

Informed User Capacity Management Decision Making: Linking Visitor Use Levels to Visitor Experience

Susan L. Vezeau, Visitor Use and Social Sciences Branch, Resources Management and Science (RMS)
Division, Yosemite National Park, PO Box 700-W, El Portal, CA 95318; susan_vezeau@nps.gov
David Pettebone, RMS, Yosemite National Park; david_pettebone@nps.gov
Bret Meldrum, RMS, Yosemite National Park; bret_meldrum@nps.gov
Todd Newburger, RMS, Yosemite National Park; todd_newburger@nps.gov
Colin Leslie, RMS, Yosemite National Park; colin_leslie@nps.gov

Abstract

IN 2009, AS PART OF GENERAL MANAGEMENT PLANNING EFFORTS IN **DEVILS POSTPILE NATIONAL Monument** (Devils Postpile), staff within the Visitor Use and Social Science branch of the Resources Management and Science division, at Yosemite National Park, initiated a process for addressing user capacity and long term monitoring, to establish indicators and suggest standards for experiential and resource-related metrics (Pettebone, Newman, and Lawson 2010). In 2010, they took the experiential and social indicators one step further by implementing evaluative measurements, including visitor perceptions and preferences. Studies were developed for both Devils Postpile National Monument, and Crystal Cave at Sequoia and Kings Canyon National Park. While both reports are currently in progress, the Crystal Cave study is highlighted for this discussion.

The research results presented in this report provides a quantitative understanding of how visitor use levels, such as Crystal Cave tour group size, affects various park management concerns and visitor experience. These results, and future results of this type, can be used to inform, and potentially guide, management decisions about visitor use.

Introduction

Visitor carrying capacity is “the type and level of visitor use that can be accommodated while sustaining the desired resource and visitor experience conditions in the park” (NPS 2006). The National Park Service (NPS) is required by the National Parks and Recreation Act (1978) to include visitor carrying capacity as a part of any park unit’s general management plan. Recent court decisions have required the NPS to address capacity issues by describing the kinds and amounts of visitor uses that are acceptable; monitoring alone is not an adequate manner to address capacity (*Friends of Yosemite Valley v. Kempthorne* 2008).

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Understanding visitor use patterns and trends is crucial for effective visitor management planning, as it allows for the development of justifiable decisions if management action is deemed necessary. Knowing when and where visitor use tends to occur can help park managers determine if management objectives are being met, and allocate resources if deficient conditions are found.

Visitor Use Studies. The onset of general management planning efforts in Devils Postpile in 2009 initiated the process of addressing user capacity and long term monitoring to establish indicators and suggest standards for experiential and resource-related metrics (Pettebone, Newman, and Lawson 2010). Natural resource and biological indicators included informal trails in meadows and along the river, water quality, and riverbank erosion. Experiential and social indicators included descriptive metrics, people at one time (PAOT) counts at attraction sites, and daily visitation on trails.

In 2010, we took the experiential and social indicators one step further by implementing evaluative measurements, including visitor perceptions and preferences. Studies were developed for both Devils Postpile and Crystal Cave. While both reports are currently in progress, the Crystal Cave study will serve as our example for this discussion.

Background

Sequoia National Park is located in the Sierra Nevada Mountains, adjacent to and administered with Kings Canyon National Park. Crystal Cave is one of the park's primary visitor attractions, only accessible tickets purchased for guided tours run by the Sequoia Natural History Association. The cave has a constant temperature of 48°F, yet is only open May through October due to limited winter accessibility via the Crystal Cave Road. The Crystal Cave Road provides the sole access to the cave, other than a single, one-half mile trail which originates in the Crystal Cave parking area.

Methods

Visitor use data, including evaluative and descriptive data, was collected at Crystal Cave during the summer of 2010, using several concurrent approaches.

Descriptive data. Descriptive data included estimating visitor and vehicle use. People-at-one-time (PAOT) counts were documented in two sections of the staging zone for Crystal Cave tours, the "queue," and an informal picnic area in the middle of the parking lot (Figure 1). Observers documented PAOT every 20 minutes from 11am to 5pm on eight separate days (4 weekend and 4 week days) in June and July. Tour group attendance was collected through ticket sales reported by the concessionaire. Vehicle traffic data was collected through the use of an automated vehicle traffic counter deployed along the entrance road to the Crystal Cave parking lot (Figure 1); counters record volume, speed, and vehicle class 24 hours a day, 7 days a week. Vehicles-at-one-time (VAOT) counts were conducted in the Crystal Cave parking lot, and along the roadside (Figure 1); park managers had been concerned about parking availability, and the use of informal roadside parking. Observers documented VAOT every 20 minutes from 11am to 5pm on the same eight days that PAOT counts were collected.

Evaluative data. Evaluative data was collected through visitor surveys which were distributed at the entrance of the cave (Figure 1) to a random sample of park visitors at the completion of their Crystal Cave tour. Surveys were collected during ten days in June and July, six weekdays and four weekend days, including the fourth of July holiday. A total of 296 surveys were completed with questions on demographics, visitor experience, and perceptions of crowding. A series of survey questions pertaining to visitors' perceptions of crowding utilized photos, with visitors asked to rate the photos on a scale of -4 "Very Unacceptable" to 4 "Very Acceptable." Photo one contained 5 people, photo 2 had 15, photo 3 had 30, photo 4 had 45, and photo 5 illustrated a

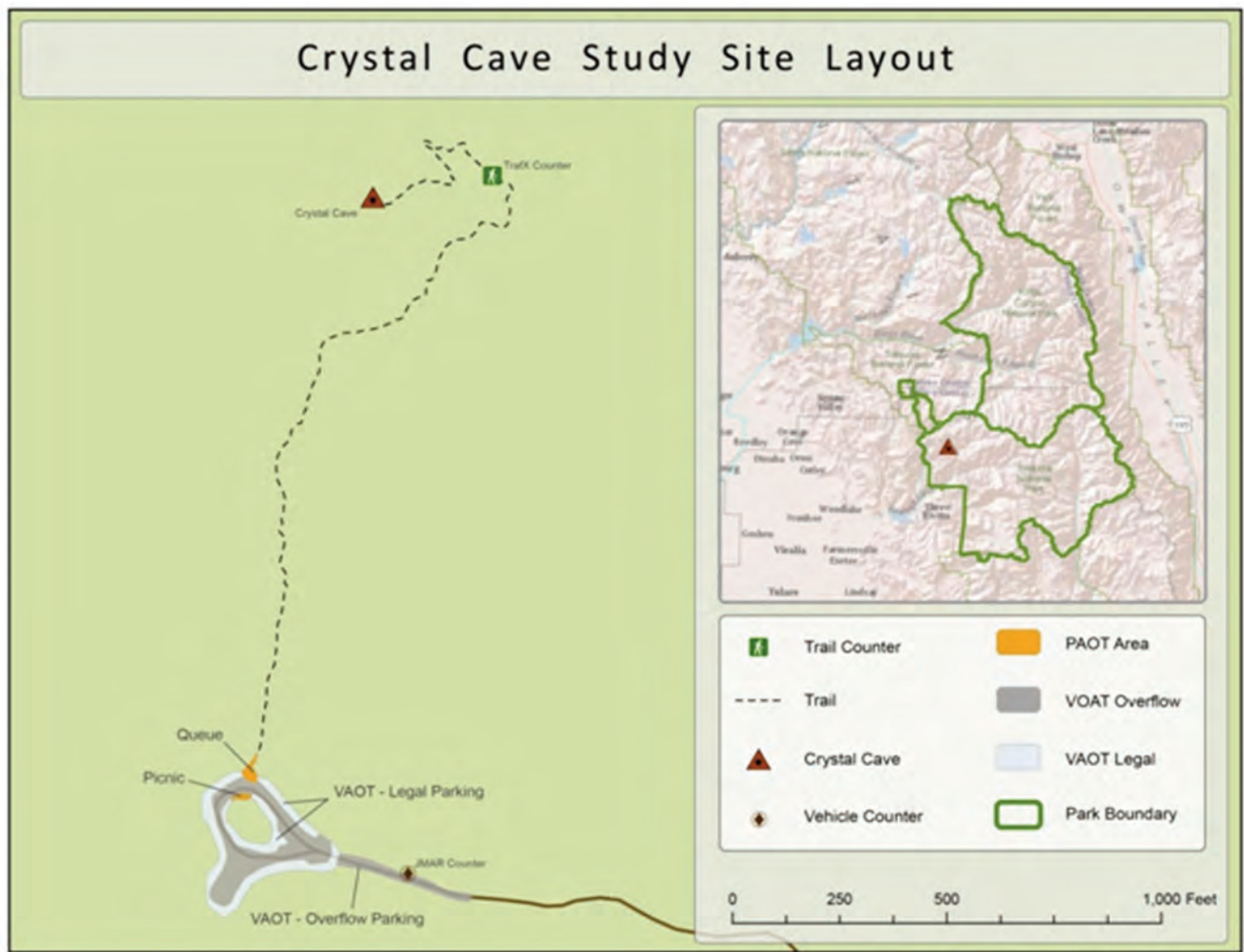


Figure 1. Crystal Cave study site.

Crystal Cave tour group size of 60 people (Figure 2). Currently, the cave is managed so that only one tour group, of up to 70 people, is allowed in the cave at a time.

Results

Survey results. Demographic results were relatively typical of national parks. Eighty six percent of the respondents reported their race as “white,” and 93% were residents of the United States, most from California. Answers to visitor experience questions were informative:

- 50% of the respondents were on their first visit to Sequoia National Park.
- 5% had been there more than ten times.
- 65% reported being fairly unfamiliar with the park.
- 81% had a personal interaction with their tour guide.
- 76% reported being 20 feet away or less from their guide during the tour.
- 68% of visitors were able to hear their Crystal Cave tour guide “well” to “very well.”

Results from the perception of crowding questions were interesting. While actual group tour attendance ranged from 6 to 55 people, with a mean of 39 people per group, visitors’ perceptions of their tour group size were rarely accurate (their perceived mean was 35). Other responses to perception of crowding questions included the following:



Figure 2. Crystal Cave survey scenario Photo 5 with 60 people.

- 61% of survey respondents reported being from “only slightly crowded” to “not crowded at all” on their tour.
- 35% reported that group size had no effect on their enjoyment, 31% that it added to their enjoyment, and 34% that it reduced their enjoyment.
- 36 was the maximum acceptable number of people in Crystal Cave at one time.
- 29 was the maximum number of people that respondents felt the NPS should allow in Crystal Cave at any one time.
- 20 was the number of people that they would prefer to see.
- 53 was the number that would cause them to never return.

Effects of tour group size. Tour group size is one of the tools used to manage Crystal Cave, and results pertaining to these analyses should prove to be the most informative for future park-planning efforts. To better understand how tour group size affected visitors’ experience at Crystal Cave, linear regression analyses were conducted using responses averaged by tour group. The strongest relationships provided evidence that 34% of the variance, or variability of answers, in response to the question “How crowded did you feel on your tour,” was related to tour group size, and 55% of the variance in answers to the question “Which photograph best represents the number of visitors you saw on your tour today,” was related to group tour size.

One of the most interesting aspects of these study results is that visitors seem to perceive tour group size as larger than reality when groups are small, 5–20 people; are able to accurately judge group size for groups of approximately 25 people; and then tend to underestimate group size when groups are relatively large, 30–55 people (Figure 3). Possible reasons why visitors percep-

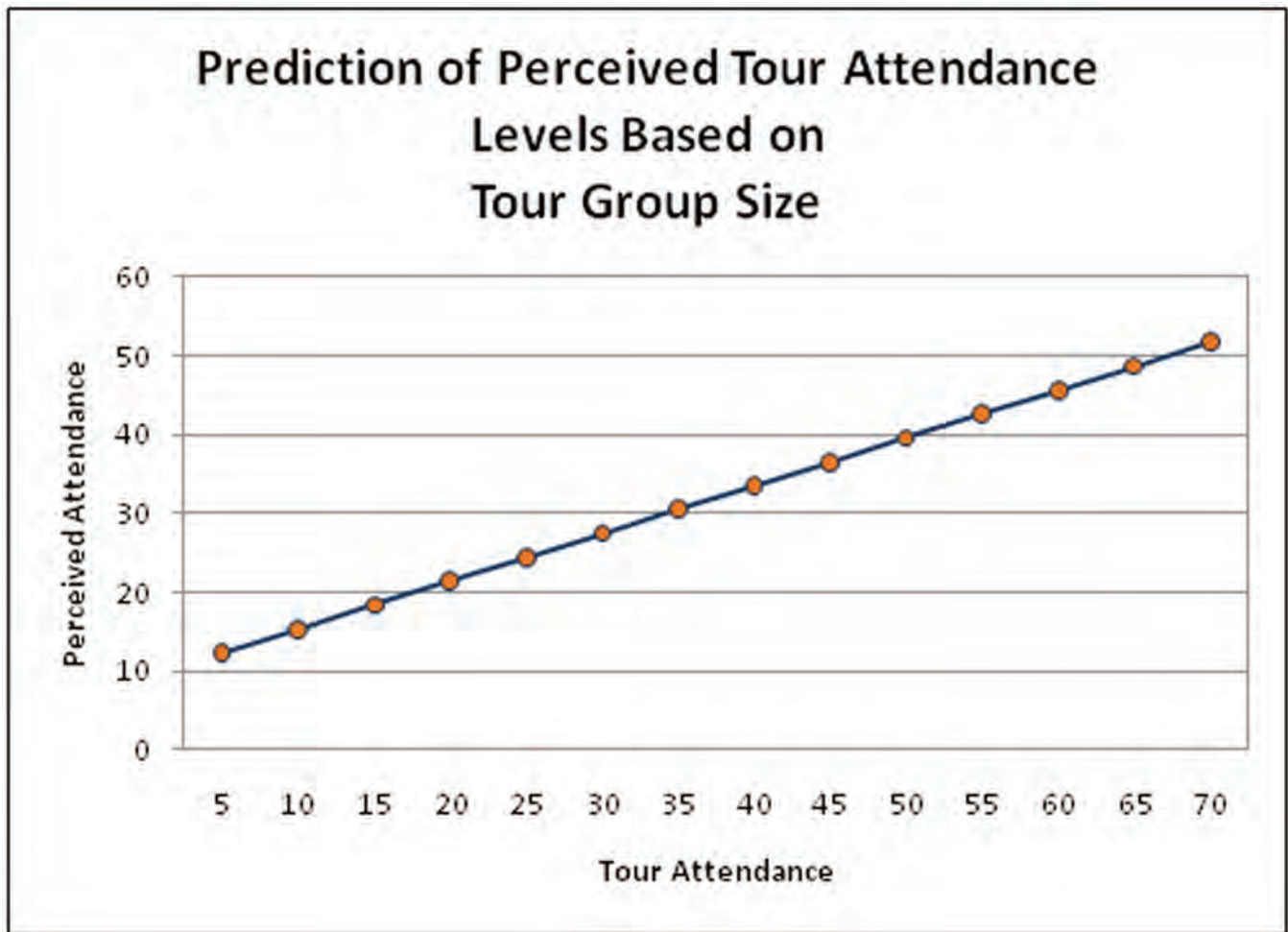


Figure 3. Crystal Cave visitors’ perceptions of tour attendance predicted by tour group size.

tions of group size are inconsistent with actual group size may include the fact that two dimensional photographic representations are different than actual experiences, the dark environment of the cave, the linear trail or route taken by the group (which would limit clustering), group size effects on sound (such as echoing) in a cave environment, or people may be concentrating more on the tour guide, or the cave environment, than on other members of the group.

Based on the finding that visitors inaccurately evaluated actual tour group size, we tested to see if evaluations of crowding could be explained by perceived tour group size. The subjective response to the question: “Which photograph best represents the number of visitors you saw on your tour today,” turned out to be the sole significant predictor of how crowded people felt on their tour; the actual tour group size, an objective variable, was non-significant.

In order to inform park managers about the effect of tour group size on visitors perceptions of crowding we developed a conceptual model which illustrates that perceived tour group size can be explained by actual tour group size, and subsequently, crowding explained by perceived tour group size (Figure 4). This relationship suggests that visitors are more tolerant of crowding at higher levels of use because they perceive fewer people than there actually are. The model provides a basis for park managers to consider the effects of tour group size on visitor experience such as perceptions of crowding.

PAOT results. PAOT results included counts taken for the “Queue” which had a mean of 15, and the “Picnic Area” with a mean of 4; both of which were combined for total PAOT with a mean of 19.5. Total mean PAOT was significantly different for weekdays and weekends, ranging



Figure 4. Conceptual model showing tour group size influencing perceived tour group size influencing perceptions of crowding.

from 13.5 on weekdays to 26 on weekends, and reaching a high of 37 for the mean total PAOT on July 4.

Tour group size explained 57% of the variance for total PAOT counts ($p < .001$). In other words, roughly half of the people on a tour (depending on group size) were found in the staging area before a tour, the remainder may have been awaiting the tour along the trail, or at the cave entrance one-half mile away.

VAOT results. VAOT results included both parking in the Crystal Cave parking lot (with a capacity of 86 spaces), and informal overflow parking along the roadway. The total hourly mean VAOT was 48, 47 for parking in the lot (which is 55% of capacity), and less than 1 for overflow parking along the road. Total hourly mean VAOT ranged from 39 on weekdays to 61 on weekends, with the fourth of July reaching 66, still well below capacity. The total hourly count of VAOT was in the range of 36–45 vehicles in the Crystal Cave parking lot 35% of the time.

Tour group size explained 66% of the variance for total VAOT counts ($p < .001$), and results show that as long as group tour size is limited to 2010 use-levels or lower, there should be adequate parking in the Crystal Cave parking area.

Vehicle traffic volume results. Automatic vehicle counters (pneumatic tube counters) collected information on vehicle volume, speed, and class. Results showed that 72% of all vehicle traffic utilizing the Crystal Cave Road was personal vehicles, including cars, trucks, and RVs. On average, 148 vehicles per day accessed the road (June had a mean of 135; July a mean of 160). Inbound traffic peaked at 11 a.m. and outbound at 3 p.m., with parking lot accumulation peaking at 1 p.m. Daily mean traffic ranged from 130 vehicles on weekdays, to 188 vehicles on weekends. Strong relationships to vehicle traffic volume were found in this study:

- Inbound vehicle traffic volume explained 47% of the variance for total VAOT taken one hour later ($p < .001$).
- Inbound vehicle traffic volume explained 43% of total PAOT counts taken one hour after the vehicles had arrived ($p < .001$).
- Tour group size explained 54% of the variance for inbound vehicle traffic volume collected one hour before tour times ($p < .001$).

Recommendations for future research

The following work is recommended for future research at Sequoia's Crystal Cave:

- Determine the impacts and implications of current use levels on natural resources and visitor experience.
- Ongoing systematic surveys (i.e. every 5–10 years) to monitor visitor perceptions of crowding.
- Regularly monitor vehicle traffic volume along Crystal Caves road to determine any changes from current conditions
- Additional research to more fully understand why people inconsistently evaluate levels of use (i.e. group size).

Conclusion

The research presented in this report provides a quantitative understanding of how visitor use levels, such as Crystal Cave tour group size, affects various park management concerns and visitor experience. These results can be used to inform, and potentially guide, management decisions about visitor use in Crystal caves. For example, the 2010 data suggests that visitors are largely tolerant of crowding related to current levels of use; however, park managers may choose to manage for smaller tour group sizes, family group tours, or adult only tours, in order to provide a less crowded, more intimate, and potentially higher-quality visitor experience, which might also prove to have less impact on the resource.

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