



Craters of the Moon National Monument and Preserve Visitor Use Monitoring Project

Report on 2021 Data Collection Effort





ON THIS PAGE

Tree on summit of Inferno Cone, Craters of the Moon National Monument and Preserve
CALEB MEYER

ON THE COVER

Big Crater, Craters of the Moon National Monument and Preserve
CALEB MEYER

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Report on 2021 Data Collection Effort

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Executive Summary

This report summarizes data collected in spring and summer 2021 on visitation levels and visitor flow in the developed area of the monument by personnel at Utah State University with assistance from the staff at CRMO. Data collected include automated vehicle and trail counter data and parking lot observations of use levels, capacities, and turnovers. These data were further analyzed using regression analysis to determine capacities under different visitation scenarios.

Descriptive Observations and Counter Highlights

Robert Limbert Visitor Center Parking Lot

- Based on N=624 paired observations, visitors spent an average of 16 minutes and 35 seconds at the visitor center parking lot.

“Fee Booth” Vehicle Counter

- Visitation was highest in July, with N=482 as a daily average of vehicles passing this counter (placed between the Lava Flow Campground and closed North Crater Flow Boardwalk). A total estimate of N=49,941 vehicles passed this counter between May and August 2021.

North Crater Trailhead Parking Lot and Trail Counter

- Based on N=164 paired observations, visitors spent an average of 26 minutes and 41 seconds at the North Crater Lot.
- Visitation to the North Crater Trail was highest in May with N=129 average visitors daily. A total estimate of N=10,950 visitors used this trail between May and October 2021.

Devils Orchard Parking Lot, Vehicle Counter, and Trail Counter

- Based on N=423 paired observations, visitors spent an average of 24 minutes and 27 seconds at Devils Orchard.
- Vehicle traffic was highest in July with an average of N=255 vehicles daily. A total estimate of N=32,421 vehicles visited Devils Orchard from June to October.
- Trail traffic at Devils Orchard was highest in May with an average of N=451 visitors daily. A total estimate of N=61,671 visitors used the Devils Orchard Trail between May and October.

One-Way Loop Road Vehicle Counters

- Visitation on the One-Way Loop Road was highest in July with a daily average of N=433 vehicles. A total estimate of N=50,217 vehicles used the One-Way Loop from June-October 2021 based on data from the counter placed at the beginning of the loop.

Inferno Cone Parking Lot

- Based on N=237 paired observations, visitors spent an average of 23 minutes and 56 seconds at Inferno Cone.
- Most visitor groups (N=192; 81.01%) hiked at Inferno Cone based on technician observations.

Spatter/Snow Cone Parking Lot

- Based on N=465 paired observations, visitors spent an average of 15 minutes and 33 seconds at Spatter/Snow Cone.

Tree Molds/Wilderness Trailhead Parking Lot, Broken Top Trail, Tree Molds Trail, and Wilderness Trail

- Based on N=235 paired observations, visitors spent an average of 36 minutes and 29 seconds at the Tree Molds/Wilderness Trailhead area.
- Visitation to Tree Molds Trail was highest in June with N=52 visitors daily on average. A total estimate of N=6,861 visitors used the Tree Molds Trail between May and October.
- Visitation to the Broken Top Trail was highest in May with N=65 visitors daily on average. A total estimate of N=7,563 visitors used the Broken Top Trail between May and October.
- Visitation to the Wilderness Trail was highest in May with N=13 daily visitors on average. A total estimate of N=1,243 visitors used the Wilderness Trail between May and October.

Caves Area Parking Lot and Trail Counter

- Based on N=187 paired observations, visitors spent an average of 57 minutes and 56 seconds at the Caves.
- A trail counter collected data on the main Caves trail for 10 days in June but was stolen multiple times resulting in a substantial data gap for this study at the Caves. Based on that limited data, an average of N=540 visitors used the Caves area daily for a total estimate of N=16,200 visitors in June.

Systemic Relationships Between Areas in CRMO Summary Tables

The following table summarizes capacities in areas of CRMO under different conditions. Parking lot conditions at CRMO are generally stable under current visitation. Inferno Cone is the only area which regularly eclipses capacity and should receive further effort to understand visitation patterns and identify strategies to deal with congestion.

Location of parking lot	Number of total parking spot	Functional parking capacity	Estimated conditions that maximize functional parking capacity	Current condition averages
Visitor Center	29	25	325 vehicles on highway per hour	Hourly averages for all times = 85 vehicles per hour; Peak use at 2pm=203 vehicles per hour

North Crater	17	14	248 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Devils Orchard	31	26	96 vehicles entering the Devils Orchard area via the spur road per hour	Hourly averages for all times = 9 vehicles per hour; Peak use average at 12pm = 32 vehicles per hour
Inferno Cone	16	14	66 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Spatter/Snow Cone	28	24	125 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Tree Molds/Wilderness Trail	25	21	195 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Caves	61	52	165 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour

Other Highlights and Recommendations

- It was rare for technicians to see full parking lot conditions, except at Inferno Cone where conditions were perceived as full in 16.5% (N=14) of 30-minute lot observations, and on average conditions eclipsed total capacity around 11:00 AM with capacity being reached in rapid fluctuations throughout afternoons.

- Continued efforts are recommended to understand visitor use in CRMO through survey data, establishment of thresholds, and filling in key data gaps such as at the Caves area, where only very limited visitation data was collected in 2021.
- The park is generally not exceeding the capacity of the existing infrastructure and there appears to be room to absorb additional visitation. Park managers are also encouraged to do some follow up trail and parking lot monitoring in the coming season to test the capacity calculations offered in this report. If they prove to work well, a monitoring plan could be designed that uses the regression approach most years with a more detailed set of observations every 3-5 years unless visitation or conditions change for some reason.

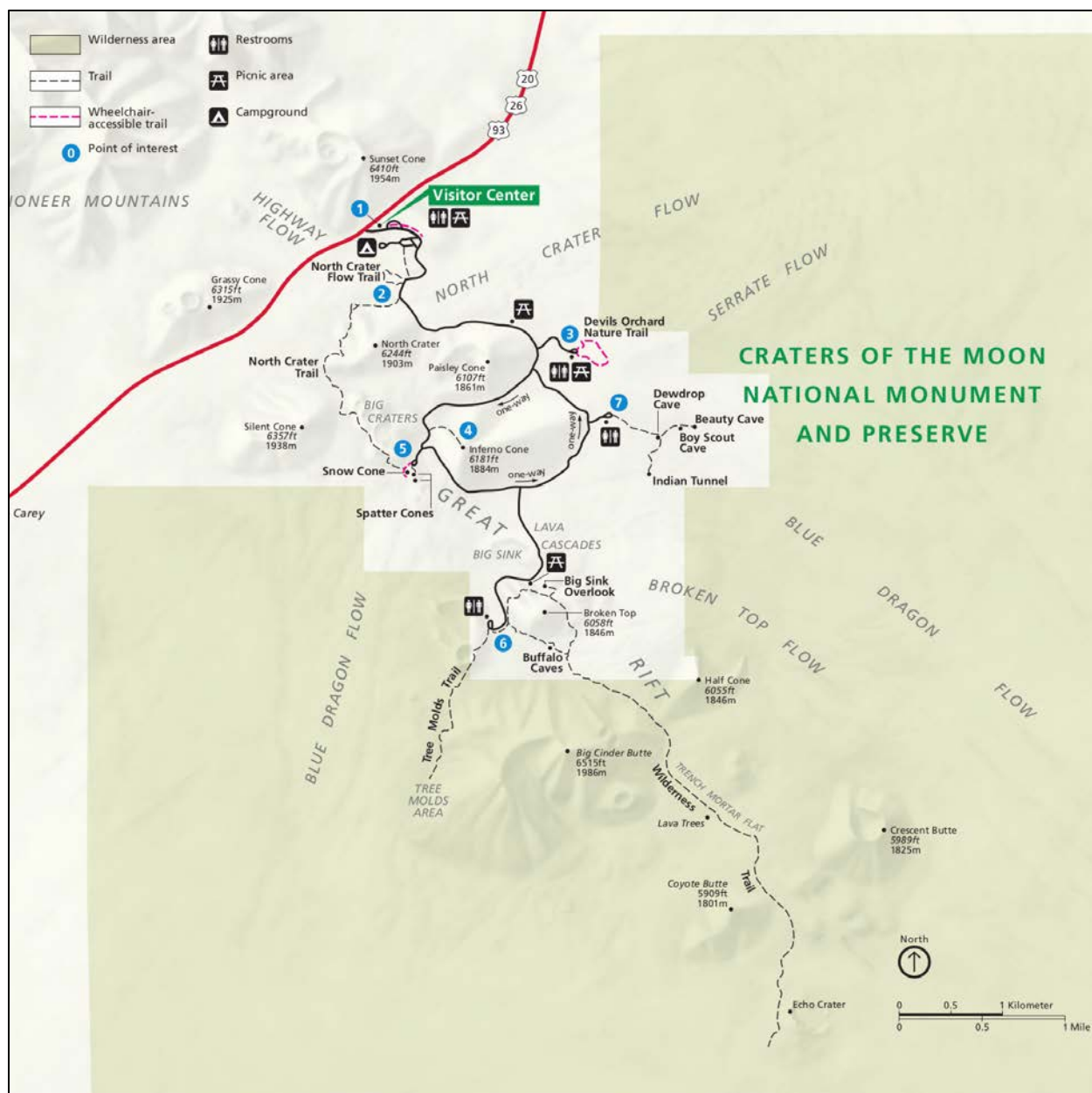


Figure 1. Craters of the Moon Visitor Map (NATIONAL PARK SERVICE).

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And immeasurably grateful to the wasps, wind, and wild rocks of Southern Idaho.

List of Terms, Small Glossary, Acronyms, or Contacts

CRMO – Craters of the Moon National Monument and Preserve

NPS – National Park Service

PPA – parks and protected areas

Introduction

Craters of the Moon National Monument and Preserve (CRMO) received an estimated 272,000 recreation visits in 2019 (NPS Visitor Use Statistics 2019). This is aligned with the upward trend in visitation that has been observed agency-wide in the National Park Service (NPS). While not so drastic at CRMO as in large national park units, this increase in visitation further highlights the necessity of understanding and managing shift in use in a proactive manner. Understanding how much use is occurring and how visitation flows throughout developed recreation areas like the frontcountry of CRMO are essential steps in purposeful visitor use management.

Craters of the Moon National Monument and Preserve encompasses a vast lava flow created over 15,000 years on the Great Rift of Idaho. This rugged volcanic landscape is habitat for a diversity of plants and animals among unique geologic features. The Craters of the Moon lava field is the largest of its kind in the Continental United States. This high desert landscape is pockmarked with lava tubes, cinder cones, and tree molds. Human habitation of the area dates at least beyond 14,000 years ago by ancestors of today's Shoshone and Bannock Tribes, and perhaps others. It is likely these peoples witnessed volcanic eruptions along the Great Rift of Idaho forming the landscapes which draw human witnesses to this day.

Today, the primary developed area of CRMO is accessed by Highway 20/26/93 between the towns of Arco and Carey, Idaho and provides access to numerous lava tubes, cinder cones, flows, and craters. The Robert Limbert Visitor Center is accessed immediately from the highway and orients visitors before they pass beyond the entrance gate into the monument. The Lava Flow Campground provides developed overnight accommodations, and a self-guided tour takes visitors to roadside or short-hike accessible sites like Inferno Cone, the Spatter Cones, the North Crater Flow, Devils Orchard, and the primary Caves area. Longer hikes can take visitors to the Big Craters or the Tree Molds and the Wilderness Trail, which is maintained for only several miles, provides visitors access to the vast Craters of the Moon Wilderness beyond Echo Crater and the Sentinel Butte.

This report summarized use data collected in 2021 including trail and vehicle counter data from May to October and parking lot observation data collected in May, June, and July alongside syntheses of these data streams to inform management. Parking lot observations occurred at all parking lots accessing developed areas of the park open during the 2021 season (the North Crater Flow boardwalk was closed during 2021). Vehicle and trail counters were placed throughout the monument to gauge use levels. This preliminary study was intended to provide understanding into use levels and visitor flow. These data will inform future visitor use research and management in CRMO.

Methods

Study Area

This data collection effort focused on the developed frontcountry areas of CRMO. Parking lot counts occurred at the Visitor Center, North Crater Trailhead lot, Devils Orchard, Inferno Cone, Spatter Cones, Tree Molds/Wilderness Trail lot and the Caves lot. Vehicle counters were placed beyond the Lava Flow Campground, on the Devils Orchard spur road, and on either end of the one-way loop which accesses several heavily visited areas of the park. Trail counters were placed on North Crater Trail (north end), on Tree Molds Trail, Wilderness Trail, Broken Top Trail, and Devils Orchard Trail. Two trail counters were placed in the Caves area but were removed by visitors. Counter data collection in that area was largely unsuccessful. Additional data to inform syntheses were provided by the Idaho Department of Transportation which maintains a vehicle counter along Highway 20/26/93.

Parking Lot Counts

Parking lot observations occurred in May, June, and July 2021. Technicians began observations on May 27 and halted observations on June 8. A second observation period began on July 13 and ended on July 20 for a total 18 sampling days (Appendix D). This schedule was designed to equally capture all parking lots accounting for use levels and recorded pairings to determine average time spent at sites. Technicians recorded when vehicles arrived in the lot focusing on collecting as many observations as possible and on ensuring capture of departures (Appendix A). Technicians recorded lot location, vehicle type, state and last three license plate digits (for pairing), number of people in the vehicle, whether kids were present, group was multi-vehicle, and whether group hiked (at Inferno Cone only). When vehicles departed, technicians used a second form to record state and last three license plate digits again, and the parking lot location (Appendix B). This ensured data could be paired for analysis. Every 30-minutes, technicians also recorded parking lot capacity on a third form (Appendix C) which captured parking lot location, time, perception of whether the lot was full (based on available parking spots), number of vehicles, vehicle types (private vehicles, RVs, NPS vehicles, research vehicles, etc.), how many vehicles had Idaho license plates, and how many vehicles were parked in undesignated spots (on pavement), in illegal spots (off pavement), and hovering waiting for a spot.

Trail and Vehicle Counters

TRAFx infrared trail and magnetic vehicle counters were placed to determine visitor flow and use levels. Counters were placed and calibrated according to best practices later compiled by Meyer and Rempel (2022). Calibration occurred in five-hour manual calibration blocks. All counters were calibrated for 5 to 10 hours to ensure accurate correction factors. After counter placement, all were checked biweekly by Utah State University technicians when available and CRMO personnel to collect data and check for battery level and tampering. All counters except for at the Caves remained in service for most of the season between May and October. Some data gaps occurred due to factors like wind, weather, and possible tampering which is normal in operating TRAFx counters. Counters were removed from the Caves by visitors on multiple occasions and later returned, but significant data loss occurred at that site.

Analyses

Parking lot observation data was merged, indexed, and analyzed using IBM SPSS and Microsoft Excel. Trail and vehicle counter data was analyzed using TRAFx DataNet and merged with observation data and Idaho Department of Transportation data using Microsoft Excel and analyzed using IBM SPSS.

Results

Paired Vehicle Observations and Descriptive Recreation Counter Data

Sample

Parking lot observations occurred in May, June, and July 2021. Merging, indexing, removing unpaired data and outliers resulted in an overall sample of 2,335 paired arrival-departure observations.

Robert Limbert Visitor Center Lot Observations

The Robert Limbert Visitor Center is the first site many visitors arrive at in CRMO. It lies outside the park fee area and is easily accessed from Highway 20. A total of N=624 paired observations were taken of arrivals and departures at the visitor center. Tables below summarize these results.

Visitors spent an average of 16 minutes and 35 seconds at the Robert Limbert Visitor Center in CRMO. The minimum was 2 minutes, and the maximum was 3 hours, 47 minutes, and 30 seconds (Table 1).

Table 1. Duration of visits at the Visitor Center

<i>Time Spent at Site</i>	
Mean	0:16:35
Median	0:12:17
Standard Deviation	0.011982
Minimum	0:02:00
Maximum	3:47:30
Count	624

A vast majority (N=608; 97.6%) of paired observations at the Visitor Center were of personal cars, trucks, or SUVs (Table 2). A majority (N=467; 74.84%) of visitors did not have children with them and most (N=607; 97.28%) were not part of multi-vehicle groups.

Table 2. Frequency data for Visitor Center Observations

<i>Vehicle Type</i>	<i>Frequency</i>	<i>Percent</i>
Personal car, truck, or SUV	609	97.60%
Motorcycle	13	2.08%
RV or motorhome	2	0.32%
Personal vehicle towing trailer	0	0.00%
<i>Kids</i>		
No	467	74.84%
Yes	157	25.16%

<i>Multi-Vehicle Group</i>		
No	607	97.28%
Yes	17	2.72%

The average number of people observed per group at the Visitor Center was 2.56 (Table 3). The minimum was 1 and the maximum was 12.

Table 3. Group size at the Visitor Center.

<i>Number of People in Groups</i>	
Mean	2.56
Median	2
Standard Deviation	1.477513
Minimum	1
Maximum	12
Count	624

Fee Booth Vehicle Counter Data

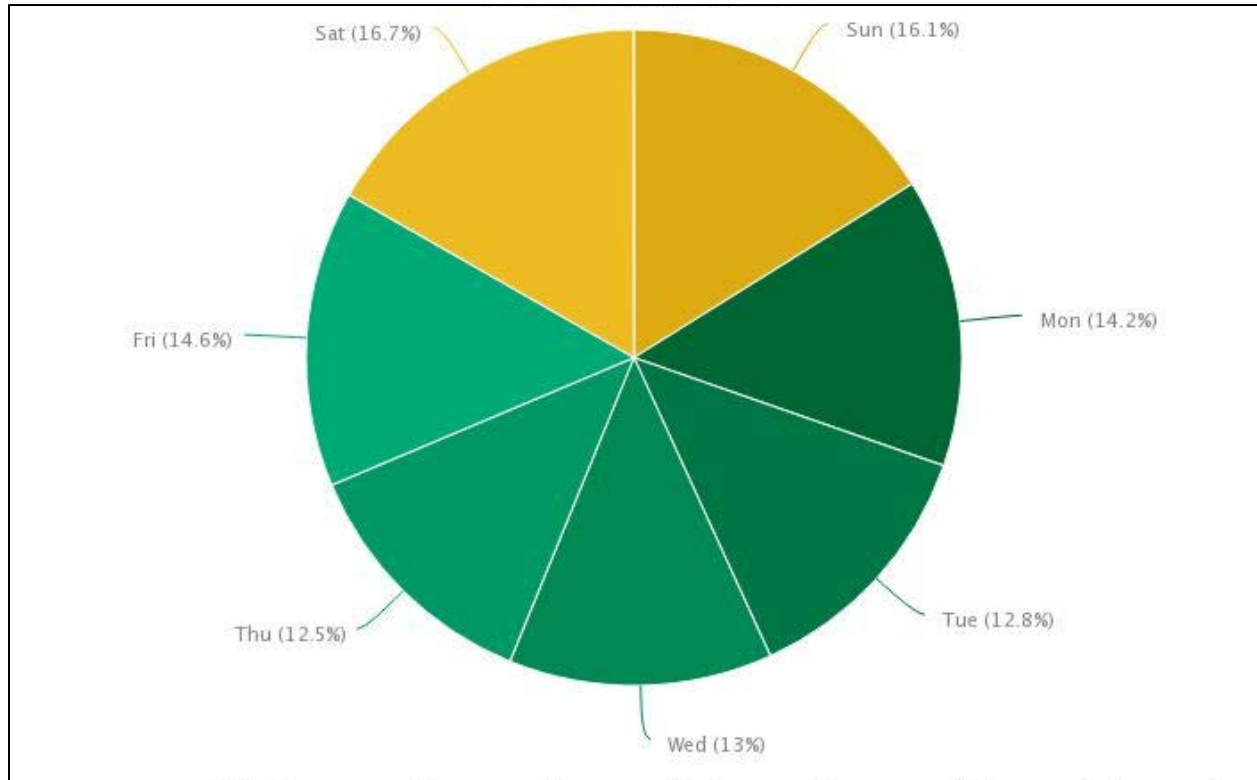
The trail counter nicknamed “Fee Booth” to capture use into CRMO beyond the initial visitor facilities was placed at the bend in the road beyond the Lava Flow Campground and before the grade climbs to the closed North Crater Flow Trail (43.459401, -113.557228). Following calibration, a correction factor of 0.881 was added to this counter. A substantial data gap occurred in the later season due to incorrect launching of the counter (Table 4).

Table 4. Summary of Fee Booth Vehicle Counter

Month	Number of days monitored	Daily average	Number of days	Total estimate
May	7	310	31	9,597
June	18	431	30	12,928
July	31	482	31	14,935
August	29	403	31	12,481
Total	85	430	123	49,941

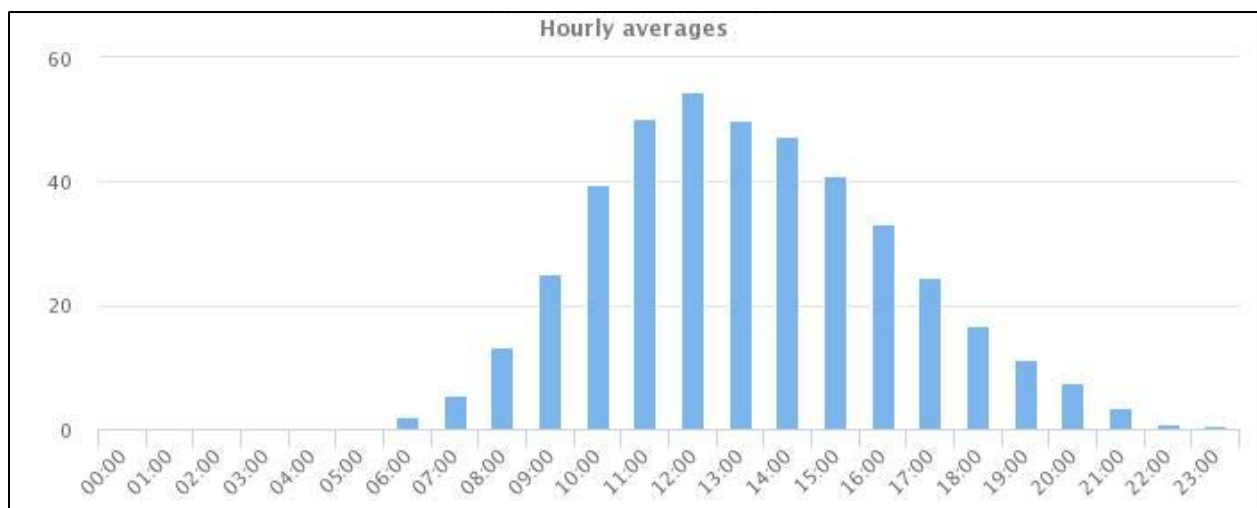
Breakdown of use by day of the week is illustrated in Figure 2. Weekend use accounted for the highest proportion of use with 16.7% of traffic through the Fee Booth occurring on Saturdays.

Figure 2. Use levels by day at the Fee Booth.



Traffic passed the Fee Booth picked up around 10:00 AM, peaked around 12:00 PM, and began tapering off substantially around 4:00 PM (Figure 3).

Figure 3. Hourly traffic at Fee Booth.



North Crater Lot Observations

The North Crater Trailhead parking lot lies passed the Lava Flow Campground (Figure 1) and before Devils Garden turnoff or the one-way loop road. It lies just after the North Crater Flow Parking Area which was closed for construction during the 2021 season. It accesses the 1.8-mile North Crater Trail, which terminates at Spatter/Snow Cone parking lot. A total of N=164 observations were made at the North Crater Trailhead parking lot.

Visitors to the North Crater Trailhead parking lot spend an average of 26 minutes and 41 seconds in the lot (Table 5). The minimum was 2 minutes and 1 second and the maximum was 3 hours, 51 minutes, and 5 seconds.

Table 5. Duration of visits at North Crater.

<i>Time Spent at Site</i>	
Mean	0:26:41
Median	0:08:22
Standard Deviation	0.0276737
Minimum	0:02:01
Maximum	3:51:05
Count	164

A majority (N=153; 93.29%) of visitors to the North Crater Trailhead parking area were in personal cars, trucks, or SUVs (Table 5). Most (N=125; 76.22%) did not have children with them and most (N=158; 96.34%) were not part of a multi-vehicle group (Table 6).

Table 6. Frequency data for North Crater.

<i>Vehicle Type</i>	<i>Frequency</i>	<i>Percent</i>
Personal car, truck, or SUV	153	93.29%
Motorcycle	1	0.61%
RV or motorhome	8	4.88%
Personal vehicle towing trailer	2	1.22%
<i>Kids</i>		
No	125	76.22%
Yes	39	23.78%
<i>Multi-Vehicle Group</i>		
No	158	96.34%
Yes	6	3.66%

The average number of people observed per group at the North Crater Trailhead was 2.31 (Table 7). The minimum was 1 person, and the maximum was 6 people.

Table 7. Group size at North Crater.

<i>Number of People in Groups</i>	
Mean	2.31
Median	2
Standard Deviation	1.059981
Minimum	1
Maximum	6
Count	164

North Crater Trail Counter Data

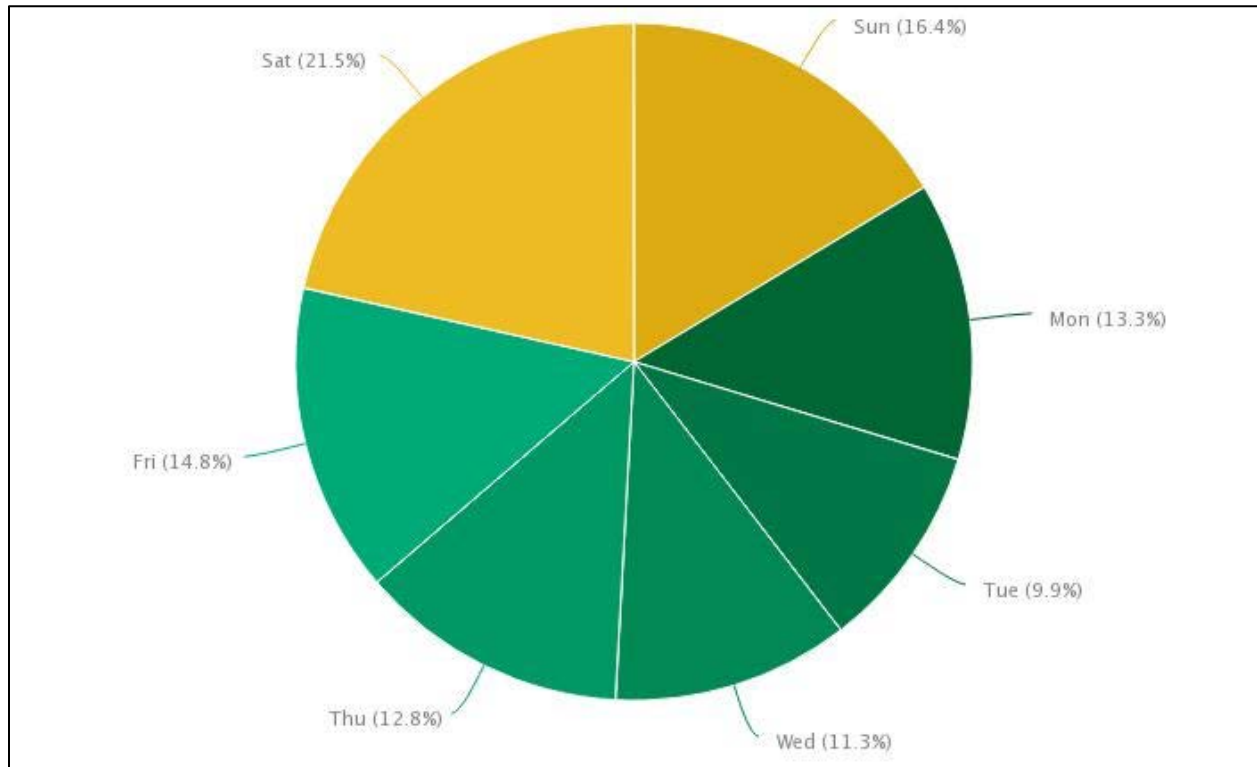
A TRAFx infrared trail counter was placed on the North Crater Trail beyond the initial climb (43.453401, -113.565167) to ensure only hikers “committed” to accessing the North Crater Flow or Big Craters were counted (Table 8). Following calibration, an adjustment factor of 1.152 was added to this counter. The counter was mounted to a tree and disguised with branches and rocks. It is worth noting that May data was collected over Memorial Day Weekend in 2021 and TRAFx DataNet extrapolated estimate monthly counts. These data may not reflect actual counts during that month.

Table 8. Summary of North Crater Trail Counter

Month	Number of days monitored	Daily average	Number of days	Total estimate
May	5	129	31	3,987
June	18	60	30	1,792
July	31	52	31	1,617
August	31	52	31	1,614
September	30	39	30	1,173
October	12	25	31	767
Total	127	51	184	10,950

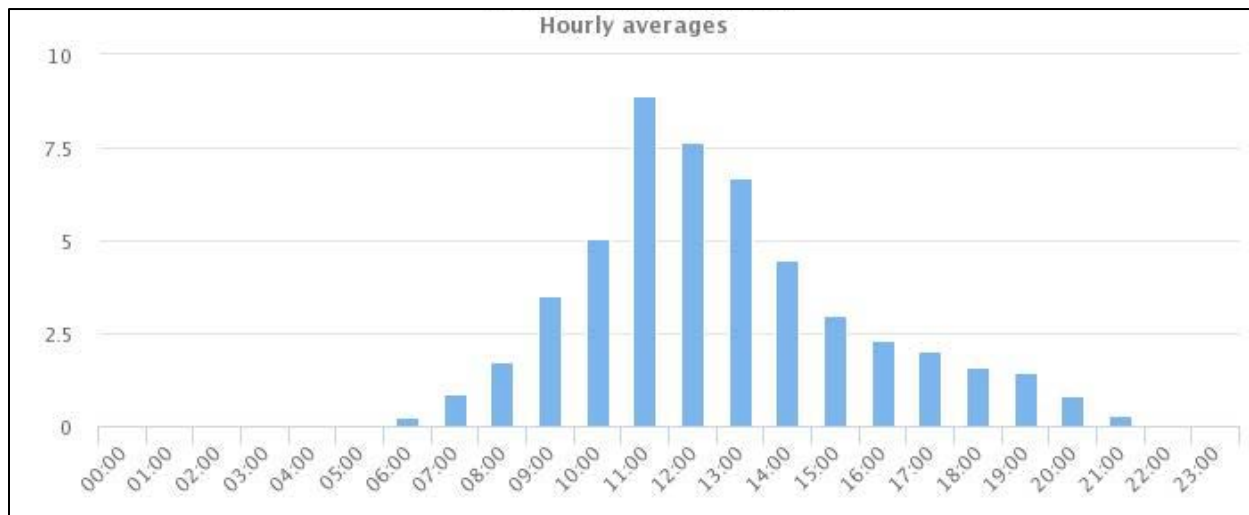
Daily findings are graphically displayed in Figure 4 below. Weekend days see higher use at North Crater Trail with Saturdays accounting for 21.5% of use.

Figure 4: Use by day at North Crater Trail



Hourly findings show use picks up around 10:00 AM, peaks around 11:00 AM, and decreases substantially after 2:00 PM (Figure 5).

Figure 5. Hourly averages at North Crater Trail.



Devils Orchard Lot Observations

Devils Orchard is accessed off a spur road prior to accessing the one-way loop road. It contains a large parking lot, picnic area, and a 0.5-mile paved nature trail. A total of N=423 paired observations were made at Devils Orchard.

Devils Orchard visitors spent an average of 24 minutes and 27 seconds in the area (Table 9). The minimum time spent was 2 minutes and 1 second and the maximum time spent was 3 hours, 2 minutes, and 18 seconds.

Table 9. Duration of visits at Devils Orchard.

<i>Time Spent at Site</i>	
Mean	0:24:27
Median	0:22:42
Standard Deviation	0.0106646
Minimum	0:02:01
Maximum	3:02:18
Count	423

A majority (N=388; 91.73%) of visitors to Devils Orchard were in personal cars, trucks, or SUVs (Table 8). N=27 (6.38%) arrived in RVs or motorhomes. Most (N=314; 74.23%) did not have children with them and most (N=405; 95.74%) were not part of a multi-vehicle group (Table 10).

Table 10. Frequency data for Devils Orchard.

<i>Vehicle Type</i>	<i>Frequency</i>	<i>Percent</i>
Personal car, truck, or SUV	388	91.73%
Motorcycle	4	0.95%
RV or motorhome	27	6.38%
Personal vehicle towing trailer	4	0.95%
<i>Kids</i>		
No	314	74.23%
Yes	109	25.77%
<i>Multi-Vehicle Group</i>		
No	405	95.74%
Yes	18	4.26%

Visitors to Devils Orchard had an average group size of 2.58 people (Table 11). The minimum group size was 1 person. The maximum group size was 10 people.

Table 11. Group size at Devils Orchard.

<i>Number of People in Groups</i>	
Mean	2.58
Median	2
Standard Deviation	1.2795661
Minimum	1
Maximum	10
Count	423

Devils Orchard Vehicle Counter Data

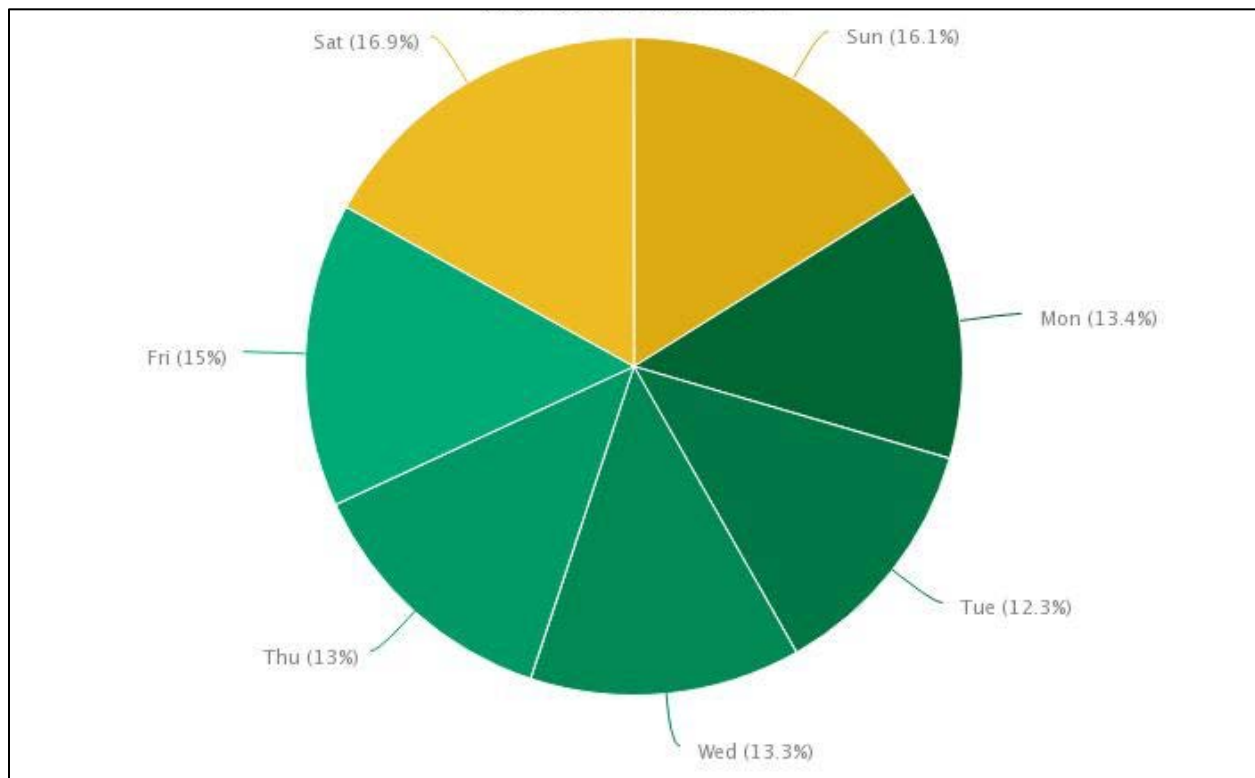
The Devils Orchard magnetic vehicle counter was placed on the spur road, in sight of the parking lot (43.451771, -113.540138) (Table 12). Following calibration, an adjustment factor of 1.011 was added to this counter. This counter was hidden in a pile of rocks and stored inside a zip lock bag and a plastic container.

Table 12. Summary of Devils Orchard Vehicle Counter

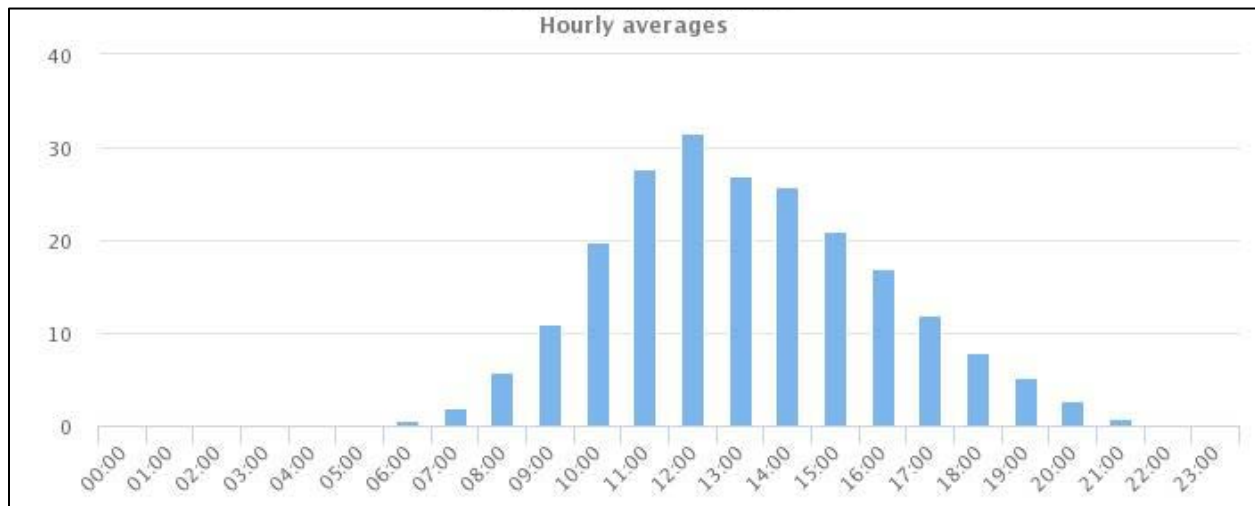
Month	Number of days monitored	Daily average	Number of days	Total estimate
June	18	237	30	7,115
July	31	255	31	7,904
August	31	216	31	6,708
September	30	211	30	6,315
October	12	141	31	4,379
Total	122	220	153	32,421

Weekly visitation patterns are broken down in Figure 6. Weekend visitation at Devils Orchard was higher than weekday traffic, with Saturdays accounting for 16.9% of use.

Figure 6. Vehicle traffic by day at Devils Orchard.



Vehicle traffic at Devils Orchard picks up around 10:00 AM, peaks around 12:00 PM, and tapers off around 4:00 PM (Figure 7)Figure 7. Hourly vehicle traffic at Devils Orchard.



Devils Orchard Trail Counter Data

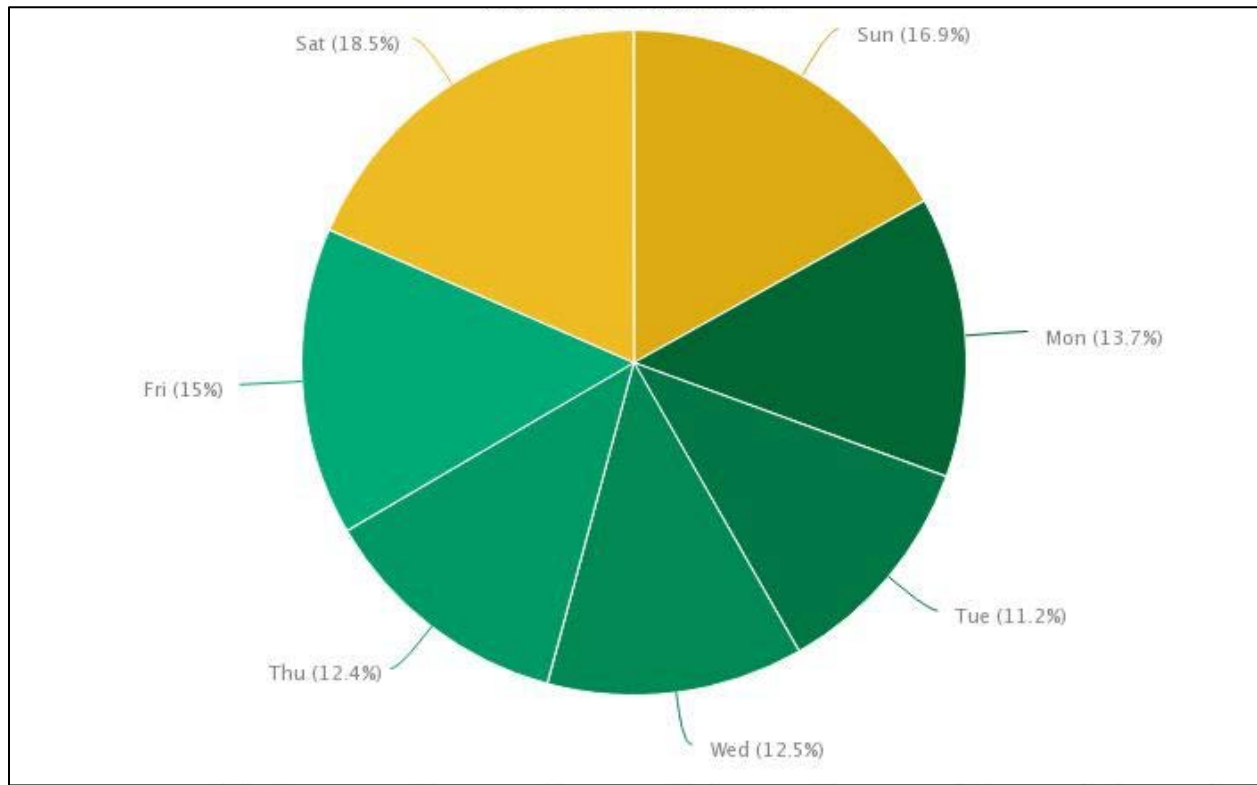
The Devils Orchard infrared trail counter was placed on the southern end of the 0.5-mile loop trail (43.450245, -113.53805) (Table 13). It was hidden in a low hanging tree branch and disguised with other foliage. Following calibration, a correction factor of 1.121 was added to this counter. It is worth noting that May data was collected over Memorial Day Weekend in 2021 and TRAFx DataNet extrapolated estimate monthly counts. These data may not reflect actual counts during that month.

Table 13. Summary of Devils Orchard trail counter.

Month	Number of days monitored	Daily average	Number of days	Total estimate
May	7	451	31	13,972
June	18	369	30	11,082
July	31	368	31	11,410
August	31	323	31	10,001
September	30	298	30	8,934
October	12	202	31	6,272
Total	129	330	184	61,671

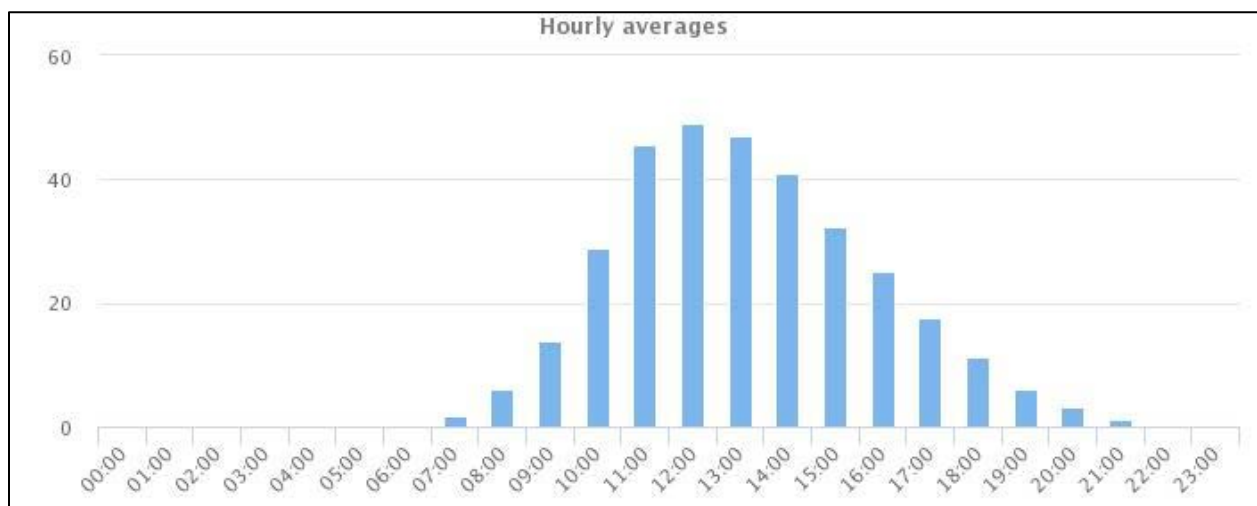
A breakdown of weekly visitation at the Devils Orchard Trail is shown in Figure 8. More trail use occurred on the weekends with Saturdays accounting for 18.5% of trail use at Devils Orchard.

Figure 8. Weekly breakdown of trail use at Devils Orchard.



Visitation to the Devils Orchard Trail picked up around 10:00 AM, peaked around 12:00 PM and tapered off around 2:00 PM (Figure 9).

Figure 9. Hourly trail use at Devils Orchard.



One-Way Loop Start Vehicle Counter

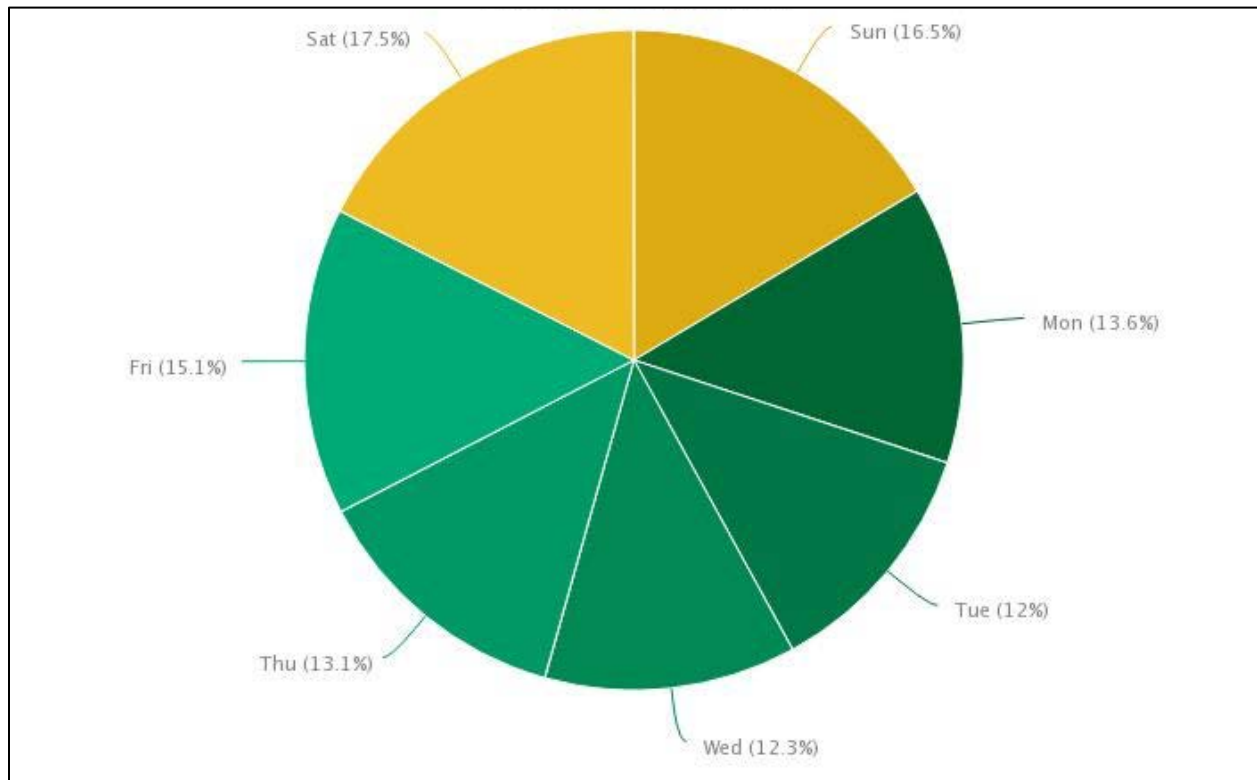
A magnetic vehicle counter was placed at the beginning of the one-way loop road beyond the turn-off for Devils Orchard (43.447004, -113.552769) (Table 14). The counter was placed in a zip lock bag and plastic container and disguised with rocks and vegetation. Following calibration, a correction factor of 0.986 was added to this counter. A substantial data gap occurred in August due to an incorrect launch and tampering by park visitors.

Table 14. Summary of One-Way Loop Vehicle Counter.

Month	Number of days monitored	Daily average	Number of days	Total estimate
June	18	386	30	11,572
July	30	433	31	13,426
August	12	304	31	9,432
September	30	312	30	9,358
October	12	207	31	6,430
Total	102	347	153	50,217

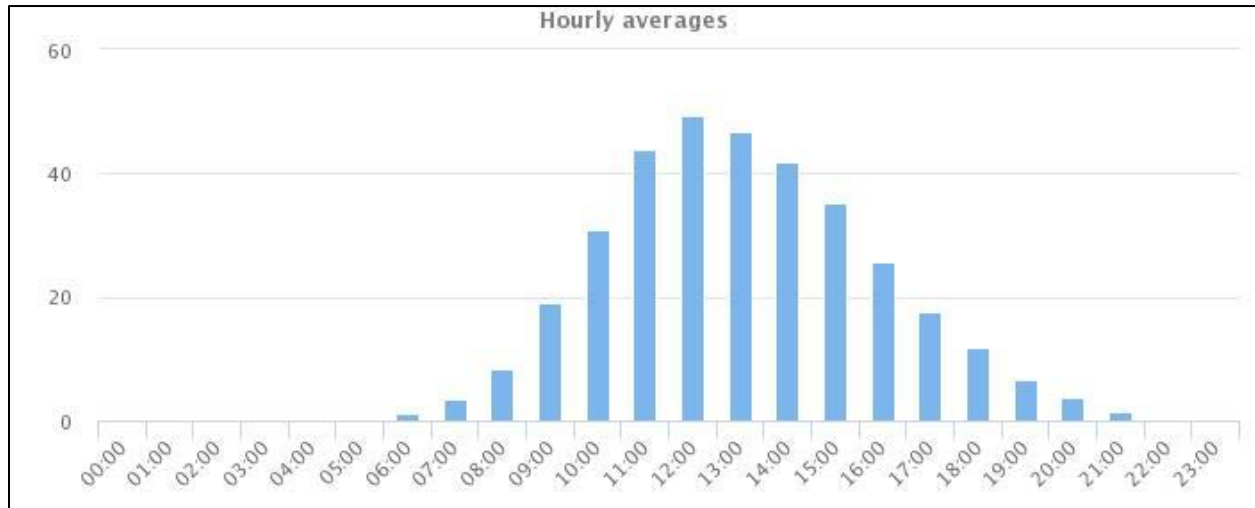
A breakdown by day of the week of vehicle traffic at the One-Way Start counter is summarized in Figure 10 below. Weekend use accounted for the largest proportion of traffic and Saturdays alone accounted for 17.5%

Figure 10. Weekly breakdown of vehicle traffic at the One-Way Start counter.



Traffic at the One-Way Start counter picked up around 10:00 AM, peaked around 12:00 PM, and tapered off around 4:00 PM (Figure 11).

Figure 11. Hourly breakdown of vehicle traffic at the One-Way Start counter.



Inferno Cone Lot Observations

This site contains a small parking area and a short (0.4-miles), but steep trail to the summit of Inferno Cone (6,181'), a cinder cone with sweeping views of the park. A total of N=237 paired observations were made at Inferno Cone.

Visitors to Inferno Cone spent an average of 23 minutes and 56 seconds in the area (Table 15). The minimum spent was 2 minutes and 17 seconds and the maximum was 1 hour, 9 minutes, and 44 seconds.

Table 15. Duration of visits at Inferno Cone.

<i>Time Spent at Site</i>	
Mean	0:23:56
Median	0:24:27
Standard Deviation	0.0078563
Minimum	0:02:17
Maximum	1:09:44
Count	237

The majority (N=215; 90.72%) of visitors to Inferno Cone arrived in personal cars, trucks, or SUVs (Table 16). Most did not have kids (N=183; 77.22%) nor were they part of multi-vehicle groups (N=230; 97.05%).

Table 16. Frequency Data for Inferno Cone.

<i>Vehicle Type</i>	<i>Frequency</i>	<i>Percent</i>
Personal car, truck, or SUV	215	90.72%
Motorcycle	0	0.00%
RV or motorhome	15	6.33%
Personal vehicle towing trailer	7	2.95%
<i>Kids</i>		
No	183	77.22%
Yes	54	22.78%
<i>Multi-Vehicle Group</i>		
No	230	97.05%
Yes	7	2.95%

The average group size at Inferno Cone was 2.49 people (Table 17). The minimum was 1 and the maximum was 6.

Table 17. Group size at Inferno Cone.

<i>Number of People in Groups</i>	
Mean	2.49
Median	2
Standard Deviation	1.1409153
Minimum	1
Maximum	6
Count	237

Due to the terrain on the Inferno Cone trail being incompatible with a TRAFx infrared trail counter dissimilar to other trails in CRMO which were monitored as such, researchers also recorded if groups hiked at Inferno Cone or not. A majority (N=192; 81.01%) of visitors hiked to the summit of Inferno Cone (Table 18).

Table 18. Did people hike at Inferno Cone.

<i>Did Group Hike</i>		
No	45	18.99%
Yes	192	81.01%

Spatter/Snow Cone Lot Observations

Spatter/Snow Cone is a developed area with a large, RV accessible parking lot, a short, paved trail to view volcanic features, and the southern terminus of the 1.8-mile North Crater Trail (which originates at the North Crater parking lot). Visitors to Spatter/Snow Cone spent an average of 15 minutes and 33 seconds in the area (Table 19). The minimum time spent was 2 minutes and 9 seconds and the maximum was 2 hours, 6 minutes, and 20 seconds.

Table 19. Duration of visits at Spatter/Snow Cone.

<i>Time Spent at Site</i>	
Mean	0:15:33
Median	0:12:50
Standard Deviation	0.0076605
Minimum	0:02:09
Maximum	2:06:20
Count	465

The majority (N=412; 88.6%) of visitors to Spatter/Snow Cone arrived in a personal car, truck, or SUV (Table 15). N=36 (7.74%) arrived in a RV or motorhome. Most groups (N=347; 74.62%) did not have kids with them and most (N=447; 96.13%) were not part of multi-vehicle groups (Table 20).

Table 20. Frequency data for Spatter/Snow Cone.

<i>Vehicle Type</i>	<i>Frequency</i>	<i>Percent</i>
Personal car, truck, or SUV	412	88.60%
Motorcycle	4	0.86%
RV or motorhome	36	7.74%
Personal vehicle towing trailer	13	2.80%
<i>Kids</i>		
No	347	74.62%
Yes	118	25.38%
<i>Multi-Vehicle Group</i>		
No	447	96.13%
Yes	18	3.87%

Average group size at Spatter/Snow Cone was 2.54 (Table 21). The minimum was 1 and the maximum was 12.

Table 21. Group size at Spatter/Snow Cone

<i>Number of People in Groups</i>	
Mean	2.54
Median	2
Standard Deviation	1.2567504
Minimum	1
Maximum	12
Count	465

Tree Molds/Wilderness Trail Lot Observations

Tree Moles/Wilderness Trail area lies off a spur road from the CRMO one-way loop and provides access to a subsystem within the park. This site/parking lot accesses the Tree Molds Trail, and Broken Top Loop Trail, and the Wilderness Trail (which further accesses the vast and diffuse Craters of the Moon Wilderness Area). A total of N=235 paired observations were made at Site 6.

Visitors spent an average of 36 minutes and 29 seconds in the Tree Molds/Wilderness Trail area (Table 22). The minimum time spent was 2 minutes and 6 seconds and the maximum was 2 hours, 42 minutes, and 14 seconds.

Table 22. Duration of visits at Tree Molds/Wilderness Trail.

<i>Time Spent at Site</i>	
Mean	0:36:29
Median	0:24:02
Standard Deviation	0.0253755
Minimum	0:02:06
Maximum	2:42:14
Count	235

The majority (N=212; 90.21%) of visitors to Tree Molds/Wilderness Trail arrived in a personal car, truck, or SUV (Table 23). N=15 (6.38%) arrived in a RV or motorhome. Most groups (N=179; 76.17%) did not have kids with them and were not part of a multi-vehicle group (N=227; 96.60%).

Table 23. Frequency data for Tree Molds/Wilderness Trail.

<i>Vehicle Type</i>	<i>Frequency</i>	<i>Percent</i>
Personal car, truck, or SUV	212	90.21%
Motorcycle	4	1.70%
RV or motorhome	15	6.38%
Personal vehicle towing trailer	4	1.70%
<i>Kids</i>		
No	179	76.17%
Yes	56	23.83%
<i>Multi-Vehicle Group</i>		
No	227	96.60%
Yes	8	3.40%

The mean group size at Tree Molds/Wilderness Trail was 2.36 people (Table 24). The minimum was 1 and the maximum was 6.

Table 24. Group size at Tree Molds/Wilderness Trail.

<i>Number of People in Groups</i>	
Mean	2.36
Median	2
Standard Deviation	1.1251881
Minimum	1
Maximum	6
Count	235

Tree Molds Trail Counter Data

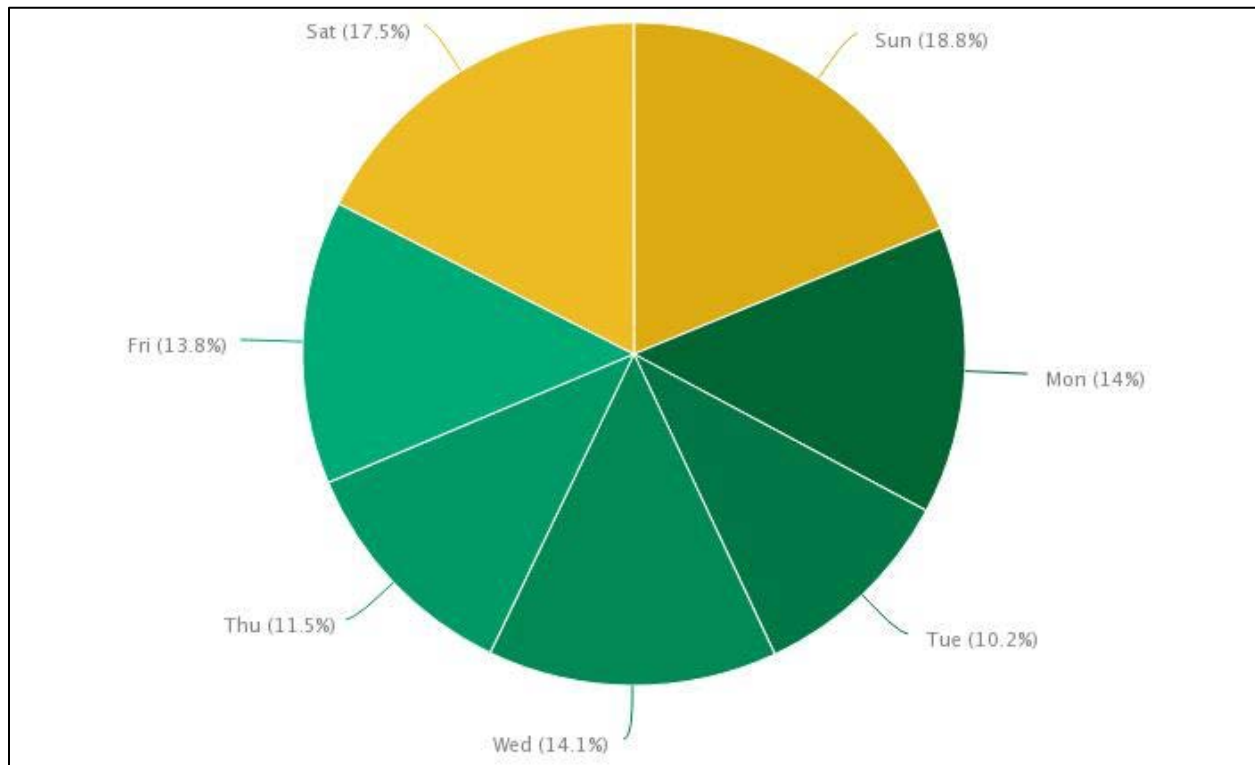
An infrared trail counter was placed near the end of the out-and-back Tree Molds Trail (43.419016, -113.554001) (Table 25). The trail provided minimal adequate locations for a trail counter, and it was ultimately placed in a stump and disguised with woody debris. Following calibration, a correction factor of 0.811 was applied to this counter.

Table 25. Summary of Tree Molds Trail Counter.

Month	Number of days monitored	Daily average	Number of days	Total estimate
May	6	39	31	1,209
June	18	52	30	1,565
July	31	46	31	1,441
August	31	17	31	513
September	30	42	30	1,273
October	12	28	31	860
Total	128	37	184	6,861

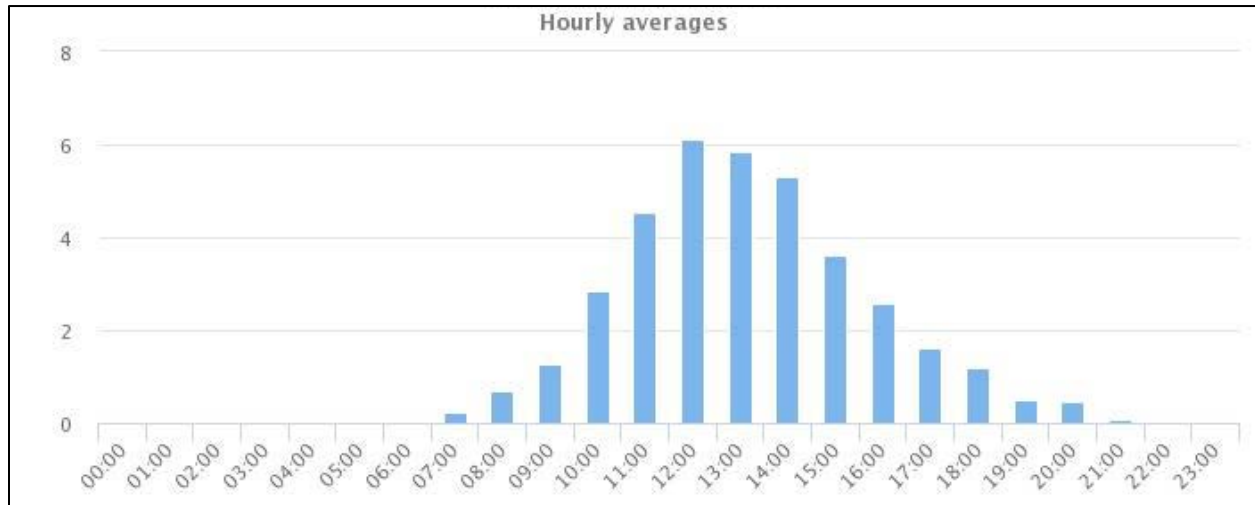
A breakdown by day of the week of use at Tree Molds is illustrated below (Figure 12). Weekend use accounted for the highest proportion of visitation to this trail and Sundays accounted for 18.8% of use.

Figure 12. Weekly breakdown of trail use at Tree Molds.



Visitation at Tree Molds picked up around 10:00 AM, peaked around 12:00 PM and tapered off after 3:00 PM (Figure 13).

Figure 13. Hourly breakdown of visitation to the Tree Molds Trail.



Broken Top Trail Counter Data

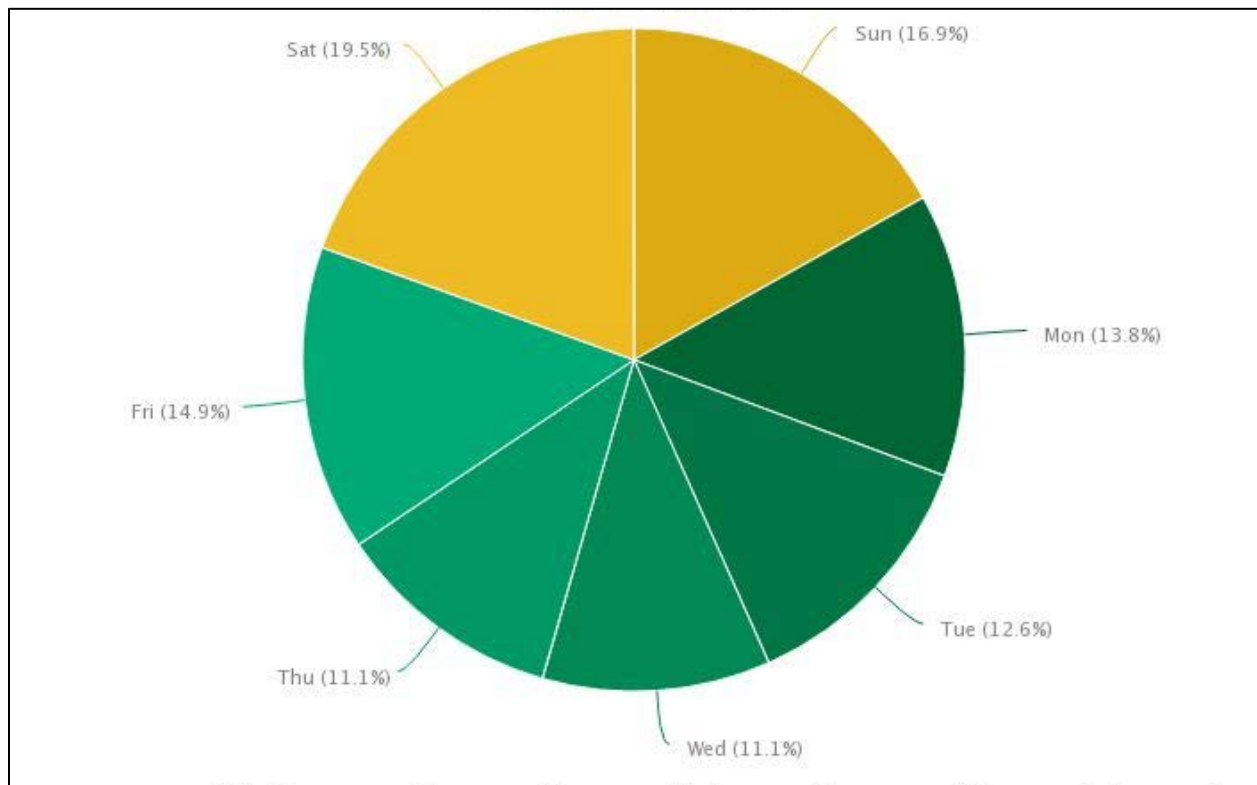
An infrared trail counter was placed on the north side of the Broken Top Trail (43.430098, -113.540195) (Table 26). This counter was mounted to a tree and disguised with foliage. Following calibration, a correction factor of 1.4 was added to this counter. Like other counters, a data gap occurred in June due to incorrect launching. A similar data gap occurred in July for this counter. An outlier was removed from these results on October 9. This anomaly was possibly due to adverse weather conditions on that date. It is worth noting that May data was collected over Memorial Day Weekend in 2021 and TRAFx DataNet extrapolated estimate monthly counts. These data may not reflect actual counts during that month.

Table 26. Summary of Broken Top Trail counter.

Month	Number of days monitored	Daily average	Number of days	Total estimate
May	6	65	31	2,025
June	17	42	30	1,260
July	21	36	31	1,101
August	31	39	31	1,196
September	30	41	30	1,236
October	11	24	31	744
Total	117	40	184	7,563

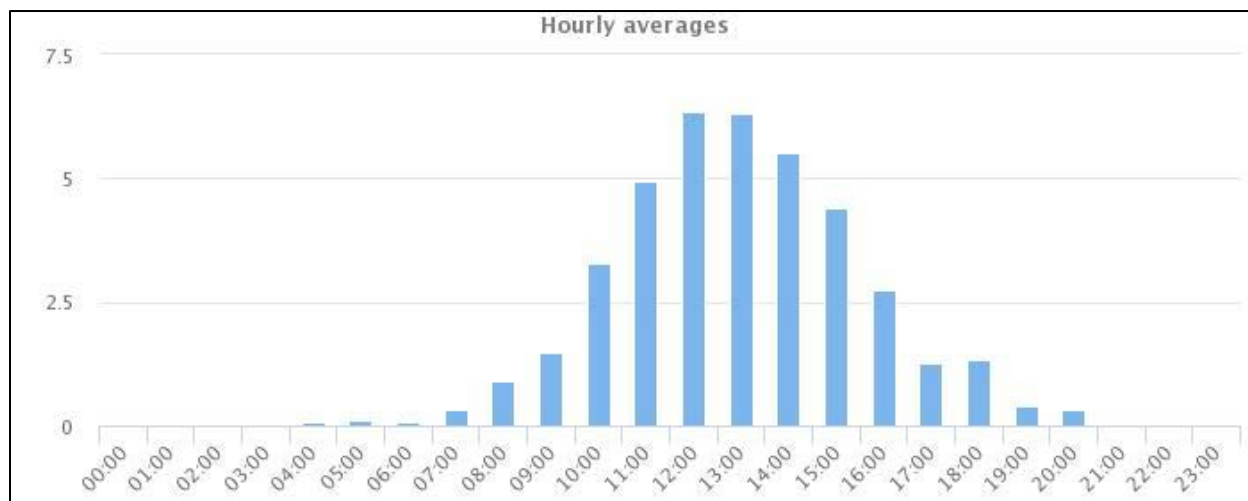
A breakdown of trail use on the Broken Top Trail by day of the week is summarized below (Figure 14). Weekend use accounted for the largest proportion of use on this trail with Saturdays alone accounting for 19.5% of use

Figure 14. Breakdown of traffic at Broken Top Trail by day of the week.



Visitation to the Broken Top Trail picks up around 10:00 AM, peaks from 12:00 PM to 1:00 PM and tapers off around 4:00 PM (Figure 15).

Figure 15. Hourly breakdown of visitation to the Broken Top Trail.



Wilderness Trail Counter Data

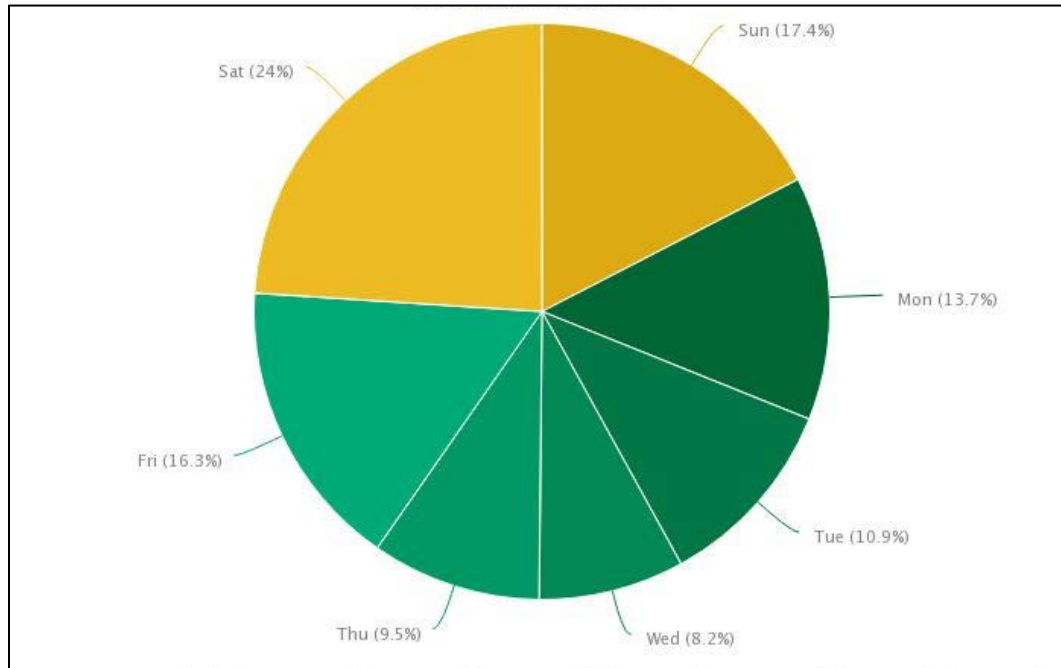
An infrared trail counter was placed roughly a mile down the Wilderness Trail (43.421066, -113.530738), which accesses the vast Craters of the Moon Wilderness (Table 27). Following calibration, an adjustment factor of 1.043 was added to this counter. Like other counters, a data gap occurred in June due to incorrect launching. It is worth noting that May data was collected over Memorial Day Weekend in 2021 and TRAFx DataNet extrapolated estimate monthly counts. These data may not reflect actual counts during that month.

Table 27. Summary of Wilderness Trail counter.

Month	Number of days monitored	Daily average	Number of days	Total estimate
May	6	13	31	408
June	18	5	30	157
July	31	5	31	161
August	31	5	31	160
September	30	6	30	187
October	12	6	31	171
Total	128	6	184	1,243

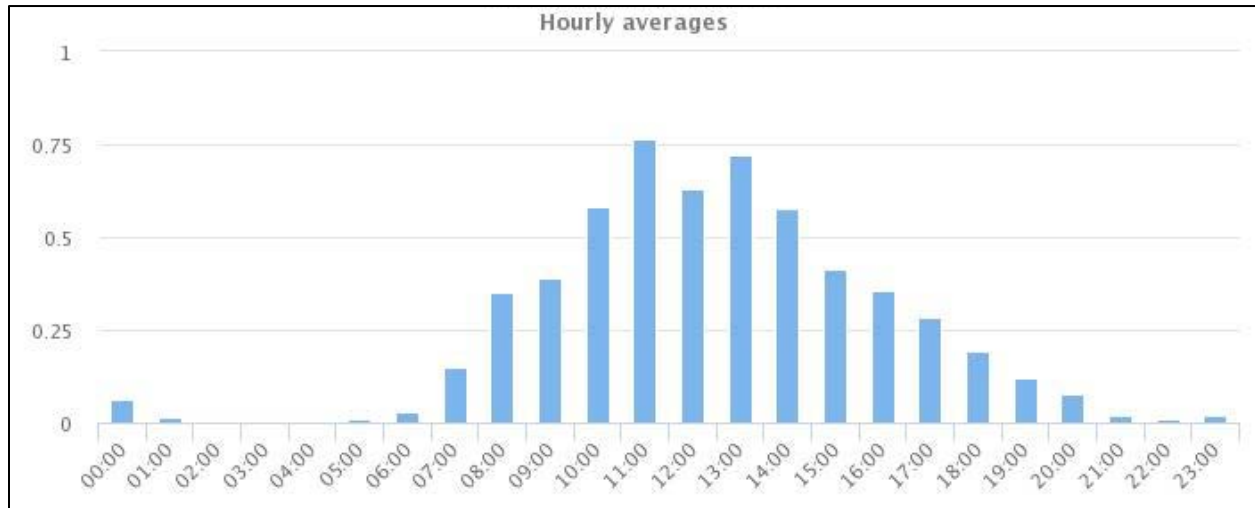
A breakdown of visitation to the Wilderness Trail by day of the week is shown in Figure 16. This counter saw a larger proportion of weekend use than other counters summarized with 24% of use occurring on Saturdays.

Figure 16. Breakdown of visitation to the Wilderness Trail by day of week.



Use at the Wilderness Trail picked up around 10:00 AM, peaks at 11:00 AM with another peak occurring at 1:00 PM. Use trails off after 4:00 PM (Figure 17).

Figure 17. Hourly breakdown of visitation to the Wilderness Trail.



Caves Lot Observations

The Caves area contains the largest parking lot in the park with 61 spots and access to the popular cave and lava tube systems in CRMO. A free permit is required for entry to the Caves to mitigate the spread of harmful disease to native bat populations. A total of N=187 observations were made at the Caves. This sample size is evidenced by the difficulty of a single researcher observing such a large space efficiently despite the heavy visitation this area receives.

Visitors spent an average of 57 minutes and 56 seconds in the Caves area (Table 28), longer than at any other site. The minimum time spent was 2 minutes and 19 seconds and the maximum time was 2 hours, 36 minutes, and 15 seconds.

Table 28. Duration of visits at the Caves.

<i>Time Spent at Site</i>	
Mean	0:57:56
Median	0:58:07
Standard Deviation	0.0241181
Minimum	0:02:19
Maximum	2:36:15
Count	187

A majority (N=173; 92.51%) of visitors to the Caves arrived in a personal car, truck, or SUV (Table 21). Most did not have kids with them (N=144; 77.01%) and were not part of a multi-vehicle group (N=184; 98.40%) (Table 29).

Table 29. Frequency data for the Caves.

<i>Vehicle Type</i>	<i>Frequency</i>	<i>Percent</i>
Personal car, truck, or SUV	173	92.51%
Motorcycle	1	0.53%
RV or motorhome	10	5.35%
Personal vehicle towing trailer	3	1.60%
<i>Kids</i>		
No	144	77.01%
Yes	43	22.99%
<i>Multi-Vehicle Group</i>		
No	184	98.40%
Yes	3	1.60%

The average group size at the Caves was 2.56 people (Table 30). The minimum group size was 1 and the maximum was 7.

Table 30. Group size at the Caves.

<i>Number of People in Groups</i>	
Mean	2.56
Median	2
Standard Deviation	1.1956787
Minimum	1
Maximum	7
Count	480

Caves Trail Counter Data 2021

Infrared trail counters were initially placed on the main Caves trail and on the spur trail to Indian Tunnel (Table 31). This location made placement extremely difficult without more permanent installations and both counters were stolen (and later returned). Only 10 days of data remain from the effort to install counters in the Caves area. Following calibration, a correction factor of 1.268 was added to this counter.

Table 31. Summary of Caves counter (2021).

Month	Number of days monitored	Daily average	Number of days	Total estimate
June	10	540	30	16,200

Based on 10 days of data, visitation to the Caves picked up around 11:00 AM, peaked at 2:00 PM, and tapers off after 5:00 PM (Figure 18).

Figure 18. Hourly breakdown of visitation at the Caves (based on limited data).

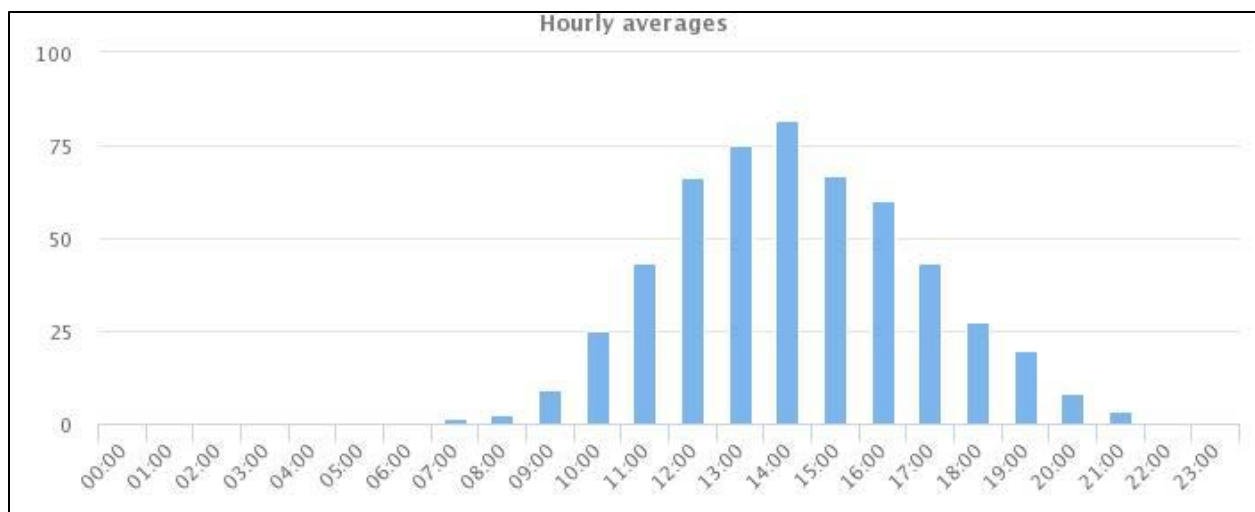
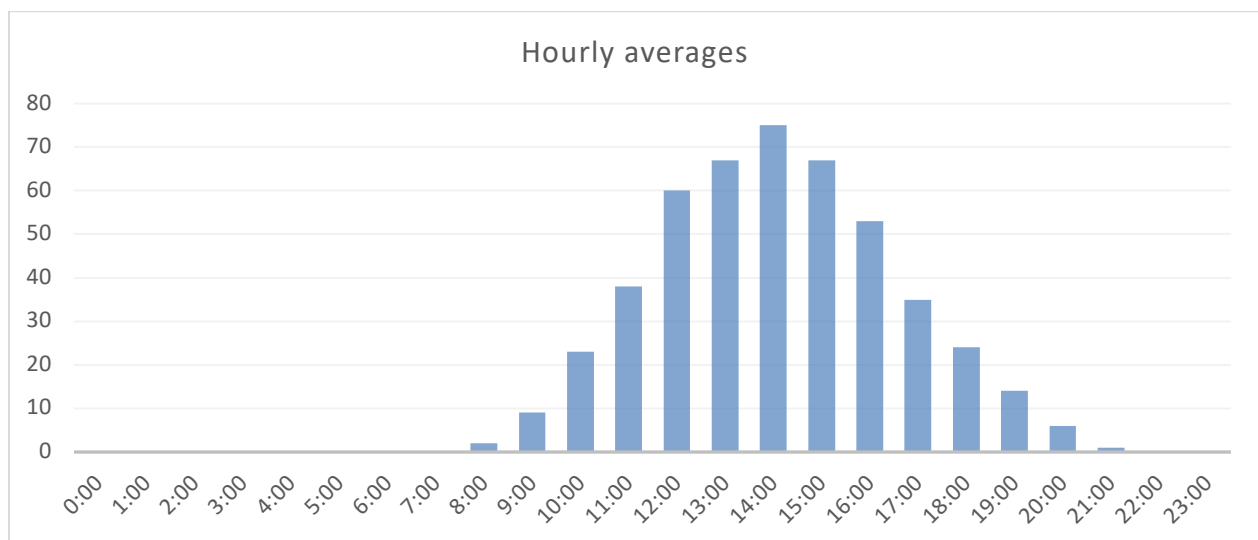


Figure 19. Hourly breakdown of visitation at the Caves in 2022.



Caves Trail Counter Data 2022

In 2022, data collection using infrared counters was replicated at the Caves site. The trail counter was in place between July 22nd and October 22nd for a total of 93 observation days. Following calibration, a correction factor of 1.268 was added to this counter.

Table 32. Summary of Caves counter (2022).

Month	Number of days monitored	Daily average	Number of days	Total estimate
July	10	471	31	14,601
August	31	332	31	10,299
September	30	292	30	8,749
October	22	212	31	6,564
Total	93	327	123	40,213

One-Way Loop End Vehicle Counter

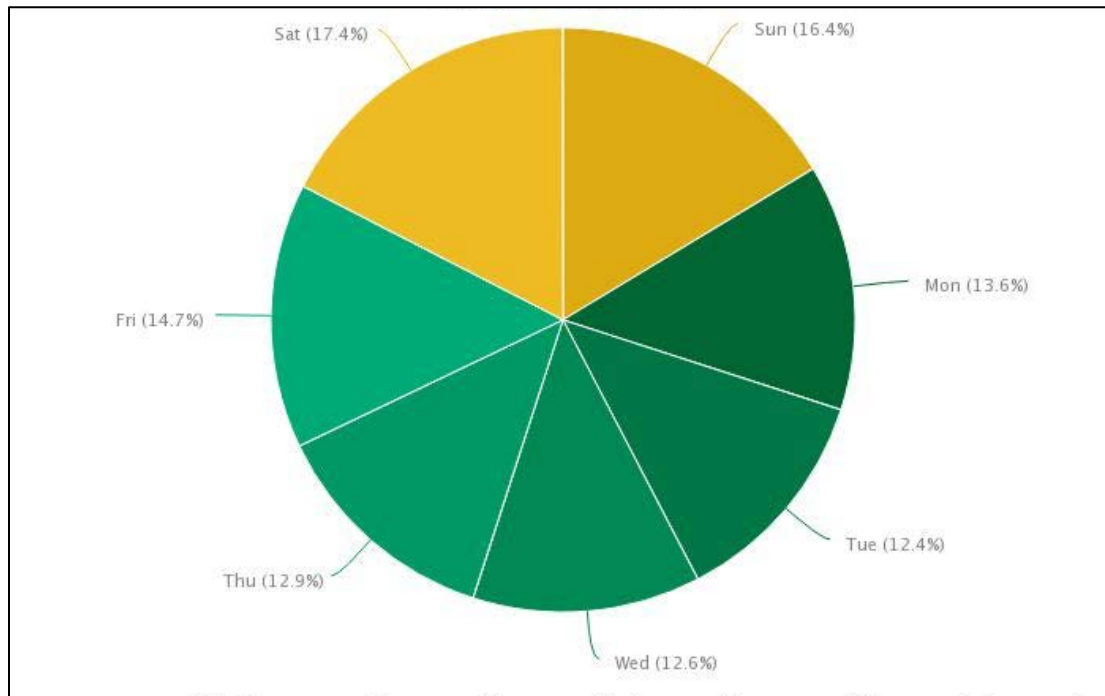
A magnetic vehicle counter was placed at the end of the one-way loop road after the turnoff to the Caves area (43.447923, -113.540265) (Table 33). Following calibration, a correction factor of 1.004 was added to this counter. The difference in this counter in the one-way start could be due to a data gap on the prior counter in August or due to common TRAFx margin-of-error (Meyer & Rempel, 2022).

Table 33. Summary of One-Way Loop End vehicle counter.

Month	Number of days monitored	Daily average	Number of days	Total estimate
June	18	358	30	10,737
July	31	405	31	12,544
August	31	326	31	10,098
September	30	289	30	8,661
October	12	194	31	6,024
Total	122	329	153	48,064

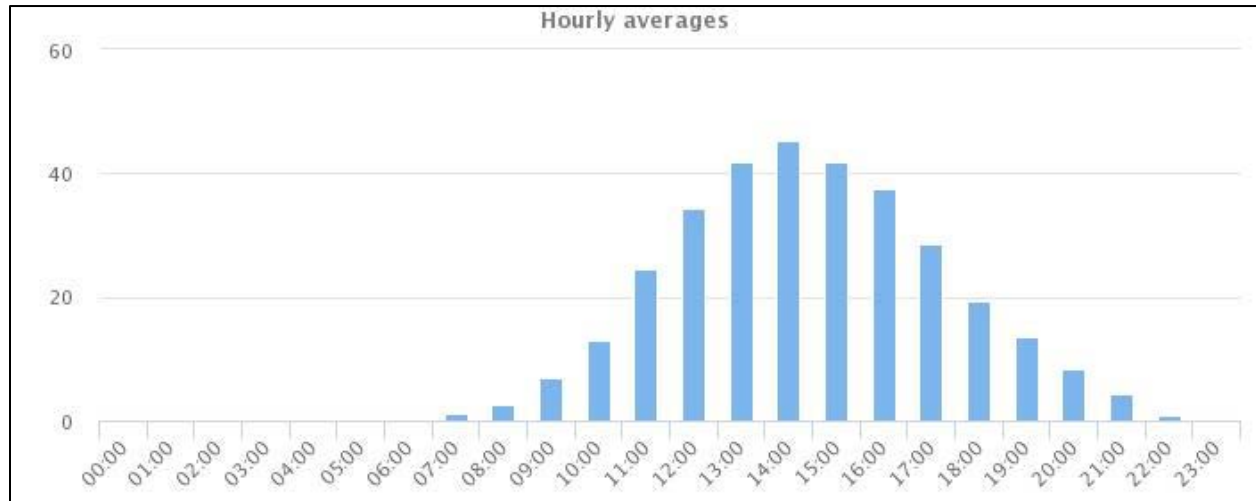
A breakdown of vehicle traffic at the One-Way Loop End counter by day of the week is summarized in Figure 20 below. Weekend use accounted for the highest proportion of use with 17.4% of use occurring on Saturdays.

Figure 20. Breakdown of traffic at One-Way Loop End counter by day of week.



Traffic at the One-Way Loop End counter picked up around 11:00 AM, peaked around 2:00 PM, and tapered off after 3:00 PM (Figure 21).

Figure 21. Hourly breakdown of traffic at One-Way Loop End counter.



Systemic Relationships Between Vehicle-Access Areas in CRMO

Linear regressions were used to analyze the relationships between different areas in CRMO, including parking lots and trails. This results section summarizes the outcomes of those analyses.

Highway 20/26/93 to Visitor Center Parking Lot

A linear regression examining the relationship between highway vehicle traffic and vehicles in the parking lot at the visitor center showed a moderate, positive, statistically significant relationship ($R^2=0.390$; $F [1,54] = 34.54$; $p<.001$). The unstandardized regression equation is as follows:

$$\text{Number of vehicles in Visitor Center parking lot} = -0.98 + 0.08(\text{Number of highway vehicles})$$

Using the above, if 100 vehicles were recorded by the highway counter in an hour, there will be approximately 7 vehicles parked at one time in the visitor center parking lot in the same hour.

Highway 20/26/93 to CRMO Interior

A linear regression examining the relationship between highway vehicle traffic and the number of vehicles entering the park past the fee booth showed a moderate, positive, statistically significant relationship ($R^2=0.576$; $F [1,2301] = 3132.08$; $p<.001$). The unstandardized regression equation is as follows:

$$\text{Number of vehicles entering the park past the fee booth} = 0.07 + 0.20(\text{Number of highway vehicles})$$

Using the above, if 100 vehicles were recorded by the highway counter in an hour, there will be approximately 20 vehicles entering park past the fee booth in the same hour (Table 34).

Table 34. Highway to CRMO scenario.

IF...	LOCATION	...THEN
100 vehicles pass the highway vehicle counter in one hour	Visitor Center Parking Lot	7 vehicles will be parked at one time in the same hour
	CRMO Interior	20 vehicles will enter the park past the fee booth in the same hour

Park Entrance to North Crater Parking Lot

A linear regression examining the relationship between the number of vehicles entering the park past the fee booth and vehicles in the North Crater Parking Lot showed a moderate, positive, statistically significant relationship ($R^2=0.183$; $F [1,42] = 9.414$; $p=.004$). The unstandardized regression equation is as follows:

$$\text{Number of vehicles in North Crater Parking Lot} = 1.61 + 0.05(\text{Number of vehicles entering the park})$$

Using the above, if 100 vehicles entered the park in one hour, there will be approximately 7 vehicles parked at one time in the North Crater Parking Lot in the same hour.

Park Entrance to Inferno Cone Parking Lot

A linear regression examining the relationship between the number of vehicles entering the park past the fee booth and vehicles in the Inferno Cone Parking Lot showed a moderate, positive, statistically significant relationship ($R^2=0.315$; $F [1,43]=19.755$; $p<.001$). The unstandardized regression equation is as follows:

$$\text{Number of vehicles in Inferno Cone Parking Lot} = 1.15 + 0.195(\text{Number of vehicles entering the park})$$

Using the above, if 100 vehicles entered the park in one hour, there will be approximately 21 vehicles parked at one time in the Inferno Cone Parking Lot in the same hour.

Park Entrance to Spatter/Snow Cone Parking Lot

A linear regression examining the relationship between the number of vehicles entering the park past the fee booth and vehicles in the Snow Cone Parking Lot showed a moderate, positive, statistically significant relationship ($R^2=0.606$; $F [1,42]=64.564$; $p<.001$). The unstandardized regression equation is as follows:

$$\text{Number of vehicles in Snow Cone Parking Lot} = -1.34 + 0.202(\text{Number of vehicles entering the park})$$

Using the above, if 100 vehicles entered the park in one hour, there will be approximately 19 vehicles parked at one time in the Spatter/Snow Cone Parking Lot in the same hour.

Park Entrance to Tree Molds/Wilderness Trail Parking Lot

A linear regression examining the relationship between the number of vehicles entering the park past the fee booth and vehicles in the Wilderness Parking Lot showed a moderate, positive, statistically significant relationship ($R^2=0.229$; $F [1,46]=13.671$; $p<.001$). The unstandardized regression equation is as follows:

$$\text{Number of vehicles in Wilderness Parking Lot} = 2.31 + 0.096(\text{Number of vehicles entering the park})$$

Using the above, if 100 vehicles entered the park in one hour, there will be approximately 12 vehicles parked at one time in the Wilderness Parking Lot in the same hour.

Park Entrance to Caves Parking Lot

A linear regression examining the relationship between the number of vehicles entering the park past the fee booth and vehicles in the Caves Parking Lot showed a moderate, positive, statistically significant relationship ($R^2=0.138$; $F [1,42]=6.718$; $p=.013$). The unstandardized regression equation is as follows:

$$\text{Number of vehicles in Caves Parking Lot} = 8.31 + 0.264(\text{Number of vehicles entering the park})$$

Using the above, if 100 vehicles entered the park in one hour, there will be approximately 35 vehicles parked at one time in the Caves Parking Lot in the same hour (Table 35).

Table 35. Summary of relationships between vehicle entrances to CRMO and parking lot use.

IF...	LOCATION	...THEN
100 vehicles enter the park past the fee booth in one hour	North Crater Parking Lot	7 vehicles will be parked at one time in the same hour
	Inferno Cone Parking Lot	21 vehicles will be parked at one time in the same hour
	Snow Cone Parking Lot	19 vehicles will be parked at one time in the same hour
	Wilderness Parking Lot	12 vehicles will be parked at one time in the same hour
	Caves Parking Lot	35 vehicles will be parked at one time in the same hour

Systemic Relationship Between Parking Lot Conditions and Trail Use in CRMO

A series of linear regressions examined the relationships between the number of vehicles parked at one time and the hourly number of visitors on trails. For some parking lot, multiple trails are accessible. For this reason, several linear regressions may connect one parking lot to hourly number of visitors on trails.

North Crater Parking Lot to North Crater Trail

The North Crater Parking Lot provides direct access to the North Crater Trail. A linear regression examining the relationship between the number of vehicles parked in the North Crater Parking Lot and the number of visitors on the trail in the same hour showed no statistically significant relationship ($R^2=0.042$; $F [1,43] = 1.87$; $p=.179$). We also examined a one-hour delay time in the hiking data, but still found no statistically significant relationship ($R^2=0.046$; $F [1,43] = 2.074$; $p=.157$).

The reason for this lack of relationship is unclear, but two possibilities are identified. The first possibility is that a larger sample size is needed. This is evident from the reasonable effect size ($r = .204$) and lack of statistical significance. However, all other models were statistically significant with similar sample sizes. A second possibility is that there is not a strong relationship between the two variables. This would mean that the vehicles who park in the North Crater Parking Lot are not predictably and regularly hiking on the North Crater Trail.

Tree Molds/Wilderness Trail Parking Lot to Tree Molds Trail

A linear regression examining the relationship between the number of vehicles parked at one time in the Wilderness Lot and the number of visitors on the Tree Molds Trail in the same hour showed a moderate, positive, statistically significant relationship ($R^2=0.304$; $F [1,46]=20.139$; $p<.001$). The unstandardized regression equation is as follows:

$$\begin{aligned} \text{Number of visitors on Tree Molds Trail} \\ = 2.03 + 1.24(\text{Number of vehicles at one time in Wilderness Lot}) \end{aligned}$$

Using the above, if 10 vehicles were parked in the Wilderness Lot, there will be approximately 14 visitors on the Tree Molds Trail in the same hour (Table 36).

Tree Molds/Wilderness Trail Parking Lot to Broken Top Trail

A linear regression examining the relationship between the number of vehicles parked at one time in the Wilderness Lot and the number of visitors on the Broken Top Trail in the following hour showed a moderate, positive, statistically significant relationship ($R^2=0.184$; $F [1,45] = 10.142$; $p=.003$). The unstandardized regression equation is as follows:

$$\begin{aligned} \text{Number of visitors on Broken Top Trail} \\ = 0.19 + 0.458(\text{Number of vehicles at one time in Wilderness Lot}) \end{aligned}$$

Using the above, if 10 vehicles were parked in the Wilderness Lot, there will be approximately 5 visitors on the Broken Top Trail in the following hour (Table 36).

Tree Molds/Wilderness Trail Parking Lot to Wilderness Trail

A linear regression examining the relationship between the number of vehicles parked at one time in the Wilderness Lot and the number of visitors on the Wilderness Trail in the following hour showed no statistically significant relationship ($R^2=0.039$; $F [1,46] = 1.883$; $p=.177$).

The reason for this lack of relationship is unclear, but two possibilities are identified. The first possibility is that a larger sample size is needed. This is evident from the reasonable effect size ($r = .198$) and lack of statistical significance. However, nearly all other models in this report were statistically significant with similar sample sizes. A second possibility is that there is not a strong relationship between the two variables. This would mean that the vehicles who park in the Wilderness Parking Lot are not predictably and regularly hiking on the Wilderness Trail (Table 36).

Table 36. Summary of relationships between parking lot conditions and trail use.

IF...	LOCATION	...THEN
For every 10 vehicles parked at one time at:	North Crater Parking Lot	There is no relationship to visitors on the North Craters Trail
	Wilderness Parking Lot	14 visitors will be on the Tree Molds Trail in the same hour
		5 visitors will be on the Broken Top Trail in the following hour
		There is no relationship to visitors on the Wilderness Trail

Park Entrance to Devils Orchard Road

Devils Orchard was treated as a subsystem that is separate from the rest of the park. The reason for this is it is one of the only places that visitors can access without heading down the one-way loop road. This allows visitors with a different type of access than other areas in the park.

A spur road provides access to Devils Orchard. A linear regression examining the relationship between the number of vehicles entering the park past the fee booth and vehicles entering the Devils Orchard area on the spur road in the same hour showed a strong, positive, statistically significant relationship ($R^2=0.917$; $F [1,2166] = 23864.67$; $p<.001$). The unstandardized regression equation is as follows:

$$\begin{aligned} \text{Number of vehicles entering Devils Orchard area} \\ = -0.314 + 0.566(\text{Number of vehicles entering the park}) \end{aligned}$$

Using the above, if 100 vehicles entered the park in one hour, there will be approximately 56 vehicles entering the Devils Orchard area via the spur road in the same hour.

Devils Orchard Road to Devils Orchard Parking Lot

A linear regression examining the relationship between the number of vehicles entering the Devils Orchard area via the spur road and vehicles in the Devils Orchard Parking Lot showed a strong, positive, statistically significant relationship ($R^2=0.305$; $F [1,31] = 13.626$; $p<.001$). The unstandardized regression equation is as follows:

$$\begin{aligned} \text{Number of vehicles in Devils Orchard Parking Lot} \\ = 1.40 + 0.255(\text{Number of vehicles entering Devils Orchard}) \end{aligned}$$

Using the above, if 20 vehicles entered the Devils Orchard area in one hour, there will be approximately 7 vehicles parked at one time in the Devils Orchard Parking Lot in the same hour.

Devils Orchard Parking Lot to Devils Orchard Trail

A linear regression examining the relationship between the number of vehicles parked at one time in the Devils Orchard Parking Lot and number of visitors on the Devils Orchard Trail in the same hour showed a strong, positive, statistically significant relationship ($R^2=0.714$; $F [1,51]=127.107$; $p<.001$). The unstandardized regression equation is as follows:

$$\begin{aligned} &\text{Number of visitors on the Devils Orchard Trail} \\ &= 11.79 + 4.023(\text{Number of vehicles in Devils Orchard Parking Lot}) \end{aligned}$$

Using the above, if 10 vehicles were parked in the Devils Orchard Parking lot, there will be approximately 52 visitors on the Devils Orchard Trail in the same hour (Table 37).

Table 37. Summary of the Devils Orchard Subsystem.

IF...	LOCATION	...THEN
100 vehicles enter the park past the fee booth in one hour	The road to Devils Orchard	56 vehicles will be on the road in the same hour
20 vehicles entered the Devils Orchard area via the spur road	The Devils Orchard Parking Lot	7 vehicles will be parked at one time in the same hour
10 vehicles were parked at one time in the Devils Orchard Parking lot	The Devils Orchard Trail	52 visitors will be on the trail in the same hour

Parking Lot Capacities at CRMO

It was rare for technicians to observe a full parking lot at CRMO. The exception to this was at Inferno Cone, where the parking lot would experience fluctuations to full in the afternoons (Figure 25). To understand the upper end of parking capacity in CRMO, we used the calculations above and parking lot capacities to understand what level of visitor use in CRMO would create full parking areas. Full was defined as 85% of the total parking spaces in each lot. This functional parking lot capacity is often used in visitor use management work, as it allows for turnover and other parking lot flow challenges.

Table 38. Parking lot capacities.

Location of parking lot	Number of total parking spot	Functional parking capacity	Estimated conditions that maximize functional parking capacity	Current condition averages
Visitor Center	29	25	325 vehicles on highway per hour	Hourly averages for all times = 85 vehicles per hour; Peak use at

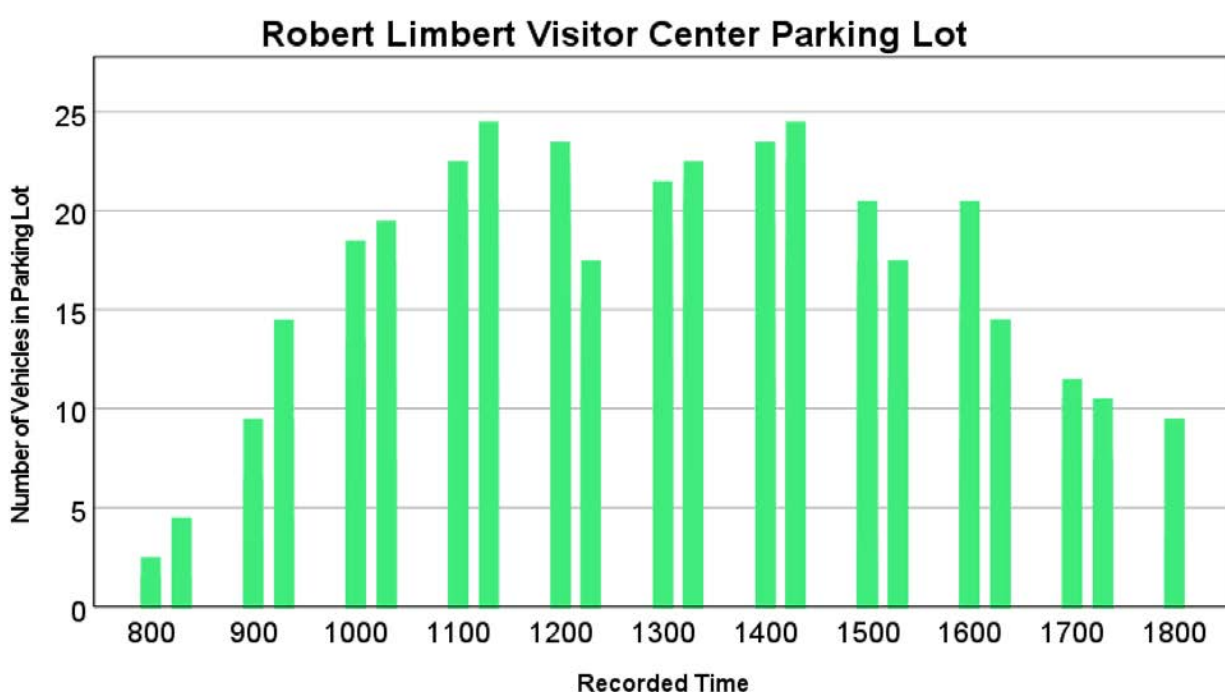
				2pm=203 vehicles per hour
North Crater	17	14	248 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Devils Orchard	31	26	96 vehicles entering the Devils Orchard area via the spur road per hour	Hourly averages for all times = 9 vehicles per hour; Peak use average at 12pm = 32 vehicles per hour
Inferno Cone	16	14	66 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Spatter/Snow Cone	28	24	125 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Tree Molds/ Wilderness	25	21	195 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour
Caves	61	52	165 vehicles entering the park past the fee booth per hour	Hourly averages for all times = 18 vehicles per hour; Peak use average at 12pm = 55 vehicles per hour

Summary Of Current Conditions Based on Parking Lot Observations

Below are summaries for each parking lot of the total number of vehicles observed on the 30-minute mark. Most lots remained below their capacity for much of the day and experienced some fluctuations in use. Inferno Cone, due to its attraction and capacity of only 16 maximum parking spaces, eclipsed that and saw use such that visitors were parking in undesignated spot.

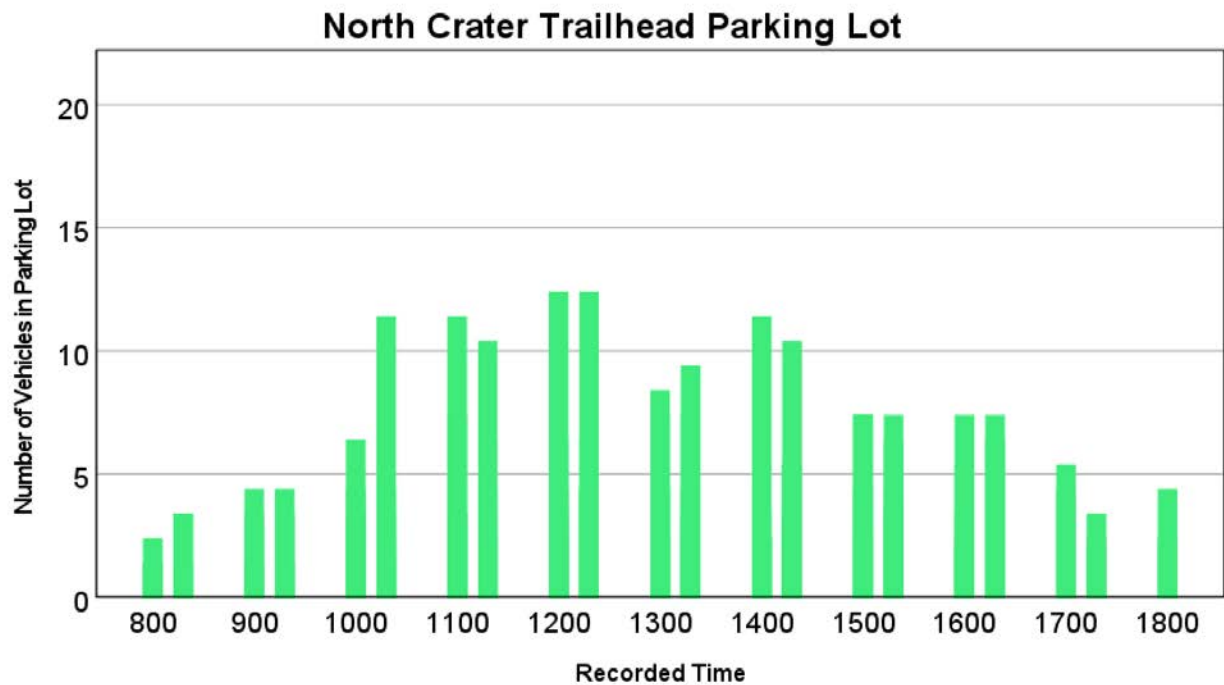
The Robert Limbert Visitor Center has a maximum capacity of 29 parking spaces and a functional capacity of 25 spaces. On average, it came close to functional capacity around 11:00 AM and 2:00 PM (Figure 22).

Figure 22. 30-minute lot observations at the Visitor Center (total parking=29; functional capacity=25).



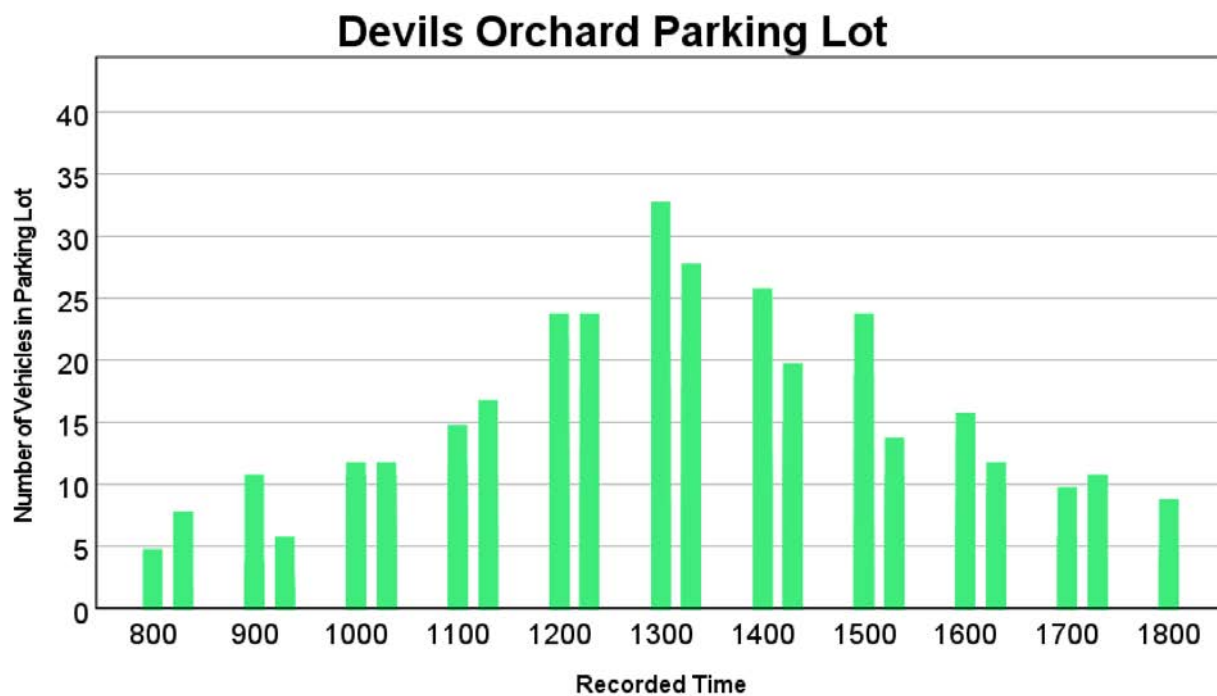
The North Crater Trailhead parking lot has a maximum capacity of 17 parking spaces and a functional capacity of 14 spaces. On average, it came closest to functional capacity around 12:00 PM (Figure 23).

Figure 23. 30-minute lot observations at the North Crater Trailhead (total parking=17; functional capacity=14).



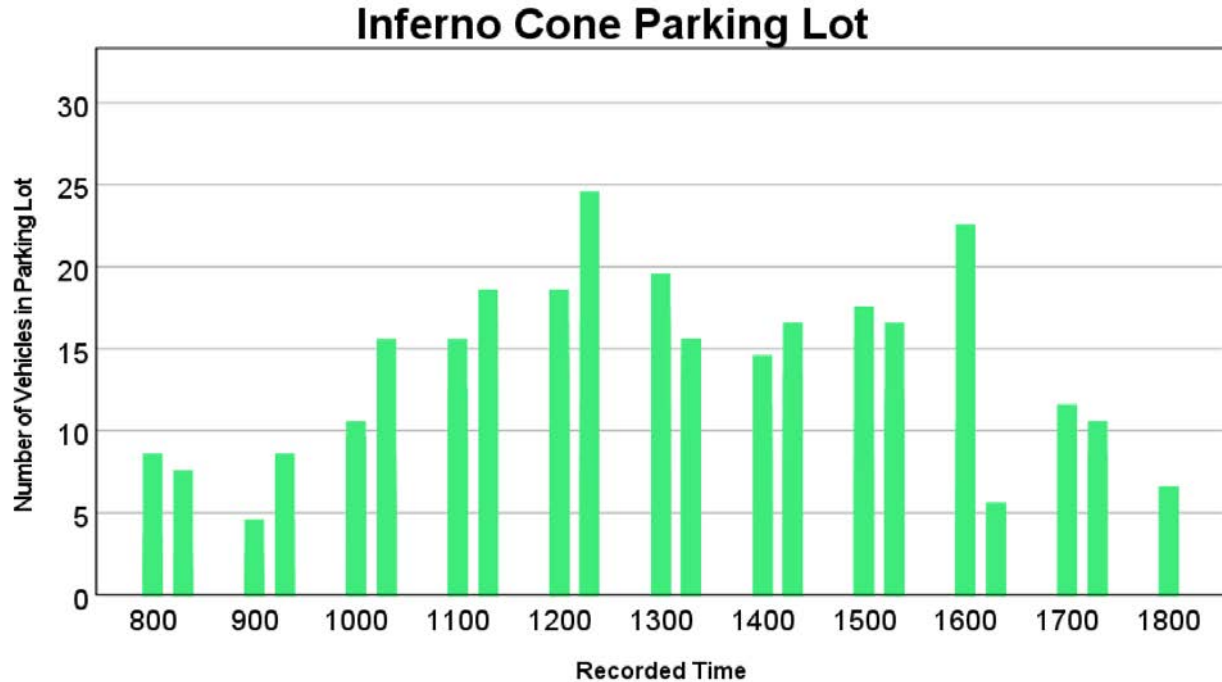
Devils Orchard has a maximum capacity of 31 parking spaces and a functional capacity of 26 spaces. On average, it passed functional capacity around 1:00 PM and tapered off after 3:00 PM (Figure 24). Reaching functional capacity at Devils Orchard indicated visitors in passenger vehicles were likely utilizing the present RV/trailer spaces.

Figure 24. 30-minute lot observations at Devils Orchard (total parking=31; functional capacity=26).



Inferno Cone has a maximum capacity of 16 parking spaces and a functional capacity of 14 spaces. On average, visitation eclipsed total capacity around 11:00 AM (Figure 25) and fluctuated above capacity until 4:00 PM with high occurrence of undesignated spots on the edges of the lot and vehicles hovering waiting for a space to park. The average peak visitation at Inferno Cone around 12:30 PM saw 10 vehicles beyond the lot's functional capacity.

Figure 25. 30-minute lot observations at Inferno Cone (total parking=16; functional capacity=14).



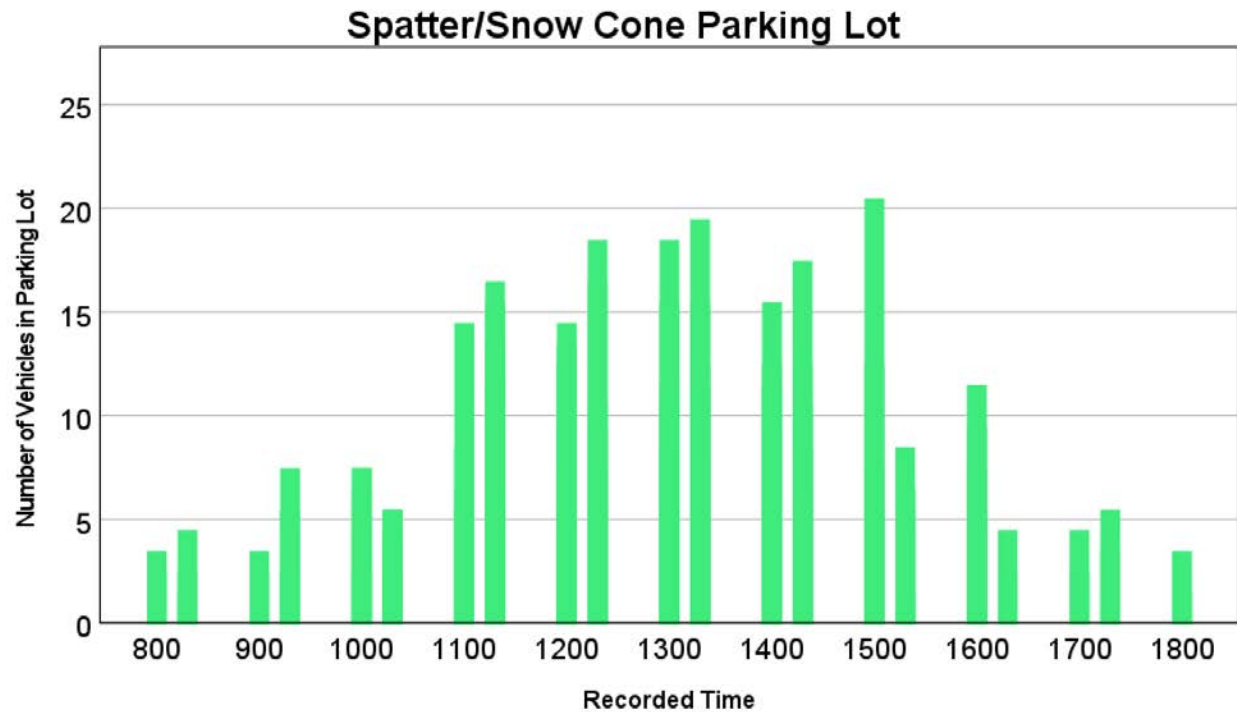
A total of N=85 30-minute observations were taken at Inferno Cone (Table 39). In contrast with other sites, where lot fill was a rare to non-existent occurrence, at Inferno Cone, the lot was perceived to be full or beyond full 16.5% of the time during observations (N=14).

Table 39. Parking lot full at Inferno Cone.

<i>Did you perceive the parking lot to be full?</i>		
No	71	83.5%
Yes	14	16.5%

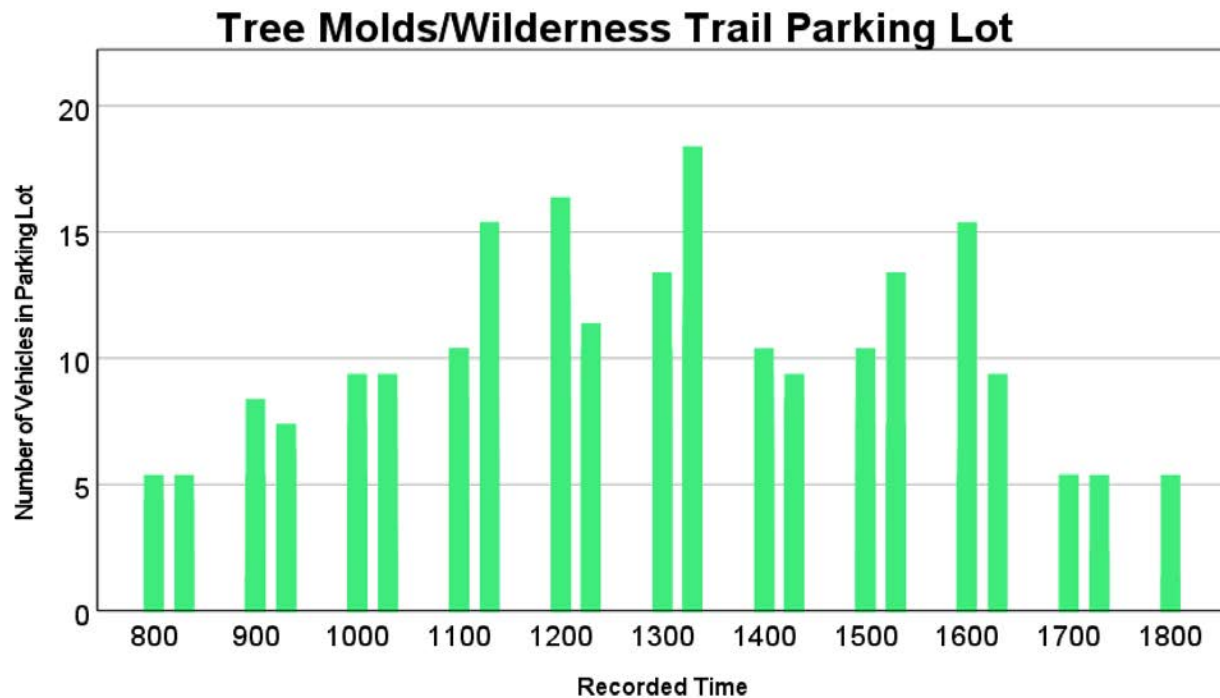
The Spatter/Snow Cones parking lot has a maximum capacity of 28 parking spaces and a functional capacity of 24 spaces. On average, it came closest to functional capacity around 3:00 PM (Figure 26) but did not fill up.

Figure 26. 30-minute lot observations at Spatter/Snow Cone (total parking=28; functional capacity=24).



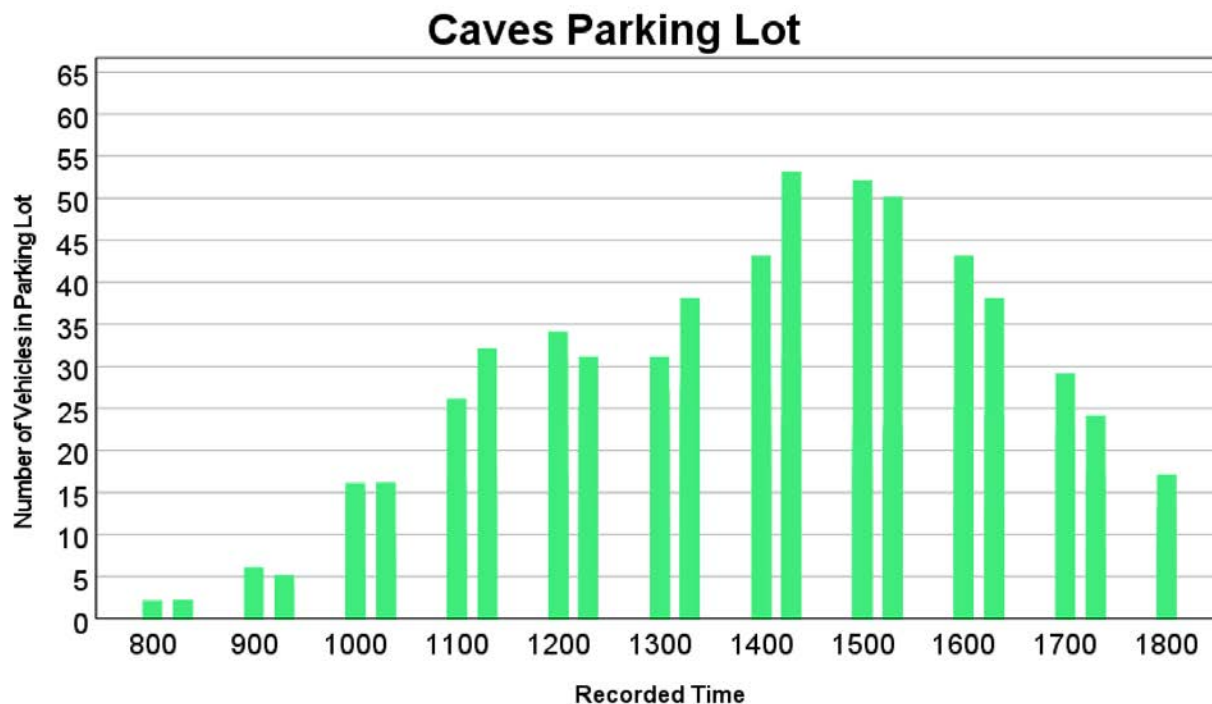
The Tree Molds/Wilderness Trailhead parking lot has a maximum capacity of 25 parking spaces and a functional capacity of 21 spaces. On average, it came closest to functional capacity around 1:00 PM (Figure 27) but did not fill up.

Figure 27. 30-minute lot observations at Tree Molds/Wilderness Trailhead (total parking=25; functional capacity=21).



The Caves area parking lot is the largest in CRMO and has a maximum capacity of 61 parking spaces and a functional capacity of 52 spaces. On average, it eclipsed functional capacity around 2:00-3:00 PM but did not fill up completely (Figure 28).

Figure 28. 30-minute lot observations at the Caves (total parking=61; functional capacity=52).



Potential Trail Conditions if Parking Lots Reach Capacity

We used the estimations from the models above to examine what trail conditions would look if parking lots were full (Table 40).

Table 40. Potential trail conditions.

Trail name	Current conditions	Trail conditions if parking reaches functional capacity
North Craters Trail	Hourly averages for all times = 4 visitors on trail per hour; Peak use a 12pm=12 vehicles per hour	No statistically significant relationship
Tree Molds Trail	Hourly averages for all times = 3 visitors on trail per hour; Peak use a 12pm=9 visitors on trail per hour	28 visitors on the trail per hour if full

Broken Top Trail	Hourly averages for all times = 2 visitors on trail per hour; Peak use a 1pm=8 visitors on trail per hour	10 visitors on the trail per hour if full
Wilderness Trail	Hourly averages for all times < 1 visitors on trail per hour; Peak use a 11am=1 visitor on trail per hour	No statistically significant relationship
Devils Orchard Trail	Hourly averages for all times = 19 visitors on trail per hour; Peak use a 12pm=51 visitors on trail per hour	116 visitors on the trail per hour if full

Recommendations and Conclusion

- Conditions for vehicle traffic, parking and encounters with visitors on trails are excellent within Craters of the Moon National Monument and Preserve. Visitors are able to enter, park and access trails with little to no waiting.
- Only one parking lot (Inferno Cone) fills regularly and only 16% of the time. Managers may want to identify those likely times and encourage visitors to reroute their stops within the park. Parking lot turnover is high in Craters of the Moon, but this turnover keeps parking lot conditions largely stable under current visitation.
- Continued efforts are recommended to understand visitor use in CRMO through survey data, establishment of thresholds, and filling in key data gaps such as at the Caves area, where only very limited visitation data was collected in 2021. This effort would likely involve semi-permanent counter infrastructure such as posts and locking boxes to deter theft. Additional data gaps include the North Crater Flow Trail, which was closed for construction during the 2021 season but may influence the overall picture of visitor use in the developed area of Craters of the Moon.
- The park is generally not exceeding the capacity of the existing infrastructure and there appears to be room to absorb additional visitation. Park managers are encouraged to do some follow up trail and parking lot monitoring in the coming season to test the capacity calculations offered in this report. If they prove to work well, a monitoring plan could be designed that uses the regression approach most years with a more detailed set of observations every 3-5 years unless visitation or conditions change for some reason.

Literature Cited

Meyer, C., & Rempel, W. (2022). A Comprehensive Manual on Recreation Counters and Working with TRAFx. *Institute of Outdoor Recreation and Tourism, Utah State University*.

National Park Service, Visitor Use Statistics. (2019). Annual Summary Report [Data set]. Retrieved from <https://irma.nps.gov/STATS/Reports/Park/CRMO>

Appendix A: Vehicle Arrival Form

Craters of the Moon Vehicle Arrival Observations

Use this form to enter observations from arriving vehicles

Parking lot location

- ☐ Visitor Center
- ☐ North Crater trail (nearest VC)
- ☐ Devil's Orchard
- ☐ Inferno Cone
- ☐ Spatter/Snow Cone
- ☐ Tree molds
- ☐ Caves

Type of vehicle

- ☐ Personal car, truck, or SUV
- ☐ Motorcycle
- ☐ RV or motorhome
- ☐ Personal car, truck, or SUV towing trailer

State and last three digits of license plate

Number of people in the vehicle

Kids in the group?

☐ No

☐ Yes

Part of multi-vehicle group?

☐ No

☐ Yes

Did people hike? (Inferno Cone)

☐ Yes

☐ No

Appendix B: Vehicle Departure Form

Craters of the Moon Vehicle Departure Observations

Use this form to enter observations from departing vehicles

State and last three digits of license plate

Parking lot location

- ☐ Visitor Center
 - ☐ North Crater trail (nearest VC)
 - ☐ Devil's Orchard
 - ☐ Inferno Cone
 - ☐ Spatter/Snow Cone
 - ☐ Tree molds
 - ☐ Caves
-

Appendix C: 30-minute Observation Form

Craters of the Moon Parking Lot Capacity Observations - 30 MINUTES

Use this sheet to record parking lot capacity observations every 30 minutes

Parking lot location

- ☐ Visitor Center
- ☐ North Crater trail (nearest VC)
- ☐ Devil's Orchard
- ☐ Inferno Cone
- ☐ Spatter/Snow Cone
- ☐ Tree molds
- ☐ Caves

Recorded time (please use science time)

Do you perceive the parking lot to be full?

- ☐ No
- ☐ Yes

Number of vehicles in parking lot

What kind and how many of each type of vehicle are in the lot?

☐ Private vehicles, trucks, or SUVs _____

☐ RVs or motorhomes _____

☐ Private vehicle with trailers _____

☐ Motorcycles _____

☐ Government, Contractor, or NPS vehicles

☐ Research vehicles _____

Number of license plates with Idaho tags

Number of vehicles in undesignated parking spots

Number of vehicles in illegal parking spots

Number of vehicles hovering in parking lot or waiting for a parking space

Appendix D: Observations Sampling Schedules

MAY 2021

SUN	MON	TUE	WED	THU	FRI	SAT
02	03	04	02	06	07	08
09	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24 USU arrives in CRMO/Count er Setup	25 Counter Setup Calibration	26 Counter Setup Calibration Observation	27 Visitor Center (CM-AM) North Crater (WR-AM)	28 Visitor Center (CM-PM) North Crater (WR-PM)	29 Devils Orchard (WR-AM) Spatter/Snow
30 North Crater (CM-AM) Devils Orchard	31 Counter Setup Calibration					

JUN 2021

SUN MON TUE WED THU FRI SAT

		01 OFF	02 Spatter/Snow (CM-PM) Tree Molds (WR-AM)	03 Caves (MV-PM) OFF (CM, WR)	04 Devils Orchard (CM-AM) Tree Molds (WR-PM) Caves (MV-PM)	05 Inferno Cone (CM-AM) Spatter/Snow (WR-AM) Caves (MV-PM)
06 Visitor Center (WR-AM) Devils Orchard (CM-PM)	07 Inferno Cone (CM-PM) Tree Molds (WR-AM) Caves (MV-AM)	08 Visitor Center (WR-PM) Inferno Cone (CM-AM)	09 Counter Data Collection USU Depart CRMO	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

JUL 2021

SUN	MON	TUE	WED	THU	FRI	SAT
				01	02	03
04	05	06	07	08	09	10
11	12 WR, CM Arrive in CRMO Meet with NPS?	13 VC (WR 8-12) DO (CM 8-12) NC (WR 12-4) CAV (CM 12-4)	14 SNO (WR 10-2) IC (CM 10-2) NC (WR 2-6) DO (CM 2-6)	15 OFF	16 VC (CM 10-2) NC (WR 10-2) SNO (CM 2-6) TM (WR 2-6)	17 TM (CM 8-12) CAV (WR 8-12) IC (CM 12-4) TM (WR 12-4)
18 TM (WR 10-2) CAV (CM 10-2) IC (WR 2-6) VC (CM 2-6)	19 SNO (WR 8-12) IC (CM 8-12) DO (WR 12-4)	20 DO (WR 10-2) NC (CM 8-12) CAV (WR 2-6)	21 Pull Counter Data CM, WR depart CRMO	22	23	24
25	26	27	28	29	30	31

Appendix E: VISITOR USE MONITORING RESEARCH GAPS

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Quinney College of Natural Resources, Department of Environment and Society,

Utah State University - December, 2023

Introduction

In this appendix to the 2021 Craters of the Moon National Monument and Preserve Visitor Use Monitoring Effort report, researchers from Utah State University have reviewed and summarized the existing visitor use monitoring data and stated desired visitor experience conditions for Craters of the Moon National Monument and Preserve (CRMO). After evaluating the existing information, the research team developed potential indicators that align with visitor experience goals of management documents. The visitor use data collected in 2021 was used as a baseline to inform the development of data collection suggestions. Finally, recommendations for future visitor experience data, and visitor use planning to develop future desired conditions are discussed.

During the initial 2021 visitor use monitoring effort, the need for continued visitor use and experience data collection was recommended, including the development of a visitor experience survey, establishment of indicators and thresholds, and continued monitoring to fill in key data gaps. This appendix is intended to provide future guidance to CRMO managers regarding these recommendations. Conversations with CRMO staff, former researchers, and a review of IRMA yielded no existing visitor use management planning documents. Although there are not many specific visitor use management documents, there are other project reports and planning documents that mention and provide some guidance regarding current visitor use management conditions and future goals. An overview of the existing documents is provided below in Table A.1. Our conclusion is that CRMO is at step 7 in the Visitor Use Management Framework (Figure A.1). Thus, the following recommendations target the development of indicators and standards or thresholds that will serve to help monitor success in implementing the park's plans.

This appendix was written by Dr. Wayne Freimund and Iree Wheeler in the Department of Environment and Society at Utah State University. This research gaps analysis was intended to supplement the visitor use monitoring conducted by a team of researchers from Utah State University in 2021, and to inform future visitor use management planning efforts.

Figure A.1 Elements and Steps of the visitor use management framework

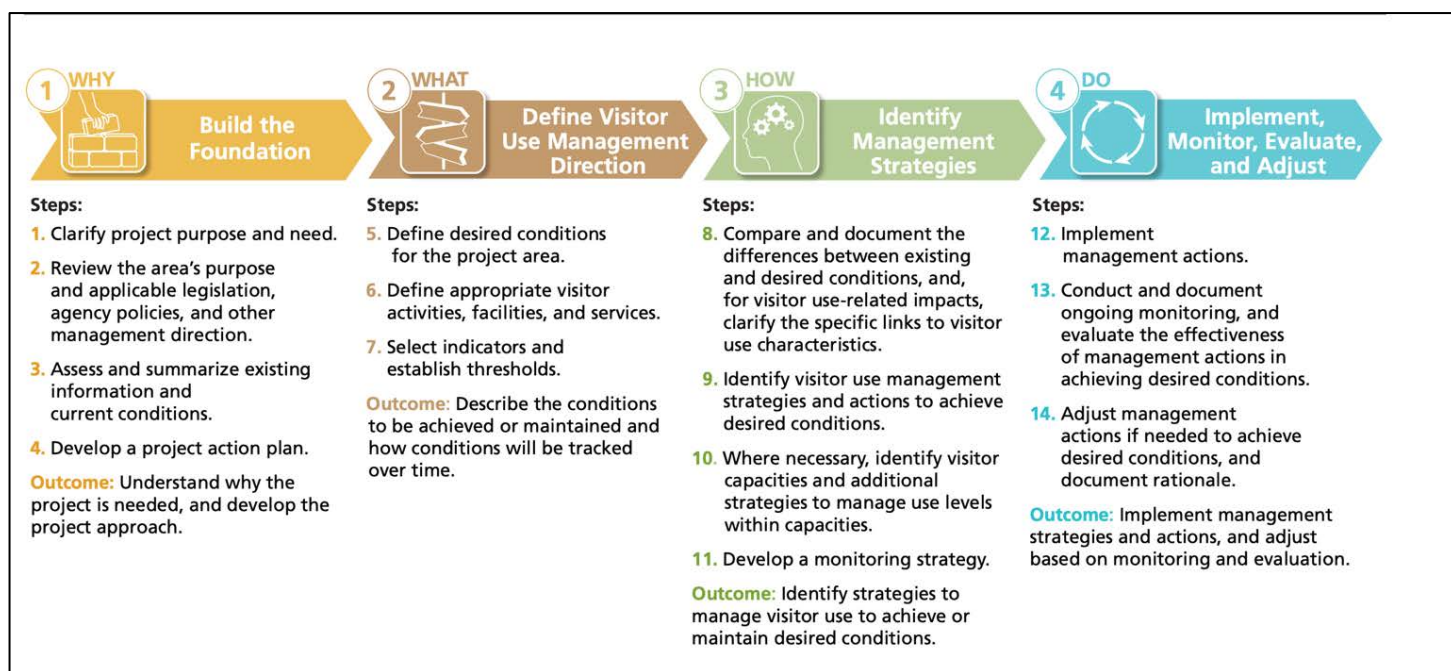


Table A.1 Overview of existing management plans and visitor experience documents

Document Title	Date	Document Summary
University of Idaho Park Studies Unit <i>Craters of the Moon National Monument and Preserve Visitor Study</i>	2004	Provides the results of a study conducted in July of 2004. 83% response rate and 426 questionnaires distributed. Most groups were 2-4 people (78%), 78% were also first-time visitors. This survey identified that 94% of respondents rated the quality of visitor services as very good or good. At the time of this study the facilities were ranked high and crowding metrics were favorable with almost nonexistent crowding conditions, 0% of visitors reporting feeling very crowded at some point and 5% feeling somewhat crowded, and 50% saying they were very uncrowded.
National Park Service <i>Craters of the Moon Proposed Management Plan/Final EIS Management Plan</i>	2007	Replaces existing management planning documents. This document addresses plans for visitor services such as the types of visitor facilities to provide, the types of roads and trail access, the extend and location of public use and the desired visitor experiences, as well as the authorized uses. Four Park zones are identified: the front country, passage, primitive, and pristine zones. Four alternatives were proposed and Alternative D was selected which emphasizes protection and restoration of physical and biological resources and processes.
University of Idaho Park Studies Visitor Survey Card	2015	A survey of National Park Service visitors in compliance with the Government Performance and Results Act. Questions regarding satisfaction with the quality of facilities, services, and recreational opportunities. Overall visitors rated the quality of facilities, services, and recreational opportunities at CRMO as very good (79%). The metric calculated by the authors identified overall visitor satisfaction in FY15 at CRMO to be 100% (average evaluation score of 4.8). Study response rate (86%) and sample size (N=321).

National Park Service <i>Foundation Document</i>	2014	Provides basic guidance for planning and management decisions. Staffing and funding needs include: increased staffing and NPS presence in the expanded area to address concerns regarding safety, illegal access, and ORV use. High priority planning and data needs include a Cave management plan, Kings Bowl Development Concept Plan, Wilderness Stewardship Plan, and Resource Stewardship Strategy. Visitor use data for the Kings Bowl area was also identified as a need.
National Park Service <i>State of the Park Report</i>	2016	An overview report that uses existing documents to identify the condition of the park's significant resources and values. There is a visitor experience section which reviews the state of the following: number of visitors, visitor satisfaction, interpretive and education programs, interpretive media, accessibility safety, and partnerships. Conditions were evaluated as good, moderate, or significant concern, and trends were evaluated. All of the visitor experience components were in good condition and either trended stable (unchanging): number of visitors, visitor satisfaction, and safety; or were improving: interpretive programs and media, accessibility and partnerships. 200,525 visitors in 2013 is higher than the 10-year average of 199,693 visitors for 2003–2012.
National Park Service <i>Craters of the Moon National Monument and Preserve Long-Range Interpretive Plan</i>	2017	A long-range plan for the interpretive services, facilities, and media content at CRMO. It recommends future actions and audiences for the monument for the next 5-7 years. This plan identifies desired visitor interpretive experiences and identifies the current audience of CRMO to be: "Since the mid-1960s, overall park visitation has remained about 200,000-250,000 visitors per year. The 2004 Visitor Study provides the most current visitor demographics, and indicates that most visitors are over the age of 45 ... Visitors may spend three to four hours visiting the park stopping at the visitor center and driving the tour road. They are often traveling through the area between stops at other parks or destination locations."
National Park Service and Utah State University <i>CRMO Visitor Use Monitoring Project: Report on 2021 & 2022 Data Collection Efforts</i>	2022	A summary report that outlines methods used, and data collected during preliminary visitor use monitoring. In this study parking lot capacity and length of visit were monitored during the summer 2021 season at the Caves, Tree Molds/Wilderness Trailhead, Spatter/Snow Cone, Inferno Cone, Devils Orchard, North Crater, and Visitor Center parking lots. Road counters were used to monitor visitor flow on the scenic loop road at the Fee booth, Devils Orchard, and on the One-way loop road. Trail use numbers were also collected in 2021 on the North Crater, Devils Orchard, Tree Molds, Broken Top, Wilderness, and Caves Trails. During the summer 2022 season additional trail monitoring was conducted on the Caves trail. Recommendations for future visitor use and experiences studies as well as related indicators are identified.

Table B.2 Management Zones from the 2007 Craters of the Moon Proposed Management Plan/Final EIS Management Plan

	FRONTCOUNTRY ZONE	PASSAGE ZONE	PRIMITIVE ZONE	PRISTINE ZONE
Basic Concept	The Frontcountry Zone would be defined by structures and grounds provided for visitor support services such as information, education, and recreation. Access would be easy and convenient, and the visitor encounter rate would be very high. High maintenance and intervention would be required to accommodate concentrated visitor use. Challenge and adventure would be less important compared to other zones. Zone corridor would be 660 feet wide along roads.	The Passage Zone is intended to accommodate the flow of people and vehicles from one place to another and to provide the minimal accommodations such as parking, trailheads, primitive campsites, and information kiosks or signs for people preparing to venture into the Primitive and/or Pristine Zones of the Monument. Where the zone is only a narrow corridor following a road (660 feet wide), the expectation is that particular road will be maintained to a consistent standard along the length of the corridor, normally a Class B or Class C road from one end of the corridor to the other.	The Primitive Zone would provide an undeveloped, primitive and self-directed visitor experience, while accommodating motorized and mechanized access on designated routes. Facilities would be rare and provided only where essential for resource protection.	The Pristine Zone would include mostly lava flows, designated Wilderness and Wilderness Study Areas. This zone would provide an undeveloped and self-directed visitor experience, generally without motorized or mechanical access. Facilities would be non-existent.
Visitor Experience	High chance for encounters with people. Travel on paved, improved, or maintained roads. Developed campgrounds. A high level of interpretation programs; informational exhibits. Diverse trail system, some paved. Low chance for encounters with livestock or associated developments. High level of contact with agency staff. Typical visitor activities: sightseeing, driving, bicycling, walking, nature study, ranger-led programs, camping, picnicking.	Medium chance for encounters with people. Travel on higher level of maintained roads than the Primitive Zone. Rustic, designated campsites. Limited interpretation, wayside exhibits. Multiuse, maintained, and designated trails. High chance for encounters with livestock or associated developments. Low to moderate level of contact with agency staff. Typical visitor activities would be driving, sightseeing, hiking, mountain biking, horseback riding, dispersed camping.	Low chance for encounters with people. Travel on low-standard roads with challenging driving. No developed campsites; dispersed primitive camping. Minimal on-site interpretation. Low-standard multiuse trails with little or no maintenance. Medium chance for encounters with livestock or associated developments. Very low level of contact with agency staff. Typical visitor activities would require self-sufficiency: hiking, hunting, horseback riding, mountain biking, remote camping, driving on unimproved roads.	High chance for solitude. Travel involves challenging conditions and no roads. No developed campsites; dispersed primitive camping. No on-site interpretation. Very few trails. Low chance for encounters with livestock or associated developments. Essentially no contact with agency staff. Typical visitor activities would require self-sufficiency and involve challenge, risk, and adventure: dispersed camping, backpacking, nature study, and hunting.
Access and Kinds of Development	Paved roads and high-standard gravel roads. Hardened and maintained pedestrian trails. Frequent signs for directions, safety, and interpretation. Offices, utilities, maintenance facilities, storage areas, visitor center, employee housing, and restrooms.	Class B-D roads. Some arterial roads would be regularly maintained to allow seasonal car, SUV, light truck passage. Trailheads; maintained motorized and non-motorized trails. Signs for directions, safety, resource protection, and interpretation. Minimal administrative structures, vault toilets.	Class C-D roads. Dirt roads, accessible seasonally only with high-clearance vehicles and OHVs. Low standard multiuse trails. Minimal signs for visitor safety and resource protection only. No buildings.	No roads. Very few trails; no motorized trails. Very few signs. No buildings.

Table B.2. presents management zones, the associated visitor experience, desired conditions, and levels of development included in the 2007 CRMO management plan. The indicators proposed in this document are grounded in the desired conditions outlined in this table.

Indicators

The Craters of the Moon National Monument and Preserve Proposed Management Plan (2007) outlines desired visitor conditions. In the 2004 visitor survey that was conducted by the University of Idaho and the NPS, visitors were asked about their satisfaction with facilities and whether they experienced any crowding in the existing facilities. At this time, visitors reported no, or very low crowding and high satisfaction with available facilities and the management plan identified that visitation had not reached a point where visitor experience or resources were impacted. The methods used in the 2004 visitor survey should be reproduced to determine if there are any changes in crowding and facility satisfaction in that past 19 years.

Description of Indicators (From the IVUMC)

An indicator is a specific measure or observable condition used to track how well desired conditions are being maintained in a project area. Indicators are selected during the visitor use management process to help determine if management actions are achieving the desired outcomes for the area. By tying indicators to zone descriptions or other expressions of desired conditions, they serve as a mechanism for monitoring change in those conditions. They are part of the framework for managing visitor use on federally managed lands and waters (IVUMC, 2016). Indicators are closely tied to thresholds, which define the limits of acceptable change to the resource conditions or visitor experiences.

- Indicators should be specific to the desired visitor experience and management objectives.
- They must be measurable and sensitive to changes in the quality of the visitor experience.
- Indicators should be manageable, meaning they are sensitive to and can be influenced by management actions.

There are three general categories of indicators generally used in Visitor Use Management on federal lands:

1. **Resource-Based Indicators:** These could involve the condition of trails or campsites.
2. **Social Indicators:** These might include measures of crowding or encounters with other visitors.
3. **Experience-Based Indicators:** Such as visitor satisfaction or the ability to find solitude.
 - These indicators help managers maintain or achieve desired conditions for visitor experiences by providing a way to measure and monitor changes over time.

Properties of a good indicator include:

- **Connected to visitor use:** Can the trend created from monitoring information demonstrate a correlation to visitor use or to an aspect of the setting that is important to achieving the desired conditions?

- **Importance:** Is the indicator highly relevant to the desired conditions? Will the indicator provide useful information to inform management decisions? Is it a good fit with the desired experience?
- **Sensitive to change:** Is the indicator sensitive enough to provide useful and timely information to managers so that management action can be taken?
- **Reasonable:** Is the indicator related to an existing monitoring effort, or can it be reasonably or feasibly monitored with existing staff or partners?
- **Reliable:** Can the indicator be monitored accurately and yield the same result if measured by different people (i.e., does the observed change in conditions reflect a true change rather than a measurement error)?

What are Thresholds in the context of public land visitor use management?

Thresholds are specific limits for indicators that define the point at which resource conditions or visitor experiences are considered unacceptable. They are used to identify when management actions should be taken to prevent or mitigate negative impacts on resources and visitor experiences. Thresholds help ensure that visitor use is managed in a way that maintains desired conditions.

Guidelines for defining effective thresholds:

- **Precision:** Thresholds should be precise, providing clear benchmarks for when conditions are unacceptable.
- **Time-Bounded:** They should be time-bounded, reflecting the fact that conditions can change over time.
- **Outcome-Oriented:** Thresholds should be outcomes of recreation use rather than types or amounts of recreation use themselves.

These guidelines help ensure that thresholds provide meaningful and actionable information for managing visitor use. It's also important to note that thresholds should be periodically reviewed and adjusted as needed to reflect changing conditions and management objectives.

Table C.3 Potential Indicators for Craters of the Moon National Monument and Preserve

Potential Indicator	Applicable Zone	Important	Sensitive	Reasonable	Reliable	Data Available	Data Needed
Parking availability	1-2	likely	yes	yes	yes	Parking lot fill percent in 2021 and 2022 data report	Visitor perception of parking. Visitor coping behavior when lots are full
The number of days that parking lots fill	1-2	likely	yes	yes	yes	Parking lot fill percent in 2021 and 2022 data report	Visitor perception of parking. Visitor coping behavior when lots are full
Wait time in queue to enter CRMO	1	possible	yes	yes	yes	Traffic counters at the entrance	Measurement of queuing time at park entrance.
Proliferation of social trails	1	possible	maybe	yes	maybe	Research team not aware of any existing social trail monitoring	Visitor perception of social trails (?), Existing social trail inventory, periodic additional trail assessments
Encounters with other visitors	1-4	likely	yes	yes	yes	No existing data we are aware of	Visitor perceptions of encounters with others on the trail, Monitoring of visitor encounters
Campsite Availability	1	possible	yes	yes	yes	Existing campsite capacity information	All required data should be available by reviewing campsite occupancy reports
Encounters with Livestock	2-3	possible	maybe	yes	maybe	No existing data we are aware of	Visitor perceptions of livestock encounters (?)

Parking related Indicators

Both parking availability and the number of days parking lots fill have good potential as indicators. They are relatively easy to measure, sensitive to changes in visitation patterns, reasonable for managers to monitor and lend themselves to measurements that are reliable over time. Existing data and models found in this report can be used as both a baseline understanding of parking conditions and a way to predict a future range of conditions. Parking related indicators could be written in several formats including availability of desired parking, wait time to secure parking, presence of overflow parking, etc. The one missing piece relative to parking as a measure is how visitors perceive it both as a relevant part of their experience and the quality of current and future access to parking. Thus, the data needed would be gained through a visitor perception study that presents scenarios related to parking to visitors and gains insight into the coping behaviors they may employ relative to each scenario.

Entrance Wait Times

Queuing times for park entrance have emerged as a useful indicator in some situations. At CRMO, there is good data available that makes this a possible option. For example, entrances at the gate are logged and time stamped. There are also traffic counters just past the gate and at the visitor center. Finally, modelling presented in this report demonstrate the relationship between traffic in the park relative to traffic on the highway. To make this indicator feasible, the models would need to be adjusted to determine the relationship between levels of road traffic and the time it takes to process an individual entrance. With these metrics, it would be possible to calculate queuing times based on levels of traffic. This would involve an observation study to assess processing time across gate attendants, time of day and through various conditions that could affect processing speed.

Encounters with Visitors

The frequency of encounters with other visitors has the potential to be an easy to accomplish and useful indicator. This indicator is relatively easy to measure using feedback from visitors through a survey instrument. The frequency of encounters with other visitors is likely relevant to visitor experience desired conditions in all of the zones identified in the 2007 CRMO management plan. This indicator is also sensitive to change, can be feasibly evaluated as part of a larger visitor survey effort, and is relatively reliable. Note that the reliability of encounter reports may vary between visitors, but a sufficient survey sample size would alleviate these reliability concerns. This indicator may vary in applicability between zones outlined in the management plan. Additionally, CRMO management should identify specific levels of encounters for the desired visitor encounter experiences identified. For example, more information regarding what high, medium, and low chances for encounters with people (frontcountry, passage, and primitive zones), and high change for solitude (pristine zone) mean should be identified before attempting to monitor this indicator.

Social Trail Indicators

The number of new social trails in the frontcountry zone has some potential as an indicator. This is relatively easy to measure, however, this potential indicator can be challenging to measure consistently across ecological zones and can be subjective between people. For example, the impacts of footsteps and sensitivity to disturbance may vary between ecological zones and ground cover type, with some areas of CRMO being more durable than others. Additionally, the classification of a new social trail may be subjective between observers, leading to challenges with reliability. If managers at CRMO determined a specific scale and substrate of concern, this indicator is potentially feasible. Once specific areas and substrates were identified, baseline conditions would need to be assessed using social trail inventorying techniques. Once initial social trail frequency is identified, the number of new trails could be monitored frequently. The frequency of social trail monitoring is dependent on multiple factors including, the sensitivity of the ecological zone, the frequency and potential increase of visitor use to that area, and the desired conditions of managers. Beyond these ecological monitoring components, visitor preferences and perceived influence of social trails on visitor experience could be evaluated through a survey instrument.

Campsite Availability

Frontcountry campsite availability is a highly feasible and easy to define indicator. The existing number of nights each season when the campsite reaches capacity could be used to measure campsite availability and demand. This indicator has the potential to be important for understanding changes in overnight visitation. Additionally, a high campground occupancy may indicate high use throughout the frontcountry zone and could trigger monitoring of other indicators such as social trail proliferation, parking, and entrance wait time. This data is likely readily available from existing information that the park collects.

Encounters with Livestock

In the 2007 CRMO Management plan, potential for encounters with livestock or associated developments was identified as a component of visitor experience that will vary between zones. In the frontcountry and pristine zones, where the chance of encounters with livestock is low, this indicator may be less important and sensitive than in the passage and primitive zones, where the change of encounters are high or medium. This indicator has the potential to be reasonable to monitor and reliable in the passage and primitive zones, if a visitor survey is conducted in these zones question regarding livestock encounters could be included. Some things to consider with this potential indicator include priority locations for visitor experience surveys. Due to current levels of use the frontcountry zone (where livestock encounter chances are low) is recommended as a higher priority for a survey effort than the passage and primitive zones. Additionally, there may be specific seasons when livestock and associated developments are higher than others. Because of these seasonal patterns, consideration should be given to the overlap between the high visitation season and the season when livestock interactions are likely when evaluating the reliability of this indicator.

Data Gaps and Needs

CRMO is the enviable situation in which it has access to quite manageable indicators of quality, visitation levels that do not exceed the physical capacity of the park, and excellent monitoring data to provide a baseline for decision-making. To move forward and its visitor management planning process, two forms of data would be quite useful to fill out the already exceptional understanding of visitor use flows within the park.

A Visitor Use Study

The purpose of this visitor use study is to assess the current conditions and visitor experiences at Craters of the Moon National Monument and Preserve (CRMO). The study will address the following objectives:

- To measure visitor perceptions of parking availability, trail congestion, manager presence, and interpretive information quality. This will help in ensuring that the final indicators chosen are truly relevant to the visitor experience.
- To obtain updated information on visitor characteristics, such as demographics, trip duration, group size, and activities.
- To understand how CRMO fits into visitors' broader travel plans, such as their origin, destination, and other stops along the way.

- To explore visitors' specific motivations for visiting CRMO, such as their interests, expectations, and preferences.
- To identify visitors' desired conditions for their visit, such as their satisfaction, enjoyment, and sense of place. This would include perceptions of cows on the road, and ecological impacts such as social trailing.
- To develop an understanding of the visitors' normative perceptions relative to the selected indicators. This data would assist managers in developing thresholds relative to the indicators.

The study would likely use a mixed-methods approach. For example, it could combine quantitative and qualitative data collection techniques, such as surveys, interviews, observations, and focus groups. The study will provide valuable insights for managing visitor use and enhancing visitor experiences at CRMO.

An Observation Study

An observation study is a method of collecting data by observing and recording the behavior and conditions of interest. This could be a low impact study that would complement the existing monitoring efforts at Craters of the Moon National Monument and Preserve (CRMO). The observation study would aim to address the following issues:

- Queuing time at the entrance station: This would measure how long visitors have to wait in line to enter the park and how this affects their experience and satisfaction. The primary variable to focus on would be the time it takes to process each vehicle when it enters.
- Overflow parking: This would track how often and where visitors park outside the designated parking lots when they are full and how this impacts the traffic flow and safety.
- Ecological impacts: This would assess the extent and severity of social trailing, which is the creation of unofficial trails by visitors, and how this affects the natural resources and habitats. The result of this study would be an inventory of the existing social trails. Information of this type would guide restoration and perhaps development efforts.
- Cows on the road: This would document the frequency and location of cows crossing or blocking the road and how this poses a risk to visitor safety and wildlife.

The observation study would provide useful information for managing visitor use and mitigating potential impacts at CRMO.

Conclusion

Craters of the Moon National Monument and Preserve (CRMO) is in a favorable situation for managing visitor use and enhancing visitor experiences. The park's infrastructure can accommodate the current visitor demand and has room for growth. Managers have a solid grasp of the park's usage patterns and trends and can rely on predictive models to anticipate the effects of increased visitation on parking and trail access. Moreover, managers have established a set of zone descriptions that define the desired conditions for different areas of the park and the indicators that measure their achievement can be derived from them. These zone descriptions provide a clear framework for managing visitor use and maintaining desired conditions. To complete a visitor management plan, two strategic studies are proposed to address the remaining data gaps. These studies will provide

information on visitor perceptions, motivations, and expectations, as well as the potential impacts of parking issues and social trailing. Their perceptions will assist in deciding which indicators make the most sense as foci for a Visitor Management Plan. Due to ongoing proactive management and data collection, managers can have confidence in their knowledge base and can continue to plan for a sustainable future that meets the park's mission and avoids crisis situations.

Sources

Interagency Visitor Use Management Council. (2016). Visitor Use Management Framework: A Guide to Providing Sustainable Outdoor Recreation (1st ed.). U.S. Department of the Interior, Bureau of Land Management; National Park Service; U.S. Fish and Wildlife Service; Department of Agriculture U.S. Forest Service; Department of Commerce National Oceanic and Atmospheric Administration; Department of Defense U.S. Army Corps of Engineers.

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