National Park Service
Joshua Tree National Park, Science and Resource Stewardship Division

Backcountry Overnight Use 2016-2017

Photo credit: NPS/D.Dagan

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Executive Summary

Joshua Tree National Park requires backcountry overnight users to fill out registration tags at backcountry boards prior to hiking in. This report analyzes a full year of registration tags (October 2016 to September 2017) for visitor demographics and trip characteristics. 6,407 tags from all 13 backcountry boards were analyzed.

Key Findings:

- Mean reported age was 33 (median = 27), and 75% of respondents reported ages under 40. Mean age did not vary significantly between backcountry boards.
- Most overnight backcountry users were from the United States (98%), and Canadians were the most commonly reported international visitors. Three-quarters of United States visitors were from California, and the majority of California visitors were from Los Angeles County. As a proportion of population, Inyo and Sierra counties had the highest density of registered backcountry overnight visitors to JOTR.
- During the summer months of June and July, more overnight backcountry visitors reported locations of origin farther from the park, including international visitors and those outside of California or neighboring states, than expected if monthly variation of the demographic was proportional to overall monthly variation.
- While the majority of respondents reported at least two safety information items (89%), there were 16 different combinations of response types across 500 permits evaluated for safety information. JOTR management may consider reformatting or rewording permit fields to increase clarity.
- The number of tags returned in one year by the same visitors range from one to 14, with most responses closely clustered around a mean of 1.53 (SD=1.24). Eighty-four percent of users visited once and 96% visited once or twice.
- The range in responses for trip duration was from zero nights to 11 days (trips longer than 14 days were discarded). Ninety-two percent of users stayed for either one or two nights. The majority of the remainder filled out a permit for zero nights (2%), likely for their day trip, or stayed for three or four nights (5%). Only one percent stated that they intended to stay for five nights or longer.
- Reported group size ranged from one to 32, and the vast majority of backcountry users traveled in groups of four or smaller (91%). The mean group size was 2.5 with a standard deviation of 2.0. The most frequent response was two, which comprised 49% of reported use. Of the 6,254 reported backcountry trips, only 38 were greater than the wilderness limit (12) and two were greater than the overall limit (25).
- The majority of backcountry overnight tags were returned at the Keys West backcountry board (28%), followed by Juniper Flats (18%), and Twin Tanks (11%).
- The following locations received the highest density of visits, according to self-reported destinations: Boy Scout Trail, Pine City, Willow Hole, California Riding and Hiking Trail, Lost

Palms Oasis, Indian Cove backcountry board, Twin Tanks, Quail Mountain, and North Entrance backcountry board.

- The busiest three months, March, April, and November, account for 56% of total use. The three least busy months, June, July, and August, account for only 3.4% of the total use. The majority of visitation took place on the weekends, with Friday and Saturday entry days accounting for 59.85% of the visitation.
- Backcountry tags which indicated trips over ten major U.S. holidays accounted for 19.8% of total returned backcountry tags. Thanksgiving was the most popular holiday weekend for backcountry use accounting for 30.9% of the total backcountry visitation for the month of November.

Recommendations

- Reformatting or rewording permit fields for phone numbers and emergency contact may improve clarity and elicit more complete response from overnight backcountry visitors.
- Because of the number of groups greater than 12 originating from the Indian Cove backcountry board, the park may consider providing informational messaging about group size restrictions at the Indian Cove group campground or backcountry board
- According to the spatial distribution of backcountry overnight visitors, it is recommended that the park focus restoration or compliance efforts in the following areas: Boy Scout Trail, Pine City, Willow Hole, California Riding and Hiking Trail, Lost Palms Oasis, Indian Cove backcountry board, Twin Tanks, Quail Mountain, and North Entrance backcountry board.

Introduction

BACKGROUND

Since 2014, Joshua Tree National Park has experienced a significant increase in visitation. For a twenty three year period, yearly visitation remained nearly static, inching slowly up from 1 million in 1990 to 1.38 million in 2013. Two years later, in 2015, visitation jumped to just over two million. The following year, the yearly total had jumped up by another 500,000. 2017 was the busiest year on record with the park receiving over 2.8 million visitors. This increase in poses significant challenges for park managers, specifically in providing visitor enjoyment in increasingly crowded conditions and protect natural and cultural resources. With 85% percent of the park's 790,636 acres managed as wilderness, park managers are interested in understanding how the increase in visitation is reflected in backcountry use patterns.

There are no park regulations stating where visitors may access the backcountry. However, vehicles may only be left overnight at one of 13 backcountry boards (Figure 1). These boards are spread fairly evenly throughout the park roads, with five in the vicinity of Park Boulevard and four along Pinto Basin Road. Of the remaining four, two are located at major campgrounds (Indian Cove and Black Rock) while two are located in more remote locations along major dirt surface Roads (Upper Covington and Pleasant Valley). Each one of these boards includes self-registration, where visitors are encouraged to provide information about themselves and their trip by filling out a permit tag (Figure 2).

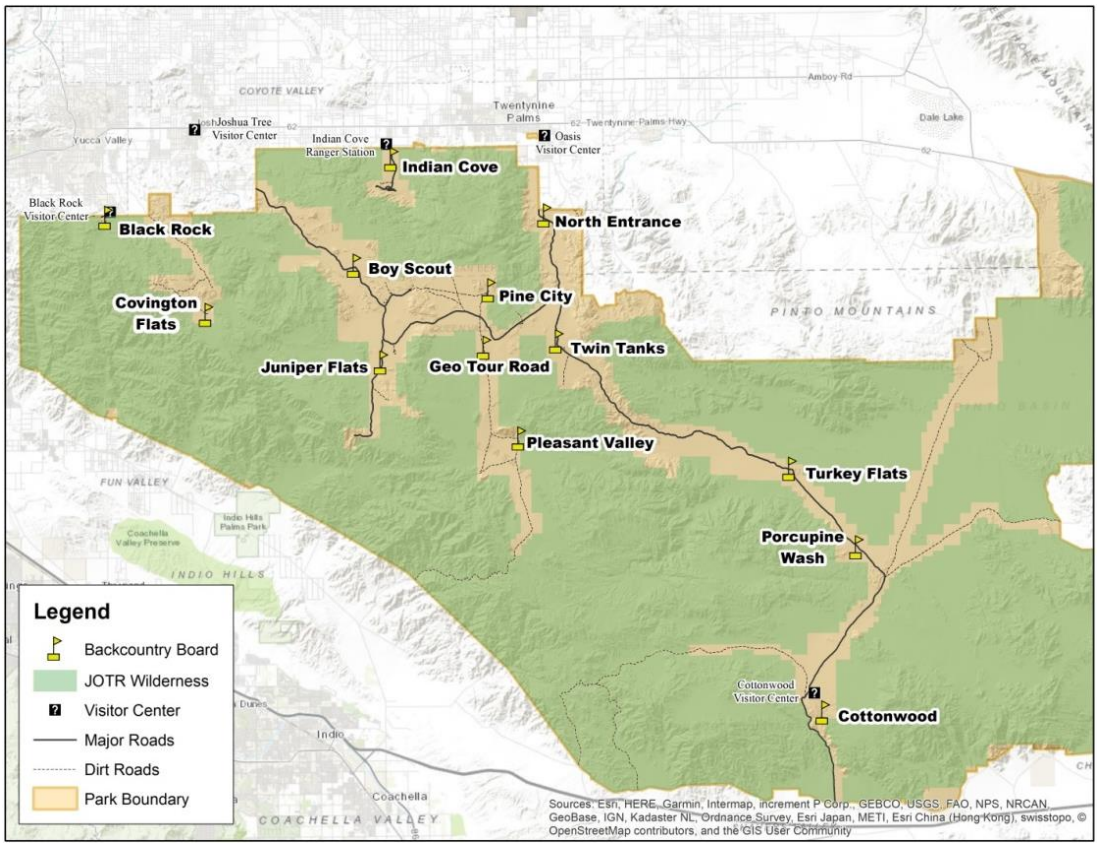

Figure 1: Locations of all 13 backcountry boards in Joshua Tree National Park.

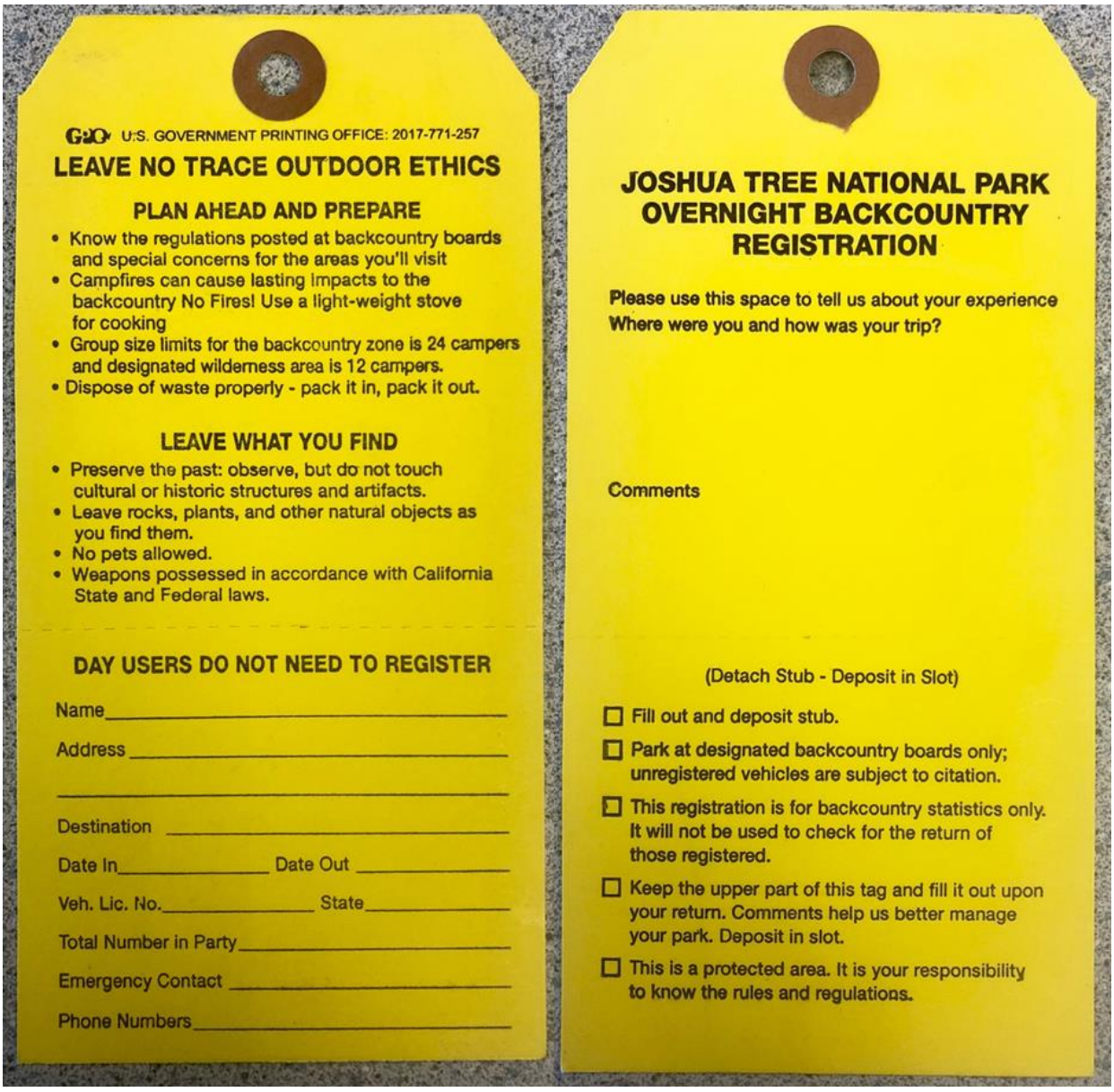

Figure 2: Photos displaying both the front and back of the self-registration permits. The data used in this study came from the bottom of the permit displayed on the left. No visitor comments were evaluated.

It is important to note that completing a self-registration permit is optional and not part of any formal backcountry registration process at Joshua Tree National Park. The data analyzed in this report only represents those backcountry visitors who choose to fill out the form, and at present, there is no estimate of self-registration rates.

There are two primary purposes for this report: (1) to identify backcountry use patterns, and (2) identify key demographic characteristics of JOTR's backcountry users. With this information, park managers can better integrate data into science-based decisions, including prioritization of resource management areas, determination of visitor use management strategies, and designing public messaging strategies.

RESEARCH QUESTIONS

Informal discussions with park management served to identify research questions regarding both visitor demographics and trip characteristics, which are grouped into eight areas for analysis below.

Visitor Demographics

1. Age demographics
2. Locations of origin
    a. What percentage of overnight backcountry users is local to Southern California?
    b. What is the distribution of overnight backcountry userrs from each state?
    c. What percentage of overnight backcountry visitors is international?
    d. Do the locations of origin of overnight backcountry users vary temporally?
3. Form completion
    a. Do visitors adequately complete information that used for search and rescue operations?

Trip Characteristics

4. Repeat visitation
    a. What percentage of overnight backcountry users is making multiple trips into the backcountry within the sample period?
5. Length of visit
    a. How long are overnight backcountry trips?
    b. Is there a relationship between length of visit and season?
6. Group size
    a. How often are overnight backcountry users reporting group sizes out of compliance with JOTR regulations?
    b. Does reported group size vary by backcountry board?
7. Spatial distribution
    a. How much overnight use is occurring at each of the park's 13 backcountry boards?
    b. What trails and destinations are most frequently visited?
    c. How far are registered overnight backcountry visitors traveling into the backcountry?
8. Temporal distribution
    a. What is the peak season for backcountry overnight use?
    b. Does overnight backcountry use peak earlier in lower elevation areas?
    c. How does the volume of overnight backcountry use vary throughout the week?

    How much additional backcountry overnight use occurs on holiday weekends?

Methods

SAMPLING PERIOD AND DATA COLLECTED

Data was analyzed for self-registration tags returned between October 2016 and September 2017, the most recent fiscal year for which complete data was available. One year of data was analyzed to track usage consecutively across all four seasons.

Data from each tag was manually entered into a database. In order to stay within the budget of this project, it was necessary to limit the amount of data entered from each tag; this change occurred partway through the data entry process, therefore some observations contain more data than others. Three of the ten fields were discarded, and another five were simplified to reduce data entry time. The following fields were discarded:

- [visitor] street address
- vehicle license number
- [vehicle] state

Additionally, the following fields were simplified:

- Names were shortened to first initial and last name.
    - This decision likely introduced a degree of error resulting from different visitors who had the same first initial and last name (i.e. James Smith versus John Smith). However, in light of the potential time savings and size of the prospective database, this introduced error was deemed acceptable.
- Date in and date out fields entered by month only, instead of month and day.
- Emergency contact and phone information was simplified twice:
    - Entries 1-707 (October) and 1,509-2001 (December): responses for both fields were simplified to whether the visitor provided a name, number, or both in each column
    - Entries 2002-3118 (January): Each field was coded as yes or no, based on whether the visitor provided a response for the field
    - Remaining entries (February-September, November): Responses for these fields were no longer recorded. This was done as it was determined that a large enough sample size had been collected to adequately characterize visitor perceptions of safety and risk as they relate to the backcountry.

QUALITY CONTROL AND CLEANING

There were several quality control mechanisms put in place during the data entry process. The first was to use Microsoft Excel's Conditional Formatting Tool to highlight names that had appeared more the once in the database, which was primarily used to recognize repeat users. However, it also acted as a quality control tool because if a name appeared that was very similar to a name already in the database, it flagged a potential repeat. When this occurred, a decision was made regarding whether they were a repeat or

unique user by addressing the following questions: (1) is the difference likely to have resulted from the fact that the name was difficult to read on the tag (this was a common problem), (2) is it a complex last name (it was thought that errors were more likely to occur in complex names than simple ones), (3) is the city the same for both entries, and (4) are the dates close together (it was thought that it was more likely to be the same user if dates were closer together). Certainly, this process involved making assumptions but it seems likely that the net gain in accuracy from using this process would be positive. That is, the number of correctly identified repeat users would outweigh the number of unique users incorrectly lumped together as a repeat user.

Another quality control mechanism employed during the data collection process was to earmark registration tags occurring geographically close to one another, as they may be multiple users filling out tags from the same trip. In some cases this was obvious, as when consecutive tags had an organization that guides trips listed in the emergency contact information. Other times it was more subtle, as when consecutive tags had the same last name, different first initials, but had the same date in, date out, and number of people in party listed. An asterisk was placed in the miscellaneous column where I believed that this was the case. In total, this was done for 142 entries. This earmark was left in the finalized database so that subsequent researchers can reach their own determinations.

Once the data had been entered, it was checked through a basic quality control process by using built-in Microsoft Excel functions, such as sorting and conditional formatting, to manually search for errors or outliers. This was performed for the following fields: backcountry board (misspellings), age (outliers), day in and day out (outliers) and number in party (outliers). More rigorous quality control methods such as spot checks were discarded because of time and budget constraints. Additionally, the data was inspected for inconsistent backcountry board naming conventions, i.e. multiple names written on permits may have been referring to the same board. This was especially important for the board at the southern Boy Scout Trailhead, which is alternately called Key's West or Boy Scout.

The city and state data was also checked where it was possible to do so without compromising data quality. This was done by sorting the data alphabetically by city and making two types of corrections. First, misspellings or typos in common or local city names were corrected (e.g. Las Angeles to Los Angeles or Follerton to Fullerton). Second, a state name was added to common or local city names where this data may not have been provided by the visitor (e.g. Arizona added for Flagstaff or California added for Joshua Tree). This likely resulted in an overrepresentation of location data from more proximate locations and big cities. However, these relatively safe assumptions likely added little error to our analysis while adding many additional data points to our visitor demographics data.

After completing the quality control process, the data was cleaned for analysis, and a number of additional fields were created. These fields are listed below:

Entry ID: A unique value (1-6407) was assigned to each row (registration tag) in the database. Numbers were assigned consecutively while entries were still in the order in which they were entered.

Visitor ID: Each "visitor" was assigned a unique ID number. In assigning this ID value, it was assumed that if different entries had the same first initial and last name, then they were the same visitor.

Number of Visits: This column was populated for each backcountry permit and represents the number of times that visitor visited the park during the study period. This was calculated using a simple COUNTIF function in excel. This column was used for analyzing repeat backcountry use (question 10).

Trip ID: Each unique trip into the backcountry was assigned its own ID number, first by checking observations earmarked using an asterisk. The data was sorted by miscellaneous column then by Entry ID number. If upon second examination, multiple registration tags seemed to represent the same trip, the same trip ID was assigned to these tags. Trip IDs 1-63 are trips that have more than one registration tag associated with them. These do not appear to be trip chaining (recommend reviewing data before making any further assumptions). The remaining tags were assigned an ID sequentially.

Country: This field is not self-reported on the registration tags. However, many foreign visitors indicated that country that they were from. If a city or state was given, and unless specifically stated otherwise, it was assumed that the visitor was from the United States. This assumption may have resulted in a small amount of error from foreign cities incorrectly identified as cities in the United States (i.e. Geneva, Illinois versus Geneva, Switzerland).

Destination Code 1,2,3: This is the means by which I converted the highly individualized responses for the destination field into data that could be analyzed using a GIS. See Appendix I for more detail.

Year: The year the backcountry use occurred.

Month Number: The alphanumeric number for the month of backcountry use.

Date In / Date Out (Full): This is the full date (mm/dd/yyyy) that the visitor entered and exited the backcountry. This field was used to calculate the # of nights.

Number of Nights: The number of nights that the user group spent in the backcountry..

The last piece of quality control was to clean up the "# of Nights" column, which after used the formula described above had an abnormally large quantity of negative numbers. This resulted from the shortcut I took in entering dates (leaving out the month) and the fact that in each group of tags (they were organized by month) there were a small number of tags for which the date in was the at end of the month and the date out was in the beginning of the subsequent month. Thus, a simple subtraction of the dates yielded a negative number (11/2/2016-11/31/2016 = -29). In these cases, I manually changed the date for the date in to the previous month (11/2/2016-10/31/2016 = 2).

After correcting for this error, there were still a number of values for the "# of nights" field that were too large to be reasonable responses. Values in excess of two weeks were deleted on the grounds they were unreasonable.

DATA ANALYSIS

Data analysis was done using both Microsoft Excel and ArcGIS 10.6. Analysis that broadly falls under the category of descriptive statistics (described above) was performed using Microsoft Excel. A CSV file of the data is available for further analyses beyond the scope of this report (Appendix I.)

It is important to note several other key methodological decisions. First, anytime a destination was mentioned in the destination, regardless of what the rest of the tag said, I coded that location as the destination for that backcountry tag. So, for example, if the response was "halfway to Twin Tanks", Twin Tanks was the destination coded. This was done for simplicity as well as to take some of the subjectivity out of the coding process, however it does introduce potential inaccuracies. Second, only the destination was coded, while the route to the destination was excluded from the analysis. For this reason, the spatial data in this report should be considered preliminary due to budgetary and personnel constraints. Future research may use alternative methods, such as deploying GPS loggers, to more accurately evaluate backcountry spatial patterns.

The exception to the rule regarding ignoring trail use to reach a specific destination is the California Hiking and Riding trail. There are two reasons behind the decision to treat this trail separately. The first is the nature of the trail in that it is so often used as a thru-hiking trail where the visitor's destination is the trail itself. For example, if a visitor departing Black Rock Campground backcountry board states North Entrance backcountry board as their destination, their goal is not really to see the North Entrance backcountry board. Their goal was likely to hike the California Hiking and Riding Trail (CRHT) between those two destinations. From this perspective, it made sense to track use of particular sections of trail. Another reason for this decision is that the nature of the trail; It is neatly dissected by for backcountry boards with two more as endcaps, which allows for this process to be done easily and neatly.

This was accomplished by doing a second set of coding where CRHT use was indicated (Figure 3). Use of the CRHT was assumed if the destination listed was another backcountry board along the trail. For example, if a person departing Black Rock Canyon listed Upper Covington Flats backcountry board as their destination, it was assumed that they hiked the section of the CRHT between those two boards. In many cases however, CRHT use was indicated without supplying a specific destination. Examples of this include responses such as "1-2 miles along the California Hiking and Riding Trail" or "Hiking and Riding Trail". In order to include this data without skewing the distributions of use between different sections of the trail, entries that indicated use of the CRHT without supplying enough detail to identify the specific section used were split 50-50 between the trail segments immediately west and immediately east of the backcountry board from which they departed. If there was only one possible direction, as at Black Rock or North Entrance, that direction was assigned. In these cases, it was assumed that the visitor only used the nearest section.

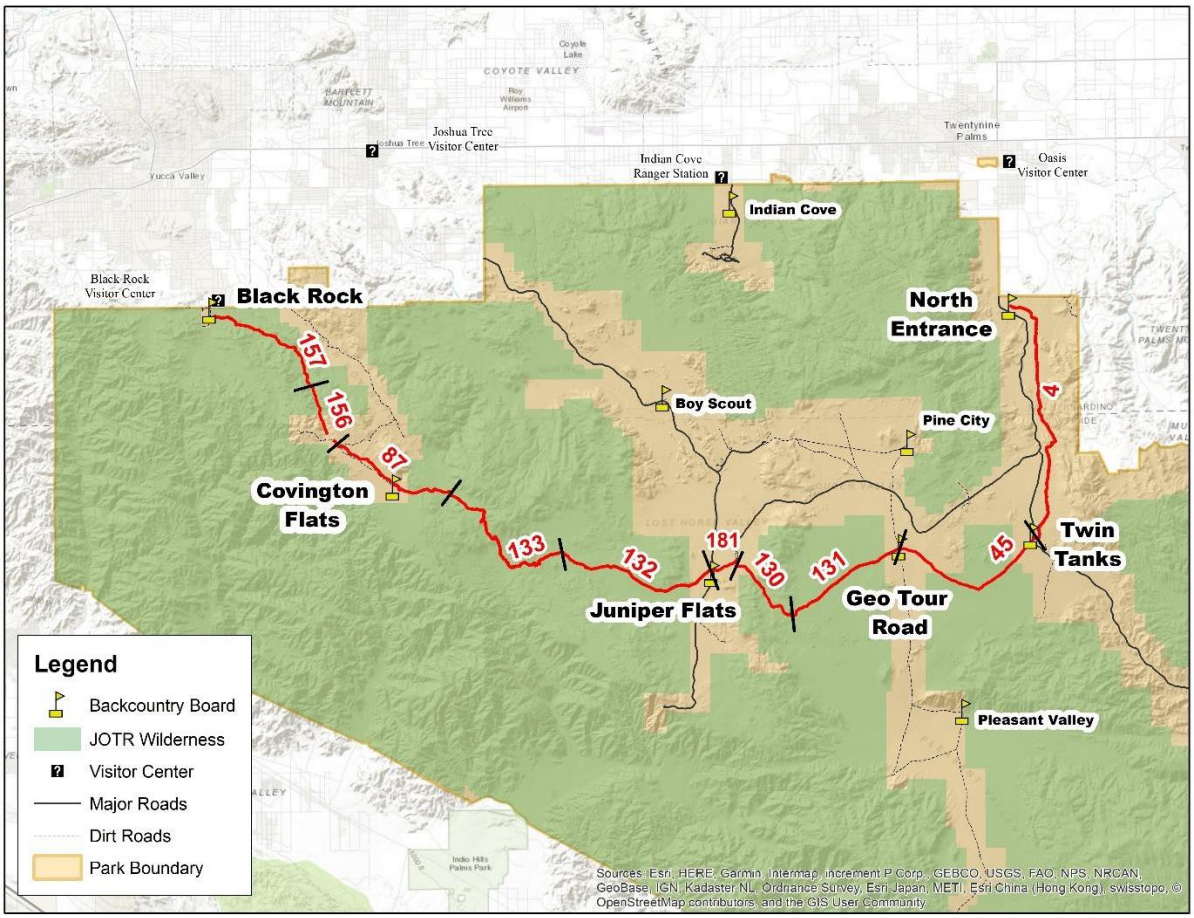

Figure 3: Map displaying the different sections (based on the geographic database) of the California Hiking and Riding Trail. Sections are labeled with an Object ID in red and divided by black slash marks. As an example, if a permit tag from Juniper Flats listed a destination of Twin Tanks backcountry board, the group was assumed to have used sections 181, 130, 131, and 45.

To evaluate visitor demographics by season, first the data was cleaned by removing observations without location fields completed, defining regions, and removing repetitive entries. Data was then converted to a ratio representing observed visitation in a month over the expected value, where the expected value is the number of visitors who would have been present if the demographic group's seasonal variation was proportional to the overall seasonal variation of overnight backcountry users.

$$Expected = \left(\frac{\#\ of\ tags\ recieved\ (total)\ for\ that\ month}{\#\ of\ tags\ recieved\ (total)\ for\ the\ year}\right) * \#\ of\ annual\ tags\ representing\ the\ demographic\ to\ be\ studied$$

$$Ratio = \frac{Observed\ Visitation}{Expected\ Visitation}$$

For example, throughout the study period there were 6,393 tags returned with completed location fields, while there were 457 returned in January 2017 total. The total number of tags returned from visitors with locations of origin within the U.S. in January was 352, and the total number of tags returned from visitors with locations of origin within the U.S. throughout the study period was 5,103. Using the above formula, the ratio of observed visitation over expected visitation is 0.96.

$$Expected\ Visitation = \left(\frac{457}{6393}\right) * 5103 = 364.79$$

$$Ratio = \frac{Actual\ Visitation}{Expected\ Visitation} = \frac{352}{Expected\ Visitation}$$

$$Ratio = \frac{352}{364.79} = 0.96$$

This ratio indicates how this demographic group behaved (i.e. how many domestic visitors returned backcountry permits in the month of January) in comparison to how often it would have behaved if visitation was distributed proportionally to the overall monthly visitation trend.

Results

In total, responses from 6,407 tags from this period were recorded. Between 99.95% and 78% of self-registered visitors completed relevant fields (Table 1). The only exception is the age field, which was not printed on all tags, and received 974 responses. Additionally, emergency information was only collected and coded from tags returned in October 2016, December 2016, and January 2017. Out of 1,116 observations, 1,060 (95%) completed at least some emergency contact information and 1,041 (93%) included a phone number.

Table 1. Field completion in returned voluntary self-registration permits, October 2016 through September 2017.

Permit Field	Frequency	% of Total
Name	6,404	99.95
Date In	6,367	99.38
Number in Party	6,335	98.88
Date Out	6,296	98.27
Destination*	5,482	85.56
City	5,376	83.91
State	5,000	78.04
Age**	974	n/a
Total permits analyzed	*6,407*	*100*

** includes inappropriate answers, e.g. "here," "the desert," "Joshua Tree"*
***only certain cards (amount unspecified) had this field, so the % total is not a true value*

VISITOR DEMOGRAPHICS

Age Demographics

Because some backcountry permits were printed without fields for age, there were only 974 tags with responses (Table 1). While this is an adequate sample size for analysis, it does not comprise the entirety of the population. This sample is unlikely to be representative, as cards with or without age fields were not equally distributed amongst backcountry boards or across the year, so results should be interpreted with care.

Backcountry visitors reported ages ranging from 10 to 76 years, with a mean of 33 and median of 27 (Figure 4). The responses are heavily skewed toward younger visitors, with 75% of respondents reporting ages under 40. The mean visitor age was relatively even across backcountry boards, ranging from 31 to 35, with Turkey Flats as an exception. There, only two visitors responded and the mean age was 28 (Table 2).

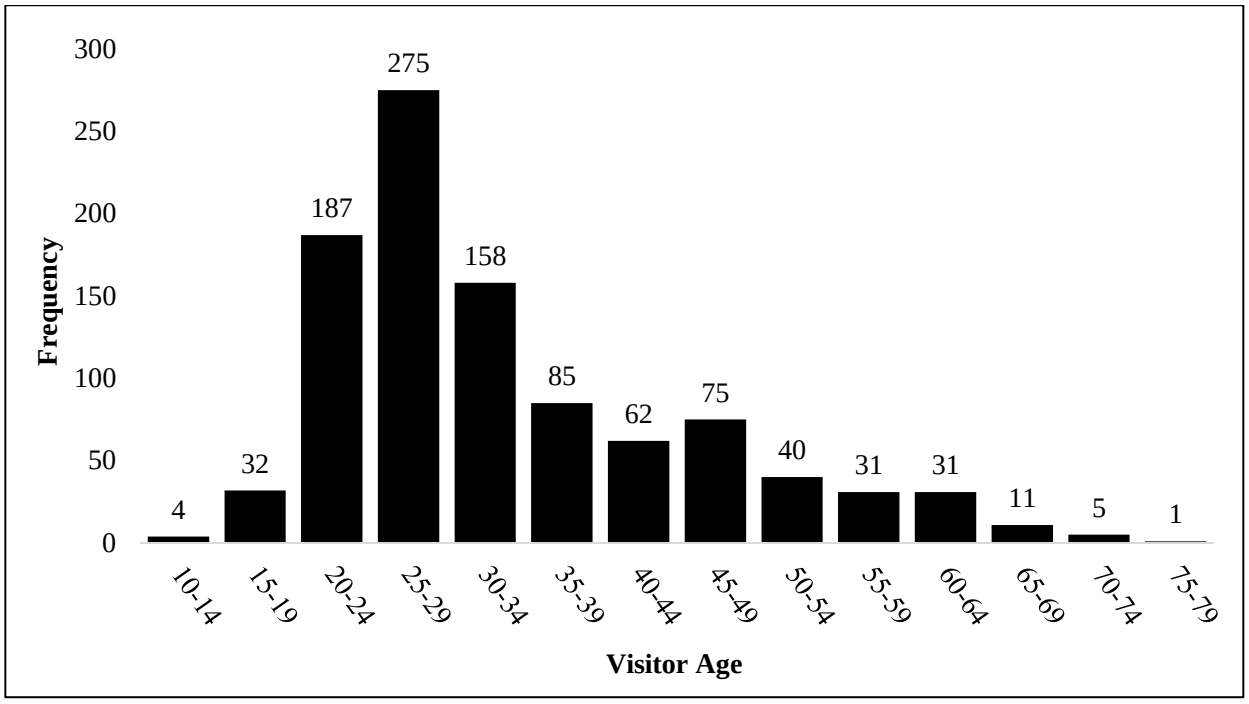

Figure 4. Distribution of reported ages at all backcountry boards in Joshua Tree National Park.

Table 2. Mean reported age of overnight backcountry visitors, by backcountry board.

Backcountry Board	Mean Age	Number of Ages Listed
Black Rock Canyon	35	175
Covington	35	86
Pine City	35	94
Geology Tour	34	82
Cottonwood	33	59
Indian Cove	33	155
North Entrance	33	6
Pleasant Valley	33	23
Juniper Flats	32	167
Key's West	32	82
Porcupine Wash	32	17
Twin Tanks	31	43
Turkey Flats	28	2
Total	*33*	*991**

*Most tags reported a single age; a few reported two or more (974 tags with ages listed and a total of 991 ages reported).

Locations of Origin

Individual visitors were the analysis unit to evaluate locations of origin. The 6,407 permits analyzed represent 12,934 visitors.

The vast majority of JOTR's backcountry users (98%) were from the United States. Canadians were the most frequent international visitors (52% of international visitors). The remaining international visitors were from European countries (33%), Mexico (5%), Asia (2 visitors) and the Middle East (3 visitors). Of the European countries, France (12 visitors) and Germany (33 visitors) were the most common.

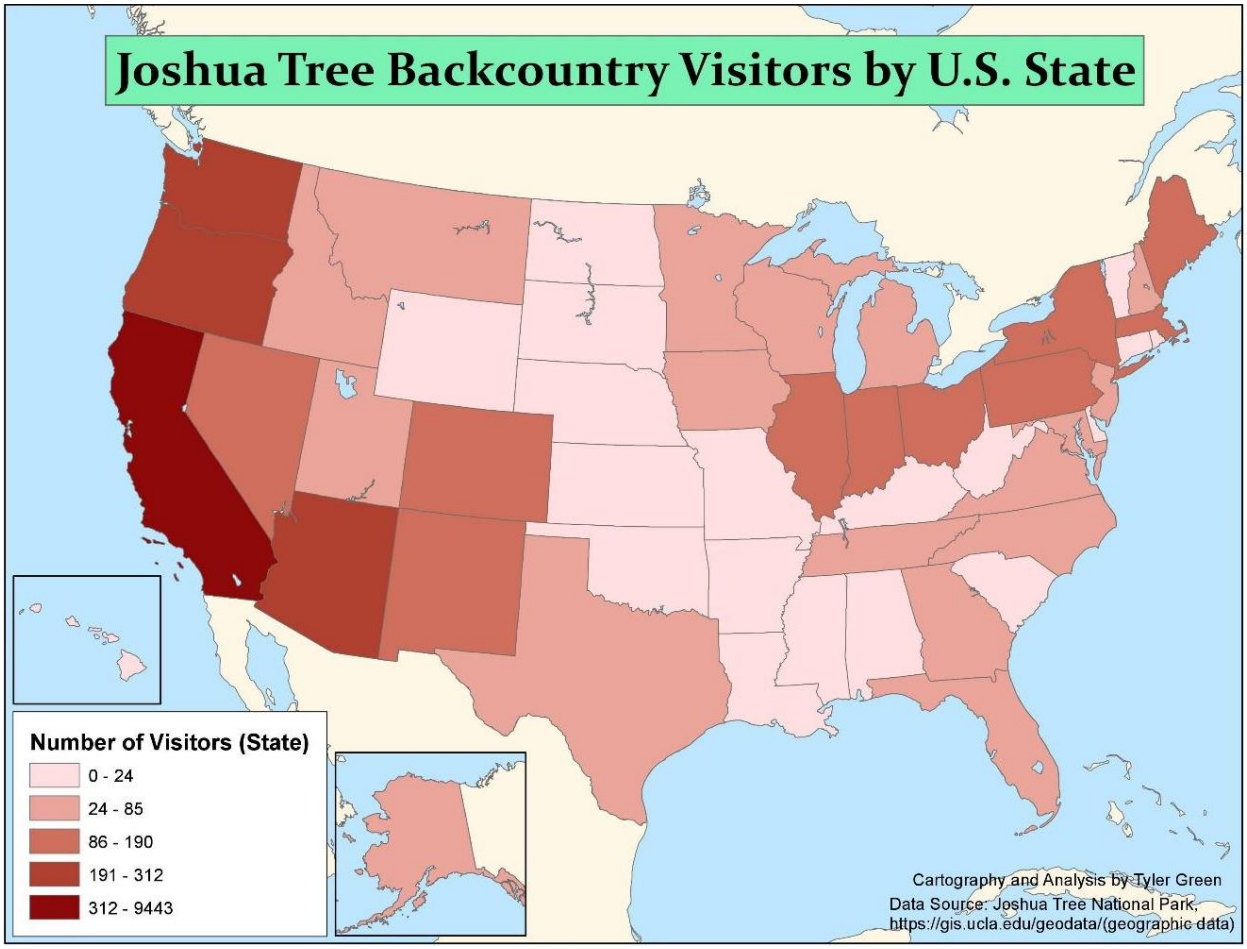

Figure 5. Distribution of overnight backcountry users' U.S. state of origin. JOTR is located in California.

California makes up 75% of domestic visitation, and followed by the nearby states of Oregon, Washington, and Arizona (Figure 5). It is likely that the higher visitation originating from the eastern states Illinois, Ohio, Pennsylvania, and New York is at least partially due to the fact that these states are among the most highly populated in the nation, however relatively few visitors originated from Texas,

which is highly populated. The high number of visitors from Maine is likely due to an error that occurred in the join process where visitors from Portland, Oregon were also assigned to Portland, Maine.

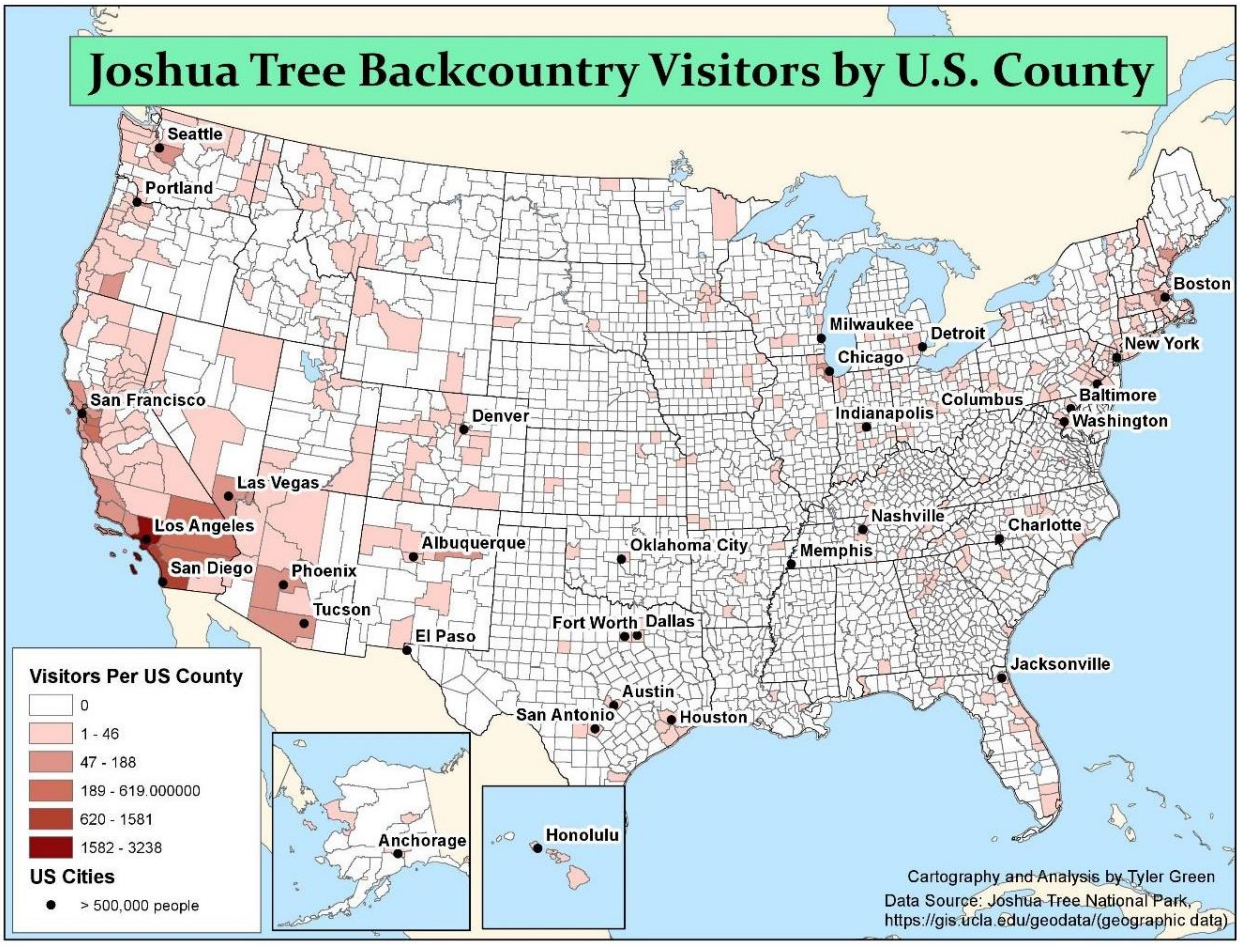

Figure 6. Distribution of overnight backcountry users' U.S. county of origin. JOTR is located in California.

A large segment of the park's visitation comes from large metropolitan areas, especially further from California and the West Coast (Figure 6).

In California, the most frequent counties of origin are either proximate to major metropolitan areas, or proximate to the park (Figure 7). As a proportion of overall county population, overnight backcountry visitors at JOTR most commonly originate from Inyo and Sierra counties, which contain relatively low overall populations but are areas with significant recreational opportunities (Figure 8). More visitors originated from Los Angeles, San Diego, Orange, and San Francisco Counties than would be expected based solely on their overall populations. In other words, high visitation from those counties cannot be explained only by high overall population; there is also a higher proportion of residents who visit the JOTR backcountry.

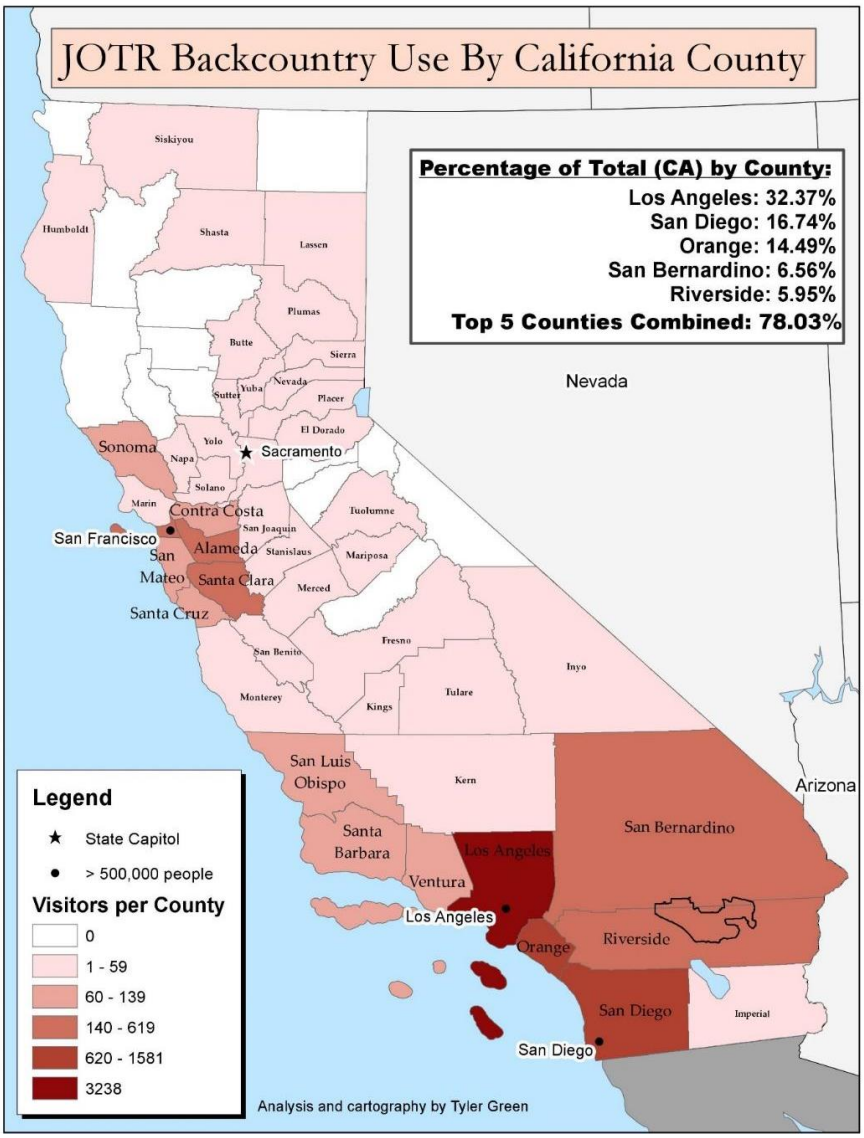

Figure 7. Distribution of overnight backcountry visitors' California county of origin. JOTR is located mostly in Riverside County, with the most popular access and gateway communities located in San Bernardino County.

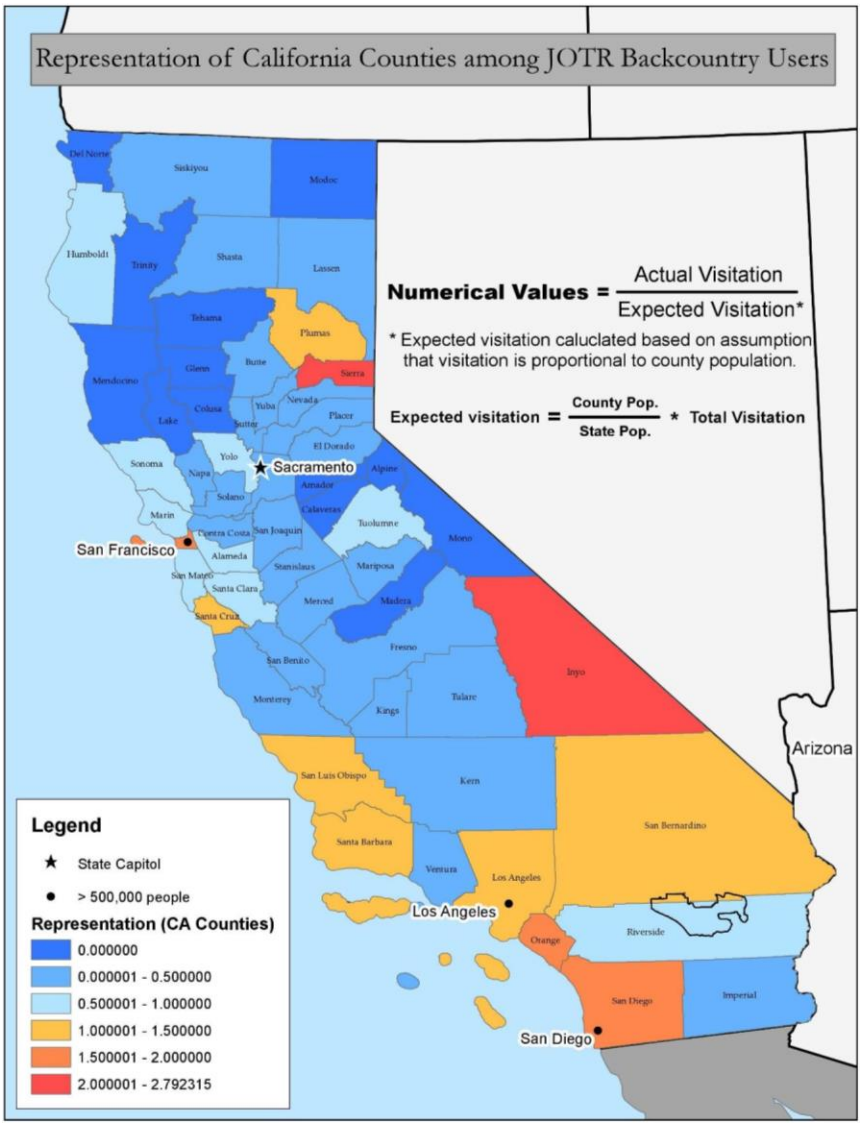

Figure 8. Frequency of reported California counties of origin, relative to expected frequencies if locations of origin were proportional to county population. Blue counties with values under one were reported less frequently than expected, while yellow-to-red counties were more common. JOTR is located mostly in Riverside County, with access and gateway communities located in San Bernardino County.

Visitor use patterns appear to vary seasonally among three different classifications based on location of origin: (1) United States and international, (2) California and the rest of the United States, and (3) California and its bordering states, and United States. In order to evaluate these differences, permit counts were evaluated as ratios of observed visitation over expected visitation. These ratios represent the difference between overall seasonal variation and seasonal variation of a demographic group. Ratio values greater than one represent observed visitation that is disproportionately high, and values less than one represent observed visitation that is disproportionately low. A value of one indicates that the observed

value is exactly the same as the expected value. (See DATA ANALYSIS for more on how ratios were calculated.)

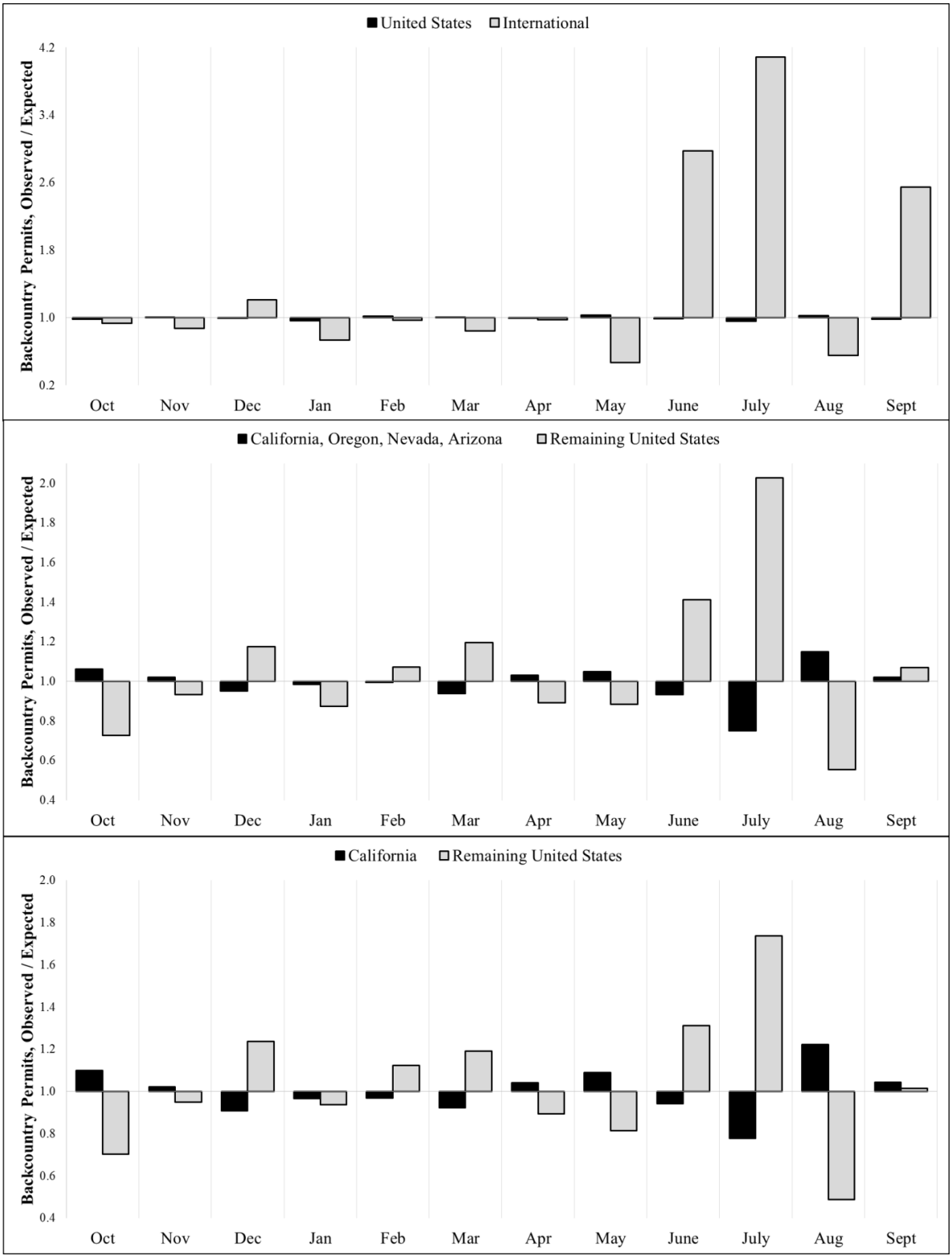

Figure 8. Frequency of reported locations of origin by month, relative to expected frequencies if visitors from each location were distributed proportionally to overall monthly variation. A value of one indicates that the observed value is the same as the expected value.

Figure 8 shows a very strong spike in the months of July and August where the ratio of actual visitation to expected visitation for international visitors was 2.98 and 4.09 respectively. In other words, international visitors were visiting at a rate three and four times higher than might be expected if they were behaving similarly to the population as a whole.

Although the actual number of international visitors for these months is very low (under 10 for both) this pattern of higher-than-expected visitation from the less local group (i.e. international versus national, national versus California, etc.) holds true for all three levels of geographic analysis. When comparing California to the remaining United States, the ratios for the same months are 1.31 and 1.74 for the non-California user group. When comparing California and its neighboring states with the remaining United States, these ratios are 1.41 and 2.03.

Collectively, this appears to indicate is that visitors from farther away are far more likely to visit during the summer months than visitors from nearby. Furthermore, the degree of difference between observed and expected visitation by month is appears to be related to distance. The ratios are highest for the furthest group, international users and lowest for the non-California.

In this analysis, reported use by California residents was compared to residents of Arizona, Nevada, and Oregon. Based on the reported states of origin seen in Figure 5, a more accurate comparison might also include the state of Washington, which has a volume of overnight backcountry users similar to that or Oregon and Arizona. This analysis could also be strengthened by evaluating at the actual number of visitors, rather than the number of registration tags. Finally, small sample sizes in the summer months may be inflating effect sizes or confounding results. A more robust analysis of multiple years of backcountry tags could provide stronger data.

Form Completion

This analysis focuses on the amount and type of information that each user filled out on the backcountry registration tag. The original impetus for this section was to assess visitor attitudes regarding safety by analyzing the emergency contact information provided on the card. This information is useful to park managers to determine the number of visitors who filled out safety information. During the analysis, this expanded to include general response rates for each of the fields.

Table 4 shows the frequency and percentage of responses for each of the eight fields entered on each of the 6,407 backcountry permits. Only a fraction of the backcountry registration tags had an age field, so and response rate was not ascertained. The response rates for Name (99.95%), Date In (99.38%), and Date Out (98.27%) were the highest, while City (83.91%) and State (78.04%) had the lowest. This could be an important consideration in designing a new permitting system. A destination was listed only 85.56% of the time and a significant percentage of those are nonsense or nondescript. It is not clear why a relatively large number of users did not report useful information, but it is possible that visitors do not see the value of listing a destination from a safety perspective, do not have a planned destination, or do not know how to describe their destination.

Table 4: Frequency of Response to Permit Questions

Permit Field	Total	% Total
Name	6404	99.95
Age**	974	15.2
City	5376	83.91
State	5000	78.04
Destination*	5482	85.56
Date In	6367	99.38
Date Out	6296	98.27
Number in Party	6335	98.88

Responses to contact information fields were more difficult to quantify because of the large array in response types. The tags contain two contact information fields: Emergency Contact and Phone Number. For each field, users left blanks, wrote in a name, number, name and number, or wrote something different (e.g. “six vehicles”). In a 500 permit subset, there were 16 different combinations of response types across the two safety-related fields (Table 5). This may stem from the fact that the two fields are written ambiguously. Visitors may have been unclear on whether to provide a name and number for each field, or use one for a name and one for a number. It appears that only 13% wrote both personal and emergency contact information.

Table 5. Response type combinations in response to fields related to contact information. Bold indicates at least one number in each field, possibly indicating both personal and emergency information.

Emergency Contact	Phone Number	Frequency	% of Total
name	number	332	66.4
number	**number**	**50**	**10.0**
number	name	34	6.8
number	*<blank>*	17	3.4
<blank>	number	15	3.0
<blank>	*<blank>*	15	3.0
name	number, number	12	2.4
name, number	**number**	**6**	**1.2**
number	**number, number**	**4**	**0.8**
name, number	**name, number**	**3**	**0.6**
name, number	*<blank>*	3	0.6
name, number	**number, number**	**2**	**0.4**
name	*<blank>*	2	0.4
name, name	number, number, number	1	0.2
number, number	**number**	**1**	**0.2**

<*blank*>	number, name	0	0.0

It was possible, however, to analyze both the number of pieces of safety information given per backcountry registration tag and the percentages of tags that had each field filled out. Two subsets of data were evaluated for different completion metrics, and the results are independent of one another (Tables 6 and 7). The vast majority of visitors (89%) provided two or more pieces of safety information while only 4.3% did not list any safety information at all. For the second analysis, 95% of permits had a response listed under "Emergency Contact" and 93% had a response for "Phone Number".

Table 6. Number of safety information items reported in the emergency contact and phone number fields.

Amount of Safety Info	Total	% of Total
4 or greater	15	1.34
3	44	3.94
2	934	83.54
1	77	6.89
0	48	4.29
Total Sample	*1118*	*100*

Table 7. Safety analysis 2

Permit Field	Completion Frequency	Percent completed
Emergency Contact	1060	94.98
Phone Number	1041	93.28
Total Sample	*1116*	

TRIP CHARACTERISTICS

Repeat Visitation

The purpose of this section is to characterize repeat overnight backcountry use, defined as visitors who filled out more than one backcountry permit during the period between October 2016 and September 2017. Actual repeat use may be higher, as this does not capture groups where tags are completed by different individuals, groups that do not fill out a tag for every visit, and users who repeat visitors outside of the one-year sample period.

The number of tags returned in one year by the same visitors range from one to 14, with most responses closely clustered around a mean of 1.53 (SD=1.24). Eighty-four percent of users visited once and 96% visited once or twice (Figure 9).

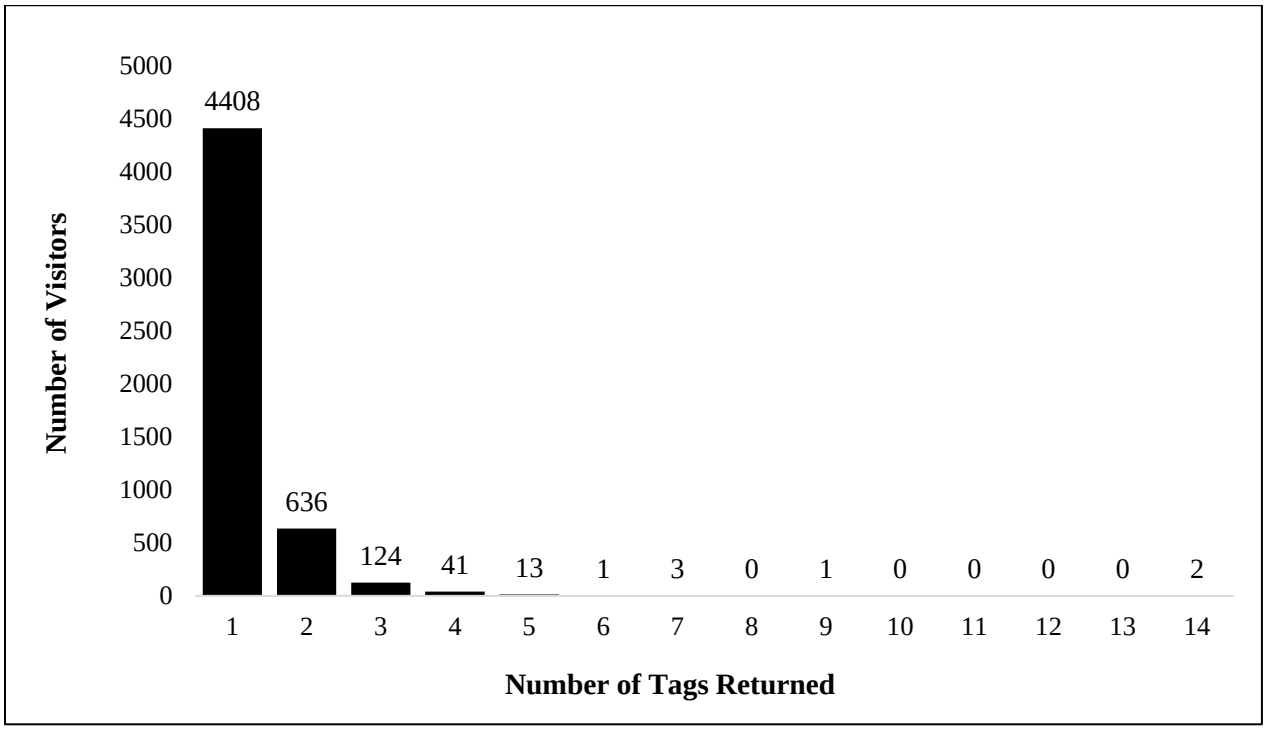

Figure 9. Frequency of repeat visitation, measured as the number of tags returned by unique visitors over the one-year sample period

It seems likely that the results suffer from a reasonable amount of error resulting from the decision to abbreviate the first name of the visitor, where multiple visitors with the same first initial and last name combination may appear to be one visitor with a high number of visits. Evaluating the locations of origin may indicate whether each set of first initial and last name belongs to one individual or multiple visitors.

Each of the two visitors with 14 visits reported a consistent location of origin, indicating that they are likely the same individual returning 14 tags. However, of the seven apparent users who visited 6 or more times, four included different locations of origin and are likely multiple visitors. A more refined analysis could involve querying the data to see how often this is the case in users with three to five backcountry tags to their name, and future analysis would benefit from including full first names.

Length of Visit

The range in responses for trip duration was from zero nights (likely a day trip) to 11 days, although trip durations of longer than 14 days were deleted from the data set because it seems likely that trip durations of this length likely result from a misinterpretation of the permit (i.e. length of total trip, not time in the backcountry). Reported trip lengths heavily cluster around a mean of 1.30 (SD = 0.80) (Figure 10). Ninety-two percent of users stayed for either one or two nights. The majority of the remainder filled out a permit for zero nights (2%), likely for their day trip, or stayed for three or four nights (5%). Only one

percent stated that they intended to stay for five nights or longer. A practical upper limit for most users of two nights in the backcountry makes sense in a desert environment without water sources.

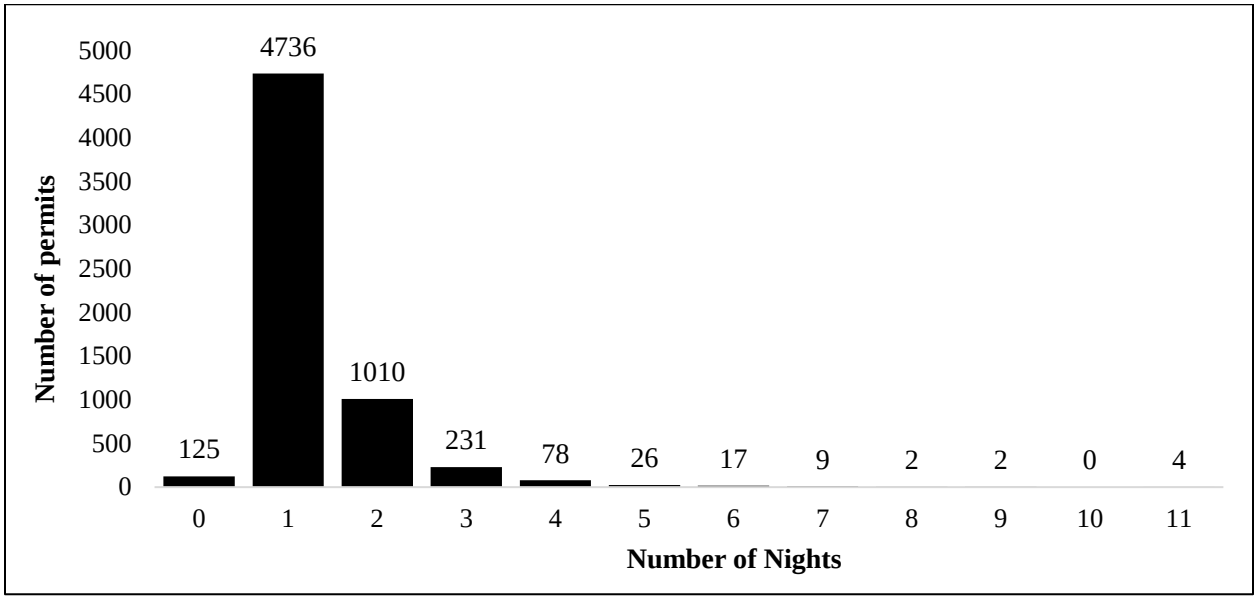

Figure 10. Frequency analysis of the number of nights spent in the backcountry by different groups.

Mean trip length for each month varies seasonally, with the longest mean trip lengths occurring during cooler winter and spring months (Figure 11). The months of December, January, and March had the highest mean trip length (1.45, 1.36, and 1.40, respectively) while the months of June, July, and August had the lowest mean trip lengths (1.23, 1.16, and 1.05, respectively). Longer average trip lengths in January and March may be due to winter holidays and spring break.

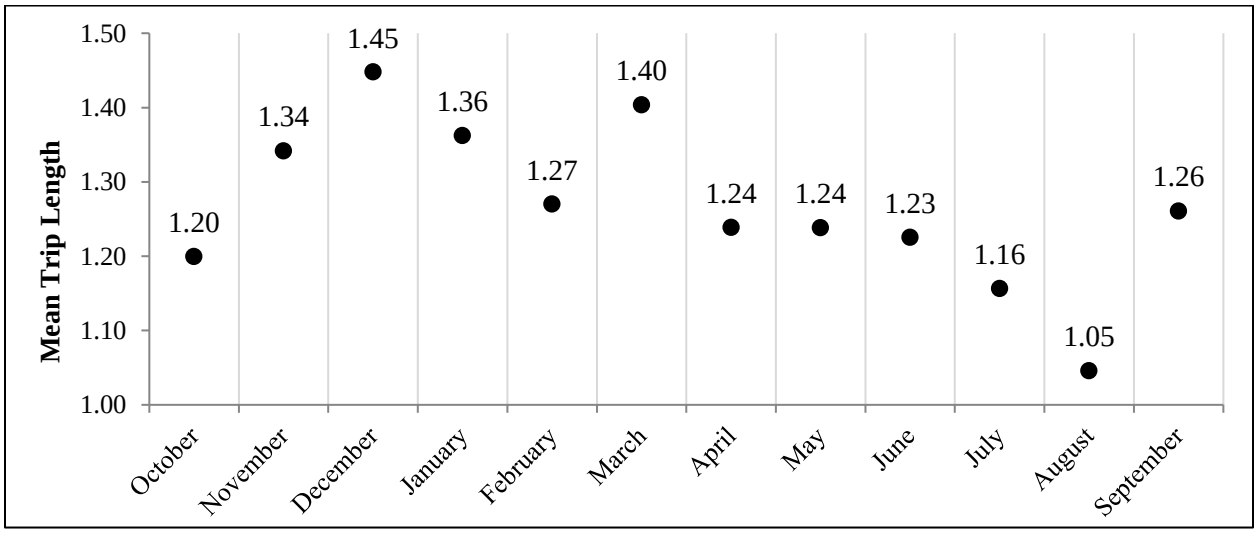

Figure 11. Average reported trip length by month.

On the other hand, there was no correlation between elevation and trip length. However, Black Rock Canyon and North Entrance, the terminuses of the California Riding and Hiking Trail, were found to have the longest average trip length (1.72 and 1.86 respectively).

Group Size

Reported group size ranged from one to 32, and the vast majority of backcountry users traveled in groups of four or smaller (91%). The mean group size was 2.5 with a standard deviation of 2.0. The most frequent response was two, which comprised 49% of reported use (Figure 12).

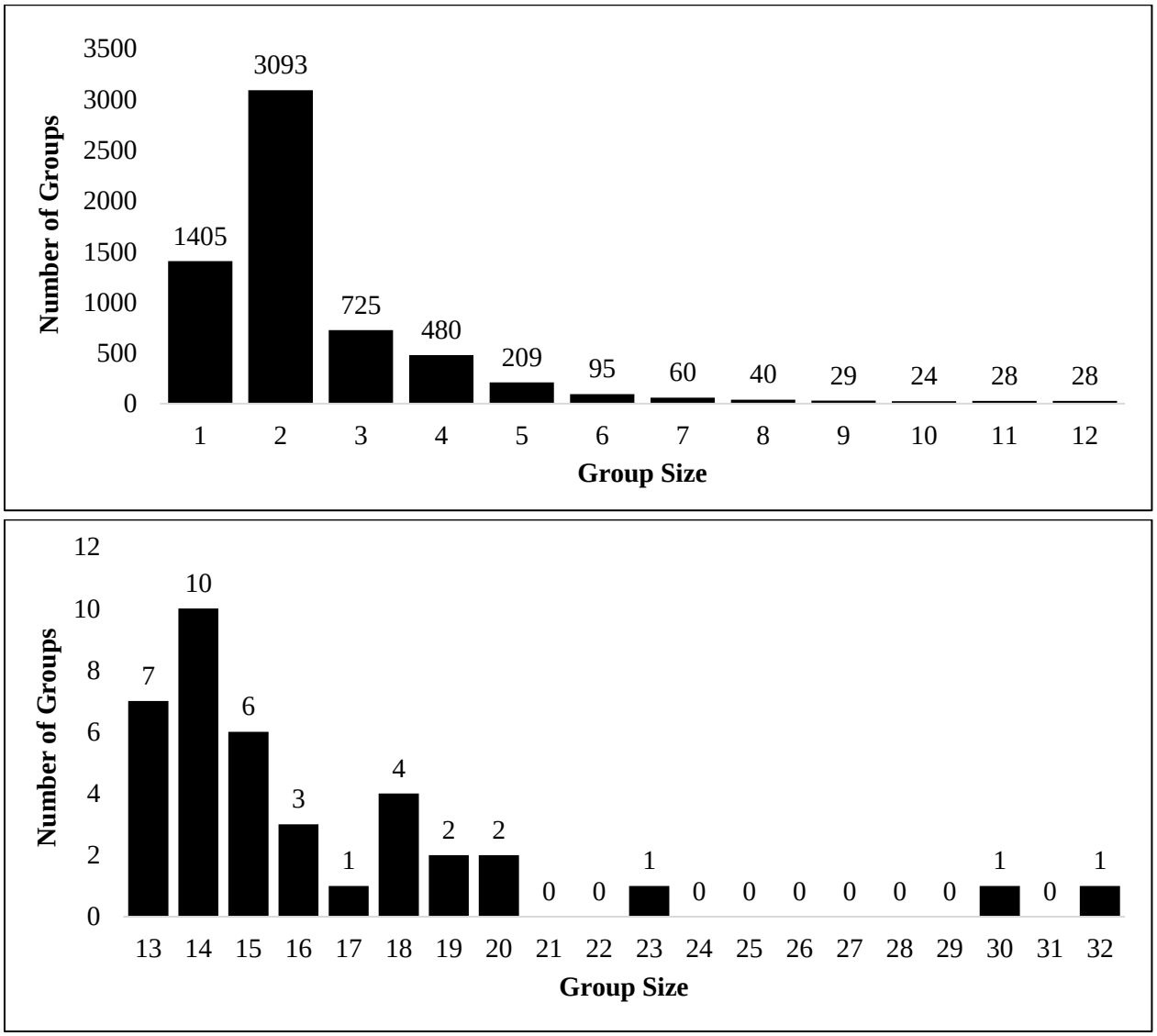

Figure 12. Frequency of reported group sizes. Top histogram displays frequency of group sizes 12 and under with a maximum frequency of 3,093. The bottom histogram displays group sizes greater than 12 wish a maximum frequency of 10.

Of the 6,254 reported backcountry trips (i.e. the total number of permits minus those that were deemed duplicates), only 38 violated the policy for maximum group size in wilderness and only two of these violated the policy for maximum group size. Twenty of these instances occurred at boards accessing the Boy Scout Trail, with ten at Indian Cove and ten at Key's West. Indian Cove in particular saw a disproportionate share of group sizes over 12, as 26% of these groups returned tags at Indian Cove while that board only accounted for 7.31% of total tags.

Additional analyses looked at the relationship between month and group size and backcountry board and group size (Table 8). The largest mean group size was in Indian Cove (3.09) and the smallest at Turkey Flats (2.00). Group size was generally largest in the spring and smaller during the summer months (Figure 13). This may be due to less general interest in backcountry use during the hot summer months.

Table 8. Average reported group size by backcountry board.

Backcountry Board	Mean Group Size	Std. Dev
Indian Cove	3.09	2.88
Pine City	2.65	1.91
Covington	2.61	1.99
Key's West	2.59	2.01
Twin Tanks	2.59	2.05
Geology Tour	2.56	1.85
North Entrance	2.54	1.95
Black Rock Canyon	2.49	1.95
Cottonwood	2.33	2.31
Porcupine Wash	2.31	2.14
Juniper Flats	2.28	1.50
Pleasant Valley	2.13	1.25
Turkey Flats	2.00	1.13

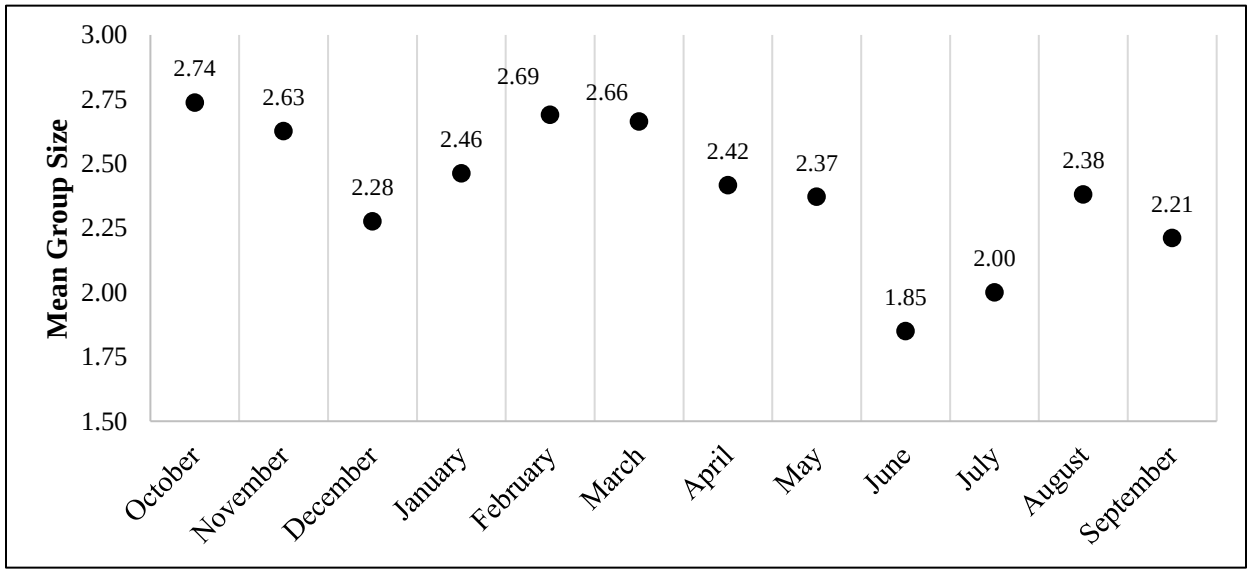

Figure 13. Average reported group size by month.

Spatial Distribution

The data used in this analysis is not the product of the backcountry database compiled as a part of this project, but rather as an independent effort from Kate McHugh, JOTR Wilderness Fellow, who tabulated the number of user nights for each backcountry board on a monthly basis.

Table 9: Backcountry user nights per month (https://irma.nps.gov/)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	*Total (% of Total)*
Keys West	367	587	398	460	558	1,123	1,276	342	82	35	119	132	*5,479 (28)*
Juniper Flats	190	621	270	327	352	805	566	244	45	9	21	53	*3,503 (18)*
Twin Tanks	137	346	101	121	168	467	579	146	24	7	57	44	*2,197 (11)*
Indian Cove	226	135	156	129	336	405	318	87	7	3	13	53	*1,868 (9)*
Pine City	116	328	43	32	152	326	360	198	23	15	38	71	*1,702 (9)*
Black Rock Canyon	85	206	116	137	159	335	193	71	20	5	4	33	*1,364 (7)*
Geology Tour Road	137	260	66	69	59	166	204	29	19	0	13	23	*1,045 (5)*
Cottonwood	56	201	42	62	170	109	201	61	29	18	24	29	*1,002 (5)*
Porcupine Wash	34	70	26	23	61	154	141	8	3	0	2	4	*526 (3)*
North Entrance	0	54	56	67	29	116	84	14	0	0	0	3	*423 (2)*
Covington	28	58	17	55	48	70	60	13	18	4	2	4	*377 (2)*
Pleasant Valley	50	55	21	20	10	36		3	3	2	5	9	*214 (1)*
Turkey Flats	6	17	13	9	20	51	45	11	1	4	8	7	*192 (1)*
Total (% of Total)	*1,432 (7)*	*2,938 (15)*	*1,325 (7)*	*1,511 (8)*	*2,122 (11)*	*4,163 (21)*	*4,027 (20)*	*1,227 (6)*	*274 (1.4)*	*102 (0.5)*	*306 (1.5)*	*465 (2)*	*19,892*

The amount of use received by the 13 different backcountry boards varies greatly in Joshua Tree National Park (Table 9). The mean total user nights reported at a board is 1,654 with standard deviation of 1,745, indicating a high degree of spread in the amount of use received by each board.

Another way to quantify the extreme variation in concentration of use is in terms of average users per night, calculated by dividing the number of user-nights per month by the number of nights in a month. In

the highest use scenario, the month of April at Key's West, that number is 43 users per night. That same month, Turkey Flats saw a reported 1.5 visitors per night. A large percentage of the use is happening at a relatively small number of boards as the top three boards account for 56% of the total use, while the bottom three account for only 3.9%. The bottom five account 8.7% of total reported user nights.

In order to identify areas with the greatest backcountry overnight visitation, six classes were identified using the Jenks Natural Breaks classification system inherent in the ArcMap 10.6 software. Users reported both destinations and trails, and the use level breaks between classes differ between trails and destinations. In this report, levels of use will be referred to by their class, with one representing the lightest relative use and six representing the heaviest use. To visualize overnight backcountry visitation, this analysis has produced a "heat map" of self-reported locations in Joshua Tree National Park's backcountry areas (Figures 14-17).

Table 10. Use levels of locations in the two heaviest use classes.

Location	Class	Number of users	Type
Boy Scout Trail	6	995	Trail
Pine City	6	266	Destination
Willow Hole	6	239	Destination
California Hiking & Riding Trail	5	313	Trail
Lost Palms Oasis	5	188	Destination
Indian Cove Backcountry Board	5	160	Destination
Twin Tanks	5	151	Destination
Quail Mountain	5	151	Destination
North Entrance Backcountry Board	5	109	Destination

Although much of the backcountry is being visited to some degree, use is in general highly concentrated to a handful of popular areas. Two destinations and one trail are in class six, and five destinations and one trail are in class five (Table 10). From a statistical standpoint, a number of these locations represent significant outliers.

The mean and standard deviation for the destination dataset are 23.95 and 47.52 respectively, meaning that Willow Hole and Pine City are four and five standard deviations above the mean (Table 10). Total overnight backcountry use at these two destinations represents 21% of the total reported locations. This number only reflects locations that were specifically listed, so it is likely inflated when compared to the true value. The mean of trail use is 43.7 with a standard deviation of 162.1. Boy Scout Trail is an outlier, with 995 uses being nearly six standard deviations above the mean. Boy Scout was mentioned over 3 times as often as the next most frequently trail, the California Hiking and Riding Trail, which is approximately 4.6 times as long according to the GIS geometry. These two trails combined represent 74.87% of trails identified as locations on the backcountry tags. These numbers likely underrepresent use, because they do not include trails used to reach a specified location.

More generally, the data also indicates that in addition to the specific locations listed above, backcountry visitor use is highly concentrated on the west end of the park. Of the seven destinations and two trails in classes five and six, only one (Lost Palms Oasis) is located in the eastern end of the park. It is worth noting that its 188 uses puts it at the top of its class. Only two other destinations in the eastern part of the park receive even moderate use (Pinto Mountain and Eagle Mountain, class 4 and class 3 respectively). Hexahedron Mine (Class 3), although visible on the East Side Map (Figure 16) is more appropriately characterized as west side use as it is most easily accessed from Geology Tour Road. Locations in classes one through four, which are not in table 10, may be under capacity, with less than 64 uses per year for destinations and 66 for trails. Managers should review these locations periodically to assess changes from baseline condition that may warrant a new management response.

Use on the California Riding and Hiking Trail varied significantly by section, ranging between 171 and 275 uses, with a mean of 212.9 and a standard deviation of 30.7 (Figures 15 and 17). Generally speaking, this trail was more lightly used near its termini, especially the section between North Entrance and Twin Tanks (section 4, 181 uses). Low numbers for sections 130 and 156, 188 and 171 uses respectively, are probably more reflective the decision to only code one section east or west (in this case, east) of each backcountry board where the destination given was nondescript. This is especially true of section 130, which is separated from the Juniper Flats Backcountry Board by a very short section of trail.

Conversely, use was highest on the sections of trail immediately west Juniper Flats (275 uses) and Twin Tanks (241 uses), which makes sense given that these are the second and third most popular backcountry boards in the park. Additionally, these sections of trails had a higher number of relatively popular sites nearby, which certainly would have increased their use and popularity amongst visitors.

There are a number of ways this backcountry use analysis could be improved, mostly significantly by incorporating routing in the results (i.e. coding for the most likely path a visitor took to get to a destination or trail instead of just coding for the destination). As described previously, to do so would have taken a considerable amount of time and was beyond the scope of this project. This could be done by either going through each of the 6409 tags individually or writing a coding system by which would automatically output routes for common destinations. This coding system would ideally be agreed upon by multiple parties, particularly those who are already familiar with the trails system at JOTR. Additionally, the map in Figure 15 could be strengthened by using a color scheme with slightly more contrast for the CRHT. The shades of brown used here were meant to fit with the color scheme for the rest of the trails. However, the colors are too similar to be easily differentiated. This could be changed easily using the data and map files (.mxds) provided along with this report.

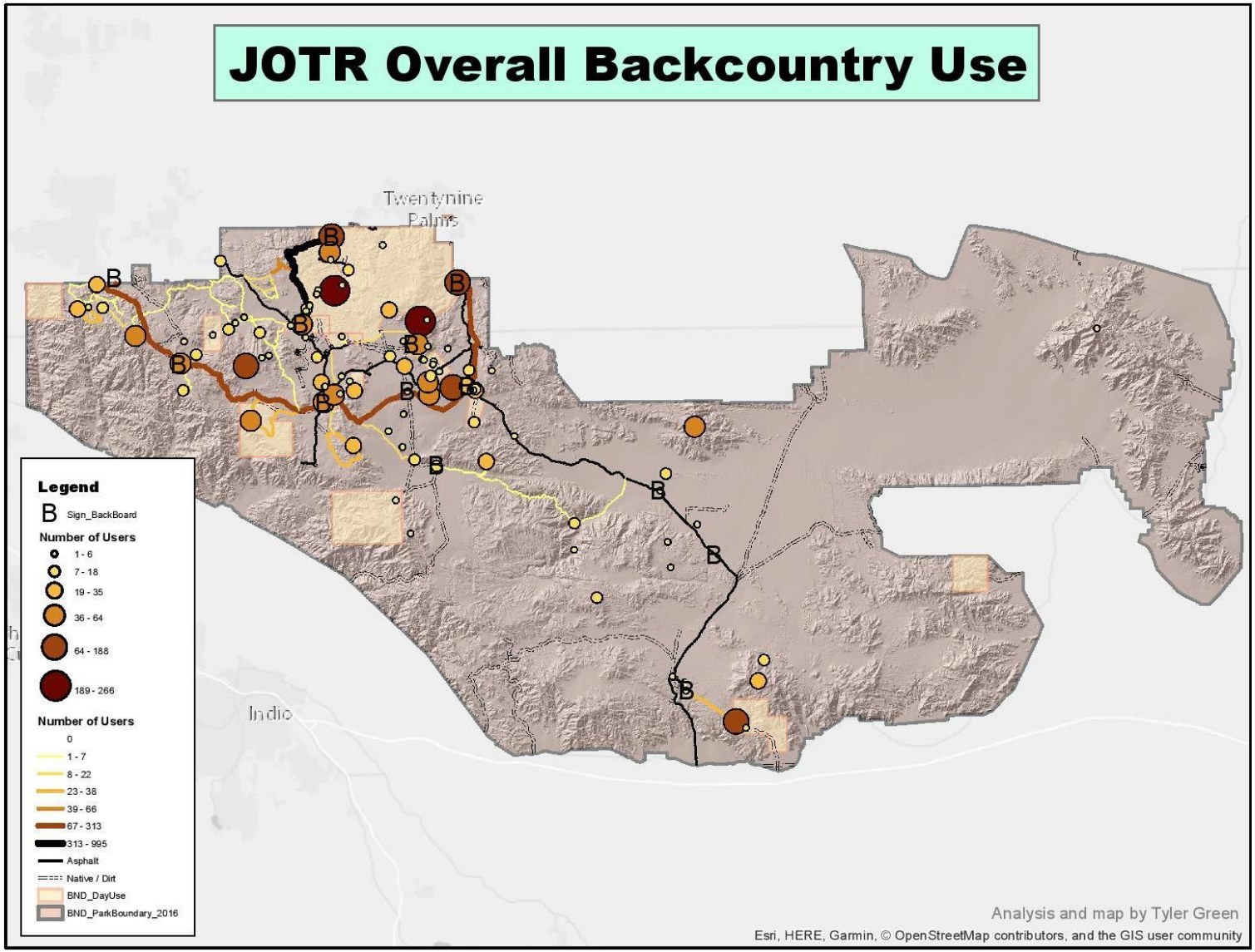

Figure 14. Overall reported locations of backcountry overnight users. Number of user bins are representative of the six use classes identified using the Jenks Natural Breaks classification system.

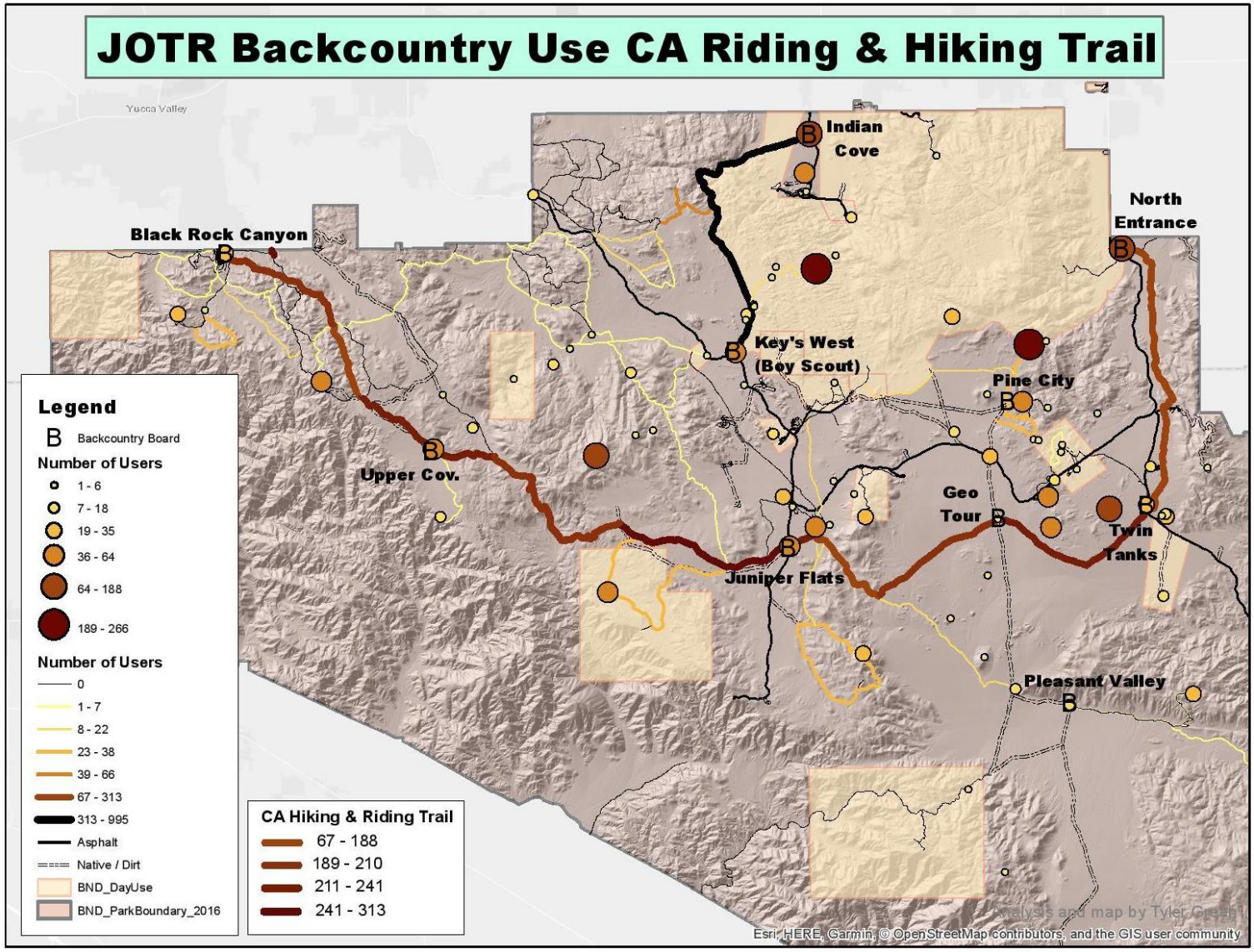

Figure 15. Reported locations of backcountry overnight users, JOTR west including the CRHT. User bins are representative of the six use classes identified using the Jenks Natural Breaks classification system.

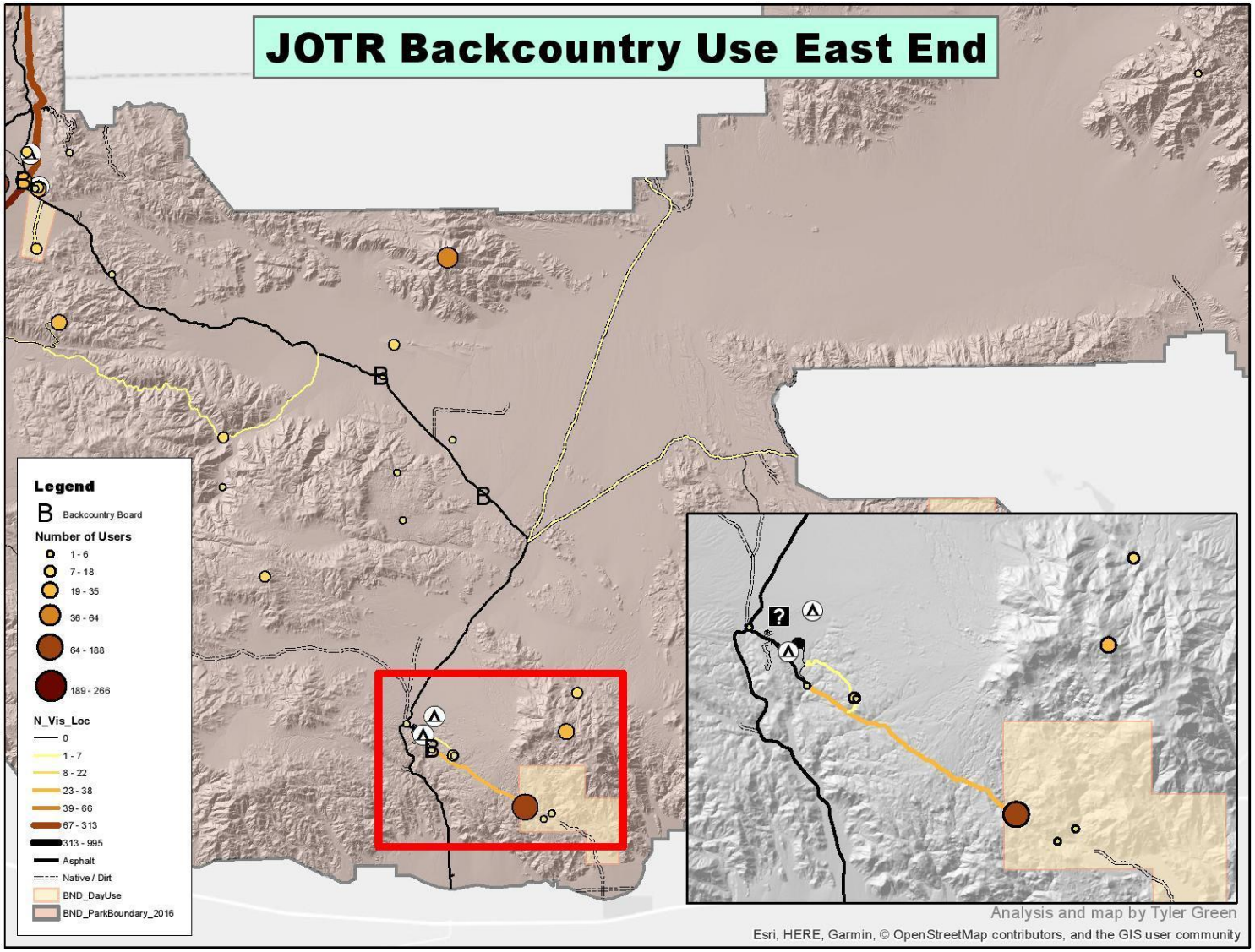

Figure 16. Reported locations of backcountry overnight users, JOTR east. Number of user bins are representative of the six use classes identified using the Jenks Natural Breaks classification system.

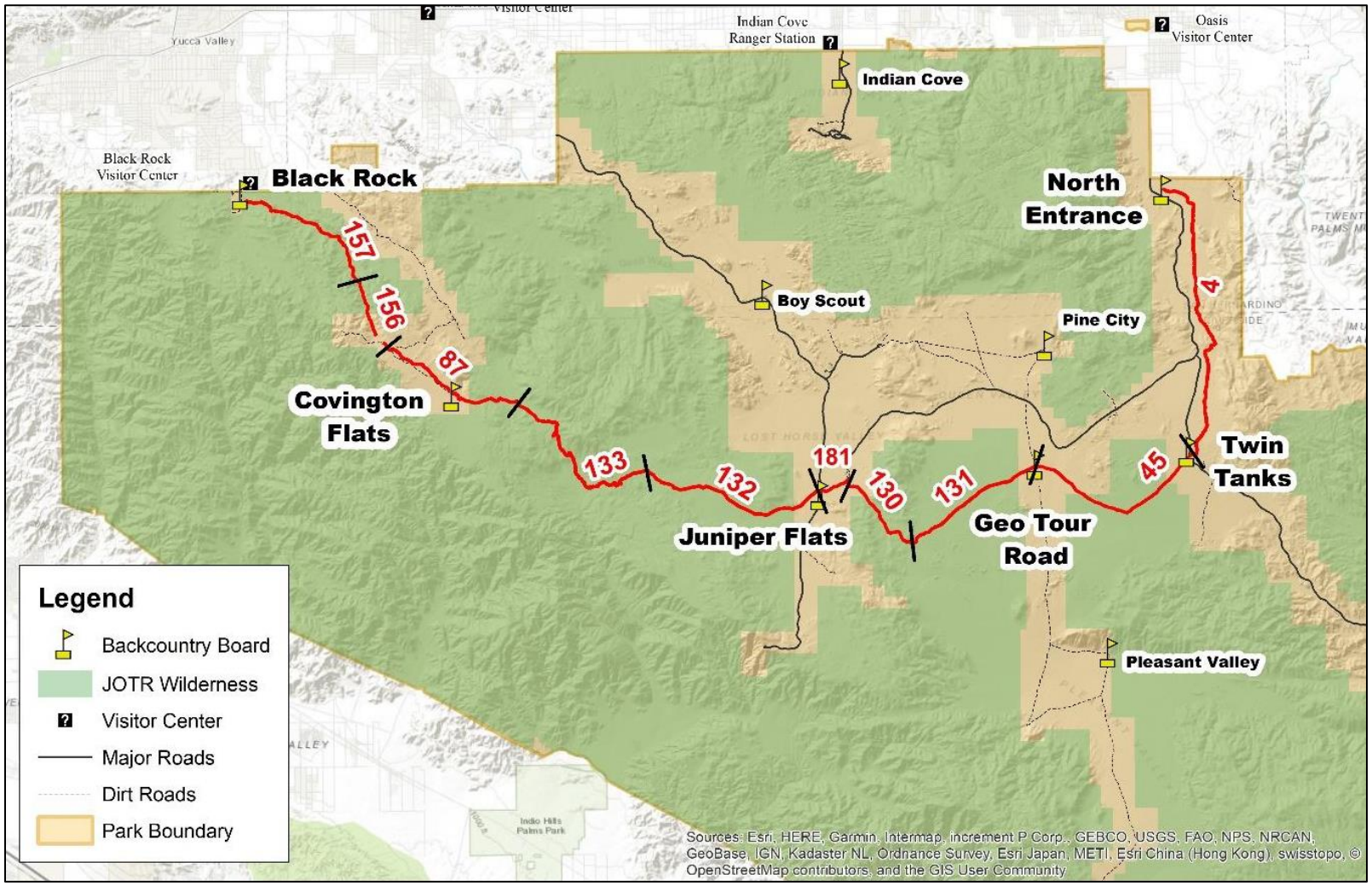

Figure 17. Map displaying the different sections (based on the geographic database) of the California Hiking and Riding Trail. Sections are labeled with an Object ID in red and divided by black slash marks. As an example, if a permit tag from Juniper Flats listed a destination of Twin Tanks backcountry board, the group was assumed to have used sections 181, 130, 131, and 45.

Temporal Distribution

The mean amount of user nights in a month is 1,658 with a standard deviation of 1,404. The busiest three months, March, April, and November, account for 56% of total use, while the three least busy months account for only 3.4% of the total use (Figure 18). This graph displays a bimodal pattern for backcountry visitation at Joshua Tree National Park, with one peak in the Spring (March and April) and a second smaller peak in the fall (November).

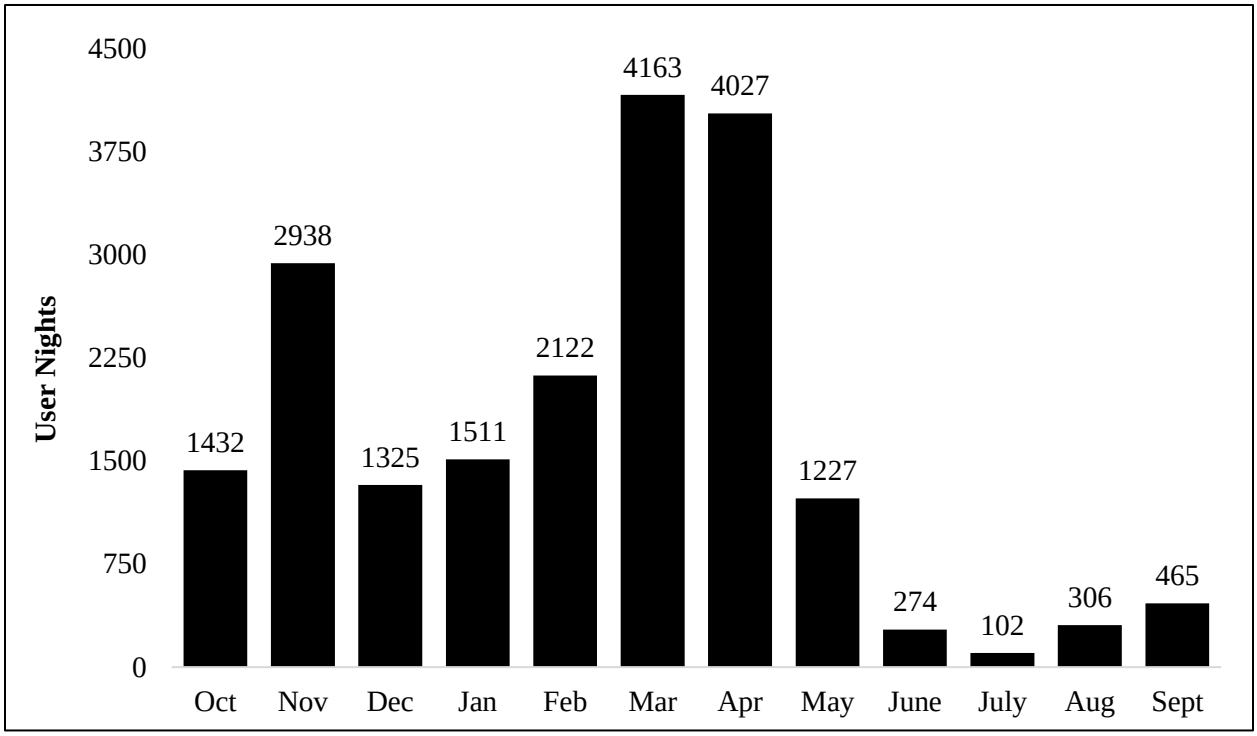

Figure 18. Total user nights across all backcountry boards by month

Because the majority of backcountry trips lasted only one night this report evaluates visitors' reported entry dates as a proxy for backcountry use by day of the week. Using this data, future analysis could use reported trip length and start date to more accurately characterize use by day of the week.

The majority of visitation, as might be expected, took place on the weekends, with Friday and Saturday entry days accounting for 59.85% of the visitation. Visitation totals on Sunday and Thursday (making up 9.18 and 9.40% of the use respectively) are only slightly elevated from other weeknight totals (an average of 7.19). Yet, if we tag these onto the weekend totals (as might be the case in terms in a visitor who takes an additional day off of work for a long weekend), these days represent approximately 80% of the use (78.43%). Also unsurprising is that Wednesday comprises the lowest percentage of backcountry use at only 6.86%.

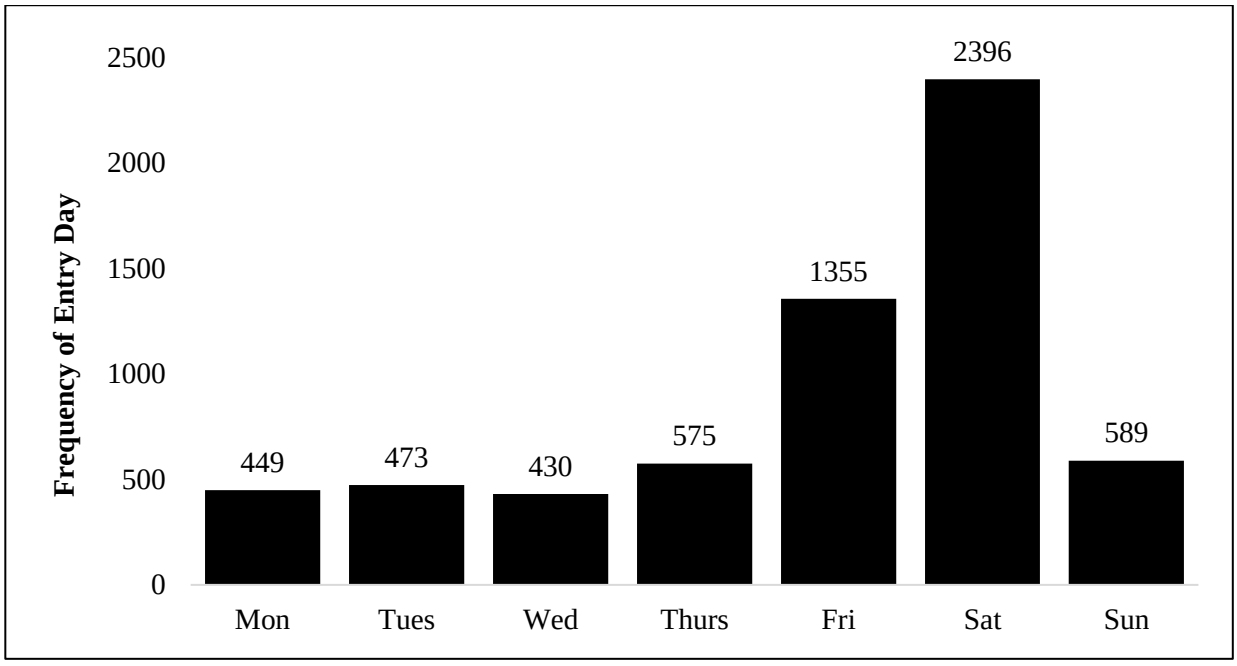

Figure 19. Frequency of backcountry overnight user entry days reported in permits

Use on ten major U.S. holidays was evaluated: New Year's Day, Martin Luther King Day, President's Day, Memorial Day, Independence Day, Labor Day, Columbus Day, and Veterans Day. Holiday weekends include Tuesday after in the event of a Monday holiday, or the Thursday before in the event of a Friday holiday. Both the Wednesday before and Friday after Thanksgiving are included. Two periods were evaluated for Christmas and New Year's, one with both the Friday before and Monday after, and the other with the entire week (Table 11).

Table 11. Backcountry tags returned during holiday weekends.

Holiday	Number of Tags	Tags per Day	Dates	Number of Days
Columbus Day	131	26.2	Fri, 10/7/2016 - Tues, 10/11/2016	5
Veteran's Day	193	48.3	Thurs, 11/10/2016 - Sun, 11/13/2016	4
Thanksgiving Day	257	51.4	Wed, 11/23/2016 - Sun, 11/27/2016	5
Christmas Weekend	41	8.2	Thurs, 12/22/2016 - Mon, 12/26/2016	5
Christmas Week	74	10.6	Wed, 12/21/2016 - Tues, 12/27/2016	7
New Year's Weekend	150	30.0	Thurs, 12/29/2016 - Mon, 1/2/2017	5
New Year's Week	229	32.7	Wed, 12/28/2016 - Tues, 1/3/2017	7
Martin Luther King Day	131	26.2	Sat, 1/13/2017 - Tues, 1/17/2017	5
Washington's Birthday	189	37.8	Sat, 2/17/2017 - Tues, 2/21/2017	5
Memorial Day	114	22.8	Sat, 5/26/2017 - Tues, 5/30/2017	5
Independence Day	13	3.3	Sat, 6/30/2017 - Mon, 7/3/2017	4
Labor Day	16	3.2	Sat, 9/1/2017 - Tues, 9/5/2017	5

Thanksgiving was the most popular holiday weekend for backcountry use accounting for 30.9% of the total backcountry visitation for the month of November. The week of New Year's was the second most popular holiday period, with 229 backcountry trips. The next most popular holiday weekends were Veteran's Day and President's day, with 193 and 189 trips respectively. Total number of trips over the ten holidays with the more conservative definition of New Year's and Christmas holidays as weekends is 1235, or 19.8% of the total backcountry permits returned.

Considerable improvement to this analysis could be made using the data collected in this project. One way this analysis could be accomplished would be to tally the number of visitors, rather than the number of trips, that occurred during each holiday or day of the week, since it seems that there might be some variation in group size over the course of a week on busy holiday weekends. Another weakness of this method is the lack of context given for these weekends and thus difficulty in making direct comparisons. For example, is 257 trips busy for a weekend in November? Furthermore, how do our holiday weekends compare to a weekend during peak season? These are both areas where further analysis would be helpful. It would be useful to create a graph comparing every weekend during the month containing the holiday in question to the holiday weekend. Such an analysis would enable us to see if the visitation spiked during this time.

Discussion

VISITOR DEMOGRAPHICS

Age and Locations of Origin

Mean reported age was 33 (median = 27), 75% of respondents reported ages under 40, and mean age did not vary significantly between backcountry boards. According to the Fiscal Year 2017 Visitor Survey Card Data Report (Pacific Consulting Group, 2017), only 25% of respondents reported ages under 40, with the largest age group being 61-70. This suggests that backcountry overnight users are younger than the overall visitor demographic.

Common locations of origin are metropolitan regions or proximate to the park. Most overnight backcountry users were from the United States (98%), and Canadians were the most commonly reported international visitors. Three-quarters of United States visitors were from California, and the majority of California visitors were from Los Angeles County. As a proportion of population, Inyo and Sierra counties had the highest density of registered backcountry overnight visitors to JOTR.

A relatively high proportion of visitors were from Grand and San Juan counties in southeastern Utah, which may indicate a pattern of climbers and backcountry users associated with Canyonlands and Arches National Park visiting the Joshua Tree backcountry.

During the summer months of June and July, more overnight backcountry visitors reported locations of origin farther from the park, including international visitors and those outside of California or neighboring states, than expected if monthly variation of the demographic was proportional to overall monthly variation. This may be due to the fact that this is often the time of year when people have the most time off for extended travel, and may suggest similar patterns for overall recreation visitation.

Form Completion

There are two fields for safety information on backcountry tags, one labeled “Emergency Contact” and the other “Phone Numbers.” In the 500 permits evaluated for form completion, there were 16 different combinations of information (e.g. two phone numbers, a name and a phone number, two names and two phone numbers). The majority of visitors provided two or more pieces of safety information, while only 4.29 provided no information at all. This suggests that visitors have an appreciation of the importance of listing safety information, and missing or incorrect information may be due to confusing form format.

If the park desires that visitors report both personal contact information and information for an emergency contact, management may desire to reformat or reword this section of the permit. For example, “(name & #)” could be added after the Emergency Contact field, or Phone Number could be moved up on the permit near the name and address fields to indicate that it is personal information.

TRIP CHARACTERISTICS

Repeat Visitation, Length of Visit, and Group Size

The number of tags returned in one year by the same visitors range from one to 14, with most responses closely clustered around a mean of 1.53 (SD=1.24). Eighty-four percent of users visited once and 96% visited once or twice.

The range in responses for trip duration was from zero nights to 11 days (trips longer than 14 days were discarded). Ninety-two percent of users stayed for either one or two nights. The majority of the remainder filled out a permit for zero nights (2%), likely for their day trip, or stayed for three or four nights (5%). Only one percent stated that they intended to stay for five nights or longer. In a 2010 survey of overall visitor use, respondents indicated spending a greater number of nights in the park relative to backcountry overnight use (Jette et al., 2011). Of overnight users who responded to the 2010 survey, 18% reported five or more nights in the park, 35% indicated two nights, 21% indicated one night, 16% indicated three nights, and 10% indicated four nights. This may indicate that backcountry overnight users spend fewer days in the park than campground users. Alternatively, visitors may be combining backcountry overnight use and campground use during the course of their trips.

Reported group size ranged from one to 32, and the vast majority of backcountry users traveled in groups of four or smaller (91%). The mean group size was 2.5 with a standard deviation of 2.0. The most frequent response was two, which comprised 49% of reported use. Similarly, 52% of respondents reported a group size of two in the 2010 visitor survey, suggesting that group sizes for overnight backcountry users do not greatly differ from overall recreation users (Jette et al., 2011). Mean group sizes are greater during the peak season.

Of the 6,254 reported backcountry trips, only 38 were greater than the wilderness limit (12) and two were greater than the overall limit (25). A disproportionate number of instances of group sizes over 12 originated at the Indian Cove backcountry board, perhaps because there are a large number of group campgrounds at Indian Cove Campground. JOTR management may consider targeting these group campgrounds with informational messaging about the damage posed to park resources by large backcountry groups. However, as these tags specifically capture overnight users, they may not accurately represent areas with the greatest overall visitation pressure including day use.

Spatial Distribution

The majority of backcountry overnight tags were returned at the Keys West backcountry board (28%), followed by Juniper Flats (18%), and Twin Tanks (11%). There did not appear to be any correlation between elevation and temporal distribution of visitor use.

The following locations received the highest density of visits, according to self-reported destinations: Boy Scout Trail, Pine City, Willow Hole, California Riding and Hiking Trail, Lost Palms Oasis, Indian Cove backcountry board, Twin Tanks, Quail Mountain, and North Entrance backcountry board. Park managers may consider prioritizing restoration or efforts to enforce rule compliance in these areas.

Temporal Distribution

The busiest three months, March, April, and November, account for 56% of total use. The three least busy months, June, July, and August, account for only 3.4% of the total use. The majority of visitation took place on the weekends, with Friday and Saturday entry days accounting for 59.85% of the visitation.

A potential takeaway from this is that, in terms of backcountry use, the park's busy season actually extends for eight months (October to May) and only tapers off significantly during the extreme heat of summer. Perhaps a more accurate way to look at the data is to adopt a three-tier pattern of use, with November, March, and April constituting the top tier (busiest months), October, December, January, and May representing the second tier, and June to September representing the bottom tier (least busy months).

This somewhat resembles overall recreation visitation reported in the NPS Integrated Resource Management Applications Portal (IRMA). Like reported backcountry overnight use, the statistics reported in IRMA show that over the same period, the greatest visitation was in March and April and the least visitation occurs in the June through September period (Figure 20). However, November is not one of the largest months for overall visitation in the study period.

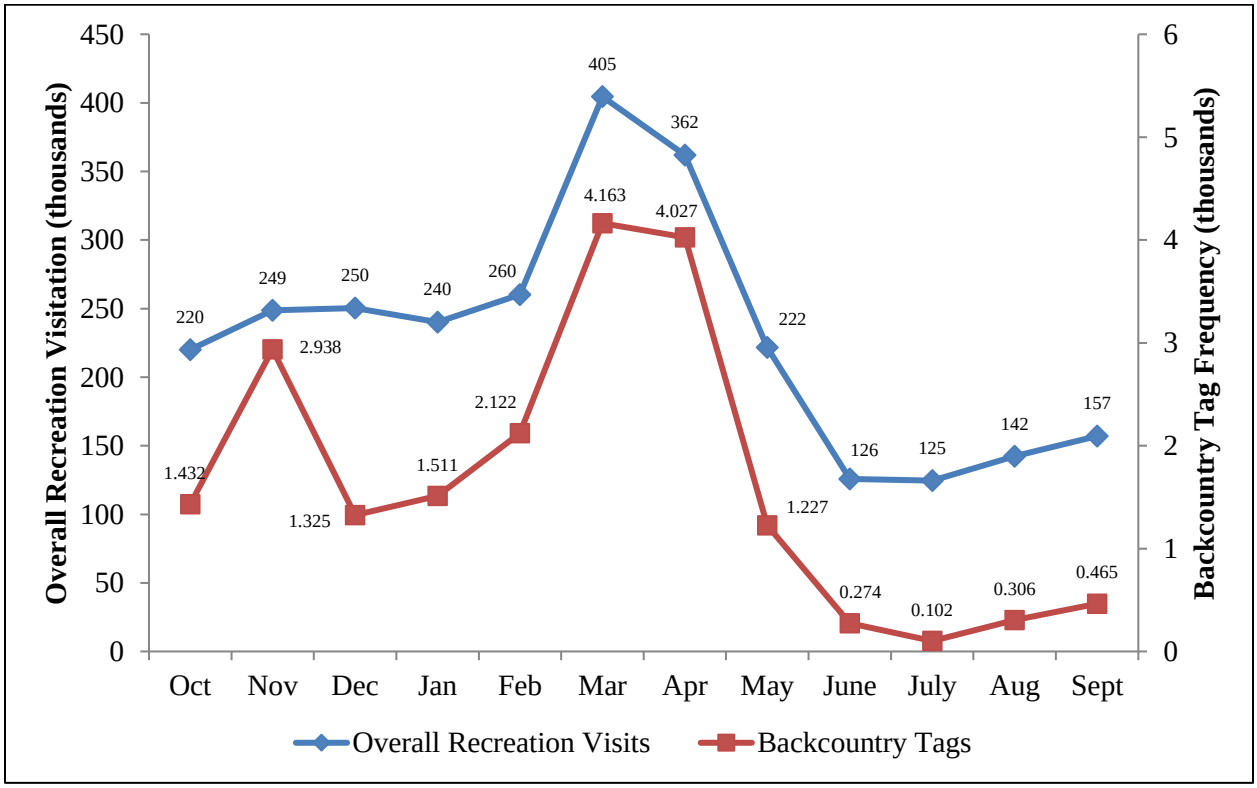

Figure 20. Monthly overall visitation as reported in IRMA and backcountry tag frequency, October 2016 through September 2017 (thousands).

Backcountry tags which indicated trips over ten major U.S. holidays accounted for 19.8% of total returned backcountry tags. Thanksgiving was the most popular holiday weekend for backcountry use accounting for 30.9% of the total backcountry visitation for the month of November.

Considering that the holiday weekend days defined in this report make up 13.1% of the number of days in a year, these holidays see more overnight backcountry use than would be expected if visitation was evenly distributed. However, if one were to consider the then holiday weekends as a percentage of total weekends in a year (10/52 = 19.2%) these holiday weekends do not appear significantly busier than an average weekend.

It was a goal of this study to evaluate whether visitors were camping in the backcountry as an alternative to full campgrounds. Given the available data, it cannot be determined at what rate this is occurring. While overnight backcountry use is more common when campgrounds are full, it cannot be identified whether this is a result of the same drivers for increased overall visitation (e.g. weather, holidays) or a result of campground capacity.

LIMITATIONS

There are several additional analyses that could be done on the project that are not included in this report, but which would improve the analysis. For example, statistical analysis pairing data on nightly backcountry board use with developed campground occupancy could improve understanding of how overnight backcountry use may relate to camping in developed campgrounds. Additionally, a routing analysis might be performed used GIS to identify the distance each backcountry board is from the park's most popular campsites. This might help to identify which backcountry boards are most at risk of being used as overflowing camping and thus help direction where enforcement efforts might be directed.

Additionally, this report does not evaluate the distances visitors travel in the backcountry for a number of reasons. First, it was determined that evaluating destinations was more valuable for management, as distance travelled does not indicate specific areas with a greater volume of visitor use. Second, this analysis would require making assumptions about the routes taken by visitors and, as discussed during the methods section, this would add significantly to the expense associated with this analysis.

This report only evaluates those visitors who returned a registration tag. Therefore, numbers provided here are likely smaller than the true value. Using this data, there is no way to estimate the percentage of visitors using the backcountry without filling out a registration tag. It seems likely that users who arrive late or use the backcountry boards as overflow camping when developed campgrounds are full may be failing to return permits. Future research may use observational methods to approximate return rates, identify non-response bias if any, and apply multipliers to improve the accuracy of this data.

Finally, this project was carried on by one individual working more or less independently, with occasional input from Joshua Tree Division of Science and Resource Stewardship staff. Many decisions regarding data cleaning and analysis were made without necessary input, and it was often unclear which decision would have the best results. This analysis has not undergone peer-review, from which it would no doubt benefit, and these findings should be considered preliminary and used accordingly.

Appendix I

General Process for Analyzing Visitor Demographics in GIS:

(1) Quality Control (QC) entered data. This included:
- (a) Adding states for city names with high likelihood state names (i.e. California for Los Angeles or Oregon for Portland).
- (b) Changing names that appeared likely to be typos (i.e. "Las Angeles" to "Los Angeles")
- (c) Substituting larger city names for local neighborhoods or boroughs. (i.e. Westwood -> Los Angeles, La Jolla -> San Diego)

(2) Acquired high quality database (free) of U.S. cities with geographic coordinates associated with them.

(3) Created an address geolocator using the ArcGIS software.

(4) Removed repeat trips (through use of trip ID field) from the Backcountry Use Dataset.

(5) Created a new column in the database called "Visitors Per City". Wrote a "SUMIF" function using ex

(6) Populated this column using the "SUMIF" function in excel.
- (a) In excel speak: =SUMIF(CityName, CityName for that Row, Number in Party)
- (b) In English: for each cell in the column "visitors per city", excel summed the values for all rows in the "Number in Party" column for which the city name matched the city name given in that specific row.

*Performed steps 5-6 ensured that every entry for each city had the total number of visitors for that city.
**This resulted in the error that we have the same number of visitors from Portland, Maine as we do from Portland, Oregon. This is obviously not very likely to be the case.

(7) Geolocated the dataset.

(8) Performed a join based on city name.

Note: This was my first attempt at making such a database. I know realize that the same thing could have been accomplished without the difficulty of geolocating the cities (steps 2, 3, 7). In the future, the same result should be possible using only the join function. Undoubtedly there are even better ways to accomplish the same end.

For backcountry use analysis, this meant linking up the responses listed in the destination field to geometry (either line or point data) provided to me by the park's GIS specialist. This required extensive coding of the highly variable responses into categories or bins that matched (as much as possible) fields (trail names, place names) provided to me in the attribute table of the available GIS data. An extensive description of code descriptions as well as metrics followed during the coding process can be found in the final database file under the "Destination Coding_Notes" tab. A detailed description of the specific process can be found in the "Coding_Process" tab in the same database. It should be noted that there were several problems inherent in this method. The most notable, in terms of having an influence on the process, is that there are many instances within Joshua Tree National Park where the location and the trail leading to it have the same name (e.g. Lost Palms Oasis, Lost Palms Oasis Trail). This lead to ambiguity at several levels. First, when coding the data, it was often impossible to tell whether the visitor meant the trail or the destination. (Unless specified, I assumed destination). Additionally, unless these were made distinct, it could lead to the incorrect tabulation of results during the table join. To get around this, I made

a list of places and trails that had the same name and added “Trail” to trail features that had the same name as a specific place. This list can be found under the “Coding_Process” tab.

It is likely that I did not find every incidence of a place name and trail name having the same name, although it is likely that all of the common ones have been accounted for. Thus, it is possible that there is still a small amount of extant error in the output shapefiles resulting from this process. Another shortcoming of the method I used – for both the visitor demographics and backcountry use analysis – is that only one record (i.e. row of data) got linked to the geospatial data. Thus, it is impossible to perform multiple layers of analysis with the existing geospatial data. For instance, it is not possible to use the joined data to answer the question of how many people ages 50 and up came from the state of California. This is admittedly a major shortcoming in my methods but I lacked the skill in GIS to perform this analysis any other way.

As of December 2019, data stored at \\INPJOTR5:\Visitor Use Management\Backcountry Registration Data Analysis. If files not found, search server using individual file names.

References

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