

# **Understanding Visitor Perceptions of Recreation Resource Impacts: A Comparison of Climber and Hiker Perceptions**

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**Prepared by:  
Ashley D'Antonio, PhD Candidate**

**Department of Environment and Society  
Utah State University**

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**Introduction:**

Visitor use in a park or protected area will ultimately lead to some level of resource change or impact. Resource impacts may be of particular concern at the scale of human perceptions. When examined at the human scale, resource impacts have the potential to not only influence ecological conditions but influence social conditions in parks and protected areas as well. At the human scale, certain impacts may be viewed as beneficial for specific recreational activities (Farrell et al., 2001). For example, bare ground may be viewed positively in a campsite setting or at the base of a climb. Of particular concern to researchers and managers, are visitor perceptions (positive or negative) of recreation impacts and the factors that may influence these perceptions (White et al., 2008). Managers of parks and protected areas are concerned about recreation impacts that reduce visitor enjoyment and impair the functionality or desirability of resources used by visitors (Hammitt and Cole, 1998).

Managers should not assume that their perception of recreation impacts are the same as those held by visitors (Farrell et al., 2001). Many recreationists do not recognize recreation impacts or may view impacts as beneficial or as having an amenity value (Farrell et al., 2001; Monz, 2009). In general, recent perceptions studies have shown that visitors are most perceptive of resource impacts that are the result of obviously depreciative behavior such as carving in trees, hiking off-trail, and littering (D'Antonio et al., 2012). As such, an understanding of how visitors perceive environmental conditions can provide guidance for management decisions by highlighting the types of recreation resource impacts that may be degrading the visitor experience. However, in order to effectively manage for quality recreation experiences it is important for managers to understand their visitors. Therefore, managers should not only understand the types of resource impacts which visitors are perceiving but also the subjective factors which influence visitor perceptions (White et al., 2008). Identifying the factors which drive visitor perceptions of resource impacts has implications for both interpretation and site-specific resource management.

Visitor characteristics such as level of knowledge and experience use history have been shown to influence how visitors perceive recreation related resource impact (D'Antonio et al., 2012, van Riper and Manning, 2011; White et al., 2008). Perceptions studies have also examined visitor characteristics such as place attachment, place identity, natural park affinity, place of residence (local vs. tourist), and seasonality of visit (D'Antonio et al., 2012; Eder and Arnberger, 2012; Gerner and Chihar, 2011; van Riper and Manning, 2011; White et al., 2008). Fewer studies have examined the influence of nature orientation scales, such as the new environmental paradigm (NEP) when examining visitor perceptions (Dunlap et al., 2000; Haukeland et al., 2012). However, recent studies have shown that psychographic scales, such as NEP, can better explain the variability in visitor attitudes towards ecological impacts than visitor characteristics such as experience (Haukeland et al., 2012).

Another visitor characteristic that has been overlooked in the perceptions literature is activity type. Perceptions studies, to this point, have examined only a single activity type at a time - with the majority of perceptions studies focused on hiking. Climbing has become an increasingly popular recreational activity in recent years. According to the Outdoor Foundation's 2011 Outdoor Recreation Participation Report, over 4.7 million people in the United States participated in some sort of climbing (sport, indoor, or bouldering) activity in 2010 (a 10% increase in participation from 2009). A visitor survey conducted in Joshua Tree National Park (Jette et al., 2011) indicated that almost 30% of groups visiting Joshua Tree National Park participated in technical climbing or bouldering. Traditionally, climbing studies have only examined the impacts of the activity itself and not included survey work (Camp and Knight 1998). Very few studies have examined climber specific perceptions of resource impacts (Monz 2009). Examining visitor perceptions could expand the knowledge of climbing impacts by including participant perceptions.

No studies to date have compared visitor perceptions across activity types such as climbing and hiking. Understanding visitor perceptions of different types of resource impacts as stratified by user group can help inform management decisions in areas that are popular for multiple activities types. For example, climbing is a unique recreational activity in that it is often pursued in popular areas accessed via informal trails (Monz, 2009). Therefore, the nature of the activity and the reliance on resource impacts to access climbing sites may result in climbers viewing some resource impacts as having an amenity value. On the other hand, hikers in the same area may view the use of these informal trails by climbers as a depreciative behavior (D'Antonio et al., 2012). Understanding any differences in perceptions and/or judgments of resource impacts can help managers provide quality experiences for all user groups.

Finally, no perceptions study to date has been conducted in a desert park or protected area examining desert-specific resource conditions/impacts. Desert ecosystems may be especially susceptible to recreation related impacts and associated impacts may be longer lasting as compared to more temperate ecosystems. The semiarid nature of desert systems results in slow growth, and potentially slow recovery, for vegetation that may have been trampled (Belnap, 1998). The lack of plant litter and large spaces between plants can make soils less resistant to erosion (both natural and recreation caused) and compaction (Belnap, 1998). Results from this study can be used to better understand how visitors view desert resource impacts specifically and if visitor perceptions in a desert park differ from those in a non-desert park. Results from the study can be generalizable to other parks in the desert southwest and additionally to parks where climbers are a dominate user group. Overall, the design and analysis from this study can provide better understanding of a visitor group (climbers) and a setting (desert parks) which has mostly, heretofore, not been examined in the visitor perceptions literature.

This study has two objectives:

- 1) Explore the relationship between visitor characteristics and visitor perceptions of specific types of resource impacts in Joshua Tree National Park.
- 2) Explore potential differences in visitor perceptions based on visitor user groups; specifically examine visitor perceptions stratified by climbers and hikers.

## Methods:

### *Study Sites*

Self-administered surveys were conducted at two areas in Joshua Tree National Park – the Hidden Valley Nature Trailhead and the Hall of Horrors trailhead/parking lot (Figure 1). These two locations were chosen for survey sites because both locations are frequented by both climbers and hikers and both had easily observable recreation-related resource impacts. Other trailheads that were frequented predominately by only one user group (hikers or climbers) were excluded from the study. The Hidden Valley Nature Trail is a 1-mile long nature loop with various climbing routes throughout the area. The Hall of Horrors is a popular climbing and bouldering area with a network of trails (both designated and informal) that are popular for hikers as well.

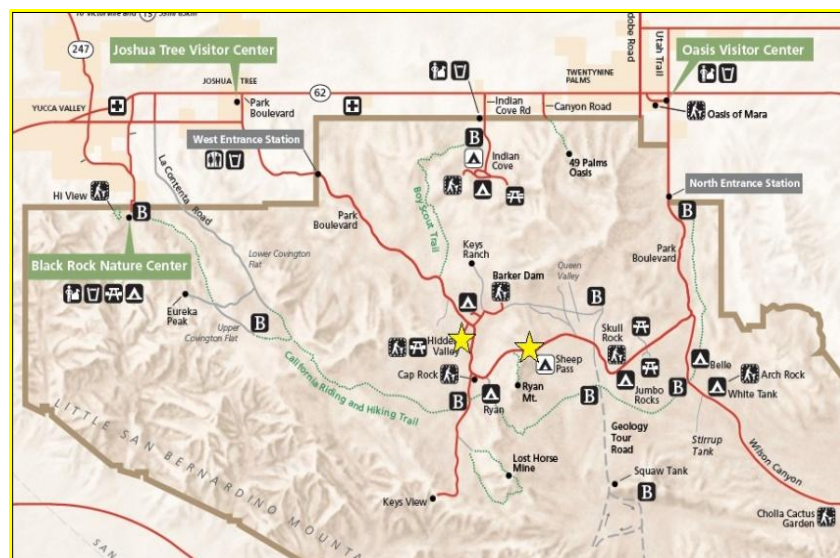


**Figure 1: Location of survey sites; Hall of Horrors and Hidden Valley Nature Trail**

### *Data Collection*

Visitor surveys were administered during two different survey periods; Thanksgiving week (November 21<sup>st</sup> and November 26<sup>th</sup>) of 2011 and a week during mid-March (March 11<sup>th</sup> to March 17<sup>th</sup>) of 2012. The Hidden Valley Nature Trailhead was surveyed for 10 days and the Hall of Horrors was surveyed for 4 days for a total of 14 sampling periods during the study. Sampling days were stratified by day of week and time of day. Sampling efforts were split into am (9am to 1pm) and pm (1pm to sunset) to ensure that a representative sample of visitors was collected. Only one trailhead was sampled at a time to ensure that visitors who may visit both sites in a single day during their visit to Joshua Tree National Park were not over-burdened. Hiker groups were intercepted as they exited the trailhead at random intervals to ensure a representative sample of hikers. Due to the low number of climbing groups at each trailhead, as compared to hikers, a census of climbing groups (identified by the presence of climbing gear) was attempted. Approximately all climbing groups that exited the trail during a sampling period were intercepted and asked to participate in the study. Only one individual per group was asked to complete the on-site, self-administered questionnaire.

### *Variables*

The survey instrument collected data on various visitor characteristics which could potentially influence visitor perceptions of recreation resource impacts. Visitors first identified their activity type: hiking, climbing, or bouldering. Experience use history was measured using three indicators. Visitors reported the total number of visits that they have made to Joshua Tree National Park, the trailhead they were using to access their primary destination, and to their primary destination for that day (D'Antonio et al., 2012; Hammitt et al., 2004; van Riper and Manning, 2011; White et al., 2008). In the case of climbers, their primary destination was the name of the climb and hiking groups may or may not have had a primary destination.

Values orientation/environmental attitude was measured using the New Environmental Paradigm revised scale (Dunlap et al., 2000) with suggestions from Hawcroft and Milfont (2010). Participants responded to both protectionist and utilitarian statements on a Likert scale (1 = strongly disagree to 7 = strongly agree). Both groups of statements were framed around the concept of attitudes towards the use of "natural areas". The utilitarian statements included (1) humans should manage natural areas so that humans benefit, (2) the needs of humans are more important than protecting natural areas, (3) recreation use of natural areas is more important than protecting species that live there, and (4) the primary value of natural areas is to provide for humans. The protectionist statements included (1) natural areas should be protected for their own sake rather than to simply meet the needs of humans, (2) natural areas should have rights similar to the rights of humans, (3) recreational use of natural areas should not be allowed if it damages these areas, and (4) natural areas have value whether humans are present or not.

Visitors self-rated their knowledge of the natural history and management issues of Joshua Tree National Park as a measure of local ecological knowledge on a Likert-like scale (1= no knowledge, 3 = some knowledge, 5 = proficient knowledge) (D'Antonio et al., 2012; Leujak and Ormond, 2007). Natural history topics examined in this study included mammals, birds, insects, reptiles, plants, geology, desert ecology, and night sky as they relate to Joshua Tree National Park. Management topics or issues included endangered/threatened species, vegetation management, fire management, air quality, wilderness management, adjacent lands development, nonnative species, and climate change. Knowledge of low impact practices was measured using a series of multiple choice questions based on the frontcountry principles of Leave No Trace (D'Antonio et al., 2012). Each question, and the corresponding correct answer, was formulated from one of the seven principles of outdoor ethics for frontcountry use as developed by the Leave No Trace Center for Outdoor Ethics (Leave No Trace Center for Outdoor Ethics, 2010).

In order to measure visitor perceptions of recreation resource impacts, visitors responded to attitudinal statements related to specific types of impacts on a five point Likert-scale (1=strongly disagree, 5 = strongly agree) (D'Antonio et al., 2012; Muller and Job, 2009). The specific recreation resource impacts examined were found in both study areas and would likely be experienced by both climbers and hikers. These included soil damage, trampled vegetation, the presence of informal trails, off -trail use, tree damage, and solitude/degree of crowding. For climbers, resource impact statements were also stratified by perceptions during the climbing group's approach to their climb (on designated or informal access trails) and while the group was at their climb. Due to the fact that the two study areas did not have very obvious "primary destinations" for hiking groups, hikers only responded to resource impacts that they observed during their hike. Visitors responded to questions regarding the effect (added, no effect, or detracted) of recreation resource conditions on their overall experience and whether or not they felt that the specific recreation resource impacts were a problem. Finally, the survey included various common demographics questions including gender, year of birth, state or country of residence, and highest level of formal education.

#### *Data Analysis:*

All data analysis was performed using SPSS software (SPSS, Inc., Chicago, IL, USA). Data was checked for outliers and non-normality. Following initial univariate and bivariate analyses (reliability analysis, MANCOVA to compare responses by activity type while controlling for experience use history, and paired t-tests to compare climber perceptions at different sites), structural equation modeling (SEM) was conducted using AMOS software. The purpose of the SEM was to examine the relationship between visitor characteristics and visitor. SEM allows unobservable variables or constructs (such as perceptions) to be modeled as latent variables influenced by measured or observed variables (such a knowledge).

In this SEM, total scores were calculated for the observed/measured variables of knowledge of natural history topics and management issues. Total scores were combined into a single latent variable of “local ecological knowledge”. A total score for knowledge of low-impact practices (i.e., knowledge of Leave No Trace principles) was included as a measured variable. The three experience use history variables were combined into a single latent variable and reliability of the EUH scale was assessed using Cronbach’s  $\alpha$ . The seven NEP attitude statements, with negatively worded attitudinal statements reverse coded, were combined into a single latent variable called value orientation; consistency of the scale was assessed using Cronbach’s  $\alpha$ . Consistency of the perceptions scales was also assessed using Cronbach’s  $\alpha$  and the perceptions components were combined into two latent variables; noticing and being affected by resource impacts. Only perceptions while hiking were used in the SEM since hikers were not asked about perceptions at a primary destination. Experiential impacts such as crowding and solitude were left out of the SEM to allow for a better model fit as these variables are experiential impacts not resource-related impacts. Due to the slightly skewed nature of the experience use history variable, a bootstrapping maximum likelihood model (with 500 permutations) was used for the final SEM.

## **Results:**

### *Survey Response*

A total of 238 surveys were collected during the two weeks of field work; 141 hiking groups and 97 climbing groups. Although the total number of surveys collected fell a bit short of the anticipated sample size, the sample is deemed a representative sample of use at the trailheads sampled. No response bias was found for either hikers or climbers. The overall acceptance rate was 81% with an acceptance rate of 77% for hikers and 87% for climbers.

### *Demographics*

Overall, all visitors to Joshua Tree National Park were highly educated with 83% of respondents having a BS degree or higher (Table 1). Of the survey population, 60% were males and the overall average age was 40 years (Table 1). The majority of respondents were from the United States and almost half were from the state of California (Table 2 and Table 3). Hikers were also highly educated with 86% having a BS degree or higher (Table 1). Average age of hikers was 46 years of age and 54% of hikers were male (Table 1). The majority of hikers were from the United States (76%) or Canada (13%) and almost half were from California (Table 2 and Table 3). Of the respondents who identified themselves as climbers, 79% had a BS degree or higher, the majority was male (68%), and climbers had a lower average age compared to hikers at 33 years old (Table 1). Climbers were overwhelmingly from the United States (91%) and exactly half were from California (Table 2 and Table 3).

**Table 1: Socio-demographic information for survey respondents; “all” is a combination of hiker and climber responses, N = 238.**

| Respondent Characteristic | Frequencies (%)    |                    |                    |
|---------------------------|--------------------|--------------------|--------------------|
|                           | Hikers             | Climbers           | All                |
| Education Level           |                    |                    |                    |
| High school or GED        | 5                  | 5                  | 5                  |
| Some college              | 9                  | 16                 | 12                 |
| College (BS Level)        | 36                 | 45                 | 4                  |
| Some graduate school      | 13                 | 17                 | 14                 |
| Advanced degree           | 37                 | 17                 | 29                 |
| Gender                    |                    |                    |                    |
| Male                      | 54                 | 68                 | 60                 |
| Female                    | 46                 | 32                 | 40                 |
| Mean age (SD)             | 46 yrs of age (15) | 33 yrs of age (12) | 40 yrs of age (15) |

**Table 2: Country of residence for survey respondents; “all” is a combination of hiker and climber responses, N = 238.**

| Countries                                                                               | Frequencies (%) |          |     |
|-----------------------------------------------------------------------------------------|-----------------|----------|-----|
|                                                                                         | Hikers          | Climbers | All |
| United States                                                                           | 76              | 91       | 81  |
| Canada                                                                                  | 13              | 6        | 10  |
| United Kingdom                                                                          | 4               | 1        | 2   |
| Germany                                                                                 | 2               | 1        | 2   |
| Others: Australia, Czech Republic, France, Italy, Norway, Scotland, Spain, Switzerland, |                 |          |     |

**Table 3: State of residence for survey respondents from the United States; “all” is a combination of hiker and climber responses, N = 238.**

| States     | Frequencies (%) |          |     |
|------------|-----------------|----------|-----|
|            | Hikers          | Climbers | All |
| California | 47              | 50       | 48  |
| Arizona    | 3               | 7        | 5   |
| Colorado   | 2               | 5        | 4   |
| New York   | 5               | 5        | 4   |
| Illinois   | 3               | 5        | 3   |
| Utah       | 0               | 6        | 3   |

### *Experience Use History*

For all visitors surveyed, approximately half were visiting JOTR for the first time with 13% having visited the park more than 10 times. The average number of past visits to JOTR was 16 (median 2) (Table 4). The majority of respondents (62%) were visiting that particular trailhead for the first time with an average of 8 total past visits (median 1). In terms of visits to their primary destination, 74% of respondents were visiting that destination for the first time (average past visits of 4 with a median of 1) (Table 4). The experience use history of hikers was slightly different from the overall sample with 61% of hikers visiting JOTR for the first time (average of 7 with a median of 1), 83% visiting the specific trailhead for the first time (average of 2 with a median of 1), and 84% visiting their primary destination for the first time (average of 2 with a median of 1) (Table 4). Climbers exhibited a very different pattern of experience use history. Only 30% of climbers were visiting JOTR for the first time (average of 26 with a median of 3) while 56% had visited the park 3 or more times. Climbers were found to have a significantly higher average number of visits to JOTR as compared to hikers. In terms of the specific trailhead, 35 percent of climbers were using that trailhead for the first time (average 17 with a median of 2) while 49% percent had used that trailhead 3 or more times in the past. For their primary destination, 61% of climbers were accessing that destination for the first time (average of 6 with a median of 1). No statistically significant difference ( $p>0.05$ ) was found between the average number of visits to a particular trailhead or primary destination when comparing the EUH of climbers and hikers (Table 4).

### *Values Orientation*

Overall, the majority of respondents agreed with the protectionist statements with the most agreement for the statement that “Natural areas have value whether humans are present or not (Table 5).” Respondents also mostly disagreed with the utilitarian statements with the exception of “Humans should manage natural areas so that humans benefit” which has a neutral rating. Individually, hikers and climbers followed the same trend of agreement as the overall ratings. However, hikers agreed more than climbers that natural areas should be protected for their own sake and that recreation use should not be allowed if it damages the natural area (Table 5). For all other attitude statements, there was not a significant difference between the average response of climbers and hikers ( $p>0.05$ ) when controlling for differences in experience use history.

### *Knowledge of Natural History*

Pooled, the respondents self-rated themselves as being most knowledgeable about the natural history topics of geology, plants, and desert ecology as it related to JOTR (Table 6). Respondents were least knowledgeable about the reptiles, birds, and insects of JOTR. Hikers self-rated themselves as being the most knowledgeable about plants, mammals, and geology and also least knowledgeable about reptiles, birds, and insects of JOTR. Climbers self-rated themselves as being most knowledgeable about geology, desert ecology, and night sky (Table 6).

**Table 4: Experience Use History measures for hikers, climbers, and overall sample. Reported as frequencies of visits, means, and medians by user group and overall; N =238. H = hikers, C= climbers.**

| Concept and variable identification                  | 1st Visit |    |     | 2nd Visit |    |     | 3 - 10 visits |    |     | >10 visits |    |     | Mean +/- SE |              |             | Median |   |     |
|------------------------------------------------------|-----------|----|-----|-----------|----|-----|---------------|----|-----|------------|----|-----|-------------|--------------|-------------|--------|---|-----|
|                                                      | H         | C  | All | H         | C  | All | H             | C  | All | H          | C  | All | H           | C            | All         | H      | C | All |
| Experience Use History                               |           |    |     |           |    |     |               |    |     |            |    |     |             |              |             |        |   |     |
| Total number of visits to Joshua Tree National Park* | 61        | 30 | 48  | 18        | 14 | 16  | 15            | 34 | 23  | 6          | 22 | 13  | 7<br>+/- 4  | 26<br>+/- 9  | 16<br>+/- 4 | 1      | 3 | 2   |
| Total number of visits to Trailhead                  | 83        | 35 | 62  | 9         | 16 | 12  | 6             | 36 | 19  | 2          | 13 | 7   | 2<br>+/- 1  | 17<br>+/- 10 | 8<br>+/- 4  | 1      | 2 | 1   |
| Total number of visits to primary destination        | 84        | 61 | 74  | 8         | 13 | 10  | 4             | 19 | 11  | 4          | 7  | 5   | 2<br>+/- 1  | 6<br>+/- 3   | 4<br>+/- 1  | 1      | 1 | 1   |

\* Statistically significant difference between hikers and climbers (p&lt;0.05)

**Table 5: Value orientation measures for hikers, climbers, and overall sample. Reported as frequencies of responses and mean responses by user group and overall; N =238. H = hikers, C= climbers.**

| Value                                                       | Strongly Disagree/Disagree |    |     | Neutral |    |     | Strongly agree/agree |    |     | Mean +/- SE      |                  |                  |
|-------------------------------------------------------------|----------------------------|----|-----|---------|----|-----|----------------------|----|-----|------------------|------------------|------------------|
|                                                             | H                          | C  | All | H       | C  | All | H                    | C  | All | H                | C                | All              |
| Manage natural areas so that humans benefit                 | 36                         | 40 | 38  | 21      | 15 | 18  | 52                   | 45 | 44  | 4.22<br>+/- 0.17 | 4.21<br>+/- 0.19 | 4.20<br>+/- 0.13 |
| The needs of humans are more important than protection      | 84                         | 89 | 86  | 8       | 6  | 7   | 8                    | 5  | 7   | 2.04<br>+/- 0.11 | 2.02<br>+/- 0.14 | 2.03 +/-<br>0.09 |
| Recreation use more important than protecting species       | 93                         | 85 | 89  | 3       | 12 | 7   | 4                    | 3  | 4   | 1.78<br>+/- 0.09 | 2.02<br>+/- 0.12 | 1.87<br>+/- 0.07 |
| The primary value of natural areas is to provide for humans | 86                         | 88 | 87  | 7       | 8  | 8   | 7                    | 4  | 5   | 2.13<br>+/- 0.12 | 2.01<br>+/- 0.12 | 2.08<br>+/- 0.09 |
| Natural areas should be protected for their own sake*       | 10                         | 17 | 12  | 4       | 4  | 4   | 86                   | 79 | 83  | 5.98<br>+/- 0.13 | 5.53<br>+/- 0.17 | 5.80<br>+/- 0.10 |
| Natural areas should have rights similar to humans          | 19                         | 17 | 17  | 19      | 19 | 19  | 62                   | 64 | 64  | 5.05<br>+/- 0.16 | 5.03<br>+/- 0.17 | 5.05<br>+/- 0.11 |
| Recreational use not be allowed if it causes damage*        | 10                         | 41 | 16  | 5       | 21 | 10  | 85                   | 38 | 74  | 5.65<br>+/- 0.13 | 4.78<br>+/- 0.16 | 5.29<br>+/- 0.10 |
| Natural areas have value whether humans present or not      | 4                          | 2  | 4   | 2       | 6  | 3   | 94                   | 92 | 93  | 6.41<br>+/- 0.11 | 6.54<br>+/- 0.1  | 6.47<br>+/- 0.08 |

\* Statistically significant difference between hikers and climbers (p&lt;0.05)

Like hikers, climbers were also least knowledgeable about reptiles, birds, and insects. Climbers were found to have a higher self-rated knowledge of natural history topics for all topics except birds and mammals as compared to hikers ( $p>0.05$ ) when controlling for differences in experience use history (Table 6).

### *Knowledge of Ecological Issues*

Overall, respondents self-rated themselves as being most knowledgeable about the following ecological issues: climate change, fire management, and wilderness management (Table 6). The pooled respondents rated themselves as least knowledgeable about endangered species, non-native species, and adjacent lands development. Hikers were most knowledgeable about climate change, air quality, and fire management and rated themselves as least knowledgeable about vegetation management, non-native species, and adjacent lands development (Table 6). Climbers' self-rated knowledge differed from hikers' self-rated knowledge of ecological issues of JOTR. Climbers rated themselves as most knowledgeable about wilderness management, climate change, and vegetation management and least knowledgeable about endangered species, non-native species, and adjacent lands development (Table 6). Climbers were found to have a higher self-rated knowledge of vegetation management, fire management, wilderness management, and climate change as compared to hikers ( $p>0.05$ ) when controlling for differences in experience use history (Table 6).

### *Knowledge of Low-impact Practices*

Overall, 36% of respondents answered all of the low-impact practice questions correctly, with 44% only missing one question (Table 7). The question which was answered incorrectly most often was related to proper trail etiquette when taking a break on the trail (Table 8). Almost all respondents answered questions related to leaving what you find, interacting with wildlife, and campfires correctly. The hiker results were very similar to the overall findings, with 34% of hikers answering all of the low-impact practice questions correctly and 44% missing one question (Table 7). The most often missed question for hikers was the trail etiquette question and the questions that almost all respondents answered correctly were related to leaving what you find, campfires, and interacting with wildlife. Climbers were slightly more knowledgeable about low-impact practices with 40% answering all questions correctly and 44% answering only one question incorrectly (Table 7). All climbers answered questions related to leaving what you find and interacting with wildlife correctly and few climbers answered the question related to campfires incorrectly (Table 8). Like hikers, climbers incorrectly answered the question related to trail etiquette almost 50% of the time. No difference was found between the average level of knowledge of low-impact practices when comparing climbers and hikers ( $p>0.05$ ).

**Table 6: Local ecological knowledge measures for hikers, climbers, and overall sample. Reported as frequencies and mean responses by user group; N =238, H = hikers, C= climbers.**

| Concept and variable identification | No Knowledge (1) |    |     | 2  |    |     | Some Knowledge (3) |    |     | 4  |    |     | Proficient Knowledge (5) |    |     | Mean +/- SE   |               |               |
|-------------------------------------|------------------|----|-----|----|----|-----|--------------------|----|-----|----|----|-----|--------------------------|----|-----|---------------|---------------|---------------|
|                                     | H                | C  | All | H  | C  | All | H                  | C  | All | H  | C  | All | H                        | C  | All | H             | C             | All           |
| Knowledge of Natural History        |                  |    |     |    |    |     |                    |    |     |    |    |     |                          |    |     |               |               |               |
| Geology*                            | 19               | 5  | 13  | 31 | 24 | 28  | 36                 | 28 | 33  | 12 | 30 | 20  | 2                        | 13 | 6   | 2.48+/- 0.09  | 3.21 +/- 0.11 | 2.78 +/-0.07  |
| Plants                              | 11               | 8  | 10  | 27 | 25 | 26  | 48                 | 39 | 44  | 14 | 23 | 18  | 0                        | 5  | 2   | 2.65+/- 0.07  | 2.92 +/- 10   | 2.77 +/-0.06  |
| Dessert Ecology*                    | 20               | 9  | 16  | 31 | 16 | 24  | 39                 | 33 | 36  | 9  | 35 | 20  | 1                        | 7  | 4   | 2.40 +/- 0.08 | 3.16 +/- 0.11 | 2.72 +/-0.07  |
| Night Sky*                          | 22               | 6  | 15  | 34 | 20 | 28  | 33                 | 42 | 37  | 8  | 26 | 16  | 3                        | 6  | 4   | 2.36+/- 0.09  | 3.06 +/- 0.10 | 2.65 +/-0.07  |
| Mammals*                            | 22               | 8  | 16  | 26 | 23 | 24  | 46                 | 44 | 45  | 5  | 22 | 12  | 2                        | 3  | 3   | 2.49 +/- 0.08 | 2.89 +/- 0.10 | 2.61 +/-0.07  |
| Reptiles*                           | 22               | 9  | 17  | 28 | 35 | 31  | 44                 | 35 | 40  | 4  | 19 | 10  | 2                        | 2  | 2   | 2.38 +/- 0.08 | 2.69 +/- 0.10 | 2.51 +/-0.06  |
| Birds                               | 22               | 15 | 19  | 34 | 34 | 34  | 35                 | 38 | 37  | 7  | 8  | 36  | 2                        | 5  | 4   | 2.32 +/- 0.08 | 2.56 +/- 0.10 | 2.43 +/-0.07  |
| Insects*                            | 35               | 18 | 28  | 34 | 42 | 37  | 29                 | 35 | 32  | 1  | 4  | 2   | 1                        | 1  | 1   | 1.99 +/- 0.08 | 2.28 +/- 0.09 | 2.12 +/-0.06  |
| Knowledge of Ecological Issues      |                  |    |     |    |    |     |                    |    |     |    |    |     |                          |    |     |               |               |               |
| Climate Change*                     | 28               | 19 | 24  | 26 | 23 | 25  | 30                 | 29 | 30  | 13 | 24 | 17  | 13                       | 5  | 4   | 2.36 +/- 0.10 | 2.71 +/- 0.11 | 2.51 +/- 0.08 |
| Fire Management*                    | 31               | 17 | 25  | 31 | 29 | 31  | 29                 | 28 | 28  | 7  | 21 | 13  | 7                        | 5  | 3   | 2.18 +/- 0.08 | 2.67 +/- 0.12 | 2.38 +/- 0.06 |
| Wilderness Management*              | 34               | 16 | 27  | 31 | 20 | 26  | 26                 | 39 | 32  | 6  | 23 | 13  | 6                        | 2  | 2   | 2.10 +/- 0.09 | 2.74 +/- 0.11 | 2.37 +/- 0.06 |
| Vegetation Management*              | 36               | 10 | 25  | 31 | 30 | 30  | 29                 | 42 | 34  | 4  | 17 | 10  | 4                        | 1  | 1   | 2.01 +/- 0.08 | 2.69 +/- 0.09 | 2.30 +/- 0.06 |
| Air Quality                         | 30               | 22 | 27  | 32 | 34 | 33  | 25                 | 30 | 27  | 12 | 11 | 11  | 12                       | 3  | 2   | 2.21 +/- 0.09 | 2.39 +/- 0.10 | 2.28 +/- 0.07 |
| Endangered Species                  | 37               | 24 | 31  | 26 | 26 | 26  | 31                 | 41 | 35  | 5  | 9  | 7   | 5                        | 0  | 1   | 2.09 +/- 0.09 | 2.36 +/- 0.10 | 2.21 +/- 0.06 |
| Non-native Species                  | 47               | 34 | 42  | 31 | 38 | 34  | 15                 | 21 | 18  | 6  | 5  | 5   | 6                        | 2  | 1   | 1.82 +/- 0.08 | 2.04 +/- 0.10 | 1.91 +/- 0.06 |
| Adjacent Lands Development          | 58               | 45 | 52  | 24 | 30 | 27  | 14                 | 19 | 16  | 4  | 5  | 4   | 4                        | 1  | 1   | 1.63 +/- 0.07 | 1.88 +/- 0.10 | 1.73 +/- 0.06 |

\* Statistically significant difference between hikers and climbers (p&lt;0.05)

**Table 7: Low-impact practices quiz, frequency of correct answers for hikers, climbers, and overall sample, N =238.**

| Concept and variable identification | Frequency (%) of Total Correct Answers |                   |                   |                   |                   |                   |                   |
|-------------------------------------|----------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                     | 1                                      | 2                 | 3                 | 4                 | 5                 | 6                 | 7                 |
|                                     | Hiker/Climber/All                      | Hiker/Climber/All | Hiker/Climber/All | Hiker/Climber/All | Hiker/Climber/All | Hiker/Climber/All | Hiker/Climber/All |
| LNT Total Score                     | 1/0/1                                  | 0/0/0             | 1/0/0             | 4/2/12            | 16/12/15          | 44/44/44          | 34/40/36          |

**Table 8: Frequencies of correctly answered low-impact quiz questions for hikers, climbers, and overall sample, N =238.**

| Concept and variable identification | Frequencies (%) |         |     |
|-------------------------------------|-----------------|---------|-----|
|                                     | Correct         |         |     |
|                                     | Hiker           | Climber | All |
| Leave No Trace Questions            |                 |         |     |
| Leave what you find                 | 98              | 100     | 99  |
| Interacting with wildlife           | 98              | 100     | 99  |
| Frontcountry campfires              | 98              | 98      | 98  |
| Disposal of trash                   | 95              | 91      | 93  |
| Stay on designated trail            | 86              | 88      | 87  |
| Trip preparation                    | 84              | 87      | 85  |
| Trail etiquette                     | 44              | 53      | 48  |

### *Perceptions of Resource Impacts*

Overall, respondents were most perceptive (noticed, expected to see, and affected by) of the presence of informal trails and seeing off trail use by other visitors (Table 8). The resource impacts most noticed by hikers were the presence of informal trails, people hiking off trail, and the lack of solitude. The impact least noticed by hikers was tree damage. For climbers, the most noticed impact while hiking was also the presence of informal trails followed by people hiking off trail, and trampled vegetation (Table 8). Climbers reported that while hiking they did not experience solitude. The resource impact that hikers most expected to experience was informal trails, off-trail use, and solitude. Climbers most expected to experience the presence of informal trails, off trail use, and soil damage while hiking. Climbers did not expect to experience solitude while hiking. Hikers were most affected by the presence of informal trails, off trail use, and crowding. Climbers were most affected by the presence of informal trails, trampled vegetation, and level of crowding while hiking. However, the entire affected category of variables had means less than 3, meaning that in general, visitors were not affected by the recreation related resource impacts (Table 8).

Climbers were also asked what resource impacts they were most perceptive of while at their primary destination – in this case the area where their climb was located (Table 9). At their primary destination, climbers most noticed informal trail, off-trail use, and trampled vegetation. Climbers expected to see all three of these types of resource impacts while at their primary destination. Finally, climbers were most affected by crowding, informal trails, and trampled vegetation while at their primary destination. However, the mean of all “affected” variables was less than 3 (Table 9).

Based on MANCOVA analysis controlling for differences in experience use history ( $p > 0.05$ ), climbers were more likely to notice soil damage and trampled vegetation during their hike as compared to hikers (Table 8). The average expectations for soil damage trampled vegetation, and informal trails while hiking were higher for climbers than hikers. Climbers were more likely

than hikers to be affected by trampled vegetation while hiking. Hikers were more likely to be affected by off-trail use seen while hiking as compared to climbers. Hikers also had higher expectations for experiencing solitude and were more likely than climbers to report that they did experience solitude during their hike (Table 8).

Climber perceptions while hiking and while at their primary destination were compared using paired t-tests ( $p>0.05$ ) (Table 9). Climbers reported noticing soil damage, trampled vegetation, and informal trails more while hiking than while at their primary destination. Climbers reported expecting to see soil damage, trampled vegetation, and informal trails more during their hike than while at their primary destination. Trampled vegetation and the presence of informal trails affected climbers more while hiking (Table 9). While at their primary destination, climbers expected to experience solitude more than while hiking and experienced more solitude while at their primary destination than while hiking.

### *Influence of Resource Impacts*

Overall, the degree of crowding was the recreation related impact that most detracted from visitors' experience in JTNP. However, the percentage of respondents saying that the degree of crowding was a detraction was less than half of all participants (42%) (Table 10). Most recreation related impacts had no effect on the visitor experience. For 14% of all participants, the presence of informal trails actually added to the visitor experience. When examined separately, findings from hikers and climbers show that different types of recreation related impacts detracted from each activity type's overall experience. For hikers, the degree of crowding was overwhelmingly the most detracting resource impact (35%) followed by off trail use (19%), and trampled vegetation (19%) (Table 10). A small group of both climbers (11%) and hikers (14%) reported the presence of informal trails as adding to the visitor experience. For climbers, 37% said that trampled vegetation detracted from their overall experience, followed by tree damage (34%) and the degree of crowding (34%) (Table 10).

In general, visitors to JTNP did not view recreation related resource impacts as problems (Table 11). For proliferation of informal trail, 43% of all respondents agreed that the resource impact was a problem, followed by people hiking off trail (40%), and trampled vegetation (40%). Also, many visitors (43%) disagreed that the lack of opportunities for solitude was a problem in JTNP. Hikers appear to be less likely to definitely state a resource impact as being a problem. The means for all types of resource impacts being seen as a problem was neutral or negative and 35% or less of respondents agreed that any of the impacts were a problem in JTNP (Table 11). However, 57% of climbers reported that trampled vegetation was a problem in JTNP and 52% reported that the proliferation of informal trails was also a problem. The resource impacts that climbers were least likely to view as a problem was tree damage and the lack of opportunities for solitude. Overall, based on MANCOVA controlling for experience use history ( $p>0.05$ ), climbers were more likely to report soil damage, trampled vegetation, informal trails, and off-trampled vegetation as problems when compared to hiker responses (Table 11).

**Table 8: Frequencies and means of responses to visitor perceptions of resource impact measures stratified by hikers, climbers, and overall sample, N =238.**

| Concept and variable identification  | Frequencies (%) |         |     |                            |         |     |         |         |     |                      |               |               |
|--------------------------------------|-----------------|---------|-----|----------------------------|---------|-----|---------|---------|-----|----------------------|---------------|---------------|
|                                      | While Hiking    |         |     | Strongly Disagree/Disagree |         |     | Neutral |         |     | Strongly agree/Agree |               |               |
|                                      | Hiker           | Climber | All | Hiker                      | Climber | All | Hiker   | Climber | All | Hiker                | Climber       | All           |
| Perceptions of soil damage           |                 |         |     |                            |         |     |         |         |     |                      |               |               |
| Noticed soil damage*                 | 38              | 25      | 31  | 28                         | 19      | 29  | 34      | 56      | 40  | 2.83 +/- 0.11        | 3.39 +/- 0.11 | 3.07 +/- 0.08 |
| Expected to see soil damage*         | 34              | 20      | 28  | 35                         | 27      | 30  | 34      | 53      | 42  | 2.77 +/- 0.11        | 3.66 +/- 0.11 | 3.15 +/- 0.08 |
| Affected by soil damage              | 55              | 41      | 55  | 37                         | 35      | 34  | 8       | 24      | 11  | 2.19 +/- 0.09        | 2.40 +/- 0.10 | 2.29 +/- 0.07 |
| Perceptions of trampled vegetation   |                 |         |     |                            |         |     |         |         |     |                      |               |               |
| Noticed trampled vegetation*         | 41              | 25      | 34  | 19                         | 37      | 18  | 40      | 37      | 48  | 2.90 +/- 0.11        | 3.59 +/- 0.12 | 3.19 +/- 0.09 |
| Expected to see trampled vegetation* | 40              | 19      | 31  | 31                         | 30      | 26  | 29      | 51      | 43  | 2.75 +/- 0.11        | 3.65 +/- 0.11 | 3.12 +/- 0.08 |
| Affected by trampled vegetation*     | 53              | 58      | 47  | 28                         | 35      | 30  | 19      | 7       | 23  | 2.32 +/- 0.11        | 2.81 +/- 0.11 | 2.52 +/- 0.08 |
| Perceptions of informal trails       |                 |         |     |                            |         |     |         |         |     |                      |               |               |
| Noticed informal trails              | 12              | 12      | 10  | 13                         | 12      | 12  | 75      | 76      | 78  | 3.92 +/- 0.10        | 4.14 +/- 0.10 | 4.02 +/- 0.07 |
| Expected to see informal trails*     | 19              | 9       | 15  | 25                         | 20      | 20  | 56      | 71      | 65  | 3.49 +/- 0.11        | 4.01 +/- 0.10 | 3.69 +/- 0.08 |
| Affected by informal trails          | 38              | 39      | 36  | 33                         | 37      | 32  | 29      | 24      | 32  | 2.75 +/- 0.11        | 2.94 +/- 0.12 | 2.84 +/- 0.08 |
| Perceptions of off trail use         |                 |         |     |                            |         |     |         |         |     |                      |               |               |
| Noticed off trail use                | 23              | 21      | 22  | 15                         | 17      | 15  | 62      | 61      | 63  | 3.56 +/- 0.12        | 3.59 +/- 0.13 | 3.58 +/- 0.09 |
| Expected to see off trail use        | 20              | 11      | 17  | 26                         | 24      | 22  | 54      | 65      | 62  | 3.46 +/- 0.10        | 3.90 +/- 0.11 | 3.64 +/- 0.07 |
| Affected by off trail use*           | 38              | 44      | 41  | 36                         | 43      | 34  | 26      | 13      | 25  | 2.74 +/- 0.10        | 2.66 +/- 0.12 | 2.71 +/- 0.08 |
| Perceptions of tree damage           |                 |         |     |                            |         |     |         |         |     |                      |               |               |
| Noticed tree damage                  | 47              | 57      | 52  | 22                         | 17      | 18  | 31      | 26      | 30  | 2.69 +/- 0.11        | 2.57 +/- 0.13 | 2.63 +/- 0.09 |
| Expected to see tree damage          | 46              | 49      | 47  | 33                         | 27      | 32  | 21      | 24      | 21  | 2.59 +/- 0.10        | 2.60 +/- 0.12 | 2.58 +/- 0.07 |
| Affected by tree damage              | 52              | 54      | 29  | 36                         | 35      | 34  | 12      | 11      | 13  | 2.35 +/- 0.09        | 2.39 +/- 0.11 | 2.36 +/- 0.07 |
| Perceptions of solitude              |                 |         |     |                            |         |     |         |         |     |                      |               |               |
| Experience solitude*                 | 44              | 53      | 51  | 14                         | 19      | 14  | 42      | 28      | 35  | 2.93 +/- 0.12        | 2.37 +/- 0.13 | 2.70 +/- 0.09 |
| Expected to experience solitude*     | 32              | 47      | 42  | 23                         | 24      | 22  | 45      | 29      | 36  | 3.13 +/- 0.11        | 2.45 +/- 0.12 | 2.85 +/- 0.09 |
| Affected by crowding                 | 44              | 37      | 42  | 25                         | 27      | 26  | 31      | 36      | 32  | 2.71 +/- 0.11        | 2.79 +/- 0.12 | 2.74 +/- 0.08 |

\* Statistically significant difference between hikers and climbers (p&lt;0.05)

**Table 9: Frequencies and means of responses to visitor perceptions of resource impact measures at climber's primary destination, N =238.**

| <b>At Primary Climbing Destination:</b>    |  | <b>Frequencies (%)</b>            |                 |                             | <b>Mean +/- SE</b> |
|--------------------------------------------|--|-----------------------------------|-----------------|-----------------------------|--------------------|
| <b>Concept and variable identification</b> |  | <b>Strongly Disagree/Disagree</b> | <b>Neutral</b>  | <b>Strongly agree/agree</b> |                    |
|                                            |  | <b>Climbers</b>                   | <b>Climbers</b> | <b>Climbers</b>             | <b>Climbers</b>    |
| Perceptions of soil damage                 |  |                                   |                 |                             |                    |
| Noticed soil damage*                       |  | 25                                | 37              | 37                          | 3.20 +/- 0.11      |
| Expected to see soil damage*               |  | 19                                | 30              | 51                          | 3.42 +/- 0.12      |
| Affected by soil damage                    |  | 58                                | 35              | 7                           | 2.26 +/- 0.10      |
| Perceptions of trampled vegetation         |  |                                   |                 |                             |                    |
| Noticed trampled vegetation*               |  | 25                                | 19              | 56                          | 3.43 +/- 0.12      |
| Expected to see trampled vegetation*       |  | 20                                | 27              | 53                          | 3.48 +/- 0.12      |
| Affected by trampled vegetation*           |  | 41                                | 35              | 24                          | 2.68 +/- 0.12      |
| Perceptions of informal trails             |  |                                   |                 |                             |                    |
| Noticed informal trails*                   |  | 12                                | 12              | 76                          | 3.98 +/- 0.11      |
| Expected to see informal trails*           |  | 9                                 | 20              | 71                          | 3.89 +/- 0.11      |
| Affected by informal trails*               |  | 39                                | 37              | 24                          | 2.71 +/- 0.11      |
| Perceptions of off trail use               |  |                                   |                 |                             |                    |
| Noticed off trail use                      |  | 21                                | 17              | 61                          | 3.46 +/- 0.14      |
| Expected to see off trail use              |  | 11                                | 24              | 65                          | 3.80 +/- 0.11      |
| Affected by off trail use                  |  | 44                                | 43              | 13                          | 2.51 +/- 0.11      |
| Perceptions of tree damage                 |  |                                   |                 |                             |                    |
| Noticed tree damage                        |  | 57                                | 17              | 26                          | 2.52 +/- 0.14      |
| Expected to see tree damage                |  | 49                                | 27              | 24                          | 2.60 +/- 0.13      |
| Affected by tree damage                    |  | 54                                | 35              | 11                          | 2.32 +/- 0.11      |
| Perceptions of solitude                    |  |                                   |                 |                             |                    |
| Experience solitude*                       |  | 53                                | 19              | 28                          | 2.61 +/- 0.15      |
| Expected to experience solitude*           |  | 47                                | 24              | 29                          | 2.68 +/- 0.13      |
| Affected by crowding                       |  | 37                                | 27              | 36                          | 2.90 +/- 0.13      |

\* Statistically significant difference between climbers perceptions while hiking (Table 8) (p<0.05).

**Table 10: Frequencies of responses to the influence of resource impacts on the visitor experience for climbers, hikers, and overall, N =238.**

| <b>Concept and variable identification</b> | <b>Frequencies</b> |                |            |                  |                |            |              |                |            |
|--------------------------------------------|--------------------|----------------|------------|------------------|----------------|------------|--------------|----------------|------------|
|                                            | <b>Detracted</b>   |                |            | <b>No effect</b> |                |            | <b>Added</b> |                |            |
|                                            | <b>Hiker</b>       | <b>Climber</b> | <b>All</b> | <b>Hiker</b>     | <b>Climber</b> | <b>All</b> | <b>Hiker</b> | <b>Climber</b> | <b>All</b> |
| Resource Conditions                        |                    |                |            |                  |                |            |              |                |            |
| Degree of crowding                         | 35                 | 34             | 45         | 63               | 64             | 52         | 2            | 2              | 3          |
| Trampled vegetation                        | 19                 | 37             | 27         | 80               | 60             | 71         | 1            | 3              | 2          |
| Off trail use                              | 19                 | 31             | 24         | 77               | 67             | 71         | 4            | 2              | 3          |
| Tree damage                                | 15                 | 34             | 23         | 84               | 64             | 75         | 1            | 2              | 2          |
| Informal Trails                            | 17                 | 30             | 22         | 68               | 59             | 64         | 15           | 11             | 14         |
| Soil Damage                                | 13                 | 23             | 18         | 86               | 74             | 80         | 1            | 3              | 2          |

**Table 11: Frequencies and means of responses to visitor perceptions of resource impacts being a problem at Joshua Tree National Park stratified by climbers, hikers, and overall, N =238.**

| Frequencies (%)                     |                            |         |     |         |         |     |                      |         |     |               |               |               |
|-------------------------------------|----------------------------|---------|-----|---------|---------|-----|----------------------|---------|-----|---------------|---------------|---------------|
| Concept and variable identification | Strongly Disagree/Disagree |         |     | Neutral |         |     | Strongly agree/agree |         |     | Mean +/- SE   |               |               |
| Problem:                            | Hiker                      | Climber | All | Hiker   | Climber | All | Hiker                | Climber | All | Hiker         | Climber       | All           |
| Proliferation of informal trails*   | 27                         | 20      | 23  | 38      | 28      | 34  | 35                   | 57      | 43  | 3.10 +/- 0.09 | 3.48 +/- 0.10 | 3.27 +/- 0.07 |
| People hiking off trail*            | 25                         | 19      | 23  | 41      | 32      | 37  | 34                   | 49      | 40  | 3.09 +/- 0.09 | 3.41 +/- 0.10 | 3.23 +/- 0.07 |
| Trampling of vegetation*            | 32                         | 19      | 27  | 39      | 24      | 33  | 29                   | 57      | 40  | 2.95 +/- 0.09 | 3.48 +/- 0.11 | 3.17 +/- 0.07 |
| Soil Damage*                        | 31                         | 25      | 29  | 51      | 25      | 39  | 18                   | 50      | 31  | 2.77 +/- 0.08 | 3.29 +/- 0.10 | 2.98 +/- 0.06 |
| Tree damage                         | 36                         | 41      | 38  | 52      | 37      | 45  | 12                   | 22      | 17  | 2.68 +/- 0.07 | 2.80 +/- 0.10 | 2.73 +/- 0.06 |
| Lack of opportunities of solitude   | 43                         | 43      | 43  | 32      | 33      | 32  | 25                   | 24      | 25  | 2.73 +/- 0.09 | 2.72 +/- 0.11 | 2.72 +/- 0.07 |

\* Statistically significant difference between hikers and climbers (p&lt;0.05)

**Table 12: Parameter estimates for structural equation model.**

| Independent Variables      | Dependent Variables |          |
|----------------------------|---------------------|----------|
|                            | Noticed             | Affected |
| Experience Use History     | -0.06               | -0.07    |
| Local Ecological Knowledge | 0.45*               | 0.32*    |
| Values Orientation         | -0.01               | 0.08     |
| Leave No Trace Knowledge   | 0.14*               | 0.10*    |
| R2                         | 21%                 | 12%      |

\*p&lt;0.05

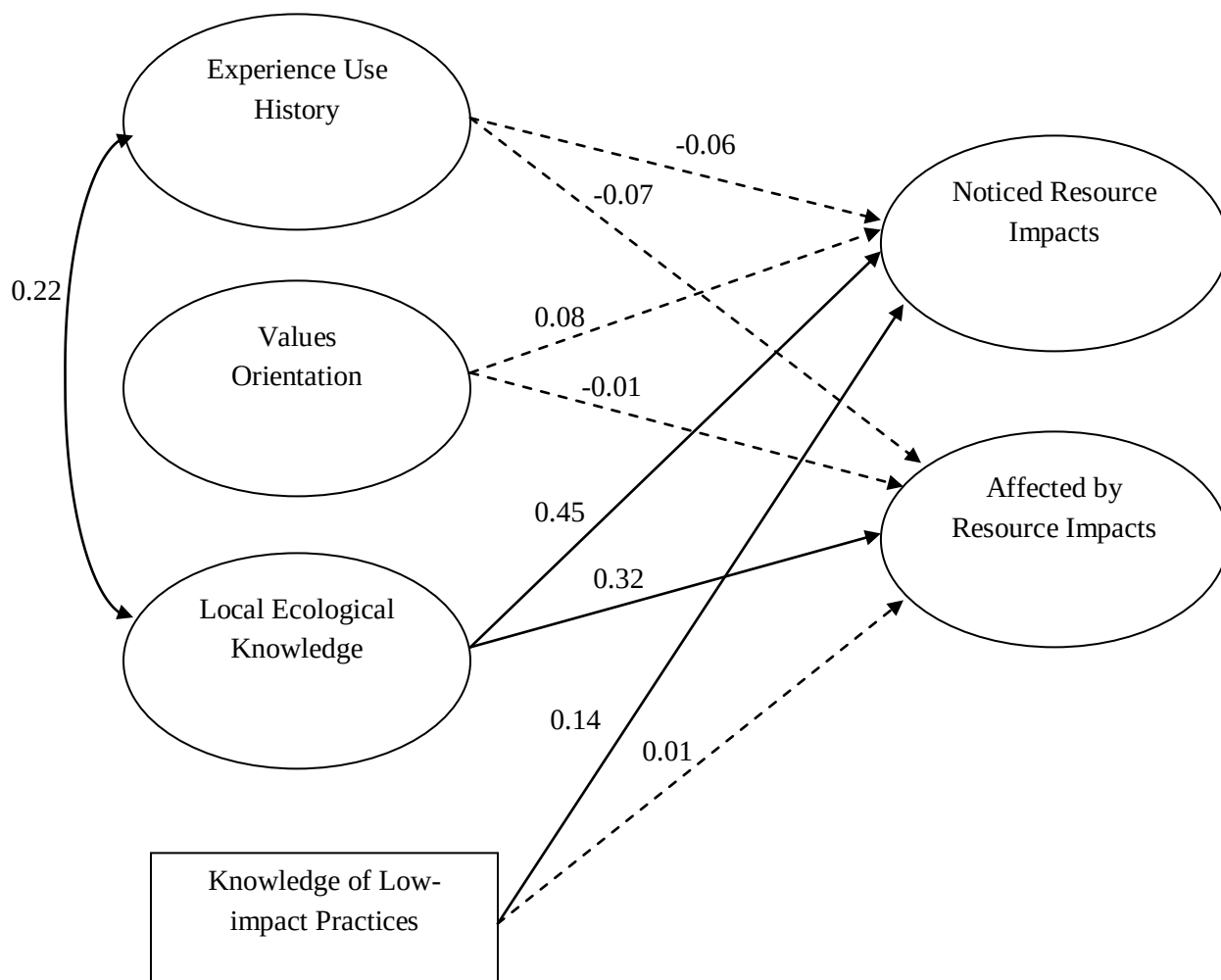
*Effect of Visitor Characteristics on Visitor Perceptions*

Cronbach's  $\alpha$  was used to test the internal consistency of the latent variables in the SEM. For "noticing resource impacts, reliability analysis indicates reasonable internal consistency ( $\alpha = 0.66$  overall,  $\alpha = 0.66$  for hikers, and  $\alpha = 0.66$  for climbers). For "being affected by resource impacts" reliability analysis indicates very good internal consistency ( $\alpha = 0.86$  overall,  $\alpha = 0.88$  for hikers, and  $\alpha = 0.85$  for climbers). The values orientation latent variable was shown to have high internal consistency across all groups ( $\alpha = 0.75$  overall,  $\alpha = 0.78$  for hikers, and  $\alpha = 0.71$  for climbers). For experience use history, reliability analysis indicates a good internal consistency across all groups as well ( $\alpha = 0.73$  overall,  $\alpha = 0.73$  for hikers, and  $\alpha = 0.73$  for climbers).

SEM analysis resulted in the following model showing adequate fit (Figure 2). The comparative fit index (CFI), root means square error of approximation (RMSEA), and the Bollen-Stine p-value (the chi-square equivalent for bootstrapping SEM procedures and when sample sizes are non-normal and/or greater than 200) were used to assess model fit. A CFI  $> 0.90$  is considered an adequate fit and the closer the value is to 1 the better the model fit. For RMSEA, any value less than 0.05 is considered a good model fit. A non-significant Bollen-Stine p-value indicates a good model fit. For the SEM in Figure 2, CFI equaled 0.94, RMSEA was found to 0.047, and the Bollen-Stine p-value equaled 0.723.

For the overall model, the relationships between experience use history and the perceptions variables were non-significant. Local ecological knowledge was shown to significantly, and positively influence both perception variables (Table 11). The relationship between the measured variable of knowledge of low-impact practices and noticing resource impacts was shown to be significant while the relationship between knowledge of low-impact practices and being affected by resource impacts was found to be non-significant. A statistically significant, positive correlation was found between experience use history and local ecological knowledge. The model explained 12% of the variance in visitors being affected by resource impacts and 21% of the variance in visitors noticing resource impacts (Table 11).

**Figure 2: Structural equation model with standardized parameter estimates. Statistically insignificant relationships are shown in dotted lines.**



## Discussion

Results from the survey highlight some important difference between hiker and climber perceptions which have implications for management. Climbers were found to be more likely to be repeat visitors to JOTR (Table 4). Climbers also held a slightly more utilitarian orientation as compared to hikers (Table 5). While hikers and climbers have equal low-impact knowledge, climbers reported higher levels of local ecological knowledge on many topics (Tables 6, 7 and 8). In terms of perceptions of crowding and experiencing solitude – unlike hikers – climbers did not expect to experience solitude while hiking (Table 8). Compared to hikers, climbers were more sensitive to soil damage and trampled vegetation. Hikers were more perceptive of off-trail use and experiencing crowding while hiking. Climbers noticed the same types of resource impacts both while hiking and while at their primary destination (their climb) but were less perceptive overall of impacts while at their primary destination (Table 9). Climbers were only perceptive of crowding while at their primary destination. Climbers found trampled vegetation, tree damage, and crowding to be equally detracting from their overall experience while, for hikers, the impact that most detracted from their overall experience was crowding (Table 10). Overall, climbers were more likely than hikers to report impacts as problems (Table 11).

Overall, both user groups were most perceptive of depreciative impacts (informal trails, off-trail use) (Table 8). However, these depreciative impacts did not seem to affect visitors and only crowding seemed to significantly detract from the overall visitor experience. The only resource impact that seemed to have “amenity value” was the presence of informal trails; which in some cases added to the visitor experience (Table 10). Finally, visitors to Joshua Tree National Park do not report that resource impacts are a problem in the park (Table 11).

Results from the structural equation model support previous findings (D’Antonio et al. 2012) that knowledge is an important factor for determining visitor perceptions (Figure 2). Both level of local ecological knowledge and level of knowledge of low-impact practices influence how much visitors perceive resource impacts (Table 12). Experience use history and values orientation, when measured with knowledge, do not significantly influence visitor perceptions.

## Management Implications

Managers and park staff may be significantly less tolerant of resource impacts when compared to visitors and therefore it is sensible to include visitor opinions about acceptability in management decisions related to resource conditions. The findings from perceptions studies can highlight the specific types of resource impacts that visitors are sensitive to. Findings can also indicate if visitors are viewing certain resource conditions, which managers may find unacceptable, as having an amenity value. Understanding how different user groups perceive and evaluate desert resource conditions can provide managers with a better understanding of the types of conditions which are favorable or unfavorable for their visitors based on activity type. Results from this

study indicate the following points which may be important for the management and protection of both resource conditions and the visitor experience in Joshua Tree National Park:

- For both user groups, the presence of informal trails and seeing off-trail use were the resource impacts visitors were most sensitive to. Restoration efforts and management techniques focused on fixing current informal trails, preventing the formation of new informal trails, and keeping people on designated trails may increase the quality of the visitor experience. Additionally, many climbers verbally reported to researchers that they desired more “designated” access trails to popular climbs – especially at Hidden Valley.
- Climbers hold a slightly more utilitarian attitude as compared to hikers and therefore certain management actions (such as those that may restrict access to areas or specific climbs) may be less acceptable to climbers than hikers.
- In a desert park, more subtle resource impacts such as erosion and trampled vegetation may be more likely to be perceived by users. Other perceptions studies conducted in more temperate climates have indicated that visitors rarely perceive erosion and trampled vegetation.
- Climbers appear to be more likely to judge resource impacts as compared to hikers. Climbers had higher agreement with the perceptions statements overall and were more likely to report resource impacts as being a problem. Combined with the fact that climbers were more perceptive of subtle impacts such as soil erosion and trampled vegetation – results may indicate that climbers may prefer a less impacted setting for a quality recreation experience as compared to hikers.
- Hikers appear to be more sensitive to crowding than climbers with the exception of when climbers are at the base of their climbs. Overall, reducing the feeling of crowding and presence of informal trails may be the most important factor in providing a quality experience to hikers. For climbers, a quality experience may depend more on providing a less impacted setting overall and reducing crowding at specific, popular climbs.
- Level of knowledge, both of low impact practices and the local ecosystem, is very important for visitor perceptions. These findings support the importance of interpretation programs at parks and protected areas for informing visitors about the consequences of recreation to natural resources. Increased interpretation may lead to visitors bring more sensitive to resource impacts and potential changes in visitor behavior to more low-impact practices.

- Climbers and hikers self-rated themselves as having the most and least knowledge in very different categories of natural history and ecological issue topics. Therefore, interpretation programs may be designed to target specific user groups and increase knowledge in areas that these user groups report having low knowledge of. For example, while climbers appear to very knowledgeable about the geology of Joshua Tree National Park, a guided geology hike may increase hiker knowledge. Both groups reported low knowledge of adjacent land development and therefore interpretative material about protecting adjacent lands could be targeted at both user groups. Results highlight areas where interpretation programs could focus for each individual user group and visitors to Joshua Tree National Park as a whole.

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