainbow Falls Viewing Area	1 Personal vehicle	69	24.9	24.9
	2 Shuttle bus	193	69.7	94.6
	3 Other	15	5.4	100.0
	Total	277	100.0	

NOTE: Detail may not sum to totals because of rounding.

Other Types of Transportation to the Trailhead

Hiking was the most frequently described "other" type of transportation used to arrive at the trailhead; sixteen people who completed the survey at the Postpile viewing area, and ten people at the Rainbow Falls viewing area, reported hiking to the trailhead (Table 2.3.17). Additional means of transportation that were written in by survey respondents included biking and horseback. There were also a few answers submitted that were not actually methods of transportation such as: camping, friend, and "I live here" (Table 2.3.17).

Table 2.3.17. Qualitative Answers to Method of Transportation to the Trailhead

Other transport				
	Qualitative Responses	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	Camping	1		
	Hiked	16		
	I live here :)	1		
	Total	18	100.0	
Rainbow Falls Viewing Area	Bike	2		
	Camping	1		
	Friend	1		
	Hiked	10		
	Horse	1		
	Total	15	100.0	

NOTE: Detail may not sum to totals because of rounding.

Parking Availability at Trailheads

When asked about parking availability at trailheads, 79.9% of Postpile, and 77.3% of Rainbow Falls survey respondents reported that there was not a problem with available parking at the trailhead (Postpile means = 0.93, Rainbow Falls = 0.89); however, there were between 14.6% (Postpile) and 17.3% (Rainbow Falls) of visitors who didn't know or had no opinion, most likely due to riding the shuttle bus (Table 2.3.18). Fifteen respondents from each of the viewing areas did have problems with parking (5.4% at each location). Since personal vehicles were used by 14.3% of Postpile, and 24.9% of Rainbow Falls, respondents overall (Table 2.3.16), this means that 37.8% of the surveyed Postpile visitors that arrived by personal vehicles, and 21.6% of those at Rainbow Falls who arrived by personal vehicles, had a problem with parking availability.

Table 2.3.18. Parking Availabilty at Trailheads

Lack of available parking at the trailhead				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = .93; Std. Deviation = 0.50)	0 Don't Know/No Opinion	40	14.6	14.6
	1 Not a Problem	219	79.9	94.5
	2 Small Problem	10	3.6	98.2
	3 Big Problem	5	1.8	100.0
	Total	274	100.0	
Rainbow Falls Viewing Area (Mean = .89; Std. Deviation = 0.50)	0 Don't Know/No Opinion	48	17.3	17.3
	1 Not a Problem	215	77.3	94.6
	2 Small Problem	12	4.3	98.9
	3 Big Problem	3	1.1	100.0
	Total	278	100.0	

NOTE: Detail may not sum to totals because of rounding.

Amount of Information Provided at the Trailhead about how to Prepare for a Hike on the Trail

When questioned about the amount of information provided at the trailhead, on how to prepare for a hike on the trail, 89.8% of Postpile survey respondents, and 86.8% of those at Rainbow Falls, reported that there was not a problem Postpile means = 1.03, Rainbow Falls = 1.10); however, there were between 5.5% (Postpile) and 11% (Rainbow Falls) of visitors who felt it was a small problem, and three visitors, two Postpile (0.7%) and one of the Rainbow Falls survey participants (0.4%), who felt that it was a big problem (Table 2.3.21).

Table 2.3.19. Amount of Information Provided at the Trailhead on how to Prepare of a Hike

Not enough information provided at the trailhead about how to prepare for a hike on the trail				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.03; Std. Deviation = 0.35)	0 Don't Know/No Opinion	11	4.0	4.0
	1 Not a Problem	247	89.8	93.8
	2 Small Problem	15	5.5	99.3
	3 Big Problem	2	.7	100.0
	Total	275	100.0	
Rainbow Falls Viewing Area (Mean = 1.10; Std. Deviation = 0.37)	0 Don't Know/No Opinion	5	1.8	1.8
	1 Not a Problem	244	86.8	88.6
	2 Small Problem	31	11.0	99.6
	3 Big Problem	1	.4	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Information Signage on the Natural and Cultural History of the Area

In response to the question regarding the amount of informational signage on the natural and cultural history of the area, 81.2% of Postpile survey respondents, and 79.0% of those at Rainbow Falls, reported that there was not a problem with having enough informational signage (Postpile means = 1.16, Rainbow Falls = 1.22); however, there were between 14.1% (Postpile) and 18.9% (Rainbow Falls) of visitors who felt it was a small problem, and eleven visitors, six at the Postpile viewing area (2.2%) and five at the Rainbow Falls viewing area (1.8%), who felt that it was a big problem (Table 2.3.20).

Table 2.3.20. Information Signage on the Natural and Cultural History of the Area

Not enough signs with information about the natural and cultural history of the area				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.16; Std. Deviation = 0.48)	0 Don't Know/No Opinion	7	2.5	2.5
	1 Not a Problem	224	81.2	83.7
	2 Small Problem	39	14.1	97.8
	3 Big Problem	6	2.2	100.0
	Total	276	100.0	
Rainbow Falls Viewing Area (Mean = 1.22; Std. Deviation = 0.46)	0 Don't Know/No Opinion	1	.4	.4
	1 Not a Problem	222	79.0	79.4
	2 Small Problem	53	18.9	98.2
	3 Big Problem	5	1.8	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Directional Signs along the Trails

When asked about directional signs along the trail, 95.3% of Postpile survey respondents, and 91.5% of those at Rainbow Falls, reported that there was not a problem, that there were enough directional signs along the trails (Postpile means = 1.04, Rainbow Falls = 1.09); however, there were between 4.3% (Postpile) and 7.5% (Rainbow Falls) of visitors who felt it was a small problem, and three of the Rainbow Falls survey participants (0.7%) felt that it was a big problem (Table 2.3.21).

Table 2.3.21. Directional Signage on Trails

Not enough directional signs along the trail				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.04; Std. Deviation = 0.21)	0 Don't Know/No Opinion	1	.4	.4
	1 Not a Problem	266	95.3	95.7
	2 Small Problem	12	4.3	100.0
	Total	279	100.0	
Rainbow Falls Viewing Area (Mean = 1.09; Std. Deviation = 0.32)	0 Don't Know/No Opinion	1	.4	.4
	1 Not a Problem	257	91.5	91.8
	2 Small Problem	21	7.5	99.3
	3 Big Problem	2	.7	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Width of Trails

In response to the question about the width of trails, 97.1% of Postpile survey participants, and 90.9% of those at Rainbow Falls, reported that there was not a problem with the trails being too wide (Postpile means = 1.02, Rainbow Falls = 1.09); however, there were between 2.5% (Postpile)

and 7.2% (Rainbow Falls) of visitors who felt it was a small problem, and eleven visitors, six Postpile (2.2%) and three of the Rainbow Falls survey participants (1.1%), who felt that it was a big problem (Table 2.3.22).

Table 2.3.22. Width of Trails

Trails are too wide				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.02; Std. Deviation = 0.17)	0 Don't Know/No Opinion	1	.4	.4
	1 Not a Problem	270	97.1	97.5
	2 Small Problem	7	2.5	100.0
	Total	278	100.0	
Rainbow Falls Viewing Area (Mean = 1.09; Std. Deviation = 0.34)	0 Don't Know/No Opinion	2	.7	.7
	1 Not a Problem	251	90.9	91.7
	2 Small Problem	20	7.2	98.9
	3 Big Problem	3	1.1	100.0
	Total	276	100.0	

NOTE: Detail may not sum to totals because of rounding.

Issues Pertaining to Human Impacts

A series of six questions in the surveys had to do with issues pertaining to human impacts in the park. These questions utilized a 4 point scale: 0) Don't Know/No Opinion, 1) Not a Problem, 2) Small Problem, and 3) Big Problem.

Trail Erosion (e.g., exposed roots, rocks, channeling)

When asked if they believed trail erosion to be a problem, 93.5% of Postpile survey respondents, and 85.4% of those at Rainbow Falls, reported that there was not a problem with the trails being too eroded (Postpile means = 1.06, Rainbow Falls = 1.15); however, there were between 6.1% (Postpile) and 12.1% (Rainbow Falls) of the surveyed visitors who felt it was a small problem, and five of the Rainbow Falls survey participants (1.8%) felt that it was a big problem (Table 2.3.23).

Table 2.3.23. Trail Erosion

Trails are too eroded (e.g. exposed roots, rocks, channeling)				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.06; Std. Deviation = 0.25)	0 Don't Know/No Opinion	1	.4	.4
	1 Not a Problem	259	93.5	93.9
	2 Small Problem	17	6.1	100.0
	Total	277	100.0	
Rainbow Falls Viewing Area (Mean = 1.15; Std. Deviation = 0.42)	0 Don't Know/No Opinion	2	.7	.7
	1 Not a Problem	240	85.4	86.1
	2 Small Problem	34	12.1	98.2
	3 Big Problem	5	1.8	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Litter along the Trails

The question pertaining to litter along the trails resulted in 92.8% of Postpile survey respondents, and 84.3% of those at Rainbow Falls, reporting that there was not a problem with litter along the trails (Postpile means = 1.08, Rainbow Falls = 1.05); however, there were between 6.8% (Postpile)

and 14.6% (Rainbow Falls) of the respondents who felt it was a small problem, and two people, one from the Postpile viewing area (0.4%) and one from the Rainbow Falls viewing area (0.4%), who felt that it was a big problem (Table 2.3.24).

Table 2.3.24. Litter along Trails

Litter along the trail				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.08; Std. Deviation = 0.28)	1 Not a Problem	259	92.8	92.8
	2 Small Problem	19	6.8	99.6
	3 Big Problem	1	.4	100.0
	Total	279	100.0	
Rainbow Falls Viewing Area (Mean = 1.15; Std. Deviation = 0.38)	0 Don't Know/No Opinion	2	.7	.7
	1 Not a Problem	237	84.3	85.1
	2 Small Problem	41	14.6	99.6
	3 Big Problem	1	.4	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Human Waste on Trails

In answer to the question of human waste on the trails, 96.1% of Postpile survey respondents, and 92.5% of those at Rainbow Falls, reported that there was not a problem with improperly disposed human waste evident on or near the trails (Postpile means = 1.00, Rainbow Falls = 1.03); however, there were between 1.8% (Postpile) and 4.6% (Rainbow Falls) of the surveyed visitors who felt it was a small problem, and one Rainbow Falls respondent (0.4%), who felt it was a big problem (Table 2.3.25).

Table 2.3.25. Improperly Disposed of Human Waste

Improperly disposed human waste evident on or near the trail				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.00; Std. Deviation = 0.20)	0 Don't Know/No Opinion	6	2.2	2.2
	1 Not a Problem	268	96.1	98.2
	2 Small Problem	5	1.8	100.0
	Total	279	100.0	
Rainbow Falls Viewing Area (Mean = 1.03; Std. Deviation = 0.29)	0 Don't Know/No Opinion	7	2.5	2.5
	1 Not a Problem	259	92.5	95.0
	2 Small Problem	13	4.6	99.6
	3 Big Problem	1	.4	100.0
	Total	280	100.0	

NOTE: Detail may not sum to totals because of rounding.

People on Trails

The question pertaining to people on the trails resulted in 83.1% of Postpile survey respondents, and 77.9% of those at Rainbow Falls, reporting that there was not a problem with too many people on the trails (Postpile means = 1.06, Rainbow Falls = 1.15); however, there were between 16.9% (Postpile) and 20.6% (Rainbow Falls) of visitors who felt it was a small problem, and two of the Rainbow Falls survey participants (0.7%) felt that too many people on the trail was a big problem (Table 2.3.26).

Table 2.3.26. People on Trails

Too many people on the trail				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.17; Std. Deviation = 0.38)	1 Not a Problem	231	83.1	83.1
	2 Small Problem	47	16.9	100.0
	Total	278	100.0	
Rainbow Falls Viewing Area (Mean = 1.21; Std. Deviation = 0.44)	0 Don't Know/No Opinion	2	.7	.7
	1 Not a Problem	219	77.9	78.6
	2 Small Problem	58	20.6	99.3
	3 Big Problem	2	.7	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Off-Trail Trampling

Off-trail trampling: 82.7% of Postpile survey respondents, and 82.9% of those at Rainbow Falls, reported that there was not a problem with off-trail trampling around the viewing area (Postpile means = 1.06, Rainbow Falls = 1.15); however, there were between 13.7% (Postpile) and 11.4% (Rainbow Falls) of the surveyed visitors who felt it was a small problem, and one of the Rainbow Falls survey participants (0.7%) felt that off-trail trampling around the viewing area was a big problem (Table 2.3.27).

Table 2.3.27. Off-Trail Trampling around the Viewing Area

Off-trail trampling around the viewing area				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.10; Std. Deviation = 0.40)	0 Don't Know/No Opinion	10	3.6	3.6
	1 Not a Problem	230	82.7	86.3
	2 Small Problem	38	13.7	100.0
	Total	278	100.0	
Rainbow Falls Viewing Area (Mean = 1.07; Std. Deviation = 0.42)	0 Don't Know/No Opinion	15	5.4	5.4
	1 Not a Problem	232	82.9	88.2
	2 Small Problem	32	11.4	99.6
	3 Big Problem	1	.4	100.0
	Total	280	100.0	

NOTE: Detail may not sum to totals because of rounding.

Sound from Aircraft

When asked about sound from aircraft, 94.2% of Postpile survey respondents, and 91.1% of those at Rainbow Falls, reported that this had not been a problem (Postpile means = 1.04, Rainbow Falls = 1.05); however, there were between 4% (Postpile) and 6% (Rainbow Falls) of the respondents who felt it was a small problem, and four of the surveyed visitors, two Postpile (0.7%) and two from Rainbow Falls (0.7%), who felt that sound from aircraft was a big problem (Table 2.3.28).

Table 2.3.28. Sound from Aircraft

Sound from aircraft				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 1.04; Std. Deviation = 0.28)	0 Don't Know/No Opinion	3	1.1	1.1
	1 Not a Problem	262	94.2	95.3
	2 Small Problem	11	4.0	99.3
	3 Big Problem	2	.7	100.0
	Total	278	100.0	
Rainbow Falls Viewing Area (Mean = 1.05; Std. Deviation = 0.33)	0 Don't Know/No Opinion	6	2.1	2.1
	1 Not a Problem	256	91.1	93.2
	2 Small Problem	17	6.0	99.3
	3 Big Problem	2	.7	100.0
	Total	281	100.0	

NOTE: Detail may not sum to totals because of rounding.

Demographics

Several questions pertaining to demographics were asked in the survey, including items on: gender, age, residency, education, ethnicity and race.

Gender & Age

Results showed that gender was fairly evenly split between Postpile respondents (50.4% male and 49.6% female), yet more men than women completed surveys at the Rainbow Falls viewing area (56.5% male and 43.5% female). To determine age, survey participants were asked to provide the year they were born and data were grouped into decades for analysis (e.g., people born between 1940 and 1949 were listed as being in their 60's). The mean age for all respondents was 47, with 30.7% of Postpile, and 25% of Rainbow Falls visitors, reporting being in their 40's (Table 2.3.29). The oldest respondent, surveyed at the Postpile viewing area, was 82; no one under the age of 18 was allowed to complete a survey.

Table 2.3.29. Respondent's Age

Respondent's Age				
Age (in decades)		Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area (Mean = 40.82; Std. Deviation = 13.12)	18-19	7	2.6	2.6
	20's	29	10.6	13.1
	30's	54	19.7	32.8
	40's	84	30.7	63.5
	50's	57	20.8	84.3
	60's	38	13.9	98.2
	70's	3	1.1	99.3
	80's	2	.7	100.0
	Total	274	100.0	
Rainbow Falls Viewing Area (Mean = 40.88; Std. Deviation = 13.35)	18-19	2	.7	.7
	20's	33	12.3	13.1
	30's	62	23.1	36.2
	40's	67	25.0	61.2
	50's	59	22.0	83.2
	60's	38	14.2	97.4
	70's	7	2.6	100.0
	Total	268	100.0	

NOTE: Detail may not sum to totals because of rounding.

Residency

Visitors were asked if they resided in the United States; if their answer was "Yes," they were asked to provide their zip code. If their answer was "No," respondents were asked to provide their country of residence. Residents of the United States comprised 93.1% of Postpile survey respondents, and 94.4% of those at Rainbow Falls (Table 2.3.30). A zip code analysis shows U.S. survey respondents' locations of residence (Figure 2.3.14).

Table 2.3.30. United States Residency

Do you live in the United States?				
Survey Response Options		Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	No	19	6.9	6.9
	Yes	257	93.1	100.0
	Total	276	100.0	
Rainbow Falls Viewing Area	No	15	5.6	5.6
	Yes	254	94.4	100.0
	Total	269	100.0	

NOTE: Detail may not sum to totals because of rounding.

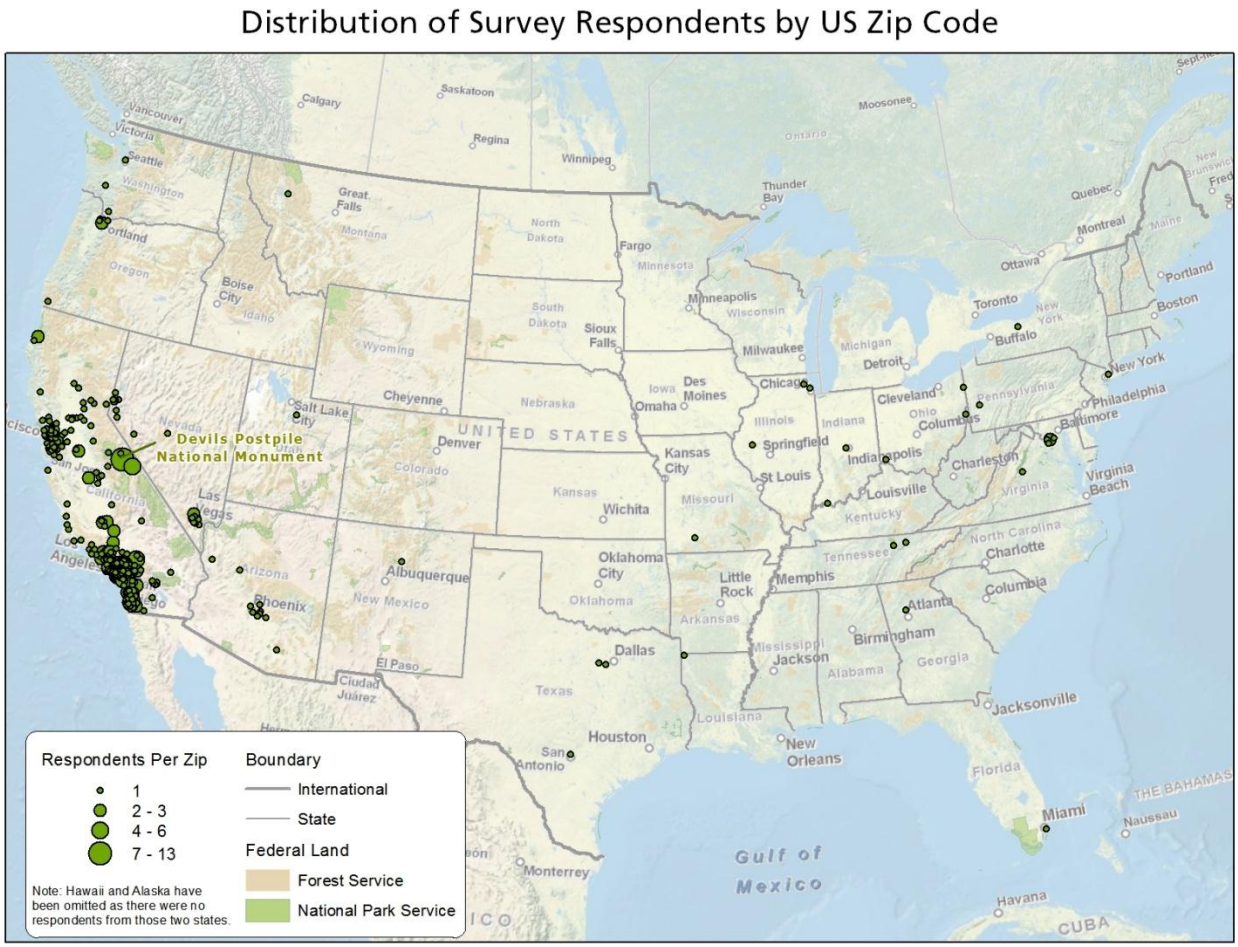


Figure 2.3.14. Zip Code Distribution of Devils Postpile National Monument Visitor Use Survey Respondents Who Reside in the U.S.A.

Of the thirty-four respondents that listed countries of residence other than the United States (19 Postpile respondents and 15 from Rainbow Falls), seven were from the Netherlands, five from Germany and five from France, with others listed with less frequency (Table 2.3.31; Figure 2.3.15).

Table 2.3.31. Other Countries of Residence

In what country do you live?				
	Qualitative Response	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	Austria	1	5.3	5.3
	Canada	1	5.3	10.6
	Canada (US Citizen)	1	5.3	15.9
	Denmark	2	10.5	26.4
	England	1	5.3	31.7
	France	3	15.7	47.4
	Germany	2	10.5	57.9
	Ireland	1	5.3	63.2
	Netherlands	5	26.3	89.5
	Switzerland	2	10.5	100.0
	Total	19	100.0	
Rainbow Falls Viewing Area	Austria	1	7.1	7.1
	Canada	1	7.1	14.3
	England	1	7.1	21.5
	France	2	14.3	35.8
	Germany	5	35.7	71.5
	Holland	1	7.1	78.6
	New Zealand	1	7.1	85.7
	United Kingdom	2	14.3	100.0
	Total	14	100.0	

NOTE: Detail may not sum to totals because of rounding.

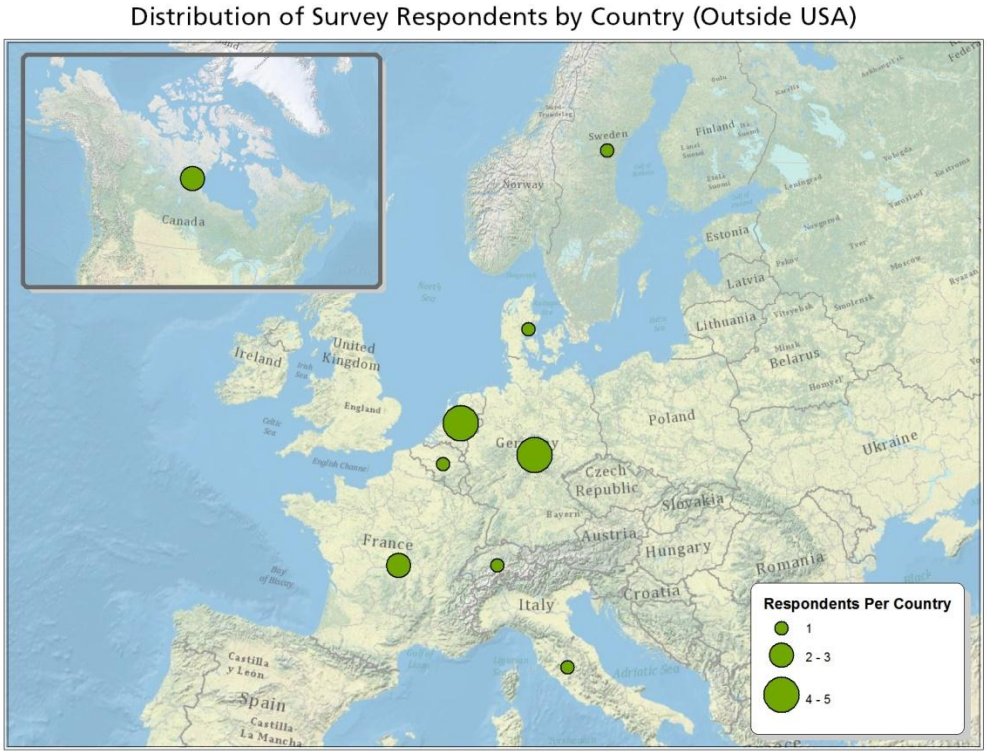


Figure 2.3.15. Distribution by Country of Survey Respondents Who Reside Outside the U.S.A.

Education

Over 90% of the surveyed visitors at both the Postpile and Rainbow Falls viewing areas were college educated. Of the Postpile respondents, 54.6% had either a college degree or some college experience, and 40% had attended graduate school or had an advanced degree; 51.6% of Rainbow Falls respondents had either a college degree or some college experience, and 42.9% had attended graduate school or had an advanced degree (Table 2.3.32).

Table 2.3.32. Level of Education

What is the highest level of education you have completed?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	Some high school	2	.7	.7
	High school grad or GED	13	4.7	5.5
	Some college, business or trade	61	22.2	27.6
	College, business or trade school	89	32.4	60.0
	Some graduate school	25	9.1	69.1
	Master's, doctoral or professional	85	30.9	100.0
	Total	275	100.0	
Rainbow Falls Viewing Area	High school grad or GED	15	5.5	5.5
	Some college, business or trade	44	16.1	21.6
	College, business or trade school	97	35.5	57.1
	Some graduate school	24	8.8	65.9
	Master's, doctoral or professional	93	34.1	100.0
	Total	273	100.0	

NOTE: Detail may not sum to totals because of rounding.

Race & Hispanic or Latino Ethnicity

Results from the question on race included 94.6% of Postpile survey respondents, and 88% of those at Rainbow Falls, reporting their race as "White;" 8.9% of Rainbow Falls respondents reported being Asian compared to 3.5% of those from the Postpile viewing area (Table 2.3.33). When asked if they were of Hispanic or Latino ethnicity, 8.7% of the Postpile survey respondents, and 11.1% of Rainbow Falls respondents, said "Yes."

Table 2.3.33. Racial Demographics

What is your race?				
	Survey Response Options	Frequency	Valid Percent	Cumulative Percent
Devils Postpile Viewing Area	American Indian or Alaska	3	1.2	1.2
	Asian	9	3.5	4.6
	Black or African American	1	.4	5.0
	Native Hawaiian or other Pacific	1	.4	5.4
	White	245	94.6	100.0
	Total	259	100.0	
Rainbow Falls Viewing Area	American Indian or Alaska	3	1.2	1.2
	Asian	23	8.9	10.1
	Black or African American	2	.8	10.9
	Native Hawaiian or other Pacific	3	1.2	12.0
	White	227	88.0	100.0
	Total	258	100.0	

NOTE: Detail may not sum to totals because of rounding.

Visitor Opinions

A list of the complete answers to the open-ended questions: "What did you like best…" and "What did you like least about your visit to the viewing area today?," are reported in Appendix A. Out of a total of 584 surveys, there were 536 responses pertaining to what people liked best. Analyses revealed that some of the most frequently mentioned answers to what people liked best were the falls, the views, and the Postpile itself (Table 2.3.34).

Table 2.3.34. Top 10 Things that People Liked Best

Top 10 Things that People Liked Best				
Ranking	Liked Best	Frequency	% out of 536 Comments	% out of 584 Total Surveys
1	falls	108	20	18
2	view	70	13	12
3	Postpile	50	9	9
4	scenery	42	8	7
5	hike/walk	41	8	7
6	beauty	41	8	7
7	weather	40	7	7
8	trails	37	7	6
9	river	26	5	4
10	rainbow	24	5	4

There were 282 substantive visitor responses to the question "What did you like least…"; some of the most frequently mention responses included: too many people, too hot, mandatory shuttle buses, and issues with signage (i.e., there were not enough signs, the signs were difficult to read, etc.) (Table 2.3.35).

Table 2.3.35. Top 10 Things People Liked Least

Top 10 Things People Liked Least				
Ranking	Liked Least	Frequency	% out of 282 Comments	% out of 584 Total Surveys
1	too many people /crowded	50	18	9
2	too hot	21	7	4
3	mandatory shuttle bus	17	6	3
4	signage/information	17	6	3
5	horse manure	16	6	3
6	shuttle bus conditions	15	5	3
7	dust	9	3	2
8	mosquitos/bugs	9	3	2
9	loud sounds	8	3	1
10	trail conditions	8	3	1

People at One Time (PAOT)

This section reports PAOT results for both the Postpile and the Rainbow Falls viewing areas in 2010, and includes PAOT for all days, weekend and weekdays. The section also includes a summary of results from the 2009 PAOT counts and compares them to those collected in 2010 for the purpose of understanding longer term relationships. In 2009, PAOT counts were taken every 15 minutes and mean hourly PAOT counts were reported. In 2010, PAOT counts were taken every 20 minutes and once again, mean hourly counts are reported so that comparisons could be made to the 2009 data where possible. Comparisons are not always possible, as locations for PAOT counts between the two years differed to a large degree. At the Postpile for example, the viewing area for the 2010 PAOT counts was smaller than that used in 2009 and did not include the picnic area; however, at Rainbow Falls, the 2010 viewing area is the same as one of the areas where PAOT counts were taken in 2009 (at the first overlook), allowing a direct comparison of data.

Results from 2010 show that the Postpile viewing area had a weekday mean of 10.85, a weekend mean of 10.23, and an overall mean of 10.53; while the Rainbow Falls viewing area had a weekday mean of 9.69, a weekend mean of 9.56, and an overall mean of 9.62 (Table 2.3.36). Mean hourly PAOT counts ranged from a minimum of no people at either viewing area, to a maximum mean hourly PAOT of 44 at the Postpile, and 33 at Rainbow Falls. At each location, the maximum mean hourly PAOT counts taken in 2010 were recorded on a weekday, rather than a weekend day. In comparison, the Rainbow Falls first overlook had a mean hourly PAOT of 11.42 in 2009 with a minimum of zero and a maximum mean hourly PAOT of 55; while the (much larger) Postpile viewing area had a mean hourly PAOT of 18.1 with a minimum of zero and a maximum of 72.

Table 2.3.36. PAOT for the Postpile & Rainbow Falls Viewing Areas in 2009 & 2010

PAOT for the Postpile & Rainbow Falls Viewing Areas in 2009 & 2010

Location		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
2009 Devils Postpile Viewing Area	Total		18.1					0	72
2010 Devils Postpile Viewing Area	Weekday	113	10.85	8.129	.765	9.33	12.36	0	44
	Weekend	125	10.23	6.494	.581	9.08	11.38	0	29
	Total	238	10.53	7.307	.474	9.59	11.46	0	44
2009 Rainbow Falls Viewing Area	Total		11.42					0	55
2010 Rainbow Falls Viewing Area	Weekday	131	9.69	7.756	.678	8.35	11.03	0	33
	Weekend	138	9.56	7.574	.645	8.28	10.83	0	30
	Total	269	9.62	7.649	.466	8.71	10.54	0	33

There was no significant difference found in 2010 between the mean hourly PAOT at the Postpile viewing area and that of the Rainbow Falls viewing area (Table 2.3.37), this test was completed using the independent samples t-test which utilizes Levene's test for equality of variances (1960). An analysis of variance (using One-Way ANOVA) shows that there were also no significant differences ($p > .05$) between weekday and weekend PAOT counts at either location (Table 2.3.38). T-tests and analysis of variance (ANOVA) are statistical tools used for comparing sample means to

determine if the evidence is strong enough to infer that the distribution of the corresponding population also differs (George & Mallory, 2011).

Table 2.3.37. Independent Sample T-Test of the Mean Hourly PAOT Counts taken at the Postpile & Rainbow Falls Viewing Areas for 2010

Independent Samples Test of total PAOT Counts between the Postpile & Rainbow Falls Viewing Areas for 2010

PAOT	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig. (p-value)	t-value	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.976	.324	1.352	505	.177	.901	.667	-.409	2.211
Equal variances not assumed			1.355	502.027	.176	.901	.665	-.405	2.207

Table 2.3.38. ANOVA between Mean Hourly PAOT on 2010 Weekends versus Weekdays at Postpile & Rainbow Falls Viewing Areas

ANOVA between Mean Hourly PAOT on 2010 Weekends versus Weekdays at Postpile & Rainbow Falls Viewing Areas

Location		Sum of Squares	df	Mean Square	F	Sig. (p-value)
Devils Postpile Viewing Area	Between Groups	22.560	1	22.560	.422	.517
	Within Groups	12631.343	236	53.523		
	Total	12653.903	237			
Rainbow Falls Viewing Area	Between Groups	1.246	1	1.246	.021	.884
	Within Groups	15680.148	267	58.727		
	Total	15681.394	268			

Hourly Mean Total PAOT Counts

Hourly mean total PAOT counts at the Postpile viewing area ranged from a minimum of 3.57 people-per-hour, taken between 9:00 and 9:59 AM, to a maximum of 17.65 which were taken between 12:00-12:59 PM (**Error! Reference source not found.**; Table 2.3.39). The hourly mean total PAOT counts at the Rainbow Falls viewing area ranged from a minimum of 1.67 people-per-hour, taken between 9:00 and 9:59 AM, to a maximum of 19.61, taken between 1:00 and1:59 PM.

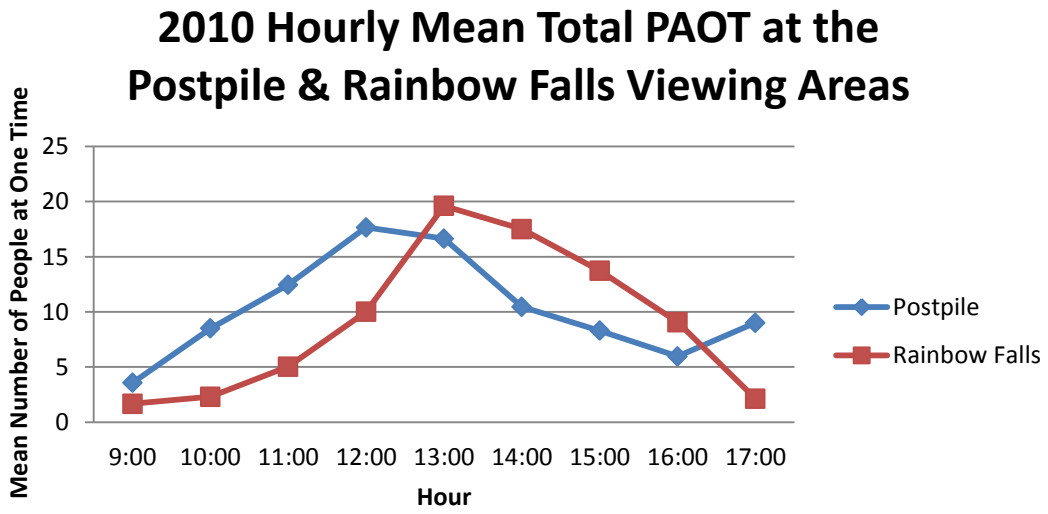


Figure 2.3.16. 2010 Hourly Mean Total PAOT at the Postpile & Rainbow Falls Viewing Areas

Table 2.3.39.2010 Hourly Statistics for Total PAOT at both the Postpile & Rainbow Falls Viewing Area

2010 Hourly Statistics for Total PAOT for the Postpile & Rainbow Falls Viewing Areas

Location		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
Devils Postpile Viewing Area	09:00-09:59	30	3.57	2.437	.445	2.66	4.48	0	8
	10:00-10:59	30	8.50	5.032	.919	6.62	10.38	2	18
	11:00-11:59	33	12.45	5.614	.977	10.46	14.44	5	21
	12:00-12:59	30	17.65	5.551	1.014	15.58	19.72	10	29
	13:00-13:59	30	16.63	10.677	1.949	12.65	20.62	5	44
	14:00-14:59	27	10.46	5.148	.991	8.43	12.50	4	18
	15:00-15:59	27	8.30	3.754	.723	6.81	9.78	3	16
	16:00-16:59	27	5.96	3.654	.703	4.52	7.41	1	13
	17:00	4	9.00	5.477	2.739	.28	17.72	3	16
	Total	238	10.53	7.307	.474	9.59	11.46	0	44
Rainbow Falls Viewing Area	09:00-09:59	33	1.67	1.854	.323	1.01	2.32	0	5
	10:00-10:59	33	2.30	1.159	.202	1.89	2.71	0	5
	11:00-11:59	33	5.03	3.294	.573	3.86	6.20	0	10
	12:00-12:59	36	10.00	3.780	.630	8.72	11.28	2	17
	13:00-13:59	36	19.61	7.171	1.195	17.18	22.04	9	33
	14:00-14:59	30	17.50	4.534	.828	15.81	19.19	9	26
	15:00-15:59	30	13.73	4.988	.911	11.87	15.60	9	24
	16:00-16:59	30	9.07	4.025	.735	7.56	10.57	2	17
	17:00	8	2.13	4.086	1.445	-1.29	5.54	0	12
	Total	269	9.62	7.649	.466	8.71	10.54	0	33

There were statistically significant differences ($p < 0.001$), between hourly mean PAOT at each location, based on the hour of the day in which the observations were made (Table 2.3.40); for example there was a significant difference between PAOT at 10:00 AM as compared to PAOT at 1:00 PM at the Postpile viewing area.

Table 2.3.40. ANOVA of 2010 Hourly Mean Total PAOT at the Postpile & Rainbow Falls Viewing Areas

ANOVA of 2010 Hourly Mean Total PAOT at the Postpile & Rainbow Falls Viewing Areas

Location		Sum of Squares	df	Mean Square	F	Sig.
Devils Postpile Viewing Area	Between Groups	5046.250	8	630.781	18.987	.000
	Within Groups	7607.653	229	33.221		
	Total	12653.903	237			
Rainbow Falls Viewing Area	Between Groups	10976.933	8	1372.117	75.832	.000
	Within Groups	4704.461	260	18.094		
	Total	15681.394	268			

When compared by hour, there were also significant statistical differences ($p < 0.05$), between the mean hourly PAOT counts taken at the Postpile viewing area as compared to those taken at the Rainbow Falls viewing area, with the exceptions of 1:00 PM hour, where the difference was non-significant (Table 2.3.41).

Table 2.3.41. ANOVA of Postpile and Rainbow Falls Viewing Areas' Hourly Mean Total PAOT

ANOVA of Postpile and Rainbow Falls Viewing Areas' Hourly Mean Total PAOT

Hour		Sum of Squares	df	Mean Square	F	Sig. (p-value)
09:00-09:59	Between Groups	56.767	1	56.767	12.270	.001
	Within Groups	282.209	61	4.626		
	Total	338.976	62			
10:00-10:59	Between Groups	603.349	1	603.349	47.351	.000
	Within Groups	777.271	61	12.742		
	Total	1380.620	62			
11:00-11:59	Between Groups	909.544	1	909.544	42.935	.000
	Within Groups	1355.775	64	21.184		
	Total	2265.319	65			
12:00-12:59	Between Groups	958.100	1	958.100	43.992	.000
	Within Groups	1393.850	64	21.779		
	Total	2351.950	65			
13:00-13:59	Between Groups	145.023	1	145.023	1.818	.182
	Within Groups	5105.904	64	79.780		
	Total	5250.927	65			
14:00-14:59	Between Groups	703.830	1	703.830	30.123	.000
	Within Groups	1285.077	55	23.365		
	Total	1988.907	56			
15:00-15:59	Between Groups	420.146	1	420.146	21.237	.000
	Within Groups	1088.083	55	19.783		
	Total	1508.229	56			
16:00-16:59	Between Groups	136.886	1	136.886	9.214	.004
	Within Groups	817.069	55	14.856		
	Total	953.956	56			
17:00	Between Groups	126.042	1	126.042	6.093	.033
	Within Groups	206.875	10	20.688		
	Total	332.917	11			

In both 2009 and 2010, visitor use was found to be quite variable with times of very high, and very low, use. The pattern of mean hourly PAOT in 2010 was similar to that found in 2009; average visitor use at the Devils Postpile viewing area in both 2009 and 2010 peaked between 12:00 and 1:00 PM, while visitor use at the Rainbow Falls viewing area (the first overlook), peaked between 1:00 and 2:00 PM.

When comparing mean total PAOT counts, it is important to note that 61% of the 2010 survey respondents at the Rainbow Falls viewing area reported having started their hike at the Devils Postpile trailhead, while only 3.9% of the survey respondents at the Postpile viewing area had started their hike at the Rainbow Falls trailhead (Table 2.3.6). It is therefore highly likely that many of the Rainbow Falls visitors were also included in PAOT counts at the Postpile viewing area at some point prior to their arrival at Rainbow Falls. Travel time between the two sites provides an explanation for some of the variance in the hour of peak usage between the two locations.

Assigned Survey PAOT Results

PAOT count values were assigned to each respondent's survey based on the mean hourly PAOT counts observed at their attraction site during the time in which the survey was completed (e. g., the observed mean hourly PAOT at Rainbow Falls between 1:00 and 1:59 PM was 13, all visitor surveys completed between 1:00 and 1:59 PM at the Rainbow Falls viewing area were assigned a survey PAOT of 13). Due to the fact that more surveys are completed when there are more visitors at an attraction site, assigned survey PAOT counts differed slightly from the observed PAOT counts

(i.e., no surveys were completed when observed PAOT counts were equal to zero, therefore assigned survey PAOT counts differ from observed PAOT counts). The resulting assigned survey mean hourly PAOT from the Postpile viewing area was 14.10, compared to an observed mean hourly PAOT of 10.53; Rainbow Falls assigned survey PAOT counts resulted in a mean hourly PAOT of 10.89, while the observed hourly mean was 9.62 PAOT (Table 2.3.42). Assigned survey PAOT results will be used in additional analyses to determine the effect of PAOT counts on other variables, such as perceptions of crowding.

Table 2.3.42. A Comparison of Observed PAOT & Survey PAOT Counts

A Comparison of Observed and Survey PAOT Counts

Location		N	Mean	Std. Deviation	Min	Max
Devils Postpile Viewing Area	Survey PAOT per Hr	250	14.10	8.316	0	44
	Observed PAOT per Hr	238	10.53	7.307	0	44
Rainbow Falls Viewing Area	Survey PAOT per Hr	293	10.89	6.850	0	33
	Observed PAOT per Hr	269	9.62	7.649	0	33

Dogs at One Time (DAOT) & Horses at One Time (HAOT)

In 2009, the numbers of dogs-at-one-time (DAOT) were documented at all of the Postpile and Rainbow Falls locations in which PAOT counts were observed. The mean number of horses-at-one-time (HAOT), was also documented, although only at the hitching rack located at Rainbow Falls, where it was found to be 1.45 horses per hour (Table 2.3.43).

Table 2.3.43. 2009 Horses at One Time (HAOT) at the Rainbow Falls Hitching Rack

2009 Horses at One Time (HAOT) at the Rainbow Falls Hitching Rack

Hour	Mean	Error (95%)	Min	Max
9 am	1.50	0.66	0	9
10 am	0.57	0.47	0	11
11 am	1.01	0.72	0	7
12 pm	3.44	1.09	0	9
1 pm	0.74	0.68	0	15
2 pm	0.29	0.17	0	14
3 pm	2.73	1.14	0	7
4 pm	1.28	0.60	0	9
Mean Total	1.45		0	15

DAOT ranged from zero to 8 within any one hour period of time; the mean hourly DAOT equaled 0.55 at the Postpile viewing area and 0.73 at Rainbow Falls (Table 2.3.44). No DAOT or HAOT data were collected during 2010.

Table 2.3.44. 2009 Mean Hourly Dogs at One Time (DAOT) Counts

2009 Mean Hourly Dogs at One Time (DAOT) Counts					
	Hour	Mean	Error (95%)	Min	Max
Postpile Viewing Area	9:00 AM	0.11	0.08	0	2
	10:00 AM	0.08	0.06	0	2
	11:00 AM	0.76	0.25	0	3
	12:00 PM	0.95	0.29	0	5
	1:00 PM	0.67	0.2	0	4
	2:00 PM	1.17	0.35	0	7
	3:00 PM	0.29	0.18	0	3
	4:00 PM	0.35	0.2	0	3
	Mean Total	0.55		0	7
Postpile Picnic Area	9:00 AM	0	0	0	0
	10:00 AM	0	0	0	0
	11:00 AM	0.03	0.05	0	1
	12:00 PM	0.06	0.06	0	1
	1:00 PM	0.09	0.08	0	1
	2:00 PM	0.2	0.19	0	3
	3:00 PM	0.05	0.03	0	1
	4:00 PM	0.06	0.06	0	1
	Mean Total	0.06		0	3
Rainbow Falls First Overlook	9:00 AM	0.06	0.09	0	2
	10:00 AM	0.13	0.11	0	2
	11:00 AM	0.23	0.16	0	3
	12:00 PM	0.25	0.17	0	3
	1:00 PM	0.42	0.15	0	4
	2:00 PM	0.59	0.2	0	6
	3:00 PM	0.27	0.11	0	2
	4:00 PM	0.32	0.13	0	3
	Mean Total	0.28		0	6
Rainbow Falls Second Overlook	9:00 AM	0.08	0.09	0	0
	10:00 AM	0.36	0.37	0	1
	11:00 AM	0.8	0.5	0	2
	12:00 PM	1.25	1.04	0	2
	1:00 PM	0.78	0.42	0	1
	2:00 PM	1.3	0.48	0	2
	3:00 PM	0.6	0.34	0	1
	4:00 PM	0.68	0.28	0	0
	Mean Total	0.73		0	2
Rainbow Falls Main Area	9:00 AM	0.16	0.12	0	2
	10:00 AM	0.1	0.1	0	2
	11:00 AM	0.23	0.11	0	1
	12:00 PM	0.48	0.25	0	4
	1:00 PM	0.27	0.17	0	3
	2:00 PM	0.7	0.38	0	8
	3:00 PM	0.33	0.19	0	3
	4:00 PM	0.37	0.17	0	3
	Mean Total	0.33		0	8
Rainbow Falls Lower Falls	9:00 AM	0.08	0.09	0	2
	10:00 AM	0.12	0.09	0	1
	11:00 AM	0.45	0.22	0	4
	12:00 PM	0.3	0.11	0	3
	1:00 PM	0.65	0.17	0	2
	2:00 PM	0.89	0.19	0	7
	3:00 PM	0.48	0.14	0	2
	4:00 PM	0.68	0.28	0	5
	Mean Total	0.46		0	7

On-Trail Visitor Use

In addition to visitor surveys and PAOT counts, visitor trail use data was collected via TRAFx automated visitor counters at nine locations in 2009, and 3 locations in 2010: the Devils Postpile Trailhead, Reds Meadow, and at the entrance to Rainbow Falls (Figure 2.2.4). Trail data was collected with the use of automated visitor counters from June 30th through September 8th in 2010, and from mid-July through September (with some exceptions) in 2009.

Monitor Calibrations

The automatic TRAFx monitors used to collect trail use data in DEPO were each calibrated via direct observation so that unique correction factors could be calculated (Yosemite, 2009). Calibration through direct observation is required to estimate automated counter data error (Pettebone, 2009). Observations for each counter were obtained using a convenience based sampling design and were conducted throughout the course of a day to ensure that the variability of daily visitor use was accurately captured. All reported data have been revised based on the specific correction factor calculated for their respective monitor.

Direction of Travel

Depending on the equipment, trail use data collected from automated counters can include full counts (i.e., total numbers of visitors), or directional counts (i.e., numbers of inbound visitors, and numbers of outbound visitors). In 2009, all automatic counters used in DEPO data collection provided full counts; in 2010, the automatic counter employed at the Postpile trailhead was a directional counter, while the ones at the Rainbow Falls and Reds Meadow trailheads provided full counts only. Of primary interest for this research is inbound visitor trail use, and as such, direction of travel had to be accounted for in order to provide the percentage of inbound traffic. Direction of travel was calculated for all automatic counters by direct observation, and raw counts were adjusted accordingly, allowing for the accurate estimation of inbound visitor arrivals (Table 2.3.45). In 2009 and 2010 the Postpile trailhead revealed that, on average, 66.5% of all visitor use on that trail was inbound while only 33.5% was outbound, meaning that 33.5% of visitors entering the Postpile trail continued on to exit the trail system elsewhere. The 33.5% of Postpile trail hikers are not exiting via the Postpile trailhead may be exiting via the Rainbow Falls trail, the Reds Meadow trail, or some may be through-hiking to other locations. The 2010 data collected at the Reds Meadow trailhead verifies that while 19% of the Reds Meadow trail use is inbound, headed toward Rainbow Falls, 81% is outbound, and headed away from Rainbow Falls toward the Reds Meadow area which includes a shuttle stop for the bus. The entrance to Rainbow Falls, however, is not a through trail and so calibration results for 2009 and 2010 naturally showed it to have equal inbound and outbound visitor use.

Table 2.3.45. Percentage of Inbound Trail Use from Automatic Trail Counters

Percentage of Inbound Visitor Trail Use from Automatic Trail Counters		
Trail Counter Location	Inbound 2009	Inbound 2010
Postpile Trailhead	0.68	0.65
Entrance to Postpile	0.76	
Lower Overlook, Postpile	0.59	
Upper Overlook, Postpile	0.72	
Bridge, Postpile	0.50	
South Monitor, Postpile	0.81	
Rainbow Falls Entrance	0.50	0.50
Rainbow Falls Trailhead	0.50	
John Muir Trail	0.50	
Reds Meadow		0.19

Inbound Visitor Trail Use Results

Automatic trail counter data was used to determine average inbound visitor use at all locations. Estimates were further analyzed to examine average use by month, day of the week, and hour. Results from both 2009 and 2010 showed that the Devils Postpile trail, including the entrance to the viewing area, received a greater amount of daily inbound visitor use (with higher daily mean totals), than any other trail under examination (Table 2.3.46).

Table 2.3.46. Mean Daily Inbound Visitor Use Estimated from Automatic Trail Counters in 2009 & 2010

Mean Daily Inbound Visitor Use Estimated from Automatic Trail Counters in 2009 & 2010		
Trail Counter Location	Inbound 2009	Inbound 2010
Postpile Trailhead	819	863
Entrance to Postpile Viewing Area	895	
Lower Overlook, Postpile	221	
Upper Overlook, Postpile	129	
Bridge, Postpile	62	
South Monitor, Postpile	395	
Rainbow Falls Entrance	471	566
Rainbow Falls Trail	498	
John Muir Trail	18	
Reds Meadow Trail		87

The total number of inbound trail users in 2010, from all three trail counters, was 106,673 people; these results were taken from data collected between June 30th and Sept 8th (Table 2.3.47). Results from the automatic trail counter at the Postpile trail included a mean daily inbound count of 863 people (with a minimum daily count of 294, and a maximum daily count of 1,883 people), the mean inbound daily trail use count at the entrance to Rainbow Falls was 566 people (with a minimum of 12 and a maximum of 1,593), and for Reds Meadow, mean inbound daily trail use was 87 people (the minimum was 14 and the maximum was 200) (Table 2.3.47).

Table 2.3.47. 2010 Inbound Visitor Use from Automatic Trail Counters.

2010 Inbound Visitor Use from Automatic Trail Counters						
Location	N	Min	Max	Sum	Mean	Std. Deviation
Postpile Trailhead	70	294	1883	60375	863	311.058
Rainbow Falls Entrance	71	12	1593	40185	566	266.680
Reds Meadow Trail	68	14	200	6113	90	36.981
Total	209	12	1883	106673	510	396.323

Monthly Inbound Visitor Trail Use

Total monthly inbound trail use in 2009 was reported for August and September for most sites with only July being recorded at the Rainbow Falls trailhead (Table 2.3.48). In 2010, monthly inbound trail use totals, and means, are reported for the months of June, July, August and September for the Postpile trailhead, the entrance to Rainbow Falls, and Reds Meadow trail. June statistics in 2010, however, are the result of data collected on June 30th only and should not be viewed as representative of the month, while September data was only collected from the 1st through the 8th, and should be interpreted as such. Since data was not consistently collected between 2009 and 2010, a direct comparison is only possible for the month of August at two locations, the Postpile trailhead and the entrance to Rainbow Falls.

Table 2.3.48. 2009 Total Inbound Trail Use by Month

2009 Total Inbound Trail Use by Month

Location	July Total	July Error (95%)	Aug Total	Aug Error (95%)	Sept Total	Sept Error (95%)	Season Total	Season Error (95%)
Postpile Trailhead			28355	1537	19800	1113	63853	3589
Entrance to Postpile			30278	1753	21070	1220	69789	4042
Lower Overlook, Postpile			8381	799	4633	442	15449	1473
Upper Overlook, Postpile			4843	112	2928	68	9038	210
South Monitor, Postpile			15745	1406	7629	681	27249	2434
Bridge, Postpile			2364	625	1174	310	4358	1153
Rainbow Falls Trailhead	14761	853						
Rainbow Falls Entrance			19676	858	7252	316	32982	1439
John Muir Trail			565	177	341	107	906	281
Equestrians on John Muir			130	N/A	88	N/A	218	

The month of July, 2010 registered the maximum number of inbound trail users recorded at all three locations where data was collected (Table 2.3.49). The 2010 total of inbound trail use for the Devils Postpile trail was 60,375 people, with July totaling 29,705 people, 49.2% inbound on the trail (mean daily use = 958) and August totaling 24,888 (mean daily trail use = 803) people, 41.2%. In August of 2009, a total of 28,355 people were recorded as inbound at the Postpile trailhead, a difference of 3467 visitors, 12.2% from those accessing the trail in 2010. The counter at the entrance to Rainbow Falls recorded a total of 40,185 inbound visitors in 2010; 18,583 (46.2%) in July with a daily mean of 599 and 17,473 (43.5%) in August with a daily mean of 564. The 2009 total of inbound visitors at the entrance to Rainbow Falls was 19,676, a difference of 2,203 or 11.2% from those accessing the trail in 2010. Reds Meadow received the least amount of trail use in 2010, with a total of 6,113 inbound visitors for the season, 2,854 (46.7%) in July with a daily mean of 92, and 2,625 (42.9%) in August with a daily mean of 94. An examination of monthly mean inbound trail use in 2010 (using One-way ANOVA), showed that while usage varied by month at all locations, the amount of variance was non-significant ($p > 0.05$) (Table 2.3.50).

Table 2.3.49. 2010 Monthly Inbound Trail Use

2010 Monthly Inbound Trail Use					
Location	Month	Mean	N	Std. Deviation	Sum
Postpile Trailhead	June 30	647	1	.	647
	July	958	31	253.806	29705
	August	803	31	262.781	24888
	September	733	7	593.683	5134
	Season Total	863	70	311.058	60375
Rainbow Falls Entrance	June 30	536	1	.	536
	July	599	31	290.237	18583
	August	564	31	181.402	17473
	September	449	8	434.058	3593
	Season Total	566	71	266.680	40185
Reds Meadow Trail	June 30	93	1	.	93
	July	92	31	139.760	2854
	August	94	28	125.251	2625
	September	68	8	258.268	541
	Season Total	90	68	152.266	6113

Table 2.3.50. One-way ANOVA for Mean Monthly Inbound Trail Use in 2010

One-way ANOVA for Mean Monthly Inbound Trail Use in 2010						
Location		Sum of Squares	df	Mean Square	F	Sig. (p-value)
Postpile Trailhead	Between Groups	557338.688	3	185779.563	2.004	.122
	Within Groups	6118898.120	66	92710.578		
	Total	6676236.808	69			
Rainbow Falls Entrance	Between Groups	145110.109	3	48370.036	.671	.573
	Within Groups	4833179.390	67	72137.006		
	Total	4978289.499	70			
Reds Meadow Trail	Between Groups	76908.281	3	1505.079	1.106	.353
	Within Groups	1476472.273	64	1361.125		
	Total	1553380.554	67			

Daily Inbound Visitor Trail Use

In 2009, trail counter results revealed Saturdays to be the busiest day of the week at all trail counter locations. In 2010, automatic trail counters recorded inbound visitor trail use on the Postpile trail to be highest on Sundays; however, the busiest day of the week for trail use at the entrance to Rainbow Falls and the Reds Meadow trail were Saturdays (Table 2.3.51; Figure 2.3.17). A comparison of means, based on day of the week, showed that there was a significant difference ($p < 0.05$) in trail use at the entrance to Rainbow Falls depending on what day of the week it was (Table 2.3.52).

Table 2.3.51. 2010 Inbound Visitor Trail Use Results by Day of the Week

2010 Inbound Visitor Trail Use Results by Day of the Week									
Location		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
Postpile Trailhead	Monday	10	794.54	244.893	77.442	619.36	969.73	360	1133
	Tuesday	10	797.19	323.610	102.334	565.69	1028.68	294	1220
	Wednesday	10	781.60	244.983	77.470	606.35	956.85	315	1137
	Thursday	10	781.14	219.165	69.306	624.36	937.93	311	1007
	Friday	10	815.33	271.971	86.005	620.77	1009.89	355	1187
	Saturday	10	1021.08	306.081	96.791	802.12	1240.03	444	1513
	Sunday	10	1046.60	456.987	144.512	719.69	1373.51	455	1883
	Total	70	862.50	311.058	37.179	788.33	936.67	294	1883
Rainbow Falls Entrance	Monday	10	505.72	172.855	54.662	382.07	629.37	211	820
	Tuesday	10	518.82	196.149	62.028	378.51	659.14	166	740
	Wednesday	11	464.89	203.125	61.244	328.43	601.35	91	749
	Thursday	10	492.45	134.113	42.410	396.51	588.39	222	622
	Friday	10	510.01	232.540	73.536	343.66	676.36	12	811
	Saturday	10	798.10	268.792	85.000	605.82	990.38	592	1506
	Sunday	10	682.00	437.412	138.322	369.10	994.91	315	1593
	Total	71	565.98	266.680	31.649	502.86	629.11	12	1593
Reds Meadow Trail	Monday	10	75.00	20.078	6.349	60.64	89.36	48	106
	Tuesday	10	78.00	33.790	10.685	53.83	102.17	16	128
	Wednesday	11	76.09	31.634	9.538	54.84	97.34	14	131
	Thursday	9	89.78	32.065	10.688	65.13	114.43	47	137
	Friday	9	96.11	30.673	10.224	72.53	119.69	50	130
	Saturday	9	116.67	41.443	13.814	84.81	148.52	76	200
	Sunday	10	101.90	51.913	16.416	64.76	139.04	41	199
	Total	68	89.84	36.981	4.485	80.89	98.79	14	200

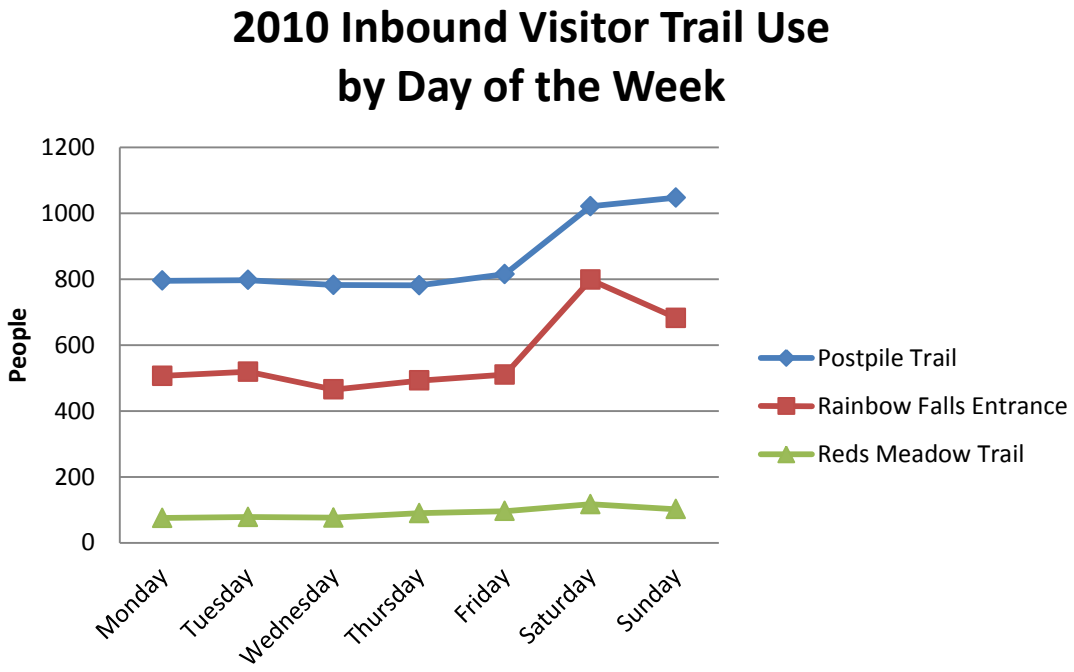


Figure 2.3.17. 2010 Inbound Visitor Trail Use by Day of the Week

Table 2.3.52. ANOVA between Day of Week for 2010 Inbound Visitor Trail Use

ANOVA between Day of the Week for 2010 Inbound Visitor Trail Use						
Location		Sum of Squares	df	Mean Square	F	Sig. (p-value)
Devils Postpile Trail	Between Groups	833113.586	6	138852.264	1.497	.194
	Within Groups	5843123.222	63	92747.988		
	Total	6676236.808	69			
Rainbow Falls Trail	Between Groups	929757.362	6	154959.560	2.450	.034
	Within Groups	4048532.137	64	63258.315		
	Total	4978289.499	70			
Reds Meadow Trail	Between Groups	13968.967	6	2328.161	1.829	.108
	Within Groups	77658.254	61	1273.086		
	Total	91627.221	67			

A multiple comparison post hoc analysis, using Fisher's Least Significant Difference (LSD) test, showed that Saturdays were significantly busier on the Rainbow Falls trail in 2010 than every other day of the week except for Sundays (Fisher, 1935). There was no significant difference between trail use, based on the day of week, for either the Postpile trail or Reds Meadow trail (Figure 2.3.17).

Hourly Inbound Visitor Trail Use

Mean hourly inbound visitor trail use in 2009 and 2010 was estimated (by means of the percentage of daily inbound trail use calibrated from the automatic trail counters), since all of the counters, other than the 2010 counter placed at the Postpile trailhead, were not directional. Mean hourly inbound trail use in 2009 most frequently peaked at noon at trail counter locations associated with the Postpile, and at 1:00 PM for Rainbow Falls trail counter locations (Table 2.3.53). In 2010, peak inbound hourly usage recorded by the directional Postpile trail counter occurred at 11:00 AM; while it is estimated that peak inbound hourly usage at the Rainbow Falls trail counter occurred at 1:00 PM, and Reds Meadow at 2:00 PM (Table 2.3.54). With some visitors beginning their hike at the Postpile trailhead and then hiking through to Rainbow Falls and even beyond to Reds Meadow before departing the trail system, staggered times for peak trail use were expected, and outbound visitor use at the Reds Meadow trail (heading into Reds Meadow and away from Rainbow Falls) was also examined. Outbound Reds Meadow peak trail use was recorded at 2:00 PM (Table 2.3.53;Table 2.3.54; Figure 2.3.18).

Table 2.3.53. Peak Mean Hourly Inbound Visitor Trail in 2009 & 2010

Peak Mean Hourly Inbound Visitor Tail Use in 2009 & 2010		
Trail Counter Location	Inbound 2009	Inbound 2010
Postpile Trailhead	12:00 PM	11:00 AM
Entrance to Postpile Viewing Area	12:00 PM	
Lower Overlook, Postpile	11:00AM & 12:00 PM	
Upper Overlook, Postpile	12:00 PM	
Bridge, Postpile	11:00 AM	
South Monitor, Postpile	12:00 PM	
Rainbow Falls Entrance	1:00 PM	1:00 PM
Rainbow Falls Trailhead	1:00 PM & 3:00 PM	
John Muir Trail	1:00 PM	
Reds Meadow (Inbound)		2:00 PM
Reds Meadow (Outbound)		2:00 PM

Table 2.3.54. 2010 Mean Inbound Visitor Tail Use by Hour

2010 Mean Inbound Visitor Trail Use by Hour															
Location	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM
Postpile Trailhead	4	20	30	44	113	135	94	114	111	79	53	33	15	16	3
Rainbow Falls Entrance	0	5	13	19	29	55	88	99	87	73	52	31	12	2	1
Reds Meadow Trail (Inbound)	0	1	3	2	3	6	8	13	16	14	13	7	4	1	0
Reds Meadow Trail (Outbound)	1	2	12	8	11	24	34	53	67	57	52	30	15	4	1

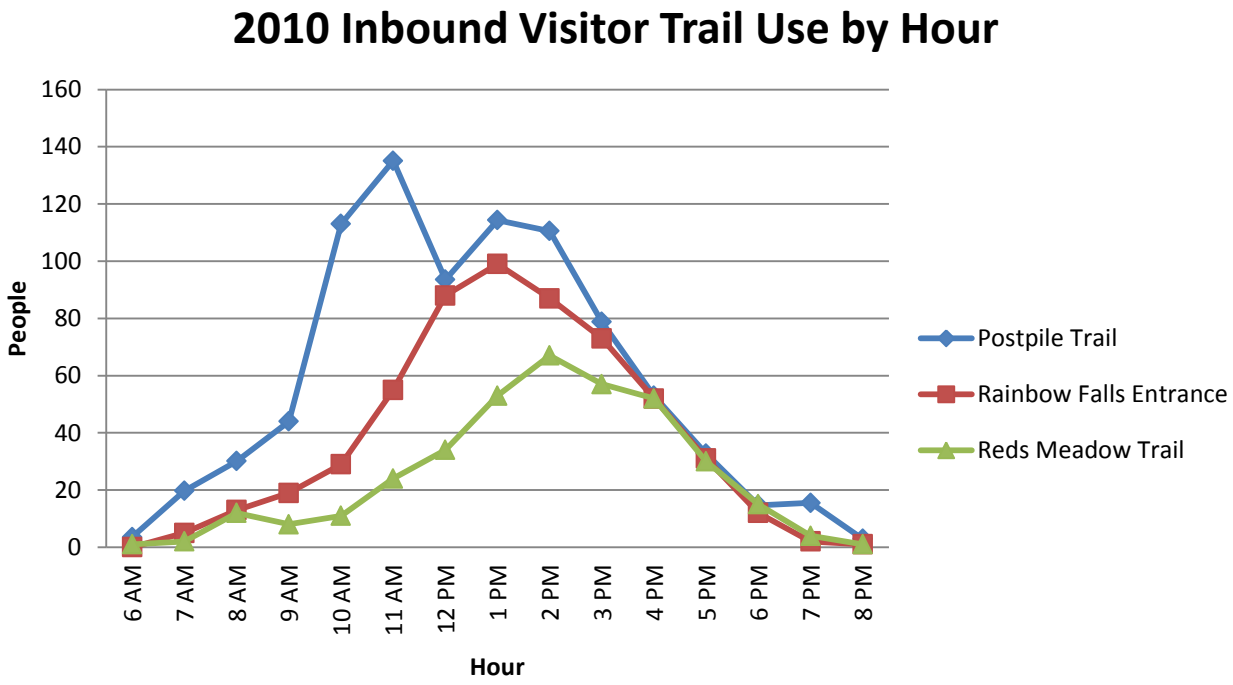


Figure 2.3.18. 2010 Estimated Mean Hourly Inbound Visitor Trail Use

Mean hourly inbound visitor trail use was also calculated for weekdays and weekends (Figure 2.3.19). It is estimated that mean inbound trail use on the Postpile and Rainbow Falls Trails was heavier during weekends than on weekdays; however, the Reds Meadow Trail counters recorded slightly more use on weekdays than on Saturdays and Sundays.

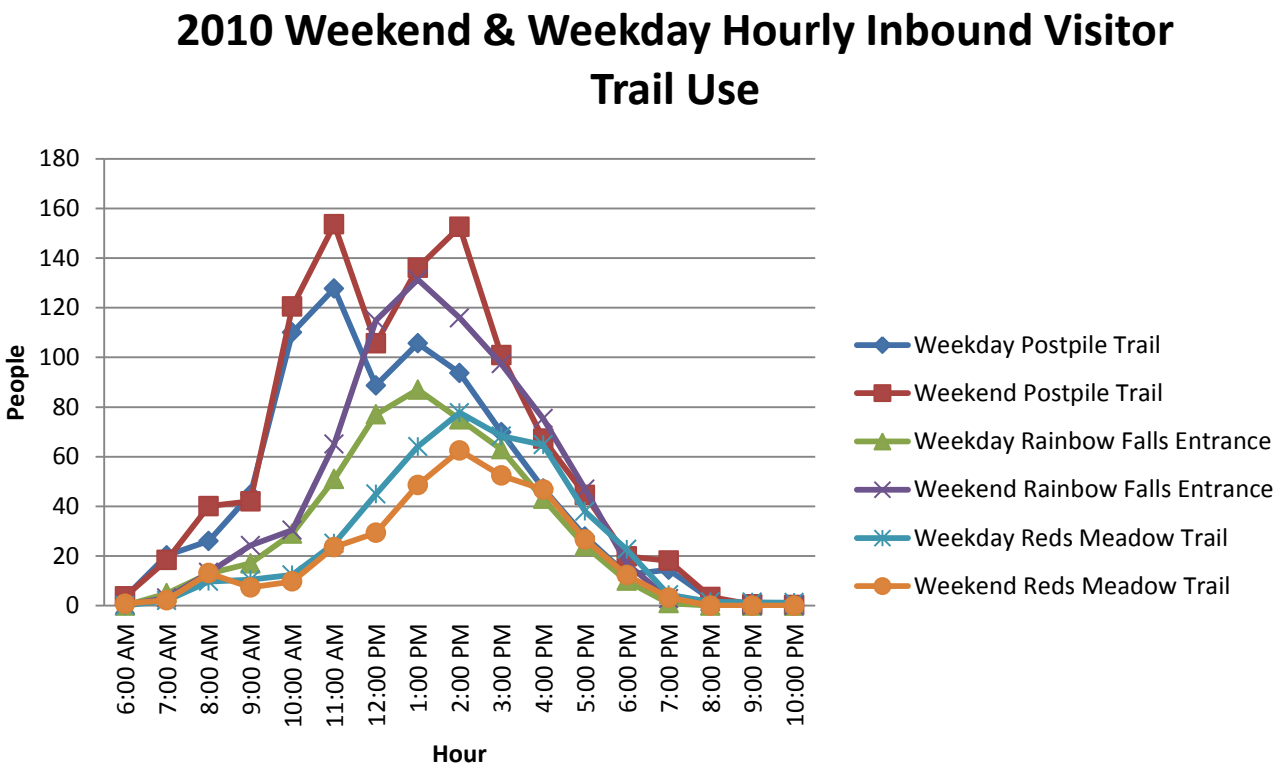


Figure 2.3.19. 2010 Weekend & Weekday Estimated Mean Hourly Inbound Visitor Trail Use

Vehicle Traffic

Vehicle access to DEPO is limited to one entrance and most visitors are required to use the bus shuttle system, in effect making this a closed system. Vehicle traffic data was collected in 2010 by DEPO personnel through the use of an automatic vehicle counter placed near the DEPO visitor center. The vehicle counter collected volume data only; data pertaining to the number of buses, and bus passengers, was obtained by the Eastern Sierra Transit Authority (ESTA), the company providing shuttle bus service to the park. Shuttle bus service to DEPO was offered between June 24th and September 2nd in 2010; however, vehicle and passenger volume data is available by fiscal year and data collected between June 24th and September 8th has been utilized in this study.

Vehicle and passenger data collected in 2010 consists of daily totals for: A) the number of vehicles entering the park (broken into two categories, buses and personal vehicles) and B) the total number of passengers (bus passengers and personal vehicle passengers). While bus passenger data was provided by ESTA, personal vehicle passenger data was computed using a commonly used multiplier of 3.5 people-per-vehicle for determining vehicle occupancy.

Vehicle Volume by Type

Inbound DEPO vehicle volume, during the study period (June 24-September 8, 2010), equaled a total of 11,442 vehicles; on average 30 shuttle buses and 94 personal vehicles entered the park

daily. Personal vehicles (cars, motorcycles, RV's, etc.) comprise 81.5% of the total vehicle volume entering the park and shuttle buses 18.5% (Table 2.3.55).

Table 2.3.55. Vehicle Volume by Type

Vehicle Volume by Type								
	N	Min	Max	Sum	Mean	Std. Deviation	Valid Percent	Cumulative Percent
Inbound Buses	71	24	50	2116	29.80	4.348	18.5	18.5
Inbound Personal Vehicles	99	10	262	9326	94.20	52.406	81.5	100.0
Total Inbound Vehicles	99	10	287	11442	115.57	61.184	100.0	

NOTE: Detail may not sum to totals because of rounding.

Vehicle Passenger Volume by Type

Between June 24th and September 8th, the 11,442 vehicles arriving in DEPO carried an estimated 91,253 passengers, an overall average of 8 people per vehicle (27.7 people per bus and 3.5 people per personal vehicle); 64.2% of all passengers arrived by bus, an average of 826 bus passengers per day, and 35.8% by personal vehicle, an average of 330 people per day (Table 2.3.56).

Table 2.3.56. Vehicle Passenger Volume by Type

Vehicle Passenger Volume by Type								
Type	N	Min	Max	Sum	Mean	Std. Deviation	Valid Percent	Cumulative Percent
Bus Passengers	71	250	1653	58614	825.55	270.968	64.2	64.2
Personal Vehicle Passengers	99	33	917	32639	329.69	183.421	35.8	100.0
Total Passengers	99	33	2374	91253	921.75	564.645	100.0	

NOTE: Detail may not sum to totals because of rounding.

Mean Monthly Vehicle Volume by Type

Monthly vehicle volume ranged from a low of 54 vehicles entering the park in September (between the 1st and the 8th), to a high of 5080 vehicles in the month of July (Table 2.3.57). Since the number of shuttle buses per day is determined collaboratively by the NPS and the ESTA there was little variance, with the overall average of 30 shuttle buses per day serving DEPO reflected in both July and August, the busiest months of the summer. Variance in the number of buses entering the park is mostly caused by tour buses, although there are occasional school buses arriving as well. There was, however, variance in personal vehicle use with June and July both receiving 81.5% of vehicle volume from personal vehicles, while August saw personal vehicle volume drop to 74.6%. Since shuttle bus service was stopped on September 2nd and we continued to count personal vehicle volume until September 8th, the percentages for September are not comparable. Overall, July was the busiest month for vehicle volume with an average of 134 personal vehicles per day entering the park, as compared to an average of 124 personal vehicles per day entering in June, 89 in August, and 35 in September.

Table 2.3.57. Mean Monthly Vehicle Volume by Type

Mean Monthly Vehicle Volume by Type

Month		N	Min	Max	Sum	Mean	Std. Deviation	Valid Percent	Cumulative Percent
June	Inbound Buses	7	26	32	199	28.43	2.299	18.6	18.6
	Inbound Personal Vehicles	7	94	250	870	124.21	56.252	81.4	100.0
	Total Inbound Vehicles	7	120	280	1069	152.64	56.972	100.0	
July	Inbound Buses	31	25	50	932	30.06	5.446	18.3	18.3
	Inbound Personal Vehicles	31	34	262	4148	133.79	46.700	81.7	100.0
	Total Inbound Vehicles	31	60	287	5080	163.85	48.330	100.0	
August	Inbound Buses	31	24	38	933	30.10	3.429	25.4	25.4
	Inbound Personal Vehicles	31	29	157	2745	88.55	36.978	74.6	100.0
	Total Inbound Vehicles	31	55	188	3678	118.65	39.169	100.0	
September	Inbound Buses	2	25	27	52	26.00	1.414	3.2	3.2
	Inbound Personal Vehicles	30	10	139	1564	52.12	34.589	96.8	100.0
	Total Inbound Vehicles	30	10	139	1615	53.85	34.651	100.0	

NOTE: Detail may not sum to totals because of rounding.

Weekday, Weekend & Holiday Vehicle Traffic Volume

Variance in shuttle bus service between weekday, weekend, and holidays is pre-determined by the ESTA with an average of 32 shuttle bus runs a day Monday through Thursday, 38 runs offered on Fridays, 50 on Saturdays and 44 on Sundays (Table 2.3.58). The 4th of July in 2010 occurred on a Sunday and no additional runs were scheduled that day. Weekday personal vehicle volume overall tended to be slightly lower than weekend vehicle volume with the a mean range of 81-85 personal vehicles per day entering the park on Mondays through Thursdays; however, personal vehicle volume on Fridays, averaging 122 vehicles per day, was the highest of all days including Saturdays, with a mean of 112 vehicles per day, and Sundays with a mean of 97 vehicles per day.

There were two holidays in which personal vehicle volume was recorded, the 4th of July and Labor Day (Monday, September 6th 2010); the average number of personal vehicles entering the park over those two days was 101 (Table 2.2.57). Including Fridays, the overall mean for weekdays was 90 personal vehicles per day; for weekend days the overall mean was 104.

Statistically significant differences were found between inbound personal vehicle volume on weekdays, weekends, and holidays using ANOVA with LSD post hoc analyses (Table 2.3.60). As expected, there were no significant differences found for inbound shuttle bus vehicle volume.

Table 2.3.58. Vehicle Volume by Day of the Week

Vehicle Volume by Day of the Week

Weekday		N	Min	Max	Sum	Mean	Std. Deviation	Valid Percent	Cumulative Percent
Sunday	Inbound	10	26	44	309	30.90	5.109	18.5	18.5
	Inbound	14	35	177	1361	97.18	46.092	81.5	100.0
	Total Inbound	14	37	207	1670	119.25	54.452	100.0	
Monday	Inbound	10	26	31	275	27.50	1.780	19.3	19.3
	Inbound	14	25	157	1151	82.21	43.492	80.7	100.0
	Total Inbound	14	25	183	1426	101.86	52.315	100.0	
Tuesday	Inbound	10	24	33	293	29.30	3.466	20.4	20.4
	Inbound	14	26	142	1142	81.54	41.669	79.6	100.0
	Total Inbound	14	26	175	1435	102.46	53.095	100.0	
Wednesday	Inbound	10	25	32	281	28.10	2.767	19.9	19.9
	Inbound	14	10	159	1130	80.68	48.330	80.1	100.0
	Total Inbound	14	10	186	1410	100.75	59.167	100.0	
Thursday	Inbound	11	26	32	309	28.09	2.256	19.6	19.6
	Inbound	15	14	164	1270	84.63	48.329	80.4	100.0
	Total Inbound	15	14	196	1579	105.23	58.036	100.0	
Friday	Inbound	10	25	38	301	30.10	4.149	15.0	15.0
	Inbound	14	34	262	1707	121.93	77.773	85.0	100.0
	Total Inbound	14	35	287	2008	143.43	84.563	100.0	
Saturday	Inbound	10	29	50	348	34.80	5.750	18.2	18.2
	Inbound	14	47	206	1567	111.89	47.401	81.8	100.0
	Total Inbound	14	50	256	1915	136.75	57.790	100.0	

NOTE: Detail may not sum to totals because of rounding.

Table 2.3.59. Weekday, Weekend & Holiday Vehicle Volume

Weekday, Weekend and & Holiday Vehicle Volume

Day		N	Min	Max	Sum	Mean	Std. Deviation
Weekday	Inbound Buses	51	24	38	1459	28.61	3.020
	Inbound Personal Vehicles	70	10	262	6316	90.23	54.716
	Total Inbound Vehicles	70	10	287	7775	111.07	63.237
Weekend	Inbound Buses	19	26	50	613	32.26	5.152
	Inbound Personal Vehicles	27	35	206	2808	104.02	47.288
	Total Inbound Vehicles	27	37	256	3421	126.72	56.457
Holiday	Inbound Buses	1	44	44	44	44.00	.
	Inbound Personal Vehicles	2	83	119	201	100.50	25.456
	Inbound Vehicles	2	83	163	245	122.50	56.569

Table 2.3.60. ANOVA between Weekday, Weekend & Holiday Mean Vehicle Volume by Type

ANOVA between Weekday, Weekend, & Holiday Mean Vehicle Volume by Type

		Sum of Squares	df	Mean Square	F	Sig. (p-value)
Inbound Personal Vehicles	Between Groups	3786.325	2	1893.163	.685	.507
	Within Groups	265359.584	96	2764.162		
	Total	269145.909	98			
Inbound Buses	Between Groups	389.398	2	194.699	14.178	.000
	Within Groups	933.841	68	13.733		
	Total	1323.239	70			

Relationships among Variables

To better understand how some variables affect other variables (e.g., how descriptive variables such as PAOT, trail use, or vehicle passenger volume affect evaluative variables such as visitors' perceptions of crowding), both simple linear regression analyses, which compare two variables with each other, and multiple regression, which compare three or more variables, were used in this study. Results were also applied in the creation of predictive models in an attempt to extrapolate the data to possible future conditions.

Effects of Mean Hourly PAOT Counts on Perceptions of Crowding

Simple Linear Regression

To better understand how the number of people at an attraction site affects visitor experience, linear regression analyses were conducted using assigned survey mean hourly PAOT counts as the independent variable and participants' responses to survey questions 8 – 10 as dependent variables (i.e., to see if responses to the perception of crowding questions were dependent on mean hourly PAOT counts). The only statistically significant results from the linear regression analyses based on survey PAOT counts, were those reported for questions: 9E: "Which photograph looks most like the number of visitors you saw at this viewing area today?" and 10: "How crowded did you feel at this viewing area today?" (Table 2.3.61).

Table 2.3.61. Regression Analyses for Questions 8-10 Based on People at One Time

Linear Regression Analyses for Questions 8-10 Based on People at One Time

Survey Question	Location	R^2	B	Std. Error	Constant	t-value	Sig. (p-value)
Q8. In general, how did the encounters you had with other people at Rainbow Falls today affect your overall enjoyment of your hiking experience?	Postpile	.000	-.002	.007	2.379	-.326	.745
	Rainbow Falls	.006	.010	.008	2.046	1.286	.199
9A Photo 1	Postpile	.000	-.001	.009	3.641	-.058	.954
	Rainbow Falls	.001	.009	.014	3.353	.615	.539
9A Photo 2	Postpile	.000	-.001	.011	3.275	-.091	.928
	Rainbow Falls	.012	.028	.015	2.528	1.852	.065
9A Photo 3	Postpile	.000	.003	.015	1.722	.222	.824
	Rainbow Falls	.011	.035	.020	.221	1.754	.080
9A Photo 4	Postpile	.005	.021	.019	-1.488	1.106	.270
	Rainbow Falls	.004	.023	.021	-1.676	1.090	.277
9A Photo 5	Postpile	.014	.030	.017	-3.010	1.789	.075
	Rainbow Falls	.005	.022	.019	-3.036	1.109	.269
Q9B. Which photograph shows maximum number of people NPS should allow in this viewing area at one time?	Postpile	.004	.006	.007	3.220	.880	.380
	Rainbow Falls	.004	.005	.009	3.089	.548	.584
Q9C. Which photograph show the number of people you would prefer to see at this viewing area?	Postpile	.003	.005	.006	2.067	.834	.405
	Rainbow Falls	.010	.012	.007	1.976	1.679	.094
Q9D. Which photograph shows the number of people at this viewing area that would cause you to never want to return?	Postpile	.000	-.001	.006	4.558	-.156	.877
	Rainbow Falls	.005	.008	.008	4.412	.998	.319
Q9E. Which photograph looks most like the number of visitors you saw at this viewing area today?	Postpile	.140	.031	.005	2.070	6.298	.000
	Rainbow Falls	.241	.055	.006	1.826	9.413	.000
Q10. How crowded did you feel at this viewing area today?	Postpile	.031	.032	.011	1.997	2.840	.005
	Rainbow Falls	.209	.117	.014	1.500	8.678	.000

Reported statistics of particular interest include: 1) the R^2 which represents the proportion of variance in one variable accounted for by the other variable (i.e. for Rainbow Falls respondents, 21% of the variance in the Rainbow Falls survey respondents' answers to question10 "How crowded did you feel at this viewing area today?" is explained by the visitor-reported mean hourly PAOT; 2) the significance level, which relates the probability that the inferences are correct (i.e. all significant results from these analyses were significant at the 99% confidence level, $p < 0.01$); and 3) the constant (Y intercept) and coefficient B (slope) for the regression equation (George & Mallory, 2011).

R^2 is a goodness-of-fit measure of linear regression; the value of R^2 falls between 0.0 and 1.0 and describes how well all of the points representing the mean values of the dependent variable (e.g., how crowded people felt at the attraction site) fall on the best fit line in relation to the independent variable (reported mean PAOT during the hour of their visit to the attraction site); the closer to 1, the better the fit (Figure 2.3.20). Knowing the value of one variable helps you to predict the value of the other variable. The constant is the Y intercept, or the value of Y when X equals zero. Coefficient B defines the steepness of the slope. It equals the change in Y for each unit change in X (i.e., how the numbers other people affect your perceptions of crowding for every additional 10 people at the attraction site) (GraphPad Software, Inc., 1999). It is important to remember that a high R^2 value does not necessarily mean that X causes Y but that the meaning of the relationship depends on the nature of the variables. "Associations in the social sciences tend to have smaller R^2 values than those in the physical sciences as they are dealing with human factors that often involve more unexplained variation" (Knott & Bolton, 2009).

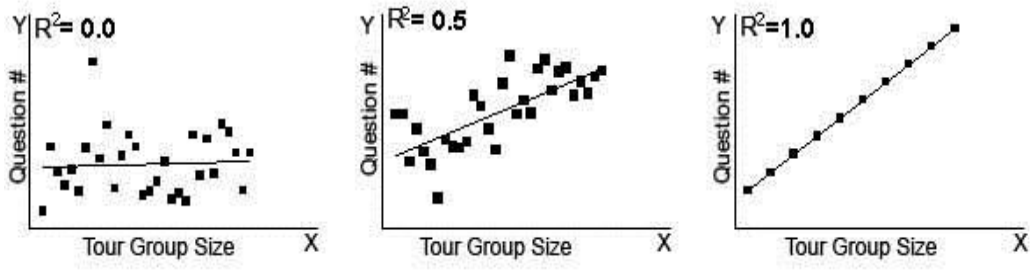


Figure 2.3.20. Examples of Linear Regression

There are a number of implications associated with these regression results. First, the relationships between PAOT and the responses to questions 9E and 10 are statistically significant but are considered "weak" to "moderate" based on their R^2 values (Cohen, 1988). As seen in the graphic example (Figure 2.3.21), Rainbow Falls survey respondents' answers to question 10 ("How crowded did you feel at this viewing area today?"), suggest that while there is a significant relationship ($p < .001$), PAOT explains only a moderate amount (R^2= 21%), of the variance in perceptions of crowding (Table 2.3.61).

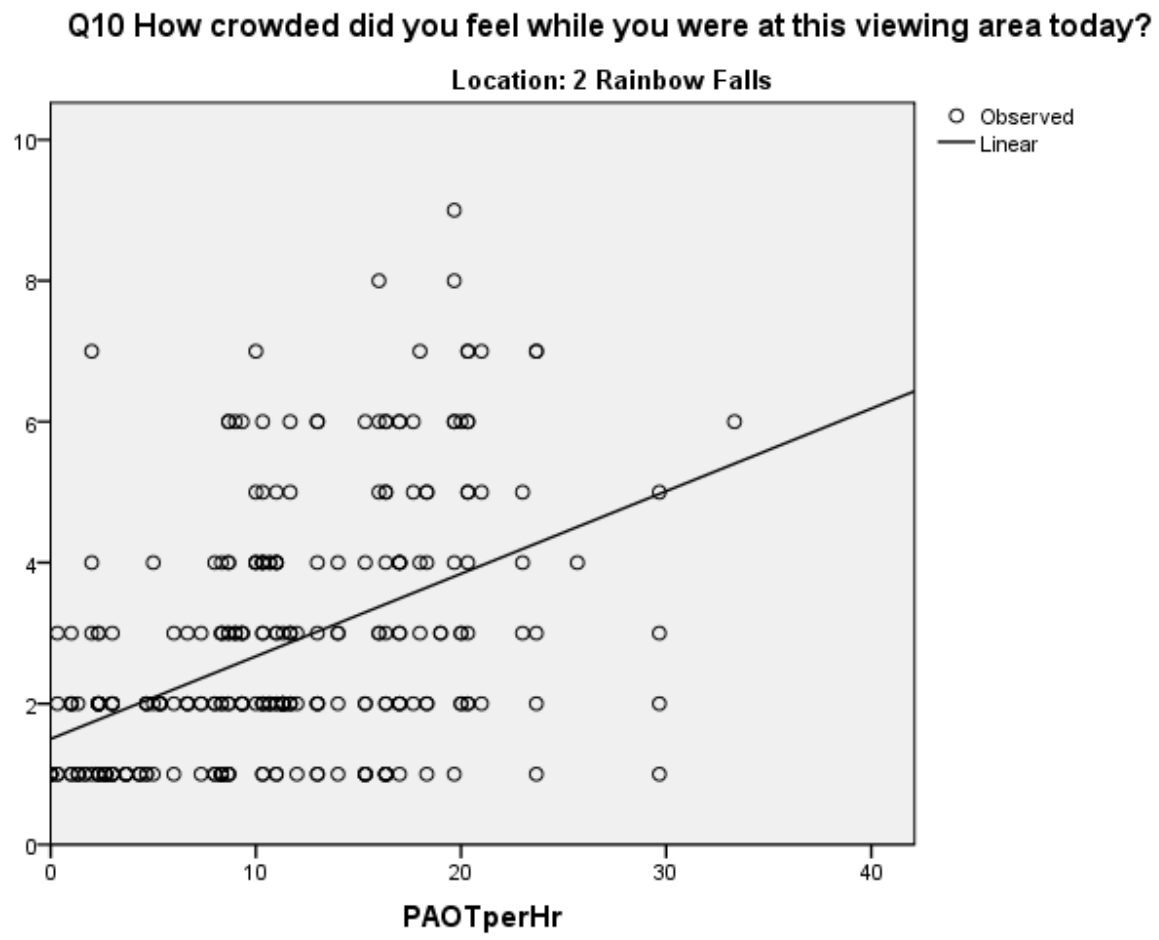


Figure 2.3.21. Linear Regression of Rainbow Falls Respondents' Perceptions of Crowding Based on People at One Time

Multiple Regression

Multiple regression analysis is used to explain the influence of two or more independent variables on a dependent variable. As more variables enter into an equation, relationships become more complicated and the amount of variance explained by each item can change. Stepwise, a method used to remove weaker variables from an equation, has been used in these analyses (George & Mallery, 2011). An additional statistic, "Beta" (the standardized regression coefficient) is reported and indicates the relative influence of the entered variables. In these analyses, the only significant model, which utilized both Q9E and PAOT per hour, came from the Rainbow Falls survey responses; this model explains 35% of the variance in Q10, how crowded visitors felt at the Rainbow Falls viewing area the day they completed their survey (Table 2.3.62). Visitors' responses to Q9 "Which photograph looks most like the number of visitors you saw at this viewing area today?" (Beta = .423), were more influential than hourly PAOT counts (Beta = .256) in explaining perceptions of crowding.

Table 2.3.62. Multiple Regression Analyses for Q10 based on Q9 & PAOT per Hour

Multiple Regression Analyses for Q10 based on Q9E & PAOT per Hour							
Location	Model	R^2	B (Unstandardized)	Std. Error (Unstandardized)	Beta (Standardized)	t-value	Sig. (p-value)
Rainbow Falls Viewing Area	(Constant)	.350	-2.69	.281		-.956	.340
	Q9E		.967	.127	.423	7.615	.000
	PAOT per Hour		.066	.014	.256	4.613	.000

Predictive Modeling using *PAOT Counts*

Knowing the relationship between variables, allows for predictive modeling. In the case of perceptions of crowding based on future PAOT counts, the first model predicts that if there are more than 30 people at one time at the Rainbow Falls viewing area, visitors will feel moderately crowded, and if there are more than 55 people, visitors will feel extremely crowded (Figure 2.3.22).

The next predictive model (Figure 2.3.23), illustrates the moderate relationship between observed mean hourly PAOT and Rainbow Falls visitors' subjective responses to question 9E ("Which photograph looks most like the number of visitors you saw at this viewing area today?"). Results suggest that while there is a significant relationship ($p < .001$) between these variables, hourly mean PAOT counts explain only 24% of the variance in the number of people that visitors perceived to have been at the Rainbow Falls viewing area during the hour in which they were at the site and completed their survey (Table 2.3.61). The predictive model, based on these results (Figure 2.3.23), further demonstrates this moderate relationship: predicting that when PAOT counts are low, visitors will tend to overestimate the numbers of people present, will tend to underestimate them when PAOT counts are high, and that visitors' perceptions will be accurate when there ~20 people at one time at the Rainbow Falls viewing area.

At the Postpile viewing area, weak relationships were associated with the perceived crowding response variables Q9 and Q10, implying that PAOT did not influence respondent's evaluations (Table 2.3.61), rather visitors evaluated these questions independently of the mean hourly PAOT which suggests that these responses can be considered "normative" (Jackson, 1965; Manning, 1999).

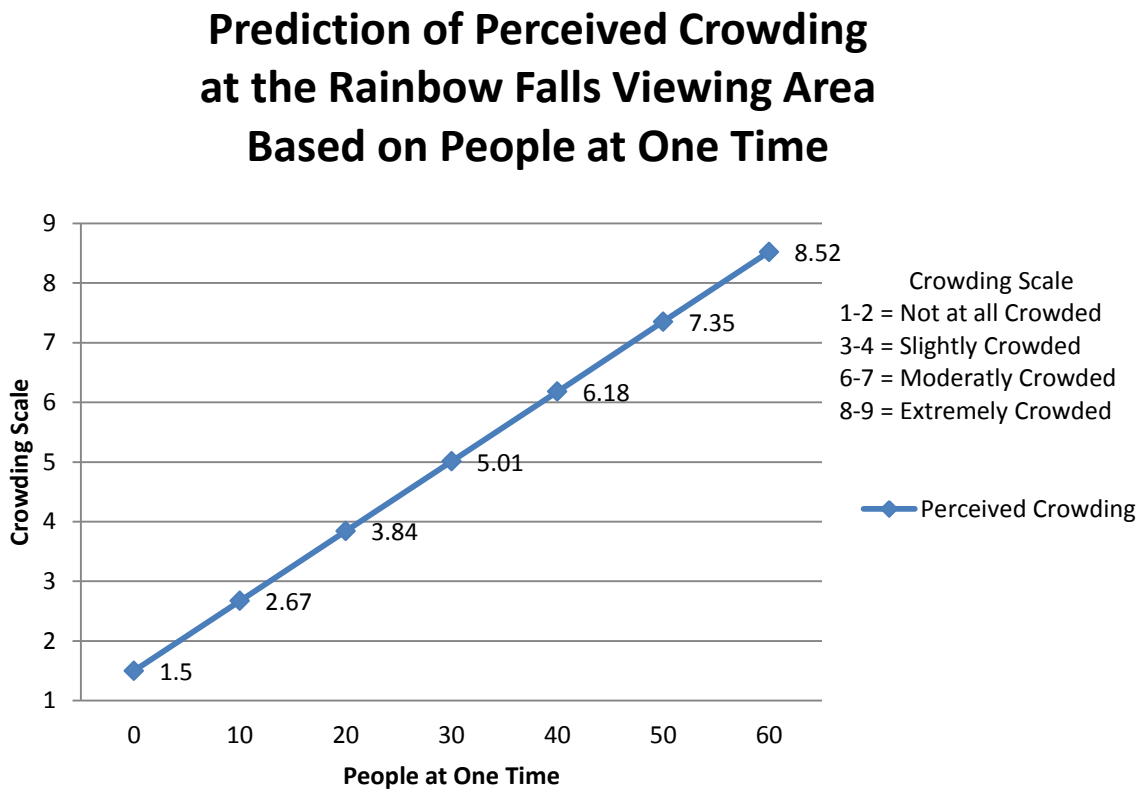


Figure 2.3.22. Predictive Model of Perceived Crowding based on People at One Time at the Rainbow Falls Viewing Area

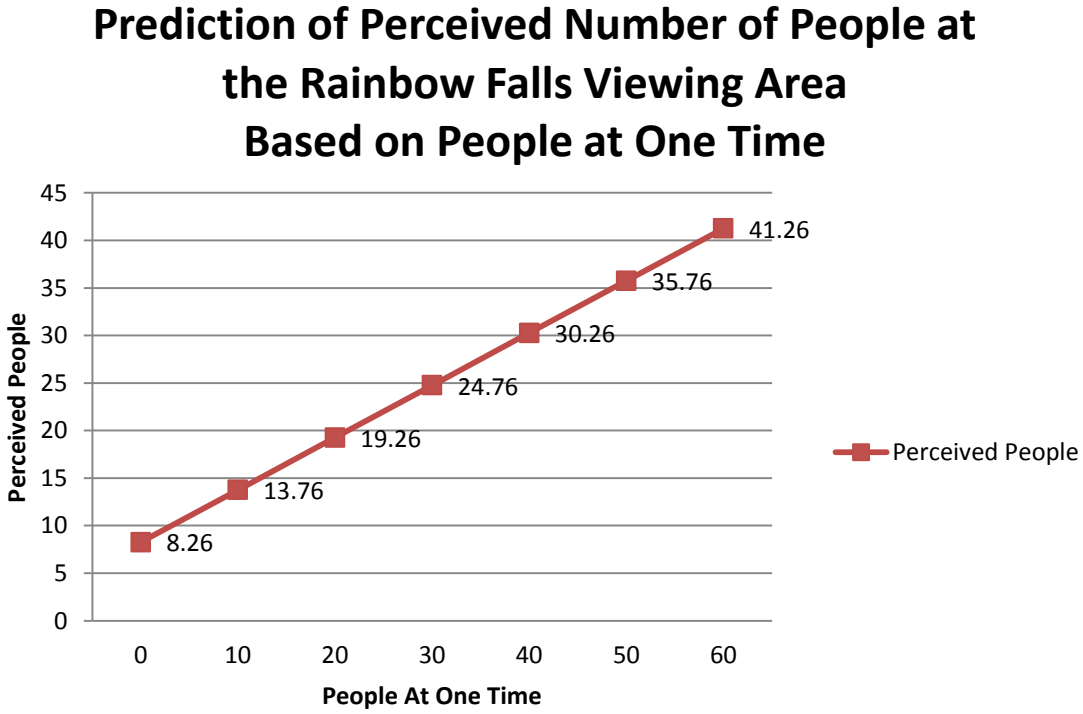


Figure 2.3.23. Prediction of Perceived Number of People at the Rainbow Falls Viewing Area Based on People at One Time

Simple Linear Regression

An examination of the relationships between observed mean hourly PAOT counts, taken at the Devils Postpile and Rainbow Falls viewing areas, and mean hourly trail use estimations revealed that the strongest relationships came from comparing trail use data collected up to two hours before PAOT counts were taken to account for travel time. Inbound visitors who crossed the Postpile trailhead counter one hour earlier than PAOT counts were taken at the Postpile accounted for 19.3% of the variance; 48% of the Rainbow Falls observed mean hourly PAOT counts can be explained by the number of inbound visitors who crossed the Postpile trailhead two hours earlier (Table 2.3.63). Inbound visitors crossing the automatic trail counter at the Rainbow Falls entrance (during the same hour) explained 60.5% of the variance in the observed mean hourly Rainbow Falls PAOT counts; however, did not significantly account for any of the observed mean hourly PAOT counts at the Devils Postpile viewing area two hours later. For the Reds Meadow trail, these analyses included data on inbound visitor use from one hour before PAOT counts were taken at Rainbow Falls, and two hours before PAOT counts were taken at the Postpile viewing areas. The Reds Meadow inbound trail use estimations did not significantly explain any of the variance from PAOT counts observed at the Postpile; however it does explain 8% of the variance from PAOT counts observed at the Rainbow Falls viewing area.

Table 2.3.63. Significant Results from Linear Regression Analyses of Inbound Trail Use & Hourly Observed PAOT Counts

Significant Results from Linear Regression Analyses of Inbound Trail Use & Hourly Observed PAOT Counts								
Trail Counter Location	PAOT Location	Model	R^2	B	Std. Error	Constant	t-value	Sig. (p-value)
Postpile Trailhead	Devils Postpile Viewing Area	Hour Before Inbound DEPO Trail	19.3	.098	.013	3.949	7.706	.000
	Rainbow Falls Viewing Area	Two Hours Before Inbound DEPO Trail	48.0	.110	.007	.679	16.398	.000
Rainbow Falls Entrance	Rainbow Falls Viewing Area	Inbound Rainbow Falls Entrance	.605	.147	.007	1.212	21.101	.000
Reds Meadow	Rainbow Falls Viewing Area	Hour Before Inbound Reds Meadow Trail	.081	.104	.015	9.139	6.891	.000

Multiple Regression

Stepwise multiple regression analyses, in which multiple independent variables are entered into a regression equation one at a time to determine if they improve the model, were used to identify how much of the observed PAOT variance, at each of the two viewing areas, was explained by the hourly mean trail data from the three trail counters used in 2010. To allow for travel time, Postpile trail use data from one hour before were compared to Postpile PAOT data, and from two hours before were compared to Rainbow Falls PAOT data. Similarly, Reds Meadow trail data from one hour before were compared to Rainbow Falls PAOT data and from two hours before were compared to Postpile PAOT data. Since the Rainbow Falls trail counter was located at the entrance to Rainbow Falls, no offset was necessary for travel time.

Hourly mean PAOT at the Postpile viewing area was significantly related to the mean hourly trail use taken from the Postpile trailhead and the entrance to Rainbow Falls, R^2=.266; inbound visitor use on the Postpile trail, an hour before the PAOT counts were taken, was the most influential (Beta=.554), while inbound trail use from two hours earlier at the Rainbow Falls trail counter, was significant although less influential (Beta=-.293) and in a negative direction (Table 2.3.64). Inbound trail use from the Reds Meadow trail counter taken two hours earlier was not significantly related to Postpile PAOT counts. Unlike the observed Postpile PAOT counts, the Rainbow Falls hourly mean PAOT counts were significantly related to the mean hourly trail use data taken from all three trail counters, R^2=.66; the greatest influence came from trail counts taken an hour before at the entrance to Rainbow Falls (Beta=.429), followed by those taken an hour earlier at the Reds Meadow trail head (Beta=.301), and lastly by trail counts taken two hours earlier at the Postpile trail head (Beta=.175) (Table 2.3.64).

Table 2.3.64. Stepwise Multiple Regression Analyses of Inbound Trial Use & Hourly PAOT Counts

Stepwise Multiple Regression Analyses of Inbound Trail Use & Hourly PAOT Counts

PAOT Location	Model	R^2	B	Std. Error	Beta	t-value	Sig. (p-value)
Devils Postpile Viewing Area	(Constant)	.266	4.361	1.340			
	Hour Before Inbound Postpile Trailhead		.123	.013	.554	9.358	.000
	Two Hours Before Inbound Rainbow Falls Entrance		-.069	.014	-.293	-4.957	.000
Rainbow Fall Viewing Area	(Constant)	.660	-.161	.567			
	Hour Before Inbound Rainbow Falls Entrance		.081	.013	.426	6.052	.000
	Hour Before Inbound Reds Meadow Trail		.096	.015	.301	6.052	.000
	Two Hours Before Inbound Postpile Trailhead		.028	.010	.175	2.852	.005

Predictive Modeling using Inbound Trail Use & PAOT Counts

A predictive model estimating hourly PAOT counts at the Rainbow Falls viewing area, based on the results from the simple linear regression analysis (β =.147, Constant=1.212), graphically illustrates predictive PAOT values based on hourly inbound trail use at the Rainbow Falls entrance. Results show that for every additional 25 people crossing the Rainbow Falls entrance, there will be 3.675 additional people included in the mean hourly PAOT counts at the Rainbow Falls viewing area (Figure 2.3.24). If hourly trail use at the Rainbow Falls entrance should reach 300, the model predicts that the mean hourly PAOT count will be 45. Results from the simple linear regression analysis were used within the predictive model as they portrayed the strongest relationship, and more closely represented the data collected in 2010 (i.e., the maximum number of recorded PAOT at the Rainbow Falls viewing area was 33 and the maximum estimated hourly mean inbound trail data at the Rainbow Falls entrance was 263).

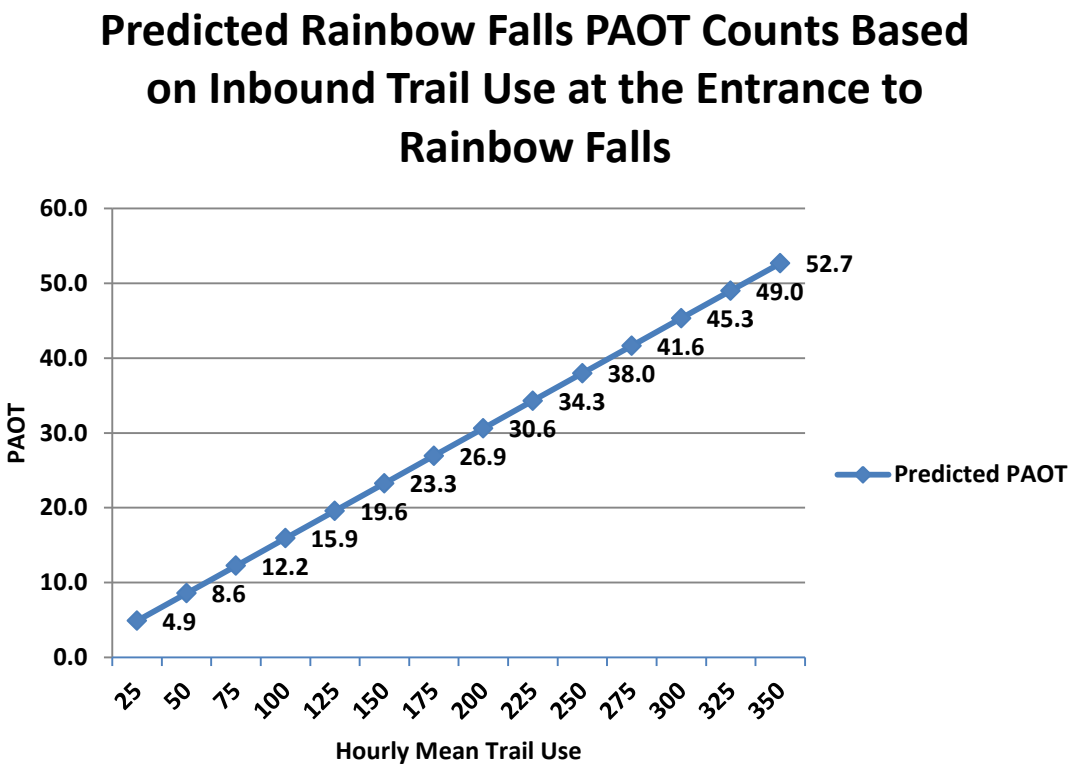


Figure 2.3.24. Predicted Rainbow Falls PAOT Values Based on Inbound Rainbow Falls Trail Use One Hour Earlier

Trail Use & Perceptions of Crowding

Simple Linear Regression

Mean hourly inbound trail use estimations from all three trail counters (taken one hour before surveys were conducted), were compared to visitors' survey responses to the perception of crowding questions (questions 8-10) using simple linear regression analyses. As was the case with the assigned PAOT counts and the questions related to the perception of crowding, the only statistically significant results were those reported for questions: 9E: "Which photograph looks most like the number of visitors you saw at this viewing area today?" and 10: "How crowded did you feel at this viewing area today?" (Table 2.3.65). Although results of these analyses were significant, the actual amount of variance explained by inbound trail use was relatively low. In general, mean hourly trail use did not account for more than 16.3% of the variance in visitors' perceptions of crowding (the result of Reds Meadow trail use data applied to Rainbow Falls survey responses to question 10) (Table 2.3.65).

Table 2.3.65. Linear Regression Analyses for Questions 9E & 10 based on Mean Hourly Trail Use One Hour Before

Linear Regression Analyses for Questions 9E &10 Based on Mean Hourly Trail Use								
Survey Question	Location	Trailhead	R^2	B	Std. Error	Constant	t-value	Sig. (p-value)
Q9E. Which photograph looks most like the number of visitors you saw at this viewing area today?	DEPO	Postpile (One Hour Before)	.106	.006	.001	1.901	5.710	.000
		Rainbow Falls (Two Hours Before)	.050	.005	.001	1.947	3.851	.000
		Postpile (Two Hours Before)	.045	.004	.001	2.270	3.604	.000
	Rainbow Falls	Rainbow Falls (One Hour Before)	.139	.008	.001	1.899	6.768	.000
		Reds Meadow (One Hour Before)	.118	.012	.002	2.019	6.145	.000
Q10. How crowded did you feel at this viewing area today?	DEPO	Postpile (One Hour Before)	.081	.012	.002	1.230	5.028	.000
		Rainbow Falls (Two Hours Before)	.053	.011	.003	1.664	4.026	.000
	Rainbow Falls	Rainbow Falls (One Hour Before)	.146	.019	.003	1.564	7.017	.000
		Reds Meadow (One Hour Before)	.163	.033	.044	1.704	7.499	.000

Multiple Regression

Stepwise multiple regression analyses were used to identify whether results from two independent variables: 1) question 9 "Which photograph looks most like the number of visitors you saw at this viewing area today?," and 2) mean hourly trail use data, significantly explain a portion of the variance for visitors responses to the dependent variable, question10: "How crowded did you feel at this viewing area today?". The models utilized inbound mean hourly trail use data gathered from all three trailheads in 2010. To allow for travel time, Postpile trail use data from one hour before surveys were conducted was compared to Postpile survey responses, and from two hours before surveys were conducted were compared to Rainbow Falls survey responses. Rainbow Falls survey responses were compared to Rainbow Falls trail use data collected during the same hour. Reds Meadow trail use data, taken from one hour before, were compared to Rainbow Falls survey responses, while data taken from two hours before, were compared to Postpile survey responses.

Significant results using Postpile trail use data, along with survey participants' responses to question 9, explained 29% of the variance in Postpile respondents' answers to question 10, and 32% of the variance in Rainbow Falls respondents' answers to question 10 (Table 2.3.66). Significant results using Rainbow Falls survey respondents' answers to question 9 and Rainbow Falls trail use data explained 34% of the variance in Rainbow Falls visitors' responses to question 10, while 36% of the variance to question 10 was explained using the inbound Reds Meadow trail data. There were no significant findings related to the Postpile survey responses based on Reds Meadow trail use data. In the models where these relationships were significant, survey participants' responses to question 9: "Which photograph looks most like the number of visitors you saw at this viewing area today?" had much more influence on how crowded these visitors felt than did the mean hourly

inbound trail data, evident by the fact that the Beta scores from question 9 were much greater than the Beta scores for trail use data in all cases.

Table 2.3.66. Significant Results of Multiple Regression Analyses for Q10 based on Q9 & Trail Use Data

Significant Results of Multiple Regression Analyses for Q10 based on Q9E & Trail Use Data

Trailhead	Location	Model	R^2	B	Std. Error	Beta	t-value	Sig. (p-value)
Postpile	Postpile	(Constant)	.287	-.786	.325			
		Q9E		1.090	.120	.489	9.061	.000
		Hour Before Inbound DEPO Trail		.005	.002	.112	2.078	.039
	Rainbow Falls	(Constant)	.356	-.415	.284			
		Q9E		1.084	.118	.467	9.210	.000
		Two Hours Before Inbound Rainbow Falls Trail		.012	.003	.245	4.836	.000
Rainbow Falls Entrance	Postpile	(Constant)	.321	=.560	.308			
		Q9E		1.161	.121	.501	9.609	.000
		Two Hours Before Inbound DEPO Trail		.006	.002	.146	2.811	.005
	Rainbow Falls	(Constant)	.341	-.521	.292			
		Q9E		1.092	.121	.471	9.033	.000
		Hour Before Inbound Rainbow Falls Trail		.011	.003	.212	4.077	.000
	Reds Meadow	(Constant)	.358	-.478	.285			
		Q9E		1.075	.118	.464	9.1238	.000
		Hour Before Outbound Reds Meadow Trail		.021	.004	.251	4.946	.000

People's perceptions of how crowded a viewing area was, an evaluative measure, were more influential in determining how crowded they felt than either of the descriptive measures, the trail count data and/or the observed PAOT counts.

Effects of Inbound Vehicle & Passenger Volume on Inbound Trail Use

Vehicle counts and passenger volume were collected daily at the entrance to Devils Postpile National Monument and do not include vehicles that by-pass the monument and go directly to the parking area for the Rainbow Falls trailhead or Reds Meadow. Since the relationship between daily inbound vehicles and passenger volume is known (inbound vehicle passenger data from 2010 consists of daily totals for the number of bus and personal vehicle passengers entering the park), it is possible to conduct a direct comparison of the relationships between the number of people entering the park by vehicle and the number of people inbound on park trails, PAOT at viewing areas, and people's perceptions of crowding.

Simple Linear Regression

Daily inbound passenger volume was compared to daily inbound trail use for the Postpile trailhead and the entrance to Rainbow Falls trail counter data, and to daily outbound trail data from Reds Meadow since outbound data comprised 81% of the use along that trail. All analyses were significant (p=<.05). Daily passenger volume accounted for 69% of the variance in daily inbound Postpile trail use (Table 2.3.67). At the entrance to Rainbow Falls daily inbound passenger volume accounted for 47% of the variance; while at Reds Meadow, daily inbound passenger volume

accounted for 55% of the of the variance in outbound trail use (heading out of Reds Meadow and into the park).

Table 2.3.67. Linear Regression Analyses of Daily Inbound Vehicle Passenger Volume & Trail Use

Linear Regression Analyses of Daily Inbound Vehicle Passenger Volume & Trail Use							
Trail Location	Direction of Travel	R^2	B	Std. Error	Constant	t-value	Sig. (p-value)
Postpile Trailhead	Inbound	.689	.615	.052	111.342	11.820	.000
Rainbow Fall Entrance	Inbound	.471	.446	.059	26.826	7.618	.000
Reds Meadow	Outbound	.553	.265	.031	58.043	8.610	.000

Multiple Regression

Due to collinearity issues between vehicle volume and passenger volume, multiple regression analyses was not used to examine the amount of variance explained in daily trail use. Collinearity means that within a set of independent variables, some variables are almost totally predicted by other variables; therefore making it difficult to estimate regression coefficients. In this instance, daily inbound vehicle and passenger volume are significantly correlated since vehicle volume is used (in the case of passenger vehicles) to calculate passenger volume, hence it has been eliminated from analyses.

Predictive Modeling using Daily Inbound Passenger Volume and Daily Inbound Postpile Trail Use

A predictive model, based on the results from the simple linear regression analysis (β =.615, Constant=111.3), graphically illustrates estimates of daily inbound trail use at the Postpile trailhead from daily inbound passenger volume (Figure 2.3.25). Results predict that for every additional 500 daily inbound passengers, there will be an additional 307.5 inbound visitors using the Postpile trail.

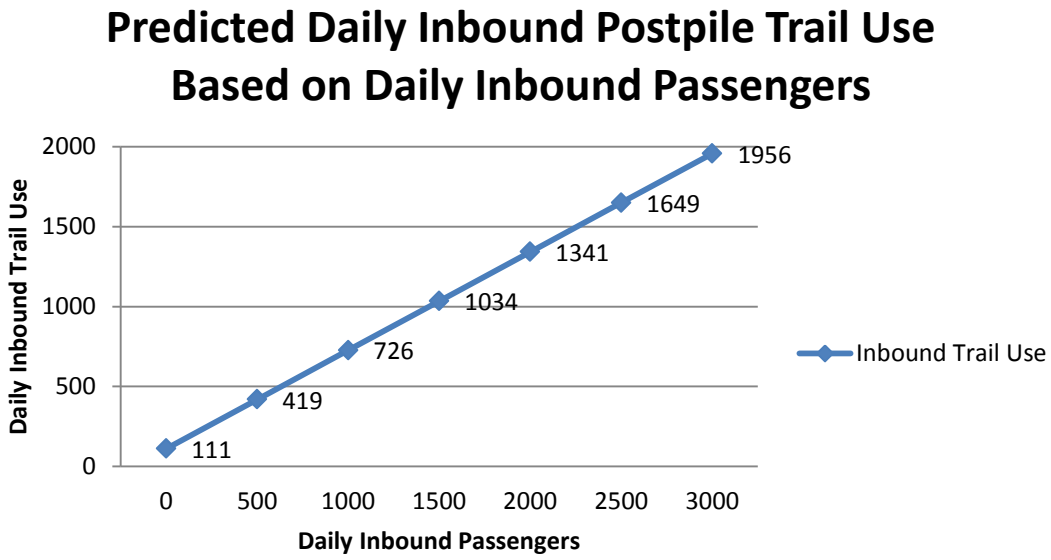


Figure 2.3.25. Predicted Daily Inbound Postpile Trail Use Based on Daily Inbound Passengers

In 2010 the maximum number of inbound passengers in one day was 2,374 which resulted in ~1,500 inbound visitors crossing the trail counter at the Postpile trailhead. The maximum number of daily inbound passengers occurring on a day in which surveys were collected was 1,561 and on that day 1,134 people used the Postpile trail. The maximum hourly trail use seen on the Postpile trail was 154 at 11:00 am on a weekend; that day total daily inbound trail use on the Postpile trail was 1,016 and total daily passenger volume was 1,556. If inbound daily passenger volume should increase to as many as 3000 visitors on any one day, then the predictive model suggests that inbound trail use will reach ~2,000, in which case maximum hourly use could reach as high as ~300 (Figure 2.3.25).

2.4 SUMMARY, DISCUSSION, & RECOMMENDATIONS FOR FUTURE RESEARCH

The purpose of this research was to estimate the level of visitor use at Devils Postpile National Monument, and to solicit visitor evaluations of their experience, in order to examine the relationships between these variables as a way of providing insights into the spatial, temporal, and experiential aspects of visitor use within the park.

General Survey Results

Visitor surveys were distributed on fifteen strategically selected days during the summer of 2010, beginning on July 8 and continuing through July 27, resulting in the collection of 584 surveys. Half of the visitors surveyed were on their first visit to Devils Postpile National Monument; 19% had visited the park on one other occasion; 22% had visited the park between three and ten times; and 5% of the visitors surveyed had been there more than ten times with some visitors reporting having visited the park on as many as 100 previous occasions. Significant results include:

- Of those surveyed, 57% of Postpile visitors, and 42% of Rainbow Falls visitors, reported being relatively unfamiliar with the park
- 42% of surveyed visitors had previously visited Rainbow Falls and 43% had previously visited the Postpile viewing area
- Gender of Postpile survey respondents' was split 50/50, while 56.5% of Rainbow Falls respondents were male and 43.5% female
- The mean age for all viewing area survey respondents was 47, the range was 18 to 82
- 93.1% of Postpile survey participants, and 94.4% of those at Rainbow Falls, were residents of the United States
- Of those surveyed, 93.8% of Postpile visitors, and 94.5% of Rainbow Falls visitors, reported having some college or a college degree
- 9% of the Postpile survey respondents, and 11% of Rainbow Falls respondents' were Hispanic or Latino
- 95% of Postpile survey respondents, and 88% of those at Rainbow Falls, reported their race as "White;"
- 3.5% of Postpile respondents reported their race as "Asian;" compared to 9% of Rainbow Falls visitors

- 84.6% of surveyed visitors at the Postpile, and 61% of those at Rainbow Falls, started their hike at the Devils Postpile Visitor Center; 31% of the Rainbow Falls respondents started their hike at the Rainbow Falls trailhead
- Hike start times peaked at 11:00 am for visitors at both viewing sites
- The number one thing that people liked least about their visit to Devils Postpile National Monument was crowding; too many people, as reported by 9% of all survey respondents

Recommendation for Future Research Based on General Survey Results

Crowding was the number one thing that visitors liked least. For many visitors, hike start times were dependent upon shuttle bus times; the earliest bus departed from the Village at Mammoth Lakes at 7:00 am, with buses then departing hourly until 11:00 am. There was also a predominance of people getting off the shuttle buses to begin their hike at the Devils Postpile Visitor Center. It is recommended that additional research examine alternative bus schedules and marketing techniques as a means of distributing visitor use more evenly amongst destination points, throughout the day, and among the days of the week. Future monitoring is also recommended to continue tracking visitor use levels on an annual basis.

Logistical Issues Pertaining to Trails and Human Impacts

Six logistical issues pertaining to trails, and six pertaining to human impacts in the park, were included in the survey. Significant results from survey respondents include:

Logistical Issues

- 99% of Postpile and 98% Rainbow Falls survey respondents reported that it was not a problem to locate trailheads
- 37.8% of the Postpile visitors that arrived by personal vehicles, and 21.6% of those at Rainbow Falls who arrived by personal vehicles, had a problem with parking availability
  90% of Postpile and 87% of Rainbow Falls survey respondents reported that there was not a problem with the amount of information provided at the trailhead about how to prepare for a hike on the trail
- 19% of Postpile and 21% of Rainbow Falls survey participants reported a problem with the amount of informational signage about the natural and cultural history of the area
- 95% of those surveyed at the Postpile and 92% of those from Rainbow Falls reported that there was not a problem with having enough directional signs along the trails
- 97% of Postpile and 91% Rainbow Falls survey respondents reported that there was not a problem with the trails being too wide

Human Impact Issues

- 94% of Postpile respondents, and 85% of those at Rainbow Falls, reported that there was not a problem with the trails being too eroded; however, 15% of Rainbow Falls respondents did feel that there was a problem with trail erosion

- 93% of those surveyed at the Postpile, and 84% of those at Rainbow Falls reported that there was not a problem with litter along the trails; however, 15% of Rainbow Falls visitors did feel that this was a problem
- 96% of Postpile and 93% of Rainbow Falls survey participants reported that there was not a problem with improperly disposed human waste evident on or near the trails
- 17% of Postpile and 21% of Rainbow Falls survey respondents reported that there was a problem with too many people on the trails
- 14% of those surveyed at the Postpile, and 12% of those surveyed at Rainbow Falls, reported that there was a problem with off-trail trampling around the viewing area

Recommendation for Future Research Based on Issues Pertaining to Trails and Human Impacts

Logistical issues in need of further research and review include parking for personal vehicles and the amount of informational signage about the natural and cultural history of the area. The human impact issues in need of future research (as over 10% of survey respondents felt these were a problem of one magnitude or another), include: trail erosion, off trail trampling around viewing areas, litter along the trails, and crowding. Crowding was the issue of most concern to visitors, with 17% of Postpile and 21% of Rainbow Falls survey respondents reporting a problem with too many people on the trails.

Perceptions of Crowding

A series of seven questions pertaining to perceptions of crowding were posed to survey respondents at both the Postpile and Rainbow Falls viewing locations. For some of those questions, visitors were shown a collection of five photographs with progressively greater numbers of people populating their current viewing location; Postpile photos ranged from zero people in Photo 1 to 50 people in Photo 5, while Rainbow Falls' photos ranged from zero people in Photo 1 to 40 people in Photo 5. Significant results include:

- 50% of the Postpile respondents and 62% of the Rainbow Falls respondents reported that encounters with other people at their viewing area added to their enjoyment
- 74% of Postpile respondents reported that 15 people in the Postpile viewing area, Photo 3, were acceptable, and 54% of the Rainbow Falls respondents also found the number of people in Photo 3, 20 people, to be acceptable
- 59% of survey participants at the Postpile viewing area, and 68% at the Rainbow Falls viewing area, found the number of people represented in Photo 5 to be unacceptable (i.e., 50 people at the Postpile viewing area at one time, and 40 people at the Rainbow Falls viewing area, were found to be unacceptable)
- Norm curves suggest that more than ~26 people at one time at the Postpile viewing area, and more than ~23 at the Rainbow Falls viewing area, begin to negatively affect visitors' experience
- 52% of Postpile survey respondents, and 47% of those at Rainbow Falls, selected Photo 3 (with 15 people at the Postpile viewing area and 20 people at Rainbow Falls) as most representative of the maximum number of people the National Park Service should allow at any one time

- The number of people in the viewing area that survey respondents would *prefer* to see at the Postpile was ~5 people; the number they would prefer to see at the Rainbow Falls viewing area was ~10 people
- 96.5% of the survey respondents were quite clear that they prefer to see lower numbers of visitors than were represented during their visit that day, which on average equaled ~14 at the Postpile viewing area, and ~11 at Rainbow Falls
- When asked the number of people at the viewing area that would cause them never to want to return, the mean for Postpile respondents was ~42 people and the mean for Rainbow Falls respondents was ~35 people
- The mean for survey respondents at both viewing areas described them as feeling slightly crowded, with 64% of Postpile visitors, and 55% of those at Rainbow Falls, reporting not feeling crowded at all

While the mean level of use at any one time (observed PAOT) reported for this study at the Postpile was 10.5 people, and 9.6 at Rainbow Falls (Table 2.3.36), visitors' perceptions were different; survey respondents' reported that the number of people at their viewing area consisted of an average of ~14 people at the Postpile, and ~11 at Rainbow Falls. Other social science studies have found similar results, where survey respondents' analyses of photographic representations of crowding conditions resulted in perceptions of crowding that differed from actual crowding conditions (Manning, et al., 2002). While there are several theories as to the cause of this effect, the results are situational and no definitive explanation has been determined. The maximum number of people that visitors found acceptable in their viewing area at one time was 15 at the Postpile and 20 at Rainbow Falls; these figures were also the maximum number of people that the survey respondents' felt the National Park Service should allow in the viewing areas at any one time. These results suggest that the volume of future visitor use may need to be disbursed (or limited) in order to continue to provide for a positive visitor experience.

Recommendation for Future Research Based on Perceptions of Crowding

It is recommended that future research based on the perceptions of crowding be conducted at regularly spaced intervals (i.e. every 5-10 years) to monitor these results.

People at One Time (PAOT)

In 2009, data was collected on the numbers of people, dogs, and horses, seen at one time in different viewing areas. In 2010, only people-at-one-time (PAOT) counts were taken. Unlike the 2009 and 2010 viewing areas at the Postpile which were not directly comparable, the 2010 viewing area at Rainbow Falls was the same area where PAOT counts were taken in 2009, allowing a direct comparison of PAOT data. In 2009, results from Rainbow Falls showed a mean hourly PAOT of 11.4, with a minimum of zero and a maximum mean hourly PAOT of 55; results from the 2010 Rainbow Falls PAOT data revealed an overall mean of 9.6, with mean hourly PAOT counts ranging from a minimum of zero to a maximum of 33 (Table 2.3.36). The average mean hourly PAOT for the two years at Rainbow Falls was 10.5, the same as the overall mean PAOT found at the Postpile in 2010, where mean hourly PAOT ranged from zero to 44. Other significant results include:

- There was no significant difference in 2010 between the Postpile and Rainbow Falls mean hourly PAOT
- There were significant differences found in total mean hourly PAOT counts by hour between the two viewing locations in 2010; PAOT counts ranging from 3.57 between 9 & 10 am, to 17.65 between 12 & 1 pm at the Postpile, and from 1.67 between 9:00 and 9:59 am, to 19.61 between 1 & 2 pm at Rainbow Falls
- In 2010, at both viewing locations, there was no significant difference between weekday and weekend mean PAOT counts
- Average visitor use at the Postpile viewing area in both 2009 and 2010 peaked between 12 & 1 pm, while visitor use at the Rainbow Falls viewing area (the first overlook), peaked between 1& 2pm.
- In 2009 the mean number of dogs at one time (DAOT) ranged from zero to 8 within any one hour period of time; the mean hourly DAOT equaled 0.55 at the Postpile viewing area and 0.73 at Rainbow Falls
- In 2009 the mean number of horses at one time (HAOT), documented at the hitching rack located at Rainbow Falls, was 1.45 per hour
- 21% of the variance in the Rainbow Falls survey respondents' answers to question10 "How crowded did you feel at this viewing area today?" is explained by the visitor-reported mean hourly PAOT
- 24% of the variance in the Rainbow Falls survey respondents' answers to question 9E: "Which photograph looks most like the number of visitors you saw at this viewing area today?" is explained by the visitor-reported mean hourly PAOT
- Rainbow Falls survey responses to question 9E, and PAOT per hour, together explain 35% of the variance in question 10; however, 9E responses were more influential than hourly PAOT counts in explaining perceptions of crowding
- Predictive modeling suggests that if there are more than 30 people at one time at the Rainbow Falls viewing area, visitors will feel moderately crowded, and if there are more than 55 people, visitors will feel extremely crowded
- Predictive modeling also suggests that when PAOT counts are low, visitors will tend to overestimate the numbers of people present, will tend to underestimate them when PAOT counts are high, and that visitors' perceptions will be accurate when there ~20 people at one time at the Rainbow Falls viewing area

Recommendation for Future Research Based on People at One Time

High levels of visitor use can pose a threat to natural resources, park infrastructure, and visitor experience; however, it should be noted that these results are purely descriptive and do not suggest that current use patterns are too high or are unsustainable. It is recommended that further research be conducted to determine the impacts and implications of current use levels on natural resources and that in the future, PAOT counts be included as an indicator which is monitored on a regular basis.

Trail Use

Trail use data was collected via TRAFx automated visitor counters at nine locations in 2009, and 3 locations in 2010: the Devils Postpile Trailhead, Reds Meadow, and at the entrance to Rainbow Falls. Automatic trail counter data was used to determine average inbound visitor use at all locations. Results from both 2009 and 2010 showed that the Devils Postpile trail received a greater amount of inbound visitor use than any other trail under examination with a daily average of 819 visitors inbound on the trail in 2009 and 863 in 2010. Other significant results include:

- The average number of visitors inbound at the entrance to Rainbow Falls was 471 per day in 2009 and 566 per day in 2010
- 2010 results from the Postpile trail included a mean daily inbound count of 863 people, a minimum daily count of 294, and a maximum daily count of 1883 people
- 2010 results from the entrance to Rainbow Falls revealed that the mean inbound daily trail use count was 566 people, the minimum was12 and the maximum was1593
- 2010 results from the Reds Meadow trail reported that mean inbound daily trail use was 87 people, the minimum was 14 and the maximum was 200
- While the amount of trail usage varied by month (from late June through early September), the variance was non-significant
- In 2009 & 2010 trail counter results revealed Saturdays to be the busiest day of the week at all trail counter locations with the exception of the Postpile trail, which was found to be highest on Sundays in 2010
- There was no significant difference between trail use, based on the day of the week, for either the Postpile trail or Reds Meadow trail; however, Rainbow Falls were significantly busier on Saturdays and Sundays
- In 2010, peak hourly usage recorded by the Postpile trail counter occurred at 11am, while it is estimated that peak hourly usage at the Rainbow Falls trail counter occurred at 1 pm, and Reds Meadow at 2 pm
- 2010 outbound visitor use at the Reds Meadow trail (heading into Reds Meadow and away from Rainbow Falls) peak usage was also recorded at 2 pm
- 2010 mean inbound trail use on the Postpile and Rainbow Falls Trails was heavier during weekends than on weekdays; however, the Reds Meadow Trail counters recorded slightly more use on weekdays than on Saturdays and Sundays
- Inbound visitors who crossed the Postpile trailhead counter an hour earlier, accounted for 19.3% of the variance for Postpile PAOT, those crossing two hours earlier accounted for 48% of the Rainbow Falls mean hourly PAOT
- Inbound visitors crossing the trail counter at the Rainbow Falls entrance (one hour before) explained 60.5% of the variance in the mean hourly Rainbow Falls PAOT counts; however, did not significantly account for any of the mean hourly PAOT counts taken at the Devils Postpile viewing area
- Reds Meadow inbound trail use estimations an hour earlier explain 8% of the variance from PAOT counts taken at the Rainbow Falls viewing area but none of the variance from PAOT counts taken at the Postpile

- Hourly mean PAOT at the Postpile viewing area was significantly related to the mean hourly trail use taken from the Postpile trailhead and the entrance to Rainbow Falls, R^2=.266 (p <.01)
- Rainbow Falls hourly mean PAOT counts were significantly related to the mean hourly trail use data taken from all three trail counters, R^2=.66 (p <.01)
- Results of a predictive model show that for every additional 25 people crossing the trail at the Rainbow Falls entrance, there will be 3.675 additional people included in the mean hourly PAOT counts at the Rainbow Falls viewing area

Recommendation for Future Research Based on Inbound Trail Use

As with PAOT counts at viewing areas, high levels of visitor use on trails can also pose a threat to natural resources, park infrastructure, and visitor experience; however, it is worth repeating that these results are purely descriptive and do not suggest that current use patterns are too high or are unsustainable. It is recommended that further research be conducted to determine the impacts and implications of current use levels on natural resources and that in the future, inbound trail use is included as an indicator with regular monitoring advised to assist in maintaining desired natural and experiential trail conditions.

Vehicle and Passenger Volume

Strong relationships to vehicle traffic and passenger volume were found in this study in both 2009 and 2010, likely the result of the "closed" nature of the DEPO transportation system (i.e. a single road into the area and the requirement of riding a bus unless camping in the park). Significant results found during the 2010 study period, conducted between June 24th and September 8th, include:

- Inbound DEPO vehicle volume, equaled a total of 11,442 vehicles carrying 91,253 passengers
- On average 30 shuttle buses and 94 personal vehicles entered the park daily
- Personal vehicles (cars, motorcycles, RV's, etc.) comprise 81.5% of the total vehicle volume entering the park
- The overall averages for passengers equaled 27.7 people per bus and 3.5 people per personal vehicle (or 8 people per vehicle)
- 64.2% of all passengers arrived by bus (an average of 826 bus passengers per day), and 35.8% by personal vehicle (an average of 330 people per day)
- Monthly mean vehicle volume ranged from a low of 54 vehicles (of all types) per day entering the park in September to a high of 164 vehicles per day in July
- Determined collaboratively by NPS and the ESTA, the overall average was 30 shuttle buses per day serving DEPO in both July and August, the busiest months of the summer
- June and July both received 82% of vehicle volume from personal vehicles, while August saw personal vehicle volume drop to 75%
- Overall, July was the busiest month for vehicle volume, with an average of 134 personal vehicles per day entering the park, as compared to 124 personal vehicles per day entering in June, 89 in August and 35 in September

- Variance in shuttle bus service is pre-determined by the ESTA with an average of 32 shuttle bus runs a day, Monday through Thursday, 38 runs offered on Fridays, 50 on Saturdays and 44 on Sundays
- Statistically significant differences were found between inbound personal vehicle volume on weekdays, weekends and holidays; personal vehicle volume was highest on Fridays, averaging 122 vehicles per day, Saturdays had a mean of 112 vehicles per day, Sundays a mean of 97 vehicles per day, and weekdays ranged from 81-85
- Daily passenger volume accounted for 69% of the variance in daily inbound Postpile trail use, 47% of the variance at the entrance to Rainbow Falls, and 55% of the of the variance in outbound trail use at Reds Meadow
- Predictive modeling suggests that if inbound daily passenger volume should increase to as many as 3000 visitors on any one day, inbound trail use will reach ~2000, in which case maximum hourly use could reach as high as ~300

Recommendation for Future Research Based on Vehicle and Passenger Volume

It is recommended that as indicators, future research on vehicle traffic and passenger volume be conducted annually to assist in maintaining desired conditions within the park. Results suggest that the current transportation system, requiring that the majority of visitors access DEPO via public bus, effectively manages both vehicle and passenger volume. While there were some negative responses in the survey comments, only 6% pertained to mandatory use of the shuttle bus system, and 5% were directed toward conditions on the buses. Regular routine monitoring of shuttle bus conditions and passenger satisfaction is suggested.

2.5 VISITOR USE CONCLUSION

The research presented in this report provides a quantitative understanding of how visitor use levels (i.e. PAOT at viewing areas) affects various park management concerns and visitor experience. These results can be used to inform, and potentially guide, management decisions about visitor use in Devils Postpile National Monument. These data suggest that visitors are largely tolerant of crowding related to current levels of use; however, park managers may choose to manage for a more dispersed and subsequently smaller visitor volume in order to provide a less crowded, more intimate, and potentially higher quality visitor experience. Decisions about what levels of visitor use should be accommodated is best informed by considering the overall effects of use levels on visitor experience, park resources, and park operations (e.g. parking capacity or PAOT at the viewing areas) in order to maximize park operations and visitor experience while minimizing impacts on natural and cultural resources; the regular monitoring of social and experiential indicators can help inform those decisions.

3 WATER QUALITY

3.1 INTRODUCTION TO WATER QUALITY

During the summer and early fall of 2009, NPS staff sampled water quality along the Middle Fork of the San Joaquin River corridor within Devils Postpile National Monument (DEPO) to obtain baseline water quality information. The objective of this sampling was to assess, to the extent possible, influences of human-use on the river corridor, and to begin the process of establishing site-specific water quality standards. Provided that baseline sampling indicates good water quality, standards would be developed to help protect these water quality indicators and prevent them from degrading.

3.2 MEASUREMENT

The following constituents were measured: fecal coliform, nutrients (total dissolved nitrogen, nitrate and nitrite, total dissolved phosphorus, orthophosphate, and total phosphorus), and total petroleum hydrocarbons. A summary is provided of the analytical methods used and any applicable state standards (Table 3.2.1). Associated field data collected with each water quality sample included water temperature, and specific conductivity.

Proposed Standard: Anti-degradation for each segment measured per NPS policies (2006) and State of California San Joaquin Basin Plan (1988).

Table 3.2.1 Water Quality Constituents Sampled in 2009

Constituent	Analytical Method	Analytical Reporting Limit	California Standard	Source Document
Total Dissolved Kieldahl Nitrogen (DKN)	EPA 351.2[1]	0.0035 mg/l	None	
Nitrate + Nitrite (NO3+NO2)	EPA 353.1[1]	0.001 mg/l	10 mg/l (Drinking water)	State of California Regulations, Title 22 – Drinking water standards, Maximum Contaminant Levels - Inorganic Chemicals
Total Phosphorous (TP)	EPA 365.3[1]	0.001 mg/l	None	
Total Dissolved Phosphorous (DP)	EPA 365.3[1]	0.001 mg/l	None	
Orthophosphate (OP)	SM 4500-PE[2]	0.001 mg/l	None	
Fecal coliform	SM 9221E[2]	2 MPN/100ml (MPN = Mean Probable Number of bacterial colonies)	Five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml.	State of California, 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region. Fourth Edition—1998. California Regional Water Quality Control Board.
Total Petroleum Hydrocarbons (TPH)	EPA 306M[1]	13-17 µg/l	Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.	State of California, 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region. Fourth Edition—1998. California Regional Water Quality Control Board.

3.3 FIELD METHODS

Sampling

Sampling took place in 2009 on a monthly basis from the end of June through the end of September (four sampling events) at three locations (Figure 3.3.1). Quality control procedures included the collection and analysis of field blanks and replicates for nutrients. Details of the sampling protocol may be reviewed in the "Visitor Use and Impact Monitoring: Field Guide" (Yosemite National Park, 2011).

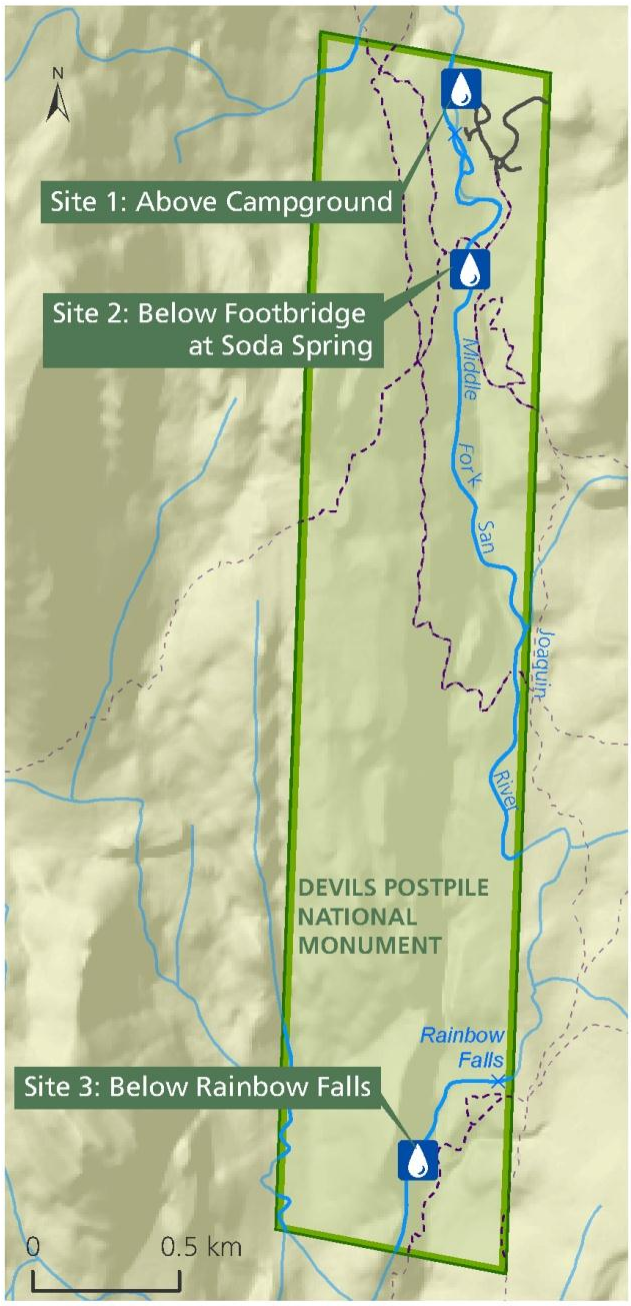


Figure 3.3.1. Water Quality Sampling Locations on the Middle Fork of the San Joaquin River

3.4 RESULTS

Analytes from the 2009 sampling effort include: nitrate and nitrite (NO3/NO2), total dissolved kieldahl nitrogen (DKN), orthophosphate (OP), dissolved phosphorous (DP), total phosphorous (TP), fecal coliforms (FC), and total petroleum hydrocarbons (TPH). Data distribution by site is provided, which summarizes quality control analytical results for 2009 which were quite good (Table 3.4.1). Quality control samples (field equipment blanks and replicates) accounted for 25% of the sample load and indicate consistent laboratory results and minimal sample contamination.

Table 3.4.1 2009 Water Quality Data Summary by Site

Site Name	Sample Date	NO3/ NO2	DKN	OP	DP	TP	FC	TPH
		(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	MPN/100 ml	ug/L
San Joaquin River above Campground	6/30/2009	0.03800	<0.0035	0.00100	0.00200	0.00400	4	
	7/29/2009	0.00100	<0.0035	0.00200	0.00400	0.00500	11	
	8/31/2009	0.00800	<0.0035	0.00300	0.00800	0.00900	9	
	9/29/2009	0.00400	<0.0035	0.00400	0.01200	0.01300	2	
San Joaquin River below Footbridge at Soda Spring	6/30/2009	0.03500	<0.0035	0.00100	0.00300	0.00400	2	<13.8
	7/29/2009	0.00300	0.04500	0.00200	0.00500	0.00600	8	<13.4
	8/31/2009	0.00500	<0.0035	0.00400	0.01000	0.01200	4	<13.8
	9/29/2009	0.00300	<0.0035	0.00800	0.01700	0.01800	2	<13.7
San Joaquin River below Rainbow Falls	6/30/2009	0.03200	0.04900	0.00400	0.00600	0.00700	6	
	7/29/2009	0.00100	0.04000	0.00800	0.01100	0.01400	22	
	8/31/2009	0.00500	<0.0035	0.01600	0.02500	0.02700	9	
	9/29/2009	0.00100	0.03600	0.00100	0.04100	0.04200	2	

3.5 DISCUSSION

The results above show that water quality in this reach of river is quite good. The limitations of this data are: 1) it represents only a single summer season, 2) it does not include samples collected during infrequent summer storms that can mobilize contaminants into the river, and 3) it only reflects general conditions along the river in this area as this sampling was not intended to identify specific potential point sources of contamination. While these data could be used to form the basis of site-specific water quality standards, additional baseline data from a larger sample of years, including storm events, would increase the robustness of an eventual standard(s).

4 INFORMAL TRAILS

4.1 INTRODUCTION TO THE EXTENT AND PROLIFERATION OF INFORMAL TRAILS

Informal trailing has been identified as a potential indicator for impacts to the sensitive natural resources of DEPO as well as to the visitor experience. The initial objectives for trail monitoring at DEPO were to: 1) Understand informal trail use at destination areas in order to form a baseline for overall extent and condition of informal trails at high-use sites, and 2) Quantify informal trail networks in meadows and determine the degree of potential resulting habitat fragmentation.

Managing informal trails is a constant challenge to resource managers at parks and protected areas. Understanding their distribution, level of degradation to the resource, and impacts to ecological integrity are important tools for implementing management actions. Monitoring the occurrence and proliferation of informal trails at visitor destinations and in meadows informs park management on the overall extent of these impacts and provides a tool for tracking changes as management actions are implemented. Additionally, studying informal trail networks in meadows allows us to gain a better understanding of the impacts and condition of resulting trails which can be analyzed to assess the degree of habitat fragmentation caused by such uses.

With these objectives, biological technicians from Yosemite National Park (YOSE) worked to assess informal trail impacts at destination sites in DEPO, as well as in a sensitive riparian ecosystem, in 2009 and 2010. Efforts were made to inventory and measure informal trails at three sites: Soda Springs Meadow, Rainbow Falls, and the Postpile formation. The purpose of this report is to discuss the findings related to the implementation of a long-term monitoring site at the Soda Springs Meadow and to discuss secondary attempts at quantification of impacts at key destination sites.

In an effort to select applicable indicators for consideration as long-term monitoring tools within the monument, informal trails seemed to represent several characteristics that would make this a useful study tool and potential long-term indicator. Based on the success of informal trail monitoring efforts in YOSE, and the development of fragmentation indices specifically for trailing impacts in meadows (National Park Service, 2009), YOSE researchers recorded trail impacts in the meadow surrounding Soda Springs.

4.2 INFORMAL TRAIL IMPACTS

Informal trails, or visitor-created "social" trails, may be defined as discernible and continuous trail segments that were created by visitors and which do not follow a park's formal trail system (Leung, Shaw, Johnson, & Duhaime, 2002). Since informal trails are not planned or constructed, they are usually poorly located with respect to terrain. These trails also receive very little or no maintenance, substantially increasing their potential for degradation in comparison to formal trails. The proliferation of informal trails may increase habitat fragmentation and can directly threaten sensitive habitats when crossed or accessed by unplanned trails (Marion, Leung, &Nepal, 2006). From a social perspective, a web of informal trails creates a visually scarred landscape and may lead to safety and liability concerns. Other major concerns based on the proliferation of informal trails are soil loss, soil compaction and erosion (Monz, 2010; Hammitt & Cole, 1998; Leung & Marion,

1996). Due to the proximity of Devils Postpile to the San Joaquin River, social trailing also has the potential to lead to impacts on water quality and aquatic organisms through increased sedimentation.

Most previous informal trail studies focused on their proliferation (i.e., the number of places they occurred), throughout the park landscape. These studies did not include any added information about the trail (e.g., trail length, width, or classification was not recorded). This approach makes it difficult to assess the affect trails may have on the resources. Fortunately, three main monitoring approaches have been developed specifically for informal trails. One approach is to include informal trails as part of an overall visitor-impact study. In this type of study, the level of informal trail proliferation is assessed by tallying the occurrence of informal trail segments extending from formal trail networks or recreation sites (Marion 1994; Leung et al., 2002). Another approach is to inventory and map the entire informal trail network of a park or selected portions of a park (Cole, Watson, Hall, & Spildie, 1997; Leung et al., 2002). The third approach, used to enable temporal evaluation, is to monitor informal trail networks more than once over a period of time (Yosemite National Park, 2009; Leung, Newburger, Jones, Kuhn, & Woiderski, 2010). Condition-class ratings and assessments were incorporated into most of the previous studies using these approaches.

Many studies have also utilized GPS technology for mapping and classifying informal trail networks in parks and protected areas (Rochefort & Swinney, 2000; Nisengard & Sherwood, 2008; National Park Service, 2009). This approach is appropriate to open meadow areas, but can provide difficulties in forested sites or narrow canyons with limited satellite reception, such as those at DEPO's Postpile formation and Rainbow Falls. As discovered in 2009, the monument's steep canyon walls make it difficult to gather accurate GPS data at both locations; however, GPS mapping was attempted again in 2010 with more success at the Postpile site.

4.3 Field and Data Analysis Methods

In 2009, technicians made several attempts at collecting informal trail data at both the Rainbow Falls and Postpile attraction sites. Measurement of these impacts depends on the use of GPS technology to record exact location, trail length, and other contributing information. GPS technology relies exclusively on the receiver's ability to acquire adequate satellite reception (typically a minimum of four satellites). Physical barriers such as vertical cliff walls, dense tree canopy, or a rock outcropping, can greatly reduce a receiver's ability to acquire satellites and therefore render the accuracy-based GPS unit useless for that area. Despite several repeated attempts to record information at these locations in 2009, technicians were unable to obtain data with an acceptable level of accuracy.

To address this issue, a different method of mapping informal trails was tested in 2010 at the Rainbow Falls attraction sites which combined recording trail segment measurements by hand and collecting point features on a handheld GPS unit. Adequate satellite coverage allowed the documentation of trails via GPS at the Soda Springs Meadow study area in both 2009 and 2010 but results were only acceptable in 2010 at the Postpile attraction site.

Both methods follow the same protocol for the identification and characterization of trails and disturbed areas. When choosing the appropriate condition class, lists of characteristics and photo

examples were used as guides (Figure 4.3.1, Figure 4.3.2, Figure 4.3.3, & Figure 4.3.4). Detailed instructions for mapping protocols are available in the "Visitor Use and Impact Monitoring: Field Guide" (Yosemite National Park, 2011).



Figure 4.3.1. Characteristics & Examples of the Stunted Vegetation Condition Class





Figure 4.3.2. Characteristics and Examples of Some Bare Ground & Barren Condition Classes

Feature: Disturbed Area

General characteristics:

- Polygon-type shape
- High-use area
- Must exhibit one of the following condition-classes: Stunted vegetation, some bare ground or barren

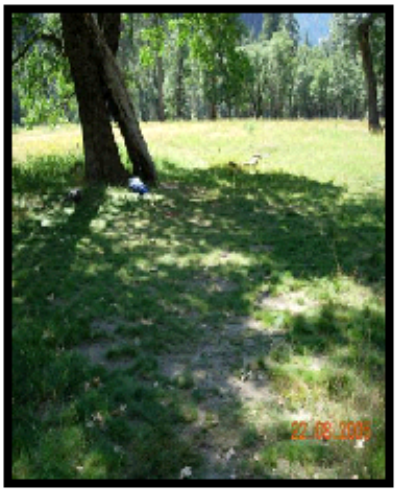


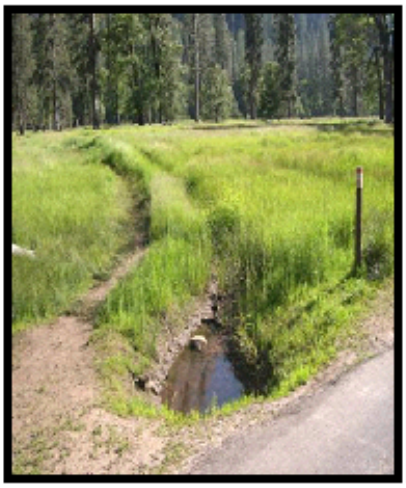


Figure 4.3.3. Characteristics & Examples of a Disturbed Area

Informal trail features: Single Trail and Braided Segment

General characteristics:

- Two or more adjacent trails (5 feet apart maximum)
- Must be a minimum of 25 feet in length
- Must exhibit one of the following condition-classes: Stunted Vegetation, Some Bare Ground and/or Barren





Informal trail feature: Single Trail

General characteristics:

- Trail with depth greater than 6 inches
- Must be a minimum of 25 feet in length
- Must exhibit one of the following condition-classes: Stunted Vegetation, Some Bare Ground and/or Barren



Figure 4.3.4. Characteristics and Examples of a Braided Trail Segment & a Single Trail

Meadow Boundary

The meadow boundaries were mapped in 2009 with Trimble GeoXT handheld GPS units. Meadow boundaries are determined based on the canopy edge of the forest/meadow vegetation.

Post-collection and Data Management

At the end of each day, technicians downloaded the GPS data and photos, updated photo-documentation logs and time-spent records, and charged the GPS units. All GPS data were differentially corrected before any GIS analysis is performed, with rover files differentially corrected as early as the day after initial data collection. Corrected (.ssf) files were then exported to shapefiles, which were used to create maps and for use in analysis. All of the informal trail and disturbed area data collected as point features were converted into lines and polygons respectively, for analysis and display purposes. Metadata information was documented for the GIS data at the time of shapefile creation.

4.4 DATA ANALYSES

The following data analysis procedures have been adapted from those developed in YOSE to assess habitat fragmentation in meadow ecosystems. Fragmentation analyses and informal trail density were only applied to data collected in Soda Springs Meadow. Total extent and proliferation of trails and disturbed areas were calculated for the Postpile and Rainbow Falls attraction sites.

Fragmentation Analyses

Weighted Mean Patch Index (WMPI)

This index was built on the Mean Patch Size (MPS) metric described by McGarigal and Marks (1995). Despite its intuitiveness, this index proved to be less effective in capturing the effect of informal trails and disturbed areas on patch size. To address this limitation, a weighting factor (wf) was added to adjust for the spatial extent of informal trail network. It is defined as the average area (in square meters) of all patches without informal trails in a landscape, weighted by the extent of disturbed areas associated with informal trail impacts. In other words, this index is indicative of the average size of patches without informal trials with consideration of the dominance of informal trail features in a landscape (Table 4.4.1). Interpretation: Decreasing values indicate increasing degrees of fragmentation. Increasing spatial extent of informal trails would result in reduced index values even if the average patch size does not change.

Table 4.4.1. Calculation of the Weighted Mean Patch Index

Calculation of the Weighted Mean Patch Index				
Metric	WMPI = wf * (∑ aij / n) * (1/10000); where wf = (∑ aij / A)			
Notations	aij = area (m2) of patch ij	n = total # of patches without informal trails	wf = weight factor	A = landscape/meadow area
Unit	Square Meters			
Range	0-Infinity			

Largest Patches Index – Five (LPI-5)

Adapted from the concept of "Largest Patch Index" (McGarigal & Marks, 1995), this index is derived from the sum of areas of the five largest patches without informal trails, divided by total landscape (meadow) area (Table 4.4.2). The main purpose of including the largest patches as a group, rather than merely the largest patch, is to reduce the index's over-sensitivity to changes in one single patch. Three and ten of the largest patches (LPI-3, LPI-10) were also considered, and five was chosen by the research team and park staff to achieve a balance between simplicity and representativeness. This index could be easily adapted if a different number of patches was desired in a later date. Interpretation: Decreasing values would suggest increasing degrees of fragmentation.

Table 4.4.2. Calculation of the Largest Patches Index - Five

Calculation of the Largest Patches Index - Five			
Metric		$LPI\text{-}5 = \sum max5\ (aij) / A * 100\%$	
Notations	maxi = the largest i patches	aij = area (m2) of patch ij	A = area (m2) of the landscape (meadow)
Unit		Percent	
Range		0-100	

Extent and Proliferation Analyses

Additional indices were used to determine the change in trail density and proliferation when compared with previous data. The following are descriptions of the additional indices:

- Median Patch Size: the average median patch size; decreasing value suggests increasing fragmentation
- Total Extent of Impact: the sum of the total areas of informal trails and disturbed areas; increasing value suggests increasing trailing
- Total Percent of Impact: the extent of impact divided by the total meadow area; increasing value suggests increasing trailing

Influence Zone

Based on work by Holmquist and Schmidt-Gengenbach (2008), a five-meter buffer was added to the informal trails and disturbed areas in the analysis of Soda Spring meadow. The justification for this buffer is based on studies in the Tuolumne meadows area of YOSE that determined the measure of impacts to terrestrial macroinvertebrate communities in relation to trail-impacts. As the invertebrate communities and overall ecology of the meadows within the San Joaquin drainage are comprised of different species and compositions, this measure is solely intended as a tool for analysis. Through the lens of this buffer, it is possible to determine the actual extent of such impacts and the potential for habitat fragmentation and impact. This influence zone allows the consideration of areas beyond the measureable impacts that could reflect disturbance to vegetation and animal communities.

4.5 RESULTS

Results for Rainbow Falls and the Postpile Attraction Sites

The 2010 results of total length of trails include 330 meters at Rainbow Falls and 889 at the Postpile (220 meters above the formation and 669 meters below); total impact extent (informal trails plus disturbed area polygons) at Rainbow Falls equaled 333 meters, while the Postpile attraction site had an extent of impact of approximately 2, 717 meters (405 meters above the formation and 2312 below) (Table 4.5.1). The Postpile formation and Rainbow Falls attraction sites were analyzed for total length of trails and total impact extent only, due to poor satellite reception below the Postpile and at the base of Rainbow Falls; hence, the numbers for these locations are approximate. The spatial distribution of informal trails and disturbed areas are illustrated graphically (Figure 4.3.1, Figure 4.5.2).

Table 4.5.1. 2010 Informal Trail Results for the Rainbow Falls and Postpile Attraction Sites

2010 Informal Trail Results for the Rainbow Falls and Postpile Attractions Sites		
Location	Total length of trails (m)	Total impact extent (m²)
Rainbow Falls	330	333
Postpile Formation (total)	889	2717
Above Formation	220	405
Below Formation	669	2312

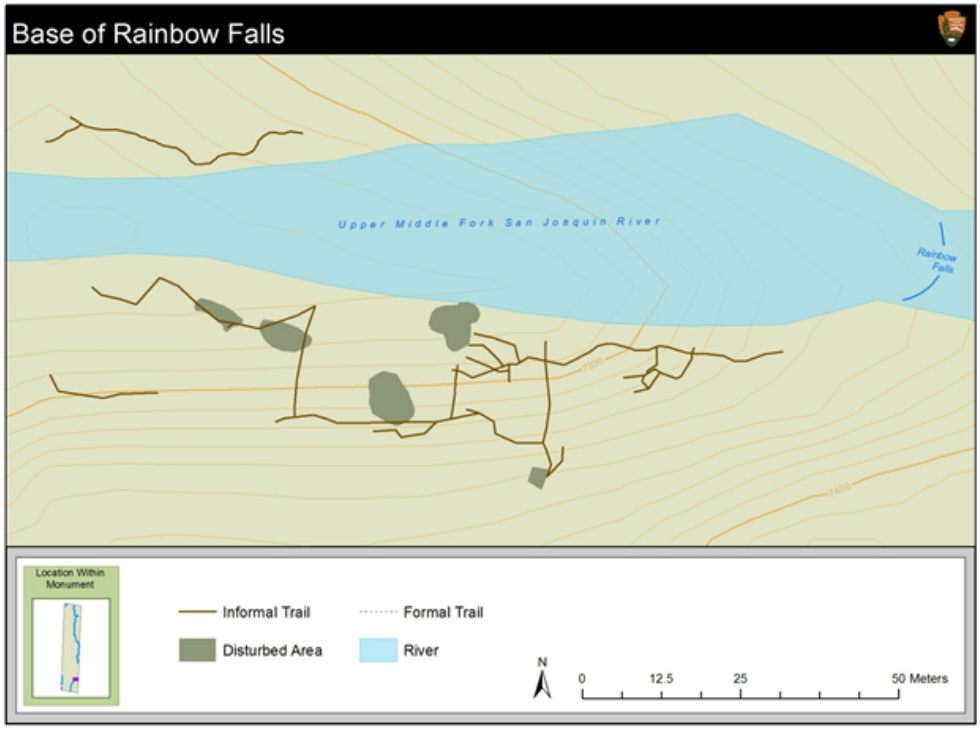


Figure 4.5.1. Informal Trails at the Rainbow Falls Attraction Site

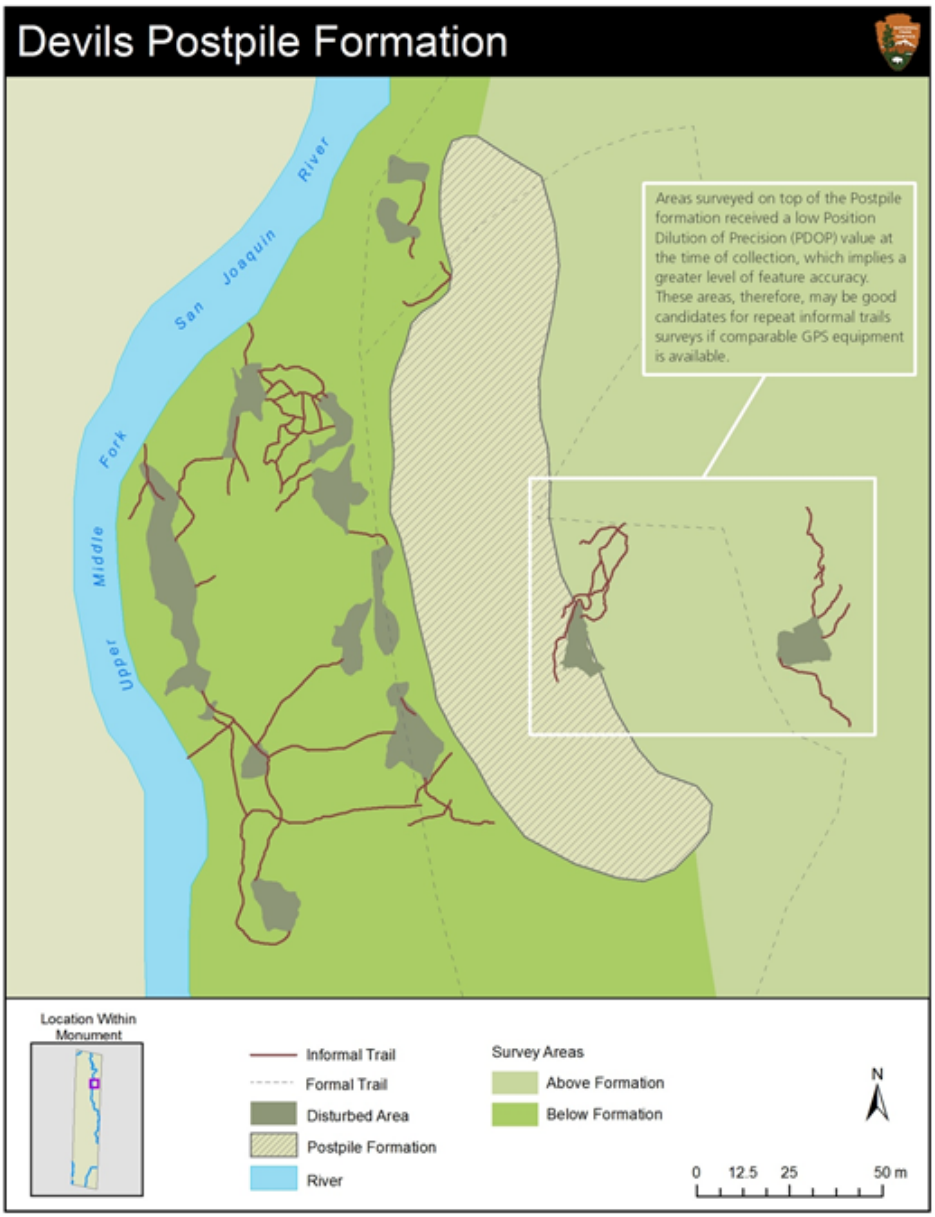


Figure 4.5.2. Informal Trails at the Postpile Attraction Site

Results for Soda Springs Meadow

Soda Springs Meadow was analyzed for all fragmentation indices, including total extent and total percent of impact for both 2009 and 2010 (Table 4.5.2). Observed informal trails impacts (by classification and width) are presented graphically for each study site (Figure 4.5.3, Figure 4.5.4).

Table 4.5.2. Results of 2009 & 2010 Fragmentation Analyses & Extent of Total Impact in Soda Springs Meadow

Results of 2009 & 2010 Fragmentation Analyses & Extent of Total Impact in Soda Springs Meadow

Soda Springs Meadow (Main Section)

	No influence zone		5-m influence zone	
Index	2009	2010	2009	2010
Weighted Mean Patch Index (WMPI)	0.358 ha (wf = 0.995)	0.088 ha (wf = 0.963)	1.452 ha (wf = 0.897)	0.387 ha (wf = 0.802)
Largest Patches Indices (LPI-5)	99.55%	96.08%	89.69%	80.24%
Number of patches	5	19	1	3
Median Patch Size	17.93 m²	3.98 m²	16183.10 m²	42.61 m²
Density of Informal Trails	124.61 m/ha	188.36 m/ha	124.61 m/ha	188.36 m/ha
Total Impact Extent (informal trails + disturbed areas)	82 m² (0.45% of meadow area)	664 m² (3.68% of meadow area)	1860 m² (10.31% of meadow area)	3566 m² (19.76% of meadow area)

Soda Springs Meadow (North Section)

	No influence zone		5-m influence zone	
Index	2009	2010	2009	2010
Weighted Mean Patch Index (WMPI)	0.238 ha (wf = 0.980)	0.046 ha (wf = 0.960)	0.161 ha (wf = 0.807)	0.141 ha (wf = 0.754)
Largest Patches Indices (LPI-5)	97.96%	95.76%	80.73%	75.37%
Number of patches	2	10	2	2
Median Patch Size	2426.43 m²	14.23 m²	1999.77 m²	1867.00 m²
Density of Informal Trails	206.17 m/ha	222.45 m/ha	206.17 m/ha	222.45 m/ha
Total Impact Extent (informal trails + disturbed areas)	101 m² (2.04 % of meadow area)	196 m² (3.95% of meadow area)	955 m² (19.27% of meadow area)	1220 m² (24.63% of meadow area

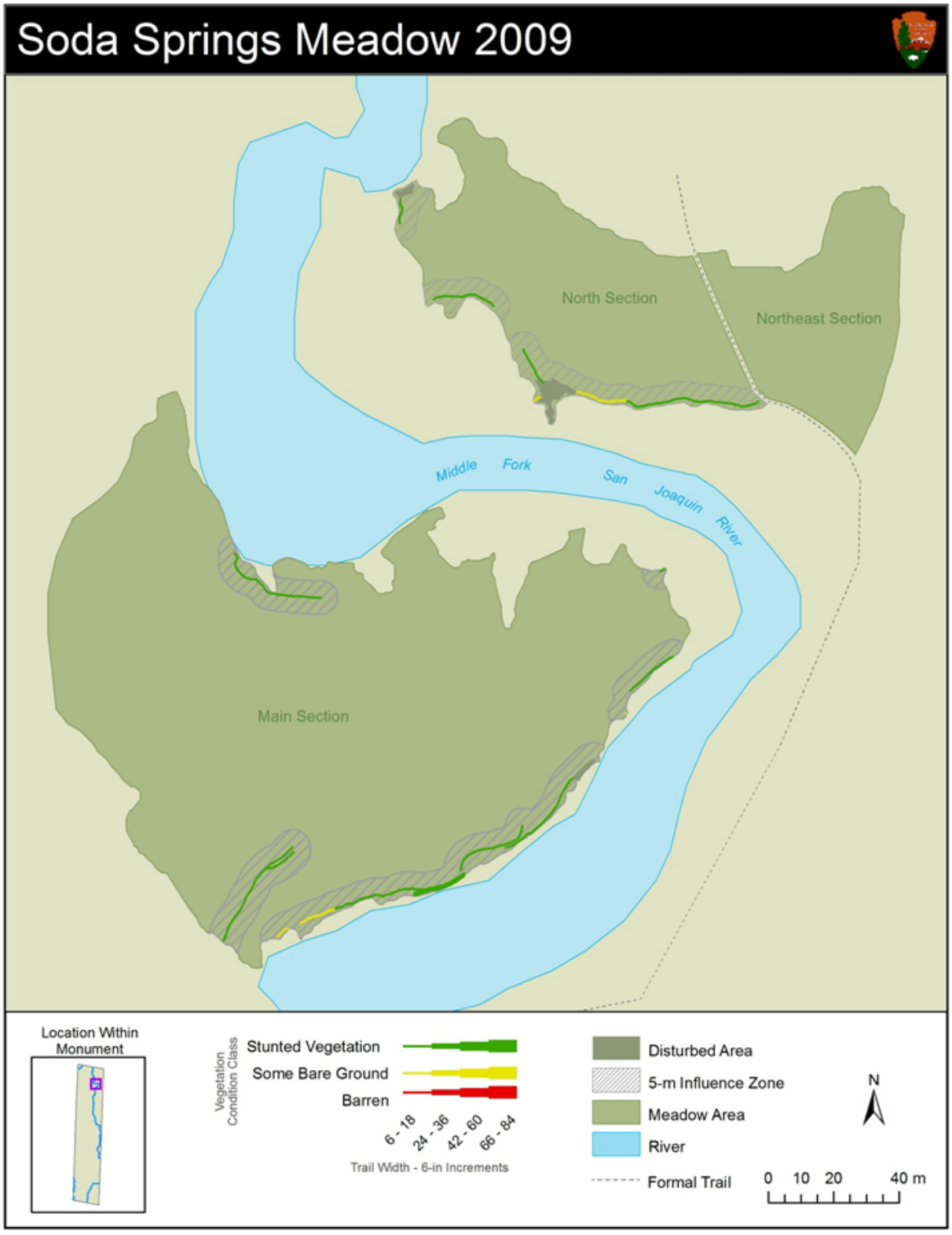


Figure 4.5.3. Informal Trails by Classification & Width in Soda Springs Meadow as Observed in 2009 (Baseline Condition)

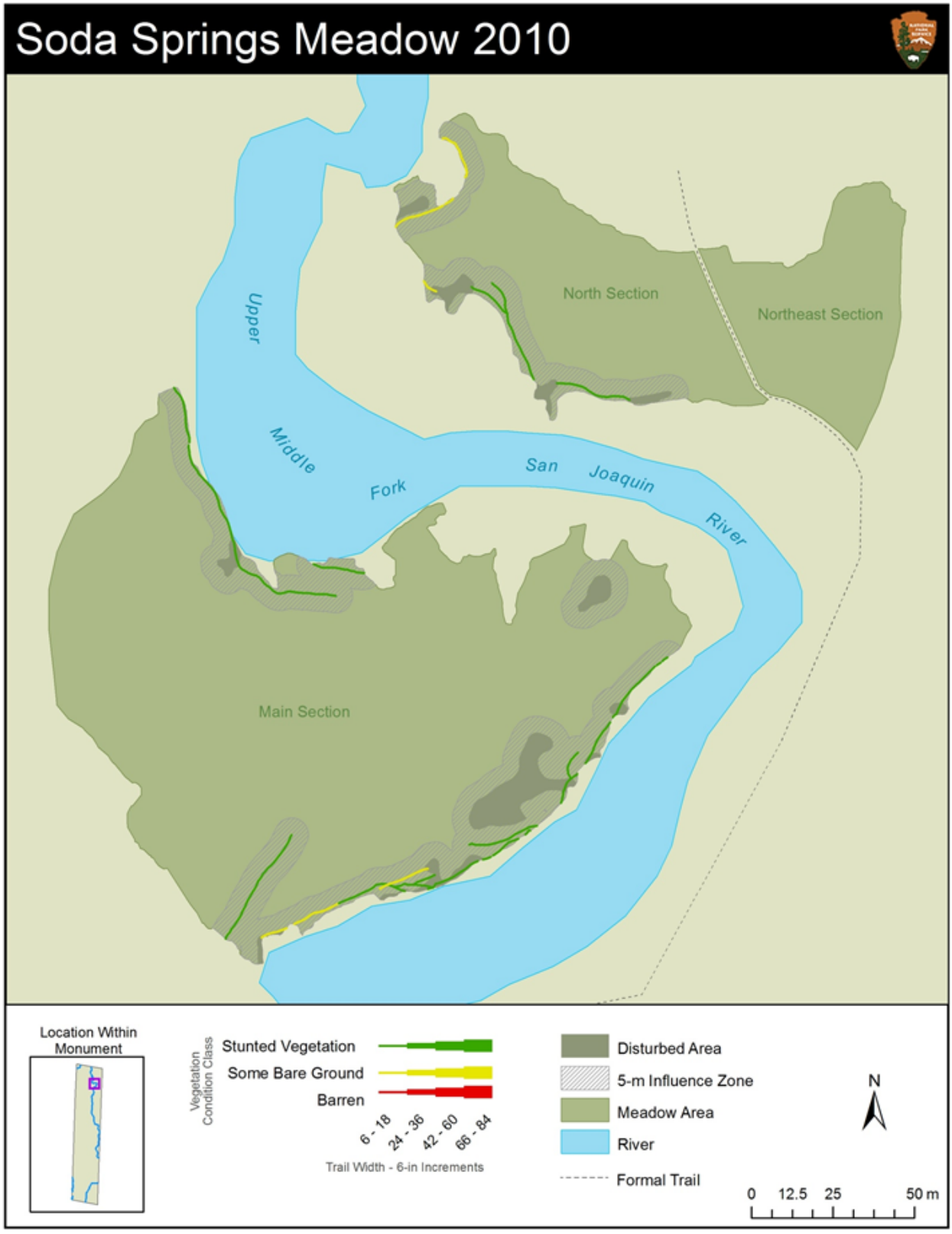


Figure 4.5.4. Informal Trail Impacts by Classification & Width in Soda Springs Meadow as Observed in 2010

4.6 DISCUSSION

The intent of these observations is to aid in the establishment of baseline conditions concerning visitor use impacts in Soda Springs Meadow, at the base of Rainbow Falls, and above and below the Postpile formation. Baseline conditions were observed in Soda Springs Meadow in 2009 and monitored again in 2010 providing comparative data for this site. Analytical results show an increase in observed impact extent for both sections of the meadow from 2009 to 2010; the total impacted area in the main section increased from a total of 82 m^2 in 2009 to 664 m^2 in 2010 while the north section experienced an increase in total extent of impact from 101 m^2 to 196 m^2 (Table 4.5.2). Despite the increase in impact extent, however, these trails did not exhibit more highly degraded condition classes than in 2009. The majority of the trails fall under the stunted vegetation condition class which has a much higher potential for recovery than other condition classes. Current management efforts, including maintained fencing and a formalized trail system, are intended to help to mitigate heavy visitor use within the meadows, thus allowing the meadows to maintain some impacts at lower levels of degradation. Though these two years of data show an increase in the extent of trampling in Soda Springs Meadow, we cannot assume an increasing trend in impacts for this area until additional years of data have been collected. The standard method of using GPS and GIS technology has proven to be suitable for this location.

Baseline conditions at the Postpile formation and Rainbow Falls were observed in 2010. The standard method of utilizing a handheld GPS unit was employed at the areas above and below the Postpile, while a second method (Method #2), which employed both GPS and manual means of recording locations, was used at the base of Rainbow Falls. The method called for using a combination of GPS points, hand-drawn maps, and on-the-ground measurements to create a suite of representative impact features in GIS. Areas surveyed with a GPS unit on top of the Postpile formation received a low "Position Dilution of Precision" (PDOP) value at the time of collection, which implies a greater level of feature accuracy; therefore, these areas may be good candidates for repeat informal trails surveys if comparable GPS equipment is available (Figure 4.5.2).

Feature accuracy was much lower at the base of the Postpile and Rainbow Falls; potentially due to the fact that Method #2 provided some challenges, both during data collection and during data post-processing, resulting in a greater possibility of inaccuracies in the data. As stated earlier, the positional accuracy of the GPS data was very poor to begin with, making it difficult to match the points with their corresponding measurements and field notes. The resulting map (Figure 4.5.1), is a general representation of trails observed at the base of Rainbow Falls and is not to be considered an absolute depiction of trailing impacts. For example, the total length of trails using on-the-ground measurements for the left side of the riverbank equaled 231 meters (added up from field data sheets), while measurement tools in GIS calculated 282 meters of trail from the shapefile that was created during post-processing (which used the GPS points to determine trail locations).

It is recommended that the informal trails indicator continue to be regularly monitored in DEPO as a means of providing data to assist in the protection of both the cultural and natural resources of the park; however alternative methods for capturing visitor use impacts (i.e., photographic monitoring), should be explored for the locations below the Postpile and at the base of Rainbow Falls, unless advanced GPS equipment becomes available for future monitoring attempts.

5 RIVERBANK CONDITION

5.1 INTRODUCTION

Riverbank condition (RBC) is a potential indicator of river health because the soils and vegetation that stabilize river banks are essential to the integrity of riparian ecosystems. Although soil erosion occurs along the river as a result of natural river processes, such erosion can be accelerated and exacerbated by human activities (Kondolf, Kattelmann, Embury, Erman, 1996). Riparian soils and vegetation influence water quality by regulating the entry of groundwater, surface runoff, nutrients, sediments and other particulates, and fine and coarse organic matter to rivers and streams. Accelerated erosion, associated with trampling and visitor access, can alter these processes, leading to changes in hydrologic function and water quality. This indicator is valuable for assessing a site's ability to sustain varying types and levels of visitor use.

Measurement

The primary areas of concern for riverbank condition measurement purposes are alluvial sections, where riverbanks are made up of material transported by the river at one time. In the case of DEPO, the only area that fits this description is the meadow area adjacent to the visitor center and campground. One, 100-meter long, sample reach (RBC Site 001), was established in this section of the river, and surveyed channel dimensions, bank vegetation cover, substrate size, and the amount of large woody debris in the channel were documented. Qualitative photographic data was also collected and will be transferred to DEPO for use in future studies. Permanent monuments were installed for exact relocation and replication.

To further delineate RBC Site 001, cross-sectional channel transects were measured between permanent markers located on opposite sides of the river at three locations: 1) the downstream end of the reach, 2) the center of the reach, and 3) the upstream end of the reach (Figure 5.1.1). In addition, three vegetation plots were established: two 50-meter-long plots (one each on the left and right banks) and one additional plot 30-meters in length. Vegetation cover, substrate size and the amount of large woody debris in the channel were measured using point-intercept methodology within the vegetation plots along transect lines. The 30-meter plot is entirely within the fenced restoration area that was established in 2004 on the left bank. These plots were chosen to most effectively represent areas that exhibit high recreational use and river access. Each vegetation plot consists of one baseline and several transect lines, resulting in approximately 50-120 points per plot. The baseline is located 3 meters beyond the top of the river terrace with the midpoint perpendicular to the reach mid-point. Transects are located from the baseline to the water's edge at 3- to 5-meter increments with point data being collected at 1-, 2-, or 4-meter increments along transects.

Within the vegetation plots, percent cover of bank stabilizing functional groups (bare ground, canopy cover, herbaceous cover, shrub cover, trees, and large woody debris) was determined using presence or absence; substrate was classified by size. Continuous bank photography was collected, using a high resolution digital camera, by taking photos approximately every 50 meters along each bank, or at such spacing as to allow stitching photos together without edge distortion.

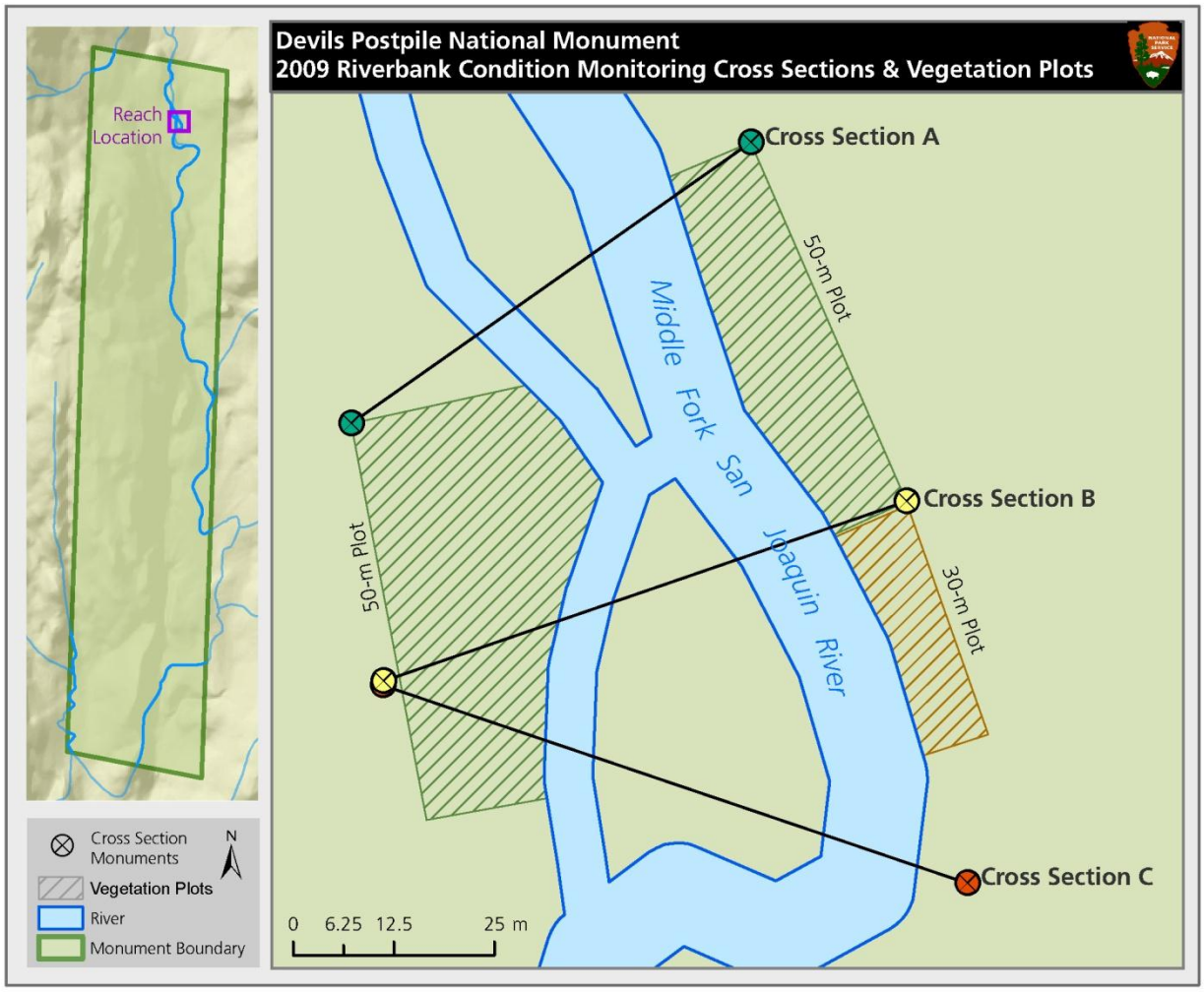


Figure 5.1.1. Riverbank Condition (RBC) Site 001(just west of the Visitor Center)

Potential Indicator Language and Standards

Potential riverbank condition indicators could include the degree to which the channel cross-sectional area changes, and the vegetative cover by certain functional groups. The data collected in this investigation should provide an adequate baseline to assess future changes. Standards are more difficult to determine though most of the areas surveyed appeared to be in good condition with the exception of the access point on river left near the picnic area. Proposed standards are: channel morphology, vegetation (trend and status).

Channel Morphology

Standard to be determined: the percent increase in cross-sectional area due to bank scour which will lead to management action.

Vegetation Condition (Trend)

Standard to be determined: amount of acceptable decrease (percent) in green understory cover as compared to a 2010 baseline.

Vegetation Condition (Status)

Standard to be determined: amount minimum amount (percent) of green understory cover per stratum.

5.2 FIELD METHODS

The following field methods were adapted from the informal trails monitoring protocol used in Yosemite National Park (YOSE) in order to suit the needs of a monitoring program for Devils Postpile National Monument. Details can be found in the "Visitor Use and Impact Monitoring: Field Guide" (Yosemite National Park, 2011).

Cross-section Setup

Each cross-section falls perpendicular to the river's average direction of flow, which sometimes results in an irregularly-shaped plot if, for example, the sample reach is on a bend in the river as was the case at RBC Site 001 (Figure 5.1.1). All monuments (stamped, aluminum-capped rebar) were placed 3 meters up from the terrace edge. Terrace location was determined by considering the break in the slope at the edge of bank and terrace, comparing the height of the opposite terrace, and using the five year flood line as a guide (Figure 5.2.1).

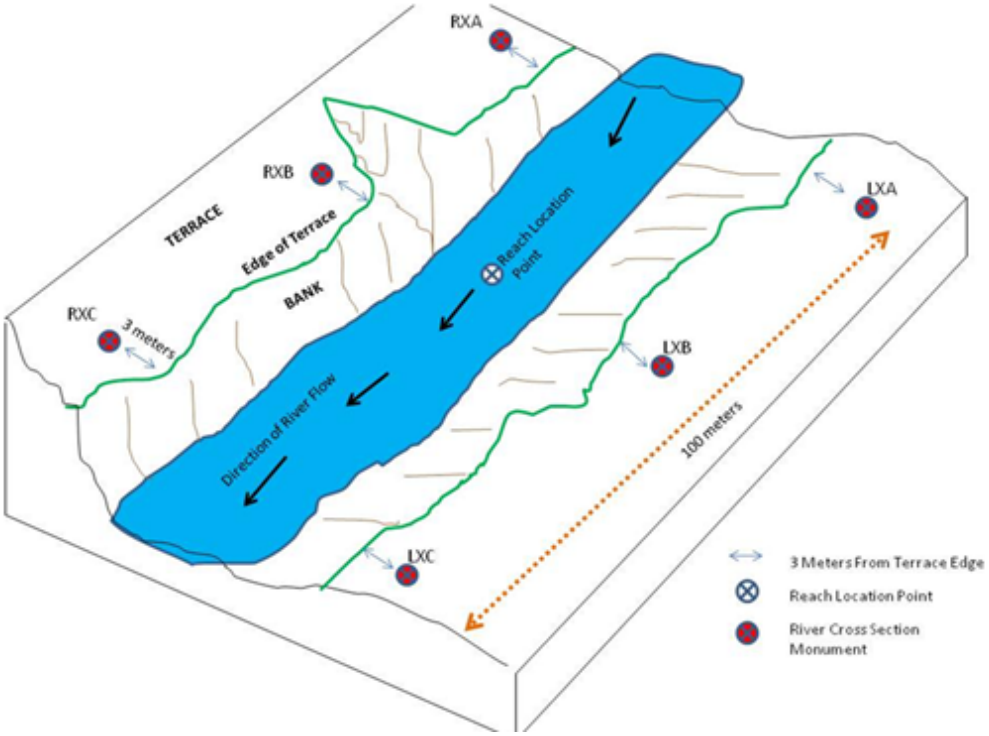


Figure 5.2.1. Sample Reach Cross Section Set-Up

Vegetation Plot Setup

The location of each vegetation plot at RBC Site 1 was deliberately chosen in order to capture the full range of vegetation cover throughout the entire reach, including in a fenced restoration zone.

Labeling Convention

To mark the monuments, a 14-18-inch piece of rebar capped with an aluminum survey cap was used. Capped rebar was installed flush to the ground. Cross-section endpoints were marked using rebar with aluminum caps that are labeled with an abbreviation of which side of the river it represents (L=left, R=right), cross-section abbreviation (X=cross-section), reach number, and a letter signifying its position within the plot (A=upstream, B=middle, C=downstream) (Table 5.2.1). When applicable, vegetation plot monuments are labeled with an abbreviation of which side of the river it represents (L=left, R=right), vegetation plot abbreviation (V=vegetation plot), reach number, and a letter signifying its position within the plot (A=upstream, B=downstream). Cross-sections and vegetation plots letters (A, B, C) are assigned from upstream to downstream (Table 5.2.1).

Table 5.2.1. RBC Monument Labeling Convention

River Right	*Flow Direction*	River Left
RX1A	V	LX1A
RV1A	V	LV1A
RX1B	V	LX1B
RV1B	V	LV1B
RX1C	V	LX1C

Monument Location Documentation

The location of the monument markers was documented: using GPS, through a description of the site, a detailed hand-drawn map (including reference points with distance and azimuth), and by photographing the site.

Photographic Monitoring

Photographs were taken with the camera on top of the monument, orientated toward the north, east, south, and west, with a photo taken in each direction, and at least one photograph was taken of the monument itself; photo numbers and corresponding azimuths were recorded together (Figure 5.2.2). The left and right banks, within the 100-meter vegetation plot range, were photographed and permanent photographic monitoring points were established using rebar and stamped aluminum caps. A map of the photo point location monument was also created for each monument (Figure 5.2.3).

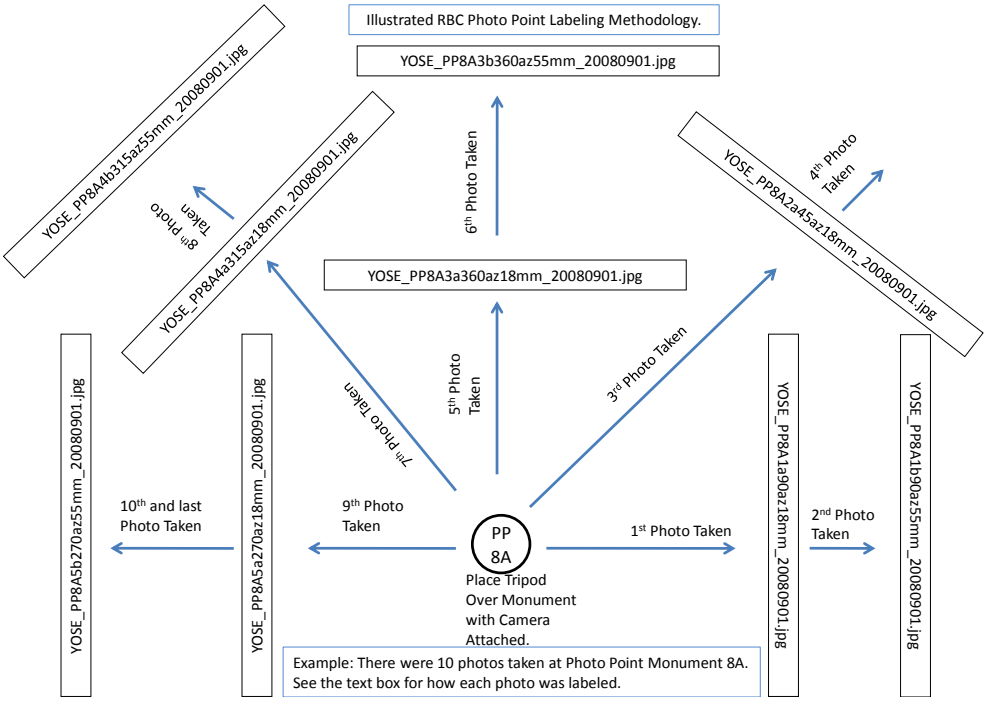


Figure 5.2.2 Example of Photo Point Sequence & Labeling

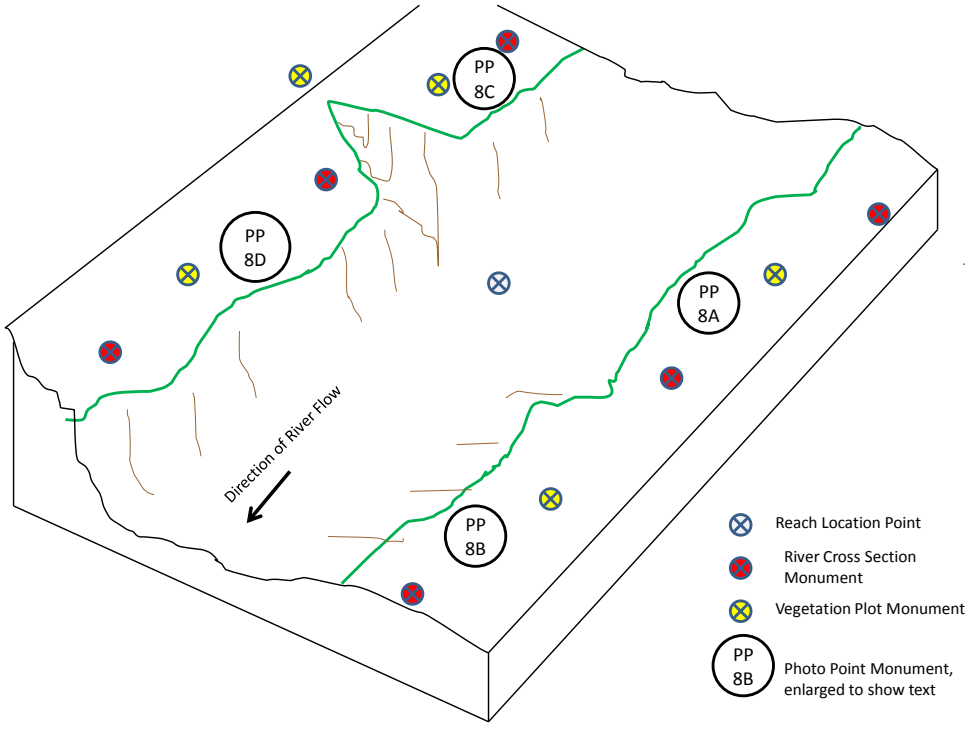


Figure 5.2.3 An Example of Photo Point Monuments.

Channel Morphology Surveys

The profile survey procedure for cross-section surveys was based on Harrelson, Rawlins, and Potyondy (1994), Section 6, pp. 26-32 and Section 8, pp. 37-41 (Figure 5.2.4). Cross-sections were conducted at the time of vegetation data collection.

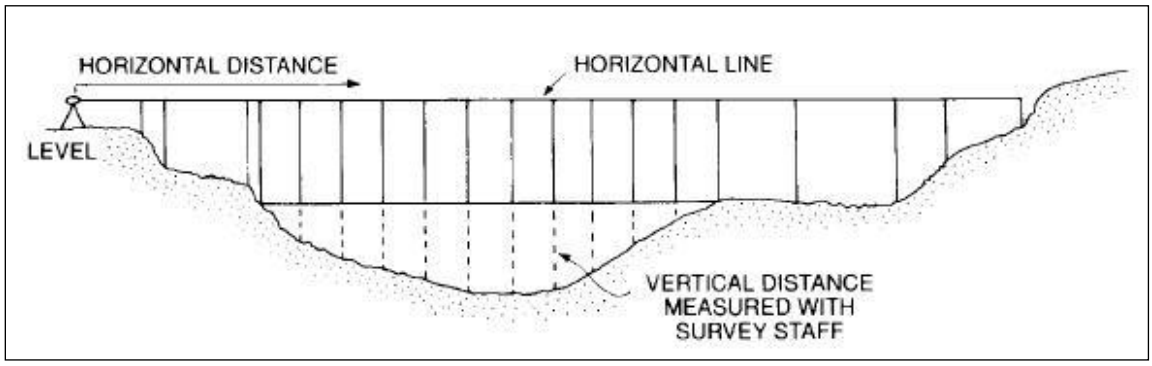


Figure 5.2.4 Diagram of a Cross-Section Survey (Harrelson et al. 1994).

Vegetation Assessment Protocol

Field personnel were trained to follow the vegetation assessment protocol found in the "Visitor Use and Impact Monitoring: Field Guide" (Yosemite National Park, 2011).

Vegetation Data Management

All data were entered into a database for further analysis, with complementary documentation including field notes, site coordinates, baselines, and photo points logged by observers at the office. Percent cover data was analyzed for adherence to established standards and statistical protocols for these analyses are currently under development.

5.3 RESULTS

Channel Morphology

In 2010 the three cross-sections at RBC Site 001 were surveyed with a Topcon total station; analysis of these cross-sections typically entails a comparison of current data to previously surveyed cross-sections at that location via the permanent benchmarks at the endpoints, as well as a calculation of the rate of bank retreat (Figure 5.3.1). Bank retreat rate for each cross-section is summed and averaged for each reach (Figure 5.3.2).

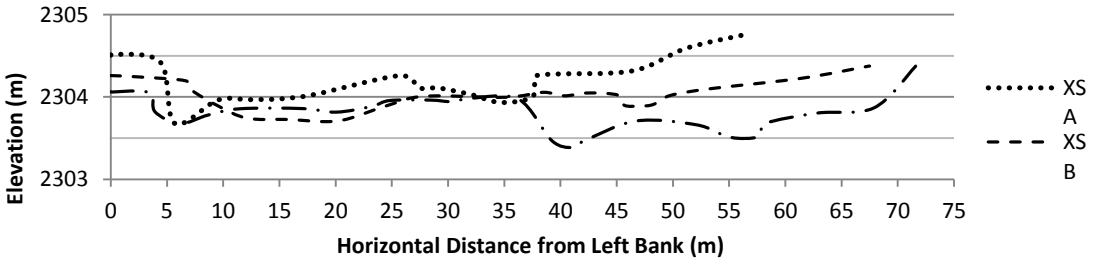


Figure 5.3.1. 2010 RBC Site 001 Cross Sections (View is Downstream with Cross Section 1A Furtherest Up& 1C Down, Stream)

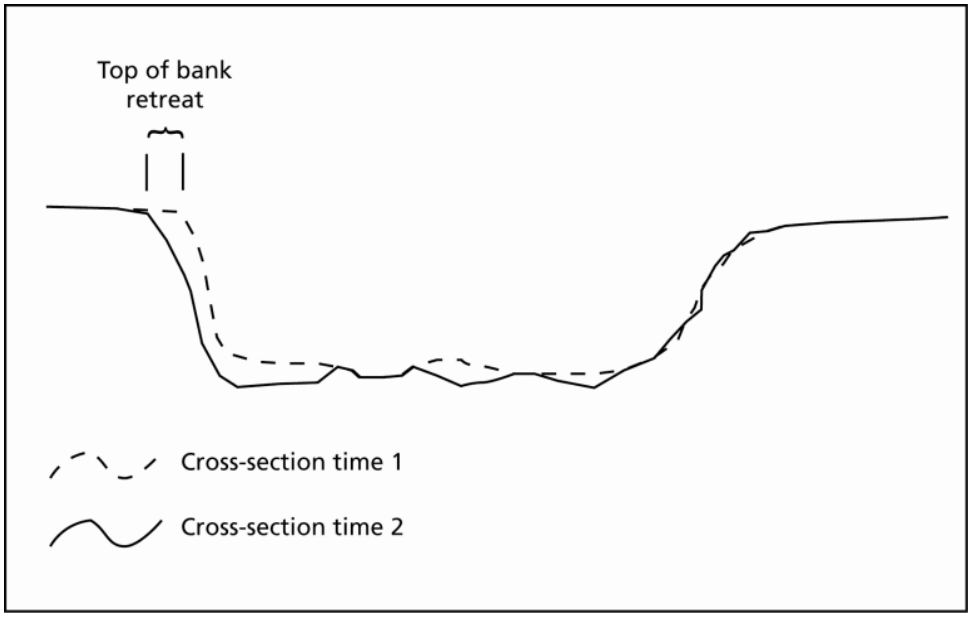


Figure 5.3.2. A Schematic Cross-Section Comparison & Calculation of Bank Retreat.

Vegetation Status

Results are presented for the three vegetation plots recorded at RBC Site 001 during the 2010 field season, and include percent cover for thirteen functional groups (Table 5.2.1, Figure 5.3.3). The highest three percentages of cover for functional groups for the left bank (when looking downstream) were: 1) litter, <25 cm dia., 56.7%, 2) deciduous trees, 48.3%, and 3) bare ground, 40%. The top three for the right bank (when looking downstream) included: 1) litter, <25 cm dia., 65.7%, 2) fibrous rooted/rhizomatous perennials, 59.3%, and 3) evergreen trees, 38.9%. The top three for the final location, the restoration site, included 1) litter, <25 cm dia., 69.3%, 2) deciduous trees, 30.7%, and 3) fibrous rooted/rhizobatous perennials, 29.3%. In addition to statistical data, detailed photo points were collected and will be archived for future use at DEPO.

Table 5.3.1. 2010 Percent Cover for Functional Groups at Deveil's Postpile National Monument Vegetation Sites

2010 Percent Cover for Functional Groups at Devils Postpile National Monument Vegetation Sites			
Functional Group	**Left Bank**	**Right Bank**	**Restoration Site**
Bare Ground	40.00	7.41	21.33
Litter <25 cm dia.	56.67	65.74	69.33
Large Woody Debris >25 cm dia.	1.67	0.00	2.67
Exposed Roots	8.33	0.00	0.00
Non-vascular Plant	3.33	6.48	4.00
Annual/ Biennial	5.00	35.19	14.67
Fibrous-rooted/ Rhizomatous Perennial	25.00	59.26	29.33
Tap-rooted Perennial	1.67	7.41	0.00
Shrub	0.00	4.63	1.33
Woody Seedling <0.5 m tall	1.67	2.78	2.67
Evergreen Tree	22.64	38.89	2.99
Deciduous Tree	48.28	8.33	30.67
Snag (Dead Standing Tree)	0.00	3.70	0.00

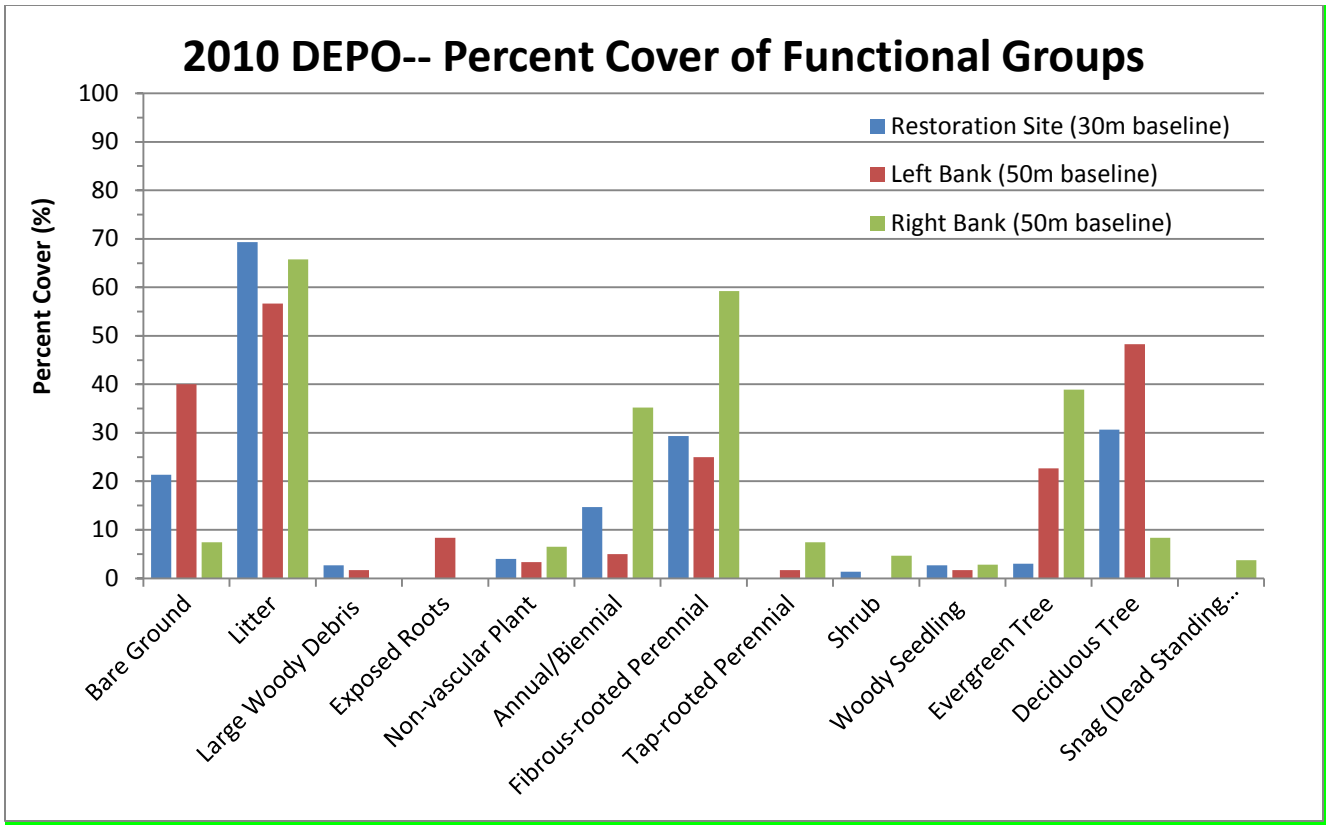


Figure 5.3.3. 2010 DEPO – Percent Cover of Functional Groups

5.4 Summary, Discussion, & Recommendations for Future Research

Channel Morphology

In 2009, two methods for surveying cross-sections were tested at RBC Site 001; cross-sections A and B were surveyed using an auto level and cross-section C was surveyed with a Topcon total station. The total station proved to be a more efficient tool for gathering data in densely vegetated segments of the cross-sections. It also allows the user to gather accurate horizontal position information of each data point if the total station occupies a location with known coordinates. In 2010, all three cross-sections were surveyed using the total station

Recommendation for Continued Monitoring of Channel Morphology

It is recommended that this indicator be monitored on a regular basis (i.e., a five year survey schedule for measuring bank retreat at this location). It is also suggested that the monitoring staff keep abreast of new technologies, incorporating them as they become available if proven to be cost effective and provide more accurate results (e.g., LIDAR, Light Detection and Ranging, scanning technology is available for monitoring changes in stream channel morphology, but can be cost-prohibitive to implement at this time).

Riverbank Vegetation Monitoring

Vegetation plots were initially surveyed in 2009 using the same protocol that was being utilized for monitoring riverbank vegetation in YOSE; however, Yosemite's protocol was further refined during the 2009 season and the 2010 methods in DEPO were revised to reflect these changes (Yosemite National Park, 2011).

In May 2011, through a cooperative agreement with the University of Idaho, a statistical analysis was completed on data collected utilizing the same approach and methodology, which delivered a statistical power analysis of Yosemite's riverbank vegetation data. The analysis package detailed the results of a statistical power analysis, sample size estimation, and confidence interval estimation based on two years of data. These techniques provide a way to look at (1) how large a sample size is needed in order to draw accurate statistical conclusions; (2) how likely the statistical test will be to detect the effects of a given size in a particular situation; and (3) the level of confidence when implementing the prior two objectives and evaluating the size of experimental effects in practice.

Although the sample size used in Yosemite is much larger, a total of 24 sites, the results of this analysis can still be useful when determining a suitable monitoring schedule for DEPO. The results of the analysis state that while an increase in the sample size corresponds to an increase in the power to detect trend, the revisit design has a greater impact on power. Data collected from the [1-2] design (3-year monitoring interval), yields test results with higher power than the other two designs (5- and 10-year intervals), as a function of time because replication of sites is obtained at a higher frequency (Starcevich, 2011).

Recommendation for Continued Monitoring of Riverbank Vegetation

Based on findings related to similar data collection efforts in Yosemite (Starcevich, 2011), it is recommended that a monitoring interval of 3 years be adopted for this indicator for established plots to achieve the greatest power for trend detection in vegetation changes. It is also recommend that the 2010 data be used as the baseline data for subsequent years of monitoring and that the previously discussed protocols, found in the "Visitor Use and Impact Monitoring: Field Guide" (Yosemite National Park, 2011), be used to ensure data consistency. The permanent plots currently in place at DEPO will allow for continued monitoring of vegetation trends in order to detect potential changes to riverbank vegetation functionality and riverbank stability.

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7 APPENDIX A – OPEN ENDED RESPONSES TO SURVEY QUESTIONS 12 & 13

7.1 OPEN ENDED RESPONSES TO QUESTION 12:

"What did you like <u>best</u> about your trip to Rainbow Falls today??"

1. Wonderful nature
2. Wonderful day sharing the Postpile + the river where we have fished with our grandchildren
3. Wildlife, the falls, being with family
4. well organized by NPS
5. Well marked open trail post pile -> falls
6. Well maintained trails, Seeing CCC in action working on the trail
7. Weather, People
8. WEATHER, NOT MUCH PEOPLE AROUND (EARLY MORNING)
9. Weather, no biting bugs
10. Weather, geology, natural beauty
11. Weather was perfect for admiring nature.
12. Weather beautiful, Children being greeted and given junior ranger books
13. Weather + Beauty
14. Weather & Scenery
15. weather & company
16. Weather Walk from Devils Postpile to burn area
17. WEATHER
18. We took a walking tour with Ranger Kyle - very interesting
19. We saw a deer and woodpecker along with other beautiful birds. The meadow is beautiful and the river is full. Lots of beautiful scenery. It is great to see family's enjoying the beauty of our national parks.
20. We learned to get here early to avoid lunchtime crowds - in past years we went to Devils Postpile before falls - we decided to reverse the order to be opposite everyone else.
21. We just arrived, but we enjoyed the hike very much.
22. We both like San Joaquin River. Also like the bus ride.
23. Waterfall spray
24. Waterfall
25. Water fall viewing
26. Water
27. water
28. Watching falls
29. Walking thru the wonderful trees, with the sound of the breeze + the creek
30. Walking down to base of falls
31. Walking along the river, the Falls the company
32. WALKIN TO THE FALL
33. Walk/Run
34. Volume of water was amazing & The informative Rainbow Falls surveyor
35. VISITING THE FALLS, AND HIKING THROUGH THE BURN AREAS.
36. Visiting Lower Falls
37. Views/Info on volcanic activity
38. Views
39. views
40. Viewing Devils Postpile.
41. View/Calm/Cleanliness
42. VIEW!

43. View, Beautiful, Clean
44. View was worth the hike
45. VIEW THE POST PILE AREA AND RAINBOW FALLS
46. View of the falls
47. View of falls + rainbow
48. view of falls
49. View from the base of the falls. Reminded me of the "Mist Trail" at Yosemite.
50. View
51. View
52. view
53. VIBE, FALLS
54. Very quiet and serene.
55. Very Pretty
56. very pretty
57. Very Pleasant Experience Trails Well Kept Plenty of Info on Distances Etc.
58. Very calm, peaceful
59. Very Beautiful hiking trails
60. USFS Employee on the bus providing additional info
61. unusual geological features
62. Unique formations of rock & surrounding environment
63. Tranquility
64. Trails, view + weather
65. trails were nice
66. trail was easily walked
67. Trail to. Friendly hikers
68. Top of Devils Postpile + Gorge near falls
69. Time with Family
70. Time w/ family in nature and easy to access w/ kids
71. There were a lot of rainbows; I came with good friends
72. THE WONDERFUL ROCKS
73. the wild
74. The whole area, being with family, and everyone that works at the mountain super friendly
75. the weather, quiet, peaceful, beautiful
76. The weather was ideal today. Not crowded.
77. The weather + view!
78. the weather - cool
79. The weather
80. The waterfalls are beautiful. The trail was very nice and easy. Just the view was fantastic.
81. The waterfall itself
82. The waterfall
83. The waterfall
84. The water and the most of all the rainbow.
85. THE WATER
86. The walkway to the lower falls of Rainbow Falls
87. The walk was scenic and tranquil
88. THE WALK
89. The views of the Postpile & mountains & river & trees
90. The views
91. the views
92. The view, the weather, nature. =)

93. The view was beautiful and the weather was perfect.
94. the view of the Rocks
95. The view of the rainbow
96. The view of the Postpile in its natural state
97. The view of the falls and the trail
98. The view of Devils Postpile itself
99. The view from the top of rainbow falls
100. The view + the beauty
101. The view & wildlife
102. THE VIEW & WEATHER
103. The view & the sound of the River
104. THE VIEW & the HIKE
105. the view the rainbow
106. The View
107. The view
108. The view
109. The view
110. The view
111. The view
112. the view
113. the view
114. The unusual pile
115. The uniqueness of the site
116. The tranquility.
117. THE TRAIL WAS REAL GOOD, THE FALLS WERE BEAUTIFUL.
118. The total experience - just making it
119. The sound of the stream, the unique geological features
120. The Sites
121. The sights and feeling like we got away from the city
122. The sights The sounds The fresh air The smell of trees Its all amazing
123. THE SHUTTLE
124. the short easy hike, relaxing atmosphere and beautiful scenery
125. The scenery. People have been very friendly.
126. The scenery, the smell of the forest
127. the scenery, fresh air, wonderful people
128. The scenery, family time
129. The scenery - view - walking
130. The scenery
131. The scenery
132. the scenery
133. the scenery
134. The rocks + the trails
135. The rock formation
136. The rainbow.
137. The Rainbow at the Falls
138. The rainbow at the falls
139. The Rainbow & the power of the 2 Falls
140. the Rainbow & the glacier polish
141. The Rainbow
142. The rainbow

143. The Rain Bow + the River
144. Devils Postpile
145. the quiet, no people, saw 2 sets of deer
146. THE QUIET JOHN MUIR TRAIL
147. the Postpile and it's very relaxing
148. The Postpile; Friendly staff
149. The Postpile, River, sounds + scenery of entire area
150. THE POSTPILE ITSELF - ITS ENVIRONMENT NATURE
151. The Postpile and the kindness of the "crew"/rangers
152. The Postpile
153. The Postpile
154. the Postpile
155. the Postpile.
156. The Pile
157. The nice people, the option on the bus tour, the incredible scenery.
158. The nature and environment
159. The nature
160. The natural wonder.
161. The natural feature itself. 2nd would be the info available @ the station, 3rd would be the H20 tap!
162. THE NATURAL BEAUTY OF ALL
163. The mist @ the bottom
164. The majestic look of the monument
165. the look of the Postpile
166. The landscape
167. the interactive explanations @ the trailhead by park ranger of diff. animals skins & skulls, etc
168. The history of the area and how this Postpile developed.
169. The hiking experience culminating in a rest on a log to view the spectacular formation.
170. the hikes and scenery
171. THE HIKE, MY WIFE, THE BEAUTY, & MY DOG
172. The Hike and the Outdoors
173. The Hike and the mist at the waterfall
174. The hike
175. The guided tour & the beautiful scenery
176. The gorgeous country all around & the beautiful San Joaquin River
177. The geology of the Postpile
178. THE FRESH AIR, BIODIVERSITY, THE GRANITE! LOVE IT ALL
179. the fresh air and the great views
180. The formation
181. the forest
182. The fishing
183. The falls.
184. The Falls! (nice view)
185. THE FALLS!
186. the falls, the burn
187. The Falls were perfect + the rainbows
188. The falls were beautiful and the hike was very enjoyable.
189. The falls themselves on the hike it - The smell of the pine
190. The falls themselves - the accessibility
191. The falls are beautiful. The rest areas are neat & clean.

192. The falls + especially the peace around the lower falls!
193. The Falls & the Hexagonal shaped french fries (Devils Postpile) & not seeing beats.
194. The falls - view and river
195. THE FALLS THE FRIENDLY, HELPFUL STAFF
196. THE FALLS
197. The FALLS
198. The Falls
199. The Falls
200. The falls
201. The falls
202. The falls
203. The falls
204. the Falls
205. THE FALL
206. The Fall
207. the fall
208. The enjoyment on people's faces from viewing such a phenomena
209. The Devils Postpile seems well preserved and the Rangers take excellent, detailed care of the trails. I will be back.
210. The Devils Postpile itself + the water
211. The Devils Postpile itself
212. The curved part
213. The cleavage from the Rocks
214. The clear thunder of the falls
215. The beauty of the total San Joaquin area
216. The beauty of the formation
217. The beauty of the falls, streams, meadows + Devils post pile. Able to walk at one's own pace, very relaxing
218. The beauty of the Falls
219. The beauty of nature and the area I live in. Learning about National Monument
220. The beauty & sounds of the water w/ wind - trees
221. THE BEAUTY
222. The beauty
223. The beauty
224. The beautiful monument and scenery.
225. The beauty of the area and being able to enjoy the tranquility of the area with a low artificial sound level
226. The base of the falls
227. The amount of water!
228. THE AMAZING VIEW/SITE
229. The amazing site + surroundings
230. The amazing geology!
231. The ability to walk about freely to explore.
232. The
233. That there are NOT crazy drivers on the road down
234. That I did it with my family!
235. Temperature was ideal and scenery always beautiful
236. Talking with your Trail person.
237. Talking to Sean the Volunteer
238. Taking this survey!

239. Swimming
240. sweet Gep;pgu
241. STONE FORMATIONS
242. Steps down to Bottom of Falls
243. Started early - less crowded
244. Spray From Fall At Base
245. Spending time with my family + having them experience the beauty of the area
246. spectacular views
247. soundless and slightly crowded adapted and well done for family
248. SMELL OF FOREST
249. sitting and eating lunch at the falls
250. Silence + Falls
251. Shuttle service in & the Postpile itself
252. Shuttle bus ride, Beautiful rock formations + valley
253. shuttle
254. Seeing the rainbow & the spray of the water from the beautiful falls.
255. seeing the Postpile & the river
256. seeing the post piles
257. seeing the piles, the stream and learning the difference between firs and pines
258. Seeing the formations and its ease of access
259. SEEING THE FALLS & ENJOYING NATURE
260. Seeing the Fall + The 3 Look outs
261. Seeing the beautiful meadow + stream + the unusual formations - all credit to Jehovah, our Creator.
262. SCENIC BEAUTY
263. scenery/full water
264. Scenery was beautiful
265. scenery solitude
266. scenery along the way, weather, beautiful dog, children
267. scenery sounds of the water quiet
268. SCENERY
269. SCENERY
270. Scenery
271. Scenery
272. Scenery
273. Scenery
274. Scenery
275. Scenery
276. Scenery, weather, waysides, trails well kept (well marked; litter free)
277. Scenery, Sites, Relaxation
278. SCENARY
279. San Joaquin river view + scenic vistas
280. Rocks
281. River + Beauty + Nature
282. RIVER & VIEWS
283. River
284. Revisited after a multi-year hiatus - every bit as glorious as before.
285. Resting by the falls after a long backpack
286. Reasonable length for kids
287. Rainbow fall

288. Rainbows Duh!
289. RAINBOW, SQUIRRELS, CHIPMUNKS, BIRDS
290. Rainbow Falls + the rainbow
291. Rainbow Falls
292. Rainbow Falls
293. Rainbow falls
294. Rainbow falls
295. Rainbow
296. Quiet! Serene surroundings almost no other people, beautiful weather (pretty cloudy)
297. Quiet, sound of river in background
298. Quiet, serene
299. QUIET
300. Quiet
301. Quick Walk
302. Pure Nature
303. Pretty. The bats.
304. Pretty Scenery
305. preservation/Trees/Trails/River
306. Postpile nice weather
307. Postpile formation
308. Postpile
309. Postpile
310. Falls
311. Possibility to get so! near to the falls. Perfect!
312. Pleasant walk in spectacular scenery
313. Photographing the falls
314. PHOTO OPS.
315. Perfect weather. Little crowds
316. PERFECT WEATHER, FEW PEOPLE
317. PERFECT DAY FOR PERFECT HIKE
318. Peaceful + there were rangers to answer questions for my children
319. Peaceful
320. PEACE, QUIET, & LOTS OF FRESH AIR
321. Peace, Calm, Being in A Beautiful Place
322. Peace and quiet
323. OK number of people opportunity to just look
324. nothing like we've ever seen before
325. Not very crowded, nice trails
326. Not too crowded
327. Not too crowded! It was a good day & people are nice & polite
328. not too crowded at 10AM
329. Not crowded well maintained trails
330. Not crowded & was a beautiful day.
331. Not a lot of cars in park Lower falls
332. Nice weather, not crowded, rainbow was visible
333. Nice trail to the Falls
334. Nice park rep!
335. Nice NPS staff
336. NEW EXPERIENCE, NICE PARK
337. Natures beauty (untouched)

338. Nature/sound of the river
339. Nature, Clean Trails
340. Nature expiuzece, Fordly tips from the ranger's for or trip
341. natural phenomenon/geology/beauty of the High Sierra
342. Natural features
343. Natural Beauty, the smell of the plants around the area
344. NATURAL BEAUTY, NICE HIKE, EASY TRAILS
345. Natural beauty of area
346. natural beauty - visiting lower falls
347. Natural Beauty
348. Natural Beauty
349. MY BEING HERE
350. Mountain smells
351. mist from the falls
352. Lower Rainbow Falls trail not crowded at all!!
353. LOWER FALLS/MIST/VIEW
354. Low crowds
355. Lovely weather + surroundings
356. Lots of water !! Beautiful rainbow We saw fish in the stream !!
357. Looking up at Postpile
358. Looking at the Postpile in a pleasant atmosphere That dogs are allowed
359. listening to the river while enjoying the site
360. lg. water volume/rainbow!
361. LEARNING ABOUT THE RAINBOW FIRE
362. Learn something new about geology
363. last part of hike to D. Postpile
364. landscape, weather
365. Lack of crowded (people)
366. Just started
367. Just being surrounded by the Beauty of the Park
368. JUST BEING OUT IN NATURE WITH FRIENDS IN A WELL MAINTAINED FOREST
369. Just a real cool geological site. Plus the chipmunks.
370. it's not a resort
371. It's natural beauty
372. It's History. Being here
373. It's Beautiful.
374. IT'S BEAUTIFUL, LOTS OF WATER
375. It's beautiful out here! Fairly Easy hike.
376. It's beautiful
377. It's a new place. I didn't know it was a National Monument
378. It was very nice. Very few people and Temperature was great.
379. It was safe and orderly - bus driver very friendly and helpful
380. It was not crowded at all.
381. It was great - liked taking bus, being greeted coming off the bus, signage is good
382. It is very well preserved, has not changed since I was here 4 years ago
383. IT IS DIFFERENT AND BEAUTIFUL
384. IT IS A NATURAL WONDER (GEOLOGY)
385. Information, people, shaded area to view, river, sun, sky … mountains
386. information from our volunteer park service employee, Sean
387. Info on signs

388. impressive geological formation
389. I love all National Parks - liked the ranger talk to understand more about what I was seeing
390. I like how there was a ranger that would give a tour and lots of information. It was nice that you could ask question when you wanted to.
391. I appreciated the easy trail that my daughter in a knee brace had no problem with
392. How full the falls were and un-crowded
393. HIKING & FALLS
394. Hiking
395. Hike down to Devils Post Pile from Agnew Meadows
396. Hike
397. high water level, interpretive signs
398. Hearing the birds + not the people
399. Having multiple viewpoints
400. H2O Flow
401. GREAT Weather, scenery
402. Great weather if crowded it did not linger long. Peaceful for the most part. Myself & one other person taking the survey were the only ones remaining at the post pile
403. GREAT VIEW, GEOLGIC MIRACLE
404. Great View
405. Great trail to 2 beautiful spots.
406. Great Talk, ranger's talk, friendly people
407. Great Geology
408. Great Geology
409. got to see it before I died. I have a serious medical condition which would hasten my demise.
410. going down to lower falls
411. Going down all the way to see the falls.
412. Getting Wet
413. getting to the falls. Beautiful view and great mist!
414. Getting real close to the falls
415. Get into the water
416. geometric formations
417. full streams
418. FRIENDLY PEOPLE + WONDERS OF NATURE
419. FRIENDLY PEOPLE
420. Friendly park service people
421. Fresh air, nature, and of course the Postpile
422. Fresh air, the falls, the rainbow, wildlife
423. Fishing
424. Fantastic geography + impressive sight of falls with beautiful rainbows
425. FAMILY TIME - NICE SCENERY
426. Family
427. Falls were beautiful and hike wasn't bad.
428. Falls were beautiful
429. Falls themselves, rainbows, wildflowers
430. Falls looked just like in photos
431. FALLS
432. FALLS
433. Falls
434. falls
435. Fall, view points

436. experiencing the Post Piles
437. Excellent/Enjoyable
438. Everything I'm very satisfied =)
439. Everything - trails were nicely kept.
440. EVERYTHING
441. EVERYTHING
442. EVERYTHING
443. Everything
444. Enjoyment of nature and photo opportunities
445. Enjoy nature with my family
446. Enjoy any time I get to spend in the area
447. eating lunch at the falls
448. easy well maintained path for small children
449. Easy trails and safe.
450. Easy trail, shuttle service
451. Easy to follow trails - wide enough for our Kids
452. EASY OFF-TRAIL NEAT THING
453. easy hike - Bus ride! Great viewing seats.
454. easily accessible
455. Ease of access for young hikers
456. ease of Access
457. Ease getting here in tram. Quick access to the trail.
458. DID NOT HAVE TO DIRVE
459. Devils Postpile is always cool
460. Deer in meadow, curvature of Postpile, cool breeze
461. Cool weather, beautiful scenery, sound of river & falls
462. Company
463. COMING AROUND THE BEND HAVING THE POST PILE SUDDENLY VISABLE
464. cold refreshing water
465. Close to end of hike…
466. Climate & crowd (more)
467. Cleanliness, great weather, not too crowded
468. cleanliness of the trails and surrounding areas
469. Clean & great weather
470. CHILDS EXPRESSION
471. Bus ride rather than drive
472. Bringing my kids to see Devils P.P. & Rainbow Falls.
473. Birds seen along the way + Falls
474. Big flow and we were only people at lower falls
475. Best waterfall I have ever seen, neat to be able to go right down to it.
476. Besides the beauty of God's creation, the Bus Driver's commentary was great.
477. Being with my family. My wife and daughter saw the Devils Postpile for the first time.
478. Being with Marianna. And the burnt forest.
479. Being with family Enjoy interaction w/ interviewer good reminders about water - comment from driver on shuttle was informative
480. Being on a class trip and learning on the way
481. Being my first trip to the Postpile, I thought the whole monument was beautiful.
482. Being in nature
483. Being away from the city
484. Being at the Base of the falls

485. Being able to see the falls before the masses arrived
486. Being able to go down to the Base of the falls
487. Being able to eat lunch alone overlooking the river
488. Been out in the woods and unique Natural History
489. Beauty, Weather, Good Day at the falls
490. beauty, nature, waterfall abundantly flowing
491. Beauty of the surrounding mountains and falls.
492. Beauty of the falls. Great atmosphere. Peaceful
493. Beauty of the falls themselves
494. Beauty of the falls
495. Beauty of it!
496. beauty of falls
497. Beauty + quiet
498. Beauty
499. Beauty
500. Beautiful. Easy access.
501. Beautiful, weather, friendly state
502. beautiful, nice people
503. BEAUTIFUL WEATHER; NICE TRAILS
504. beautiful walk with my family
505. Beautiful views of the area and Mammoth in general the creek was terrific
506. BEAUTIFUL VIEWS
507. Beautiful trail running along the San Joaquin River. Spectacular lava formations.
508. Beautiful surroundings accommodating staff
509. Beautiful scenery + nice safe trails!
510. Beautiful scenery & nice weather
511. Beautiful scenery - excellent weather
512. Beautiful Scenery
513. Beautiful Scenery
514. Beautiful scenery
515. Beautiful falls!
516. beautiful falls!
517. Beautiful day. Not crowded.
518. BEAUTIFUL DAY LOW CROWD
519. Beautiful day great hike
520. Beautiful day for a hike to beautiful falls
521. Beautiful Day
522. Beautiful area, rangers are really helpful & helpful
523. Beautiful + Awesome site
524. Beautiful
525. Beautiful
526. Beautiful scenery
527. Beautiful scenery
528. AWESOME WATER IN THE FALLS. GREAT SOLITUDE.
529. awesome beauty
530. AMOUNT OF WATER
531. amount of water on falls
532. Amazing location - Geologic Wonder!
533. AMAZING
534. All of it! hiking, the falls, the views going in the water

535. ALL GOOD :)
536. All field personnel were extremely helpful + Knowledgeable, the paths were very well kept up + viewing the terrain was unobstructed

7.2 OPEN ENDED RESPONSES TO QUESTION 13:

"What did you like <u>least</u> about your trip to Rainbow Falls today?"

1. We liked nothing the least
2. We forgot our bottle of water in the car.
3. Warm hike
4. Walking up To The Top
5. Walking thru burn area
6. walk fr Devils post pile
7. Waiting for the Bus
8. Views/Vistas of falls!
9. uphill trails
10. uphill bike ride back to campground
11. make sure buses/shuttle have bike racks
12. uphill
13. Umm… got really wet while sitting by falls
14. Trip back up for 4 year old.
15. TRIED TO GET IN YESTERDAY
16. WAS GIVEN THE "RUNAROUND" BY FRONT GATE RANGER (NOT APPRECIATED AT ALL) NATIONAL PARK SERVICE PASS WAS NOT ACCEPTED - NO CAMP SITE MAPS WERE AVAILABLE RANGER WAS GLIB ABOUT IT
17. travelling with a stroller made it a bit difficult, but we managed
18. Trash throw over the wall (as usual, water bottles) Eliminate bottled water at local concessions
19. TRAIL PATH IS ERODED
20. too warm
21. TOO TOO TOO'S
22. Too many people. The park should only let about 10 people in a day.
23. TOO MANY PEOPLE
24. TOO MANY PEOPLE
25. Too Many people
26. Too many people
27. Too many people
28. too many people
29. too many people
30. too long a wait for the shuttle (45 min)
31. TOO HOT
32. Too crowded, too many dogs chasing the natural inhabitants. This should be limited!
33. To wet.

34. TO MANY PEOPLE
35. to many green thinking; I don't like the fences around the meadow area.
36. this survey
37. This paper work!!
38. The walk back (101)
39. The views of the rapids along the creek/trail
40. The Uphill return
41. The trip was overall very nice nothing I saw I didn't like.
42. The trail is a little dry + dusty.
43. The steps. They are harder for me to navigate than the trail.
44. the steps
45. The stairs up to the top of Devils Postpile
46. THE STAIRS TO THE BOTTOM OF THE FALLS
47. The stairs back up
48. The smell of horse poop in trail
49. The shuttle
50. the rain!
51. The people.
52. The people climbing on the rocks
53. The noise of the trail maint. Equipment
54. The noise from park maintenance work (but we appreciate the work!)
55. The masses that arrived just as we were leaving
56. The long walk.
57. the length
58. The lack rangers on the trails up to RF for info
59. The lack of shade in the Barn
60. The horse waste on the floor. But I didn't really care; there is nothing I didn't like least.
61. The hike. Please move closer
62. The hike!
63. the hike up the stairs
64. The heat + stairs!
65. The heat
66. The heat 85 degrees But still not bad. Still a great day!
67. The dust -
68. The Dust
69. The crowding was definitively noticeable, but understandable.
70. The crowds
71. THE CROWD AND ABUSE OF A NATURAL WONDER
72. the crowd
73. The Bus
74. The Burnt wasted trees
75. the amt of people
76. The 1992 fire! Please warn visitors, especially from the east about how devastating a

forest fire can be.

77. THE "TALKATIVE" PEOPLE DISTURBING THE PEACE!
78. That you have to that the shuttle!!
79. That I had to leave
80. That I cannot stay longer.
81. TAPED OFF AREAS BLOCKING ACCESS TO RIVER FRONT/SIDE
82. taking this survey and picking up trash
83. Surveys
84. SURVEY
85. SURVEY
86. steep climb out
87. Stairs
88. Sound of walkers banging
89. Somewhat crowded trails
90. SOME TRASH IN WATER
91. some crowding
92. SMELL OF HORSES ROAD APPLES
93. Small visitor center we always take a family photo @ NPS sign, but this was not possible because it was on the bus route :)
94. Slippery Rock At Base
95. Slightly crowded but not overwhelming
96. Shuttle was very warm, needs more ventilation
97. Shuttle system not well signaled in Mammoth Lake
98. Shuttle mandatory and privatized and charged a fee. Maybe charge park entrance fee + make shuttles mandatory but free. I felt decided into taking shuttle because I was told you can avoid them by saying you were camping or bring a tube with you to float the river or lakes.
99. Shuttle bus in to trail
100. Shuttle Bus
101. Shuttle bus
102. Should've brought more water!
103. Should be free with National Parks Pass
104. Seemed a bit crowded
105. SEEING OTHERS WITHOUT WATER. I HAD NO IDEA THE TRAIL WOULD BE SO EXPOSED. NOT PLEASANT AT ALL.
106. Saw a family with freshly picked flowers.
107. sandy trail - would rather a more compact surface
108. Running into more and more people the closer we got to the falls -
109. Ride takes a while - waited 20min
110. Ride down
111. Restrooms are missing
112. Rainbow Falls
113. Quite a lot of people, but no great issue or problem
114. Pumice trail, horse poop on trail, Rangers not available outside of ranger station general

area

115. poop fr horses.
116. Poor contact on water bars/ check steps causing trail erosion
117. people with dogs
118. People resting at the Falls viewing + blocking newcomers from seeing.
119. People over-reacting/not friendly to dogs on trail.
120. People on trail, but IM A LONER!
121. People not following rules
122. People going off the trail at the top of trail and hikers leaving pile of trash at viewing area to be retrieved later.
123. people @ Rainbow Falls
124. People - Like quiet w/ no people
125. people
126. people
127. people
128. paying for the Bus trip
129. OTHER PEOPLE TALKING CONTINUOUSLY
130. other people
131. Other notes:
132. If park use is limited, it should be done in a way that people won't notice. For instance, only allowing access via shuttle and having the shuttle trips limited. People should not, once into the monument, be restricted in the amount of time they spend or where they can go.
133. One other hiker carrying boom box play music (rap)
134. obviously, the amount of people primarily large groups
135. nothing… maybe the sound of maintenance equipment (toward middle of my trip)
136. Not enough seating spaces along the way. Would have liked a picnic table near Rainbow Falls.
137. not being able to hike all the way
138. Not being able to drive ourselves to the hiking spot, wasn't always like this. (shuttles)
139. not allowing climbing on the rocks @ all doesn't make sense. Place a sign "responsibility of climbers"…. In other places around the world there is access to such formation w/ out any problem (Golan Heights, Iceland)
140. Not being told the truth at the base of the road- we were made to believe we could not drive to the trail head.
141. No Vending Machines JK :-)
142. No trash receptacles.
143. No shade on trail
144. No real complaints. I just prefer a more solo experience.
145. no paved walkways
146. No info on the plants/wildlife in area
147. NO ICE CREAM
148. No good estimate of trail difficulty w/ regards to people w/ heart problems, asthma, pregnancy, etc.
149. No free gelato samples

150. NO ELEVATION INFO AT TRAILHEAD
151. P.S. May want to have signs informing visitors that it is advisable to wear shoes; sandals not a good idea as I have learned. I did not realize that there was a little hiking.
152. bit of garbage on the trail
153. NO BEER
154. Need bigger view area for falls
155. near
156. mosquitos/bugs
157. Mosquitos…
158. MOSQUITOS!
159. Mosquitos
160. Mosquitos
161. mosquitos
162. mosquitoes - wish we had been warned
163. MOSQUITOES
164. More people than used to encountering on other hikes in area
165. MISQUITOS
166. mile markers on signage (outside of Rainbow Falls area)
167. Maybe the signs need to be more easy to read. Some signs said the same thing so we were confused which way to go. We had to ask other visitors.
168. Maybe not enough sitting places (benches) along trails.
169. Mandatory shuttle
170. make a bigger visitor center
171. lots of people on return trip
172. Lots of people kicking up dust on the trails, litter (bottles)
173. Lots of horse poop on trail
174. lot of mosquitoes
175. LONG BUS RIDE
176. Little bit of rain :)
177. Little - no shade on trail
178. Litter. 3 plastic water bottles along the way
179. last stretch by burn area
180. lack of trash cans
181. Lack of shade
182. Knowing that climate change threatens ecosystem
183. Jack hammer noise
184. Jack hammer and this questionnaire
185. It's hot.
186. It was a tad warm today :)
187. In Mammoth area, not enough signage how to get to the park, & shuttle
188. I wore the wrong shoes for hiking.
189. I LIKE THE SUTTLE TO TAKE VISITORS BUT WOULD LIKE BETTER INFO THAT THE SHUTTLE WAS MANDATORY BEFORE ARRIVING AT THE FEE BOOTH AND HAVING TO TURN AROUND. AT MAMMOTH THERE WERE NOT ENOUGH PROMINANTLY DISPLAYED SIGNS

TELLING VISITORS HOW TO GET TICKETS FOR THE BUS

190. I Brought the wrong camera lens.
191. Humans
192. Hot with the burned trees
193. Hot weather.
194. HOT WEATHER
195. hot
196. Horses on trail
197. Horeses poopoo on trail
198. Horses
199. Horse Shit
200. horse poop.
201. Horse poop on the trails.
202. Horse Poop
203. horse poo
204. horse manure on trail and dogs
205. Horse crap
206. HILLS
207. Heat + People
208. Heat
209. Heat
210. Heat
211. Heat
212. Having to walk back!!
213. Having to take a Bus - But seems Necessary
214. Have to leave soon.
215. Need some king of food service. Vending granola bars would suffice.
216. Have no bad comments for the Hike today
217. Hard access for Handicap
218. Group of young adults talking while the leader was talking.
219. Golden Eagle and Golden Age passes should be honored (no charge) or at the very least a discount (50%)
220. GOING INTO THE WATER AFTER THE FALL COMES DOWN
221. gnats
222. getting stopped for this survey
223. getting here and back
224. friends taking too many photos
225. Fire damage
226. entrance station fee.
227. Elevation.
228. Dusty
229. Dust
230. dust

231. DOWN HILL HIKE & DEEP STEPS
232. Dogs not on Leashes
233. dogs
234. dog not on leash
235. Dog having to wear muzzle on bus,
236. DIRT
237. Difficulty getting to trailhead
238. difficult to get good photo due to crowded at the FALLS
239. Didn't plan enough time to enjoy all of it
240. Deep dusty trails
241. Crowds on bus/trail
242. crowds
243. crowded viewpoint
244. Crowded bus ride down to the trailhead
245. Crowded bus ride
246. crowded bus
247. Crowded My own grouchy kids
248. Couldn't hear driver on bus. He had great information that someone else told me
249. CONSTRUCTION SOUNDS
250. Construction
251. construction
252. Can be too crowded at times? A "middle ground" needs to reached, because it is so beautiful
253. Bus ride down
254. Bus Ride - JC
255. Bus Ride
256. Bus Ride
257. bus ride
258. Bus Loader
259. bus driver was hard to hear - better intercom Visitor from Alaska saying it was too crowded (8 people) - Comparing trails from Alaska. Nothing positive to say
260. bus access
261. BUGS
262. Bugs
263. Bugs
264. Buckle broke on my hip pack
265. bathroom could be a bit larger, family friendly
266. Back to Civilization
267. At 76 years of age - got a little tired
268. As a person w/ a physical disability (mobility related), I often wish there were more benches.
269. animal waste
270. ALL
271. A LITTLE TOURISTY

272. A little too hot.
273. A little scary with too few people. Worried about animals.
274. A few too many people
275. a few rocky spots on trail
276. a couple of rude visitors, but they were the <1%
277. a bit hot today
278. A 5 min survey which took 15 min, Not really we didn't mind helping the parks.
279. 90 HOT!
280. $20 entrance fee "to use the roads" my tax dollars already paid for.
281. # PEOPLE
282. # of people

APPENDIX B – THE 2010 DEPO VISITOR EXPERIENCE SURVEYS

(*Note - Some formatting changes have been incorporated to facilitate inclusion in this document)

7.3 RAINBOW FALLS SURVEY

Surveyor Use Only
ID: _____
Date: / / 2010
Time:_____ AM/PM

OMB #:1024-0224 (NPS 10-023)

Expiration Date:12/31/2010

Rainbow Falls Visitor Experience Survey

1. Including this visit, approximately how many times have you visited Devils Postpile National Monument?

Number of visits: _____

2. On the scale below, please indicate how familiar you are with Devils Postpile National Monument? *(Circle one number.)*

1	2	3	4	5	6	7	8	9
Not at all familiar								**Extremely familiar**

3. Have you visited Rainbow Falls before? *(Check one.)*

❒ Yes (CONTINUE TO QUESTION 4)

❒ No (SKIP TO QUESTION 5)

4. Including this time, approximately how many times have you visited Rainbow Falls?

Number of visits:_____

5. On your trip today, where did you begin your hike? *(Check one.)*

❒ Devils Postpile Visitor Center

❒ Rainbow Falls Trailhead

❒ Overnight camping in Wilderness area

❒ Don't know

❒ Other: _____

6. On your hike today, which locations did you visit? *(Check all that apply.)*

❒ Devils Postpile

❒ Rainbow Falls

❒ None of the above

❒ Don't know

❒ Other (1):_____

❒ Other (2):_____

7. Approximately what time did you start your hike to Rainbow Falls today?

_____AM/PM *(Example: 11:00 AM/PM)*

OR

❒ Don't know

8. In general, how did the encounters you had with other people at Rainbow Falls today affect your overall enjoyment of your hiking experience? *(Please check one response, even if you did not see other people.)*

❒ Greatly added to my enjoyment

❒ Somewhat added to my enjoyment

❒ Had no effect

❒ Somewhat reduced my enjoyment

❒ Greatly reduced my enjoyment

9. A We would like to know how many other people you think you could encounter at Rainbow Falls without feeling too crowded. To help judge this, please rate each of the photographs by indicating how acceptable you find the number of people in the photo. *(Circle <u>one</u> number for <u>each photo</u>)*

	Very Unacceptable								**Very Acceptable**
Photo 1	-4	-3	-2	-1	0	1	2	3	4
Photo 2	-4	-3	-2	-1	0	1	2	3	4
Photo 3	-4	-3	-2	-1	0	1	2	3	4
Photo 4	-4	-3	-2	-1	0	1	2	3	4
Photo 5	-4	-3	-2	-1	0	1	2	3	4

B Which photograph shows the maximum number of people the National Park Service should allow at Rainbow Falls at one time? In other words, at what point should visitor use be limited? *(Record <u>one</u> photo number or check one of the boxes.)*

_____ Photo Number **<u>OR</u>** ❒ Visitor use should not be limited at any point represented in the photos **<u>OR</u>** ❒ Visitor use should not be limited at all

C Which photograph shows the number of people at Rainbow Falls that you would prefer to see? (*Record <u>one</u> photo number or check one of the boxes*)

_____ Photo Number **<u>OR</u>** ❒ Don't Know

D Which photograph shows the number of people at Rainbow Falls that would cause you to never want to return? (*Record <u>one</u> photo number or check one of the boxes*)

_____ Photo Number **<u>OR</u>** ❒ I would return regardless of the number of people at **<u>OR</u>** ❒ Don't Know

E Which photograph looks most like the number of visitors you saw at Rainbow Falls today? (*Record <u>one</u> photo number or check one of the boxes*)

_____ Photo Number

OR

❒ Don't Know

10. How crowded did you feel while you were at Rainbow Falls today? (*Circle <u>one</u> number*)

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded			Moderately Crowded		Extremely Crowded	

11. How much of a problem were each of the following items for you at Rainbow Falls today? *(Check one box for each item)*

	Not a Problem	Small Problem	Big Problem	Don't Know/No Opinion
Difficulty locating the trailhead	❒	❒	❒	❒
Lack of available parking at the trailhead	❒	❒	❒	❒
Not enough information provided at the trailhead about how to prepare for a hike on the trail	❒	❒	❒	❒
Not enough signs with information about the natural and cultural history of the area	❒	❒	❒	❒
Not enough directional signs along the trail	❒	❒	❒	❒
Trails are too wide	❒	❒	❒	❒
Trails are too eroded (e.g. exposed roots, rocks, channeling)	❒	❒	❒	❒
Litter along the trail	❒	❒	❒	❒
Improperly disposed human waste evident on or near the trail	❒	❒	❒	❒
Too many people on the trail	❒	❒	❒	❒
Off-trail trampling around the Postpile viewing area	❒	❒	❒	❒
Sound from aircraft	❒	❒	❒	❒
Sound from large groups of visitors	❒	❒	❒	❒

Sound from other visitors	❒	❒	❒	❒
Sound from NPS maintenance	❒	❒	❒	❒
Sound from vehicles (e.g. cars, buses, motorcycles)	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒

12. What did you like <u>best</u> about your trip to Rainbow Falls today?

Response:

13 What did you like <u>least</u> about your trip to Rainbow Falls today?

Response:

14. How did you get to the trailhead today?

❒ Personal vehicle

❒ Shuttle bus Other: _____

15. What is your sex? *(Check one)*

❒ Male

❒ Female

16. In what year were you born?

Year born: 19_____

17. Do you live in the United States? *(Check one)*

❒ Yes - What is your zip code? _____

❒ No - In what country do you live? _____

18. What is the highest level of formal education you have completed *(Check one)*

❒ Some high school

❒ High school graduate or GED

❒ Some college, business or trade school

❒ College, business or trade school graduate

❒ Some graduate school

❒ Master's, doctoral or professional degree

19. Are you Hispanic or Latino? *(Check one)*

❒ Yes

❒ No

20. What is your race? *(Check one or more)*

❒ American Indian or Alaska Native

❒ Asian

❒ Black or African American

❒ Native Hawaiian or other Pacific Islander

❒ White

Thank you for your help with this survey!
Please return the completed questionnaire to the survey administrator.

PRIVACY ACT and PAPERWORK REDUCTION ACT statement: 16 U.S.C. 1a-7 authorizes collection of this information. This information will be used by park managers to better serve the public. Response to this request is voluntary. No action may be taken against you for refusing to supply the information requested. The permanent data will be anonymous. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. BURDEN ESTIMATE statement: Public reporting burden for this form is estimated to average 10 minutes per response. Direct comments regarding the burden estimate or any other aspect of this form to:

Superintendent
Devils Postpile National Monument
Mammoth Lakes, CA 93546

OMB # 1024-0224 (NPS # 10-023) Expiration Date: 12/31/2010

7.4 DEVILS POSTPILE SURVEY

Surveyor Use Only
ID: _____
Date: / / 2010
Time:_____ AM/PM

OMB # 1024-0224 (NPS 10-023)

Expiration Date: 12/31/2010

Devils Postpile Visitor Experience Survey

1. Including this visit, approximately how many times have you visited Devils Postpile National Monument?

Number of visits: _____

2. On the scale below, please indicate how familiar you are with Devils Postpile National Monument? *(Circle one number.)*

1	2	3	4	5	6	7	8	9
Not at all familiar								**Extremely familiar**

3. Have you visited the Devils Postpile viewing area before? *(Check one.)*

❒ Yes (CONTINUE TO QUESTION 4)

❒ No (SKIP TO QUESTION 5)

4. Including this time, approximately how many times have you visited the Devils Postpile viewing area?

Number of visits:_____

5. On your trip today, where did you begin your hike? *(Check one.)*

❒ Devils Postpile Visitor Center

❒ Rainbow Falls Trailhead

❒ Overnight camping in Wilderness area

❒ Don't know

❒ Other: _____

6. On your hike today, which locations did you visit? *(Check all that apply.)*

❒ Devils Postpile

❒ Rainbow Falls

❒ None of the above

❒ Don't know

❒ Other (1):_____

❒ Other (2):_____

7. Approximately what time did you start your hike to the Devils Postpile viewing area today?

_____AM/PM *(Example: 11:00 AM/PM)*

OR

❒ Don't know

8. In general, how did the encounters you had with other people at the Devils Postpile viewing area today affect your overall enjoyment of your hiking experience? *(Please check one response, even if you did not see other people.)*

❒ Greatly added to my enjoyment

❒ Somewhat added to my enjoyment

❒ Had no effect

❒ Somewhat reduced my enjoyment

❒ Greatly reduced my enjoyment

9. A We would like to know how many other people you think you could encounter at the Devils Postpile viewing area without feeling too crowded. To help judge this, please rate each of the photographs by indicating how acceptable you find the number of people in the photo. *(Circle <u>one</u> number for <u>each photo</u>)*

	Very Unacceptable								Very Acceptable
Photo 1	-4	-3	-2	-1	0	1	2	3	4
Photo 2	-4	-3	-2	-1	0	1	2	3	4
Photo 3	-4	-3	-2	-1	0	1	2	3	4
Photo 4	-4	-3	-2	-1	0	1	2	3	4
Photo 5	-4	-3	-2	-1	0	1	2	3	4

B Which photograph shows the maximum number of people the National Park Service should allow at the Devils Postpile viewing area at one time? In other words, at what point should visitor use be limited? *(Record <u>one</u> photo number or check one of the boxes.)*

_____ Photo Number

<u>OR</u>

❒ Visitor use should not be limited at any point represented in the photos

<u>OR</u>

❒ Visitor use should not be limited at all

C Which photograph shows the number of people at the Devils Postpile viewing area that you would prefer to see? (*Record <u>one</u> photo number or check one of the boxes*)

_____ Photo Number

<u>OR</u>

❒ Don't Know

D Which photograph shows the number of people at the Devils Postpile viewing area that would cause you to never want to return? (*Record <u>one</u> photo number or check one of the boxes*)

_____ Photo Number

<u>OR</u>

❒ I would return regardless of the number of people at the Devils Postpile viewing area

<u>OR</u>

❒ Don't Know

E **Which photograph looks most like the number of visitors you saw at the Devils Postpile viewing area today? (*Record <u>one</u> photo number or check one of the boxes*)**

_____ Photo Number

OR

❒ Don't Know

10. **How crowded did you feel while you were at the Devils Postpile viewing area today? (*Circle <u>one</u> number*)**

1	2	3	4	5	6	7	8	9
Not at all Crowded		**Slightly Crowded**			**Moderately Crowded**		**Extremely Crowded**	

11. **How much of a problem were each of the following items for you at Devils Postpile today? *(Check one box for each item)***

	Not a Problem	Small Problem	Big Problem	Don't Know/No Opinion
Difficulty locating the trailhead	❒	❒	❒	❒
Lack of available parking at the trailhead	❒	❒	❒	❒
Not enough information provided at the trailhead about how to prepare for a hike on the trail	❒	❒	❒	❒
Not enough signs with information about the natural and cultural history of the area	❒	❒	❒	❒
Not enough directional signs along the trail	❒	❒	❒	❒
Trails are too wide	❒	❒	❒	❒
Trails are too eroded (e.g. exposed roots, rocks, channeling)	❒	❒	❒	❒
Litter along the trail	❒	❒	❒	❒
Improperly disposed human waste evident on or near the trail	❒	❒	❒	❒
Too many people on the trail	❒	❒	❒	❒
Off-trail trampling around the Postpile viewing area	❒	❒	❒	❒
Sound from aircraft	❒	❒	❒	❒
Sound from large groups of visitors	❒	❒	❒	❒
Sound from other visitors	❒	❒	❒	❒
Sound from NPS maintenance	❒	❒	❒	❒

Sound from vehicles (e.g. cars, buses, motorcycles)	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒

12. What did you like <u>best</u> about your trip to Devils Postpile today?

Response:

13 What did you like <u>least</u> about your trip to Devils Postpile today?

Response:

14. How did you get to the trailhead today?

❒ Personal vehicle

❒ Shuttle bus Other: _____

15. What is your sex? *(Check one)*

❒ Male

❒ Female

16. In what year were you born?

Year born: 19_____

17. Do you live in the United States? *(Check one.)*

❒ Yes - What is your zip code? _____

❒ No - In what country do you live? _____

18. What is the highest level of formal education you have completed *(Check one)*

- ❒ Some high school
- ❒ High school graduate or GED
- ❒ Some college, business or trade school
- ❒ College, business or trade school graduate
- ❒ Some graduate school
- ❒ Master's, doctoral or professional degree

19. Are you Hispanic or Latino? *(Check one)*

- ❒ Yes
- ❒ No

20. What is your race? *(Check one or more)*

- ❒ American Indian or Alaska Native
- ❒ Asian
- ❒ Black or African American
- ❒ Native Hawaiian or other Pacific Islander
- ❒ White

Thank you for your help with this survey!
Please return the completed questionnaire to the survey administrator.

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Superintendent
Devils Postpile National Monument
Mammoth, CA 93546

OMB # 1024-0224 (NPS # 10-023) Expiration Date: 12/31/2010

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

September 2011

Yosemite National Park
Division of Resources Management and Science
Branch of Visitor Use and Social Science
5083 Foresta Rd
El Portal, Ca 95318
http://www.nps.gov/yose/naturescience/visitor-use.htm