MOOSE-WILSON CORRIDOR USE LEVELS, TYPES, PATTERNS AND IMPACTS IN GRAND TETON NATIONAL PARK

TECHNICAL REPORT – SUMMER/FALL 2013 DATA

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EXECUTIVE SUMMARY

This report presents an initial data summary on an interdisciplinary study designed to understand visitor use levels, the types of visitors, and visitor impacts associated with use in the Moose-Wilson corridor. The overall study includes multiple data collection seasons, the first of which took place between July 1 and October 31, 2013. This report includes a summary of descriptive findings from this Summer/Fall 2013 data collection season. Limited data for October is reported here, but it should be noted that the Moose-Wilson corridor was closed to visitor use during the first two weeks of October due to the shutdown of the Federal Government.

METHODOLOGY

The Summer/Fall 2013 data collection season consisted of four sampling periods developed from total vehicle use differences observed in previous studies: July, August 1-15, August 16-31, and two weeks in September. Whenever possible and appropriate, data are summarized based on these four sampling periods in order to examine any changes or patterns seen across the entire data collection season. Various field methodologies—some census-based and some sampling-based—were used simultaneously in order to get a more accurate understanding of visitor use in the Moose-Wilson Corridor. These methods included the use of vehicle tube counters, calibrated trail counters, motion-activated cameras, GPS-tracking of various use types, vehicle traffic pattern analysis, parking lot accumulation counts, and ecological measures of parking and recreation-resource impacts. Each methodological technique used is described in detail in the body of this report.

SIGNIFICANT FINDINGS

OVERALL USE LEVELS

Results from each data collection technique are reported independently. When generalized across all sampling periods, tube-counter results show the Moose-Wilson Road sees approximately 2,000 vehicles per day between July 1 and September 30. On average there were 2.7 people per vehicle. Total use was calculated to about 5,400 (# cars x # people) people entering the corridor each day. Side roads, which include Death Canyon and the Laurance S. Rockefeller (LSR) Preserve Center, each see approximately 200 vehicles per day throughout the summer.

PEAK USE PERIODS

Data from trail counters, vehicle tube counters, and parking lot turnover counts all indicate that the first half of August (1^{st}-15^{th}) was the busiest sampling period throughout the study. For the corridor as a whole, peak use generally occurs between 11am and 2pm without much variation between weekends and weekdays. Although there was some variation by individual location and time of year, this was generally the busiest time for each of vehicle, bicycle, and pedestrian use in the corridor.

VEHICLE USE LEVELS

Results from tube counters, turning movement and automatic traffic recording cameras, and parking lot counts all suggest that peak use in the Moose-Wilson corridor occurs daily between 11am and 3pm, depending on location. Results from the turning movement cameras placed at the intersection of Moose-Wilson Road and Teton Park Road suggest that approximately 21% of traffic on Teton Park Road (from either direction) turns onto the Moose-Wilson Road.

VEHICLE MOVEMENT PATTERNS

In general, traffic levels were nearly equal in both directions at all counters with northbound traffic being slightly higher on the Moose-Wilson Road. The north entrance was the most popular due to its combination of vehicles travelling southbound through and returning upon departure through the north. About 21% of all of the vehicular traffic on the Teton Park Road that passes the Moose-Wilson Road turns onto the Moose-Wilson Road. The most common movement pattern in the corridor was northbound on the Moose-Wilson Road. The north end of the road was the most popular location for the entrance and exit of vehicles. This pattern is the result of much of the traffic in the Moose-Wilson corridor traveling in a northbound direction and a higher number of north entrance/exit loops than south entrance/exit loops. For the minority of vehicles that stopped within the Moose-Wilson Corridor, the LSR Preserve and Sawmill Ponds were the most popular stopping locations.

VEHICLE PARKING PATTERNS

The most popular stopping area in the corridor was Sawmill Ponds Overlook (averaging 40% of cars) followed by the LSR Preserve Center lot (about 20% of cars). More visitors (with at peak use periods, twice as many vehicles) park in the “overflow” areas along the Death Canyon Road than park in the designated trailhead parking lot itself. The period when parking lots were fullest was between 11:00am and 2:00pm. Although it was the busiest parking area, there was no discernable pattern of use at Sawmill Ponds. The LSR Preserve parking lot was the busiest during the later parts of the day (approximately 4:00pm-6:00pm).

USER TYPES

On average, across all sampling periods, 17 % of vehicles in the corridor were visitors with local (Teton County) license plates while the other 83% were considered non-local visitors (license plates other than WY-22 or WY-22 rental vehicles). In parking areas, on average and across all sampling periods, 24% of vehicles were local and 76% non-local. Overall average percentage of local use in designated parking lots in the Moose-Wilson corridor increased in September compared to the other sampling periods. Sawmill Ponds and Granite Canyon saw the highest level and change in level of local use in September. The LSR Preserve and Poker Flats had the highest percentage of local use during the August 16-31 sampling period. Death Canyon had fairly consistent local use throughout the sampling periods, ranging from 25% to 30% of observed vehicles having local plates.

TIME SPENT IN THE CORRIDOR

The majority of vehicle and bicycle use on the Moose-Wilson Road passes through the corridor without stopping at a destination and spends less than one hour total in the corridor. In many cases, the total time in the corridor is less than 30 minutes. For example, across all sampling periods, GPS tracking of vehicles indicates that 54% of vehicles passed through without stopping at a destination. There was not a significant difference between locals and non-locals in time spent in the corridor.

GPS-tracking of vehicles indicates that the median duration time in the corridor is 27 minutes and that the level of northbound through traffic is slightly greater than the level of southbound through traffic. GPS-tracking was also used to determine stopping patterns of vehicles and, for the minority of vehicles that did stop within the Moose-Wilson Corridor, the LSR Preserve and Sawmill Ponds were the most popular stopping locations. Visitors who leave their cars and hike on trails spend on average 2 hours and 30 minutes recreating at their destination in the Moose-Wilson Corridor.

BICYCLE USE LEVELS, PATTERNS AND TYPES

Bicycle GPS tracking shows that 74% of bicyclists rode straight through the corridor without stopping with most riders travelling southbound. Results from turning movement and automatic traffic recording cameras indicate that bicycles were between 2% and 3% of total use (depending on sampling period) entering at the Granite entrance and less than 1% of total use entering from the Moose-Wilson Road Teton Park Road intersection. Like overall use, the highest level of bicycle use was observed during the first sampling period in August (1^{st}-15^{th}). More bicycles entered and more cyclists exited the Moose-Wilson Corridor via the Moose-Wilson Road and Teton Park Road intersection versus entries or exits

from the Granite entrance station. Bicyclists had a median duration time of 40 minutes in the corridor. The most dominant type of bicyclist observed on both the Moose-Wilson Road and the Snake River Bridge pathway was single rider, road cyclists.

PEDESTRIAN USE LEVELS, PATTERNS AND TYPES

The highest pedestrian use was found just past the LSR Preserve Center on the bridge before the trail system splits. The next highest level of pedestrian use occurred at the bridge just past the LSR Preserve Center parking lot which serves the Center and the LSR Preserve trail network. The Valley Trail at the south park boundary near Teton Village received the lowest level of use with only 2,499 counts during the entire collection effort. Overall, the busiest pedestrian sampling period was the first half of August (August 1st-15th). In most cases visitor use levels do not vary substantially between weekends and weekdays. Overall, the Death Canyon Trailhead was much busier than Granite Canyon with Death having over double the amount of day and overnight use.

The most popular pedestrian destination across all sampling periods was the Valley Trail section west of Phelps Lake Overlook (53% of GPS-tracked pedestrians hiked a portion of this trail), followed by the eastern shore of Phelps Lake (46% of GPS-tracked pedestrians spent time on the shore of Phelps Lake). There were no GPS-tracked hikers that travelled up into Open Canyon itself. At Sawmill Ponds, summarizing across all sampling periods: 31% of parking visitors never left their vehicle, 43% left their vehicles but remained in the parking lot area, 19% wandered just outside the boundaries of the lot with only 5% “hiking” well away from the parking lot. The average group size for pedestrians was 3 people per group.

VISITOR USE IMPACTS

A total of 183 individual overflow/visitor-created parking areas were found in the Moose-Wilson corridor with a total combined area of 8690 m^2 (about 2 acres) of disturbance. Of those, 6130 m^2 (70%) were found along the Moose-Wilson Road with the remaining 2568 m^2 (30%) found along the Death Canyon Road. Of all the areas, those along the Moose-Wilson Road had the highest average level of impact as defined by the average condition class ratings assigned to the sites. All visitor-created parking areas along the DCR were found above the end of the paved section. These user created disturbances seemed to be of three origins: passing areas, avoidance of hazards, and parking areas. Parking lot accumulation counts for overflow parking areas indicate that Death Canyon Road had the highest use of these overflow/visitor-created parking by vehicles. The density of overflow/visitor-created parking was higher along Death Canyon Road than the Moose-Wilson Road. Overall, the overflow/visitor-created parking areas were of moderate level of impact with about 50% vegetation loss at these sites.

Based on data from GPS-tracking of pedestrians and trail counters, the most popular destinations for hikers in the Moose-Wilson Corridor were Phelps Lake Overlook and the shore of Phelps Lake. Recreation-related resource impacts, such as the presence of informal trails and visitor-created sites,

were found at these two locations. The highest level of impact was found at Phelps Lake Overlook and "Jump Rock." Sawmill Ponds, the most popular location for vehicle stopping according to results from GPS-tracked vehicles, contained primarily recreation-related resource impacts in the form of visitor-created trails. These impacts exist despite the observation that the majority of visitors to Sawmill Ponds either do not leave their vehicle or walk out of the parking lot area.

The remainder of this report contains basic methodology and detailed summaries of all findings from the Summer/Fall 2013 data collection season. Several appendices are referenced throughout the document, which contain supporting materials and maps to help illustrate the findings.

INTRODUCTION

This document is the technical report of findings from the Moose-Wilson Corridor Use Levels, Patterns and Impacts in Grand Teton National Park 2013 data collection effort. All data was collected and analyzed by Utah State University, with the exception of trail counter and trail camera data, which was collected by GRTE and analyzed by Utah State University. This document describes the methodologies used in the field and results from the 2013 data collection season, which occurred from July 1 through September 30. A summary of salient data findings is provided.

The Moose-Wilson corridor (MWC) in the southwest corner of Grand Teton National Park (GRTE) is an outstanding representation of the park's major natural ecological communities, all of which are located within a geographical area that is about seven miles in length, five miles in width, and about 10,300 acres in size. These natural communities include alpine, subalpine, forests, sagebrush flats, wet meadows and wetlands, lakes, rivers, and ponds, and an associated diversity of fish and wildlife. The MWC is enclosed roughly by the Teton Range to the west, the Snake River to the east, the community of Moose to the north, and the park's Granite Canyon entrance to the south.

The corridor contains several primary visitor use areas, including Death Canyon and Granite Canyon trailhead parking areas, Laurance S. Rockefeller Preserve, White Grass Dude Ranch and Murie Ranch historic districts, and Sawmill Ponds overlook. Other visitor use areas include Poker Flats horse trails and the Snake River levee road. The Moose-Wilson Road is the primary access point to destinations within the corridor and extends 7.1 miles northward from the terminus of Wyoming 390 at the Park's Granite Canyon entrance to Teton Park Road at Moose. The narrow, winding, partially gravel road provides access to the south end of Grand Teton National Park and a rustic, slow driving experience for visitors looking for exceptional scenery and wildlife viewing opportunities. Some residents and visitors also use the road as an alternative route to the airport and other destinations within or beyond the park during the summer months. With increasing vehicle traffic volumes, congestion along this narrow, rustic country road has become common. This observation has raised concerns about the protection of wildlife and other resources, visitor safety, visitor experience, and the effectiveness of park operations. The road is open seasonally from approximately May 1 to October 31.

The goal of this project is to collect data about levels, types, patterns and site-specific impacts of visitor activities in the corridor. These data will inform the park's planning process, which will assess the type and level of visitor use that can be accommodated while sustaining the desired resource conditions and visitor experience within the Moose-Wilson corridor. In that planning effort, the National Park Service will use this and other information to develop and evaluate a range of alternatives that considers a variety of management strategies within the corridor, aimed at achieving desired future conditions. The alternatives will be developed and evaluated through a planning process that engages the public and results in a long-term approach for corridor management.

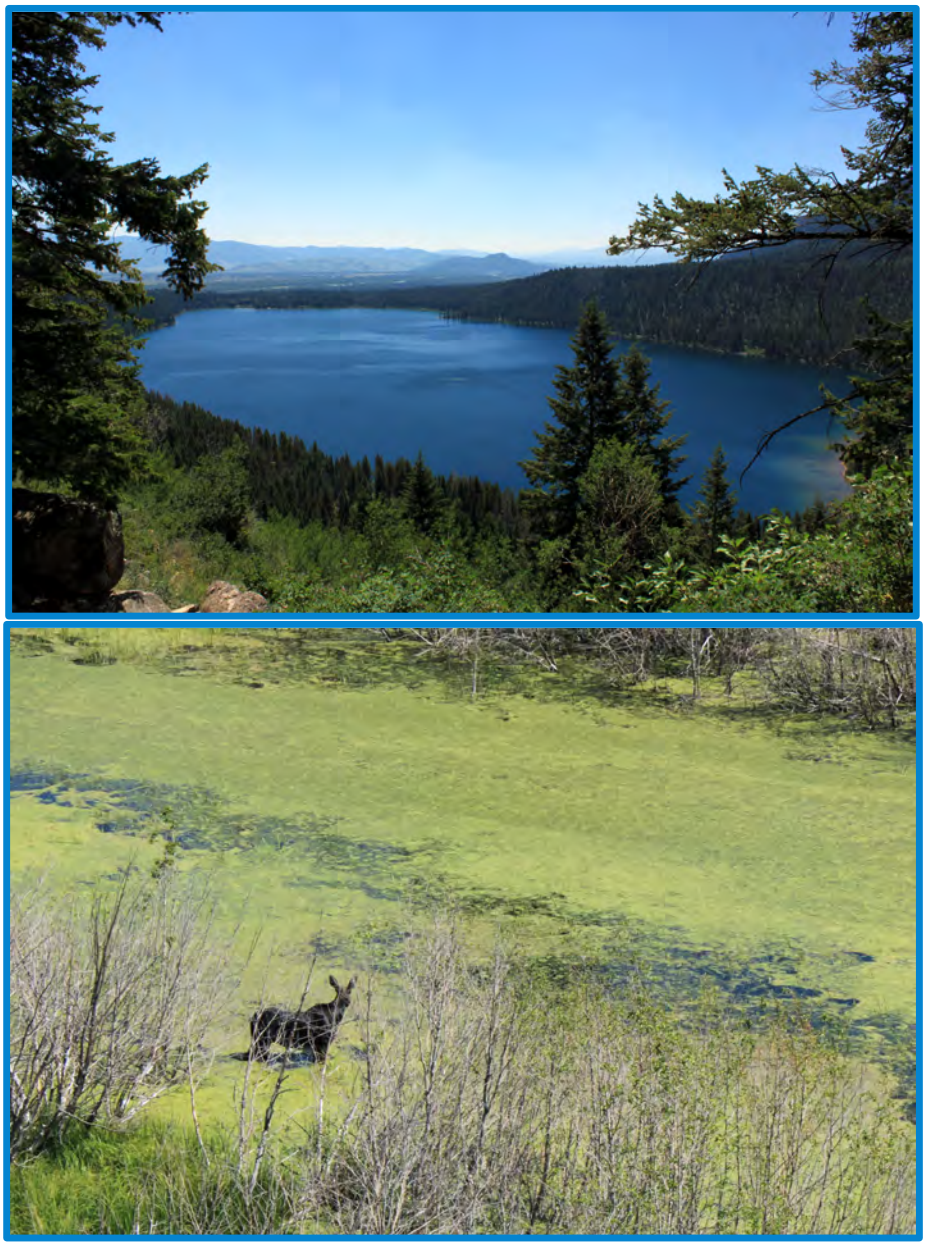


Figure 1: Top photo of Phelps Lake, a popular destination in the Moose-Wilson corridor. Bottom photo, a moose in the ponds at Sawmill Ponds overlook (photos by Ashley D'Antonio).

STUDY AREA

The Moose-Wilson Road (Figure 2) extends 7.1 miles northward from the terminus of Wyoming 390 at GRTE's Granite Canyon entrance to the Teton Park Road at Moose. It contains the full extent of both the Moose-Wilson and Death Canyon Roads. Data collection types categorize specific study site locations. Both the extent of the project study area and the location of specific data collection activities were developed in consultation with National Park Service (NPS) staff and were fully vetted in the data collection plan (Monz, D'Antonio and Heaslip 2013).

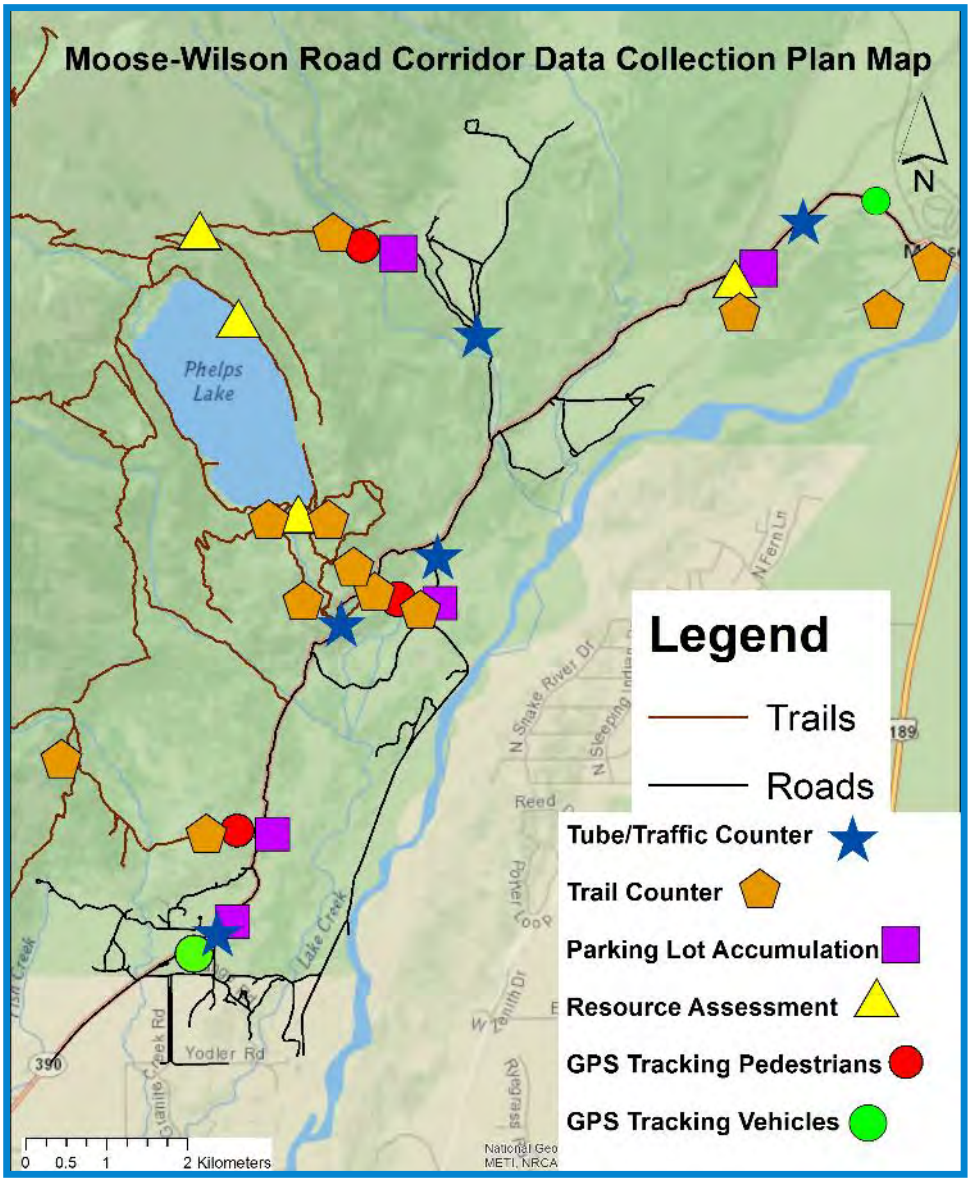


Figure 2: Data collection locations and needs for Moose-Wilson corridor study area (Summer/Fall 2013).

DATA COLLECTION NEEDS AND METHODS

SAMPLING PERIODS

Certain data collection approaches are more suitable for random sampling while other measures are continuous throughout the study from July 1 through September 30th. (Table 1 lists specific details and locations of tasks). An October sampling period was scheduled for 2013, but the federal government shutdown precluded any study activities in GRTE. Periods of random sampling were selected to reflect seasonal variations in total use of the corridor based on previous studies (McGowen et al., 2009). Note that all data collection activities did not occur on all days in the sampling period, but results will be generalized to these periods as appropriate. See Appendix A for full sampling schedule. With the exception of continuous counts (such as those from vehicle tube counters and infrared trail counters), sampling intentionally did not occur on holidays.

Period 1: July (22 randomly selected days throughout the month)

Period 2: August 1-15 (12 random days during this period)

Period 3: August 16-30 (11 random days during this period)

Period 4: September (10 random days, post Labor Day)

DATA COLLECTION DETAILS

Table 1: Summary of all data collection, basic methodology and sampling approach for each data need, and data collection-specific site locations

Information Need	Data Collection Approach	Time Frame	Locations
Visitor Flow Measurements			
1. Number of Vehicles on Roads	Directional tube counters (MetroCount) & Electromagnetic Counters (TRAFx)	Continuous counts until road closure	▪ LSR Preserve Center Road ▪ Death Canyon Road at Y with White Grass Access Road ▪ On Moose-Wilson Road at: ▪ Granite entrance ▪ North entrance (@Teton Park Road (TPR) ▪ Adjacent to the Woodland Trail crossing ▪ Murie Ranch Road
2. Vehicle Type	Video Sampling (license plate recognition*)	Stratified Random Sampling	▪ Granite entrance ▪ North entrance (@TPR)

3. Vehicle Movement Patterns and Turning Movements	GPS tracking Video Sampling	Stratified random sampling	▪ Granite entrance ▪ North entrance (@TPR) ▪ Turning Patterns at LSR Preserve and North entrance (@TPR)
4a. Number of Bicycles in MWC	Video Sampling	Stratified Random Sampling	▪ Granite entrance ▪ North entrance (@TPR)
4b. Number of Bicycles Park Shared-Use Path	Automated counters	Continuous	▪ East of Snake River Bridge @ Moose
5. Bicycle Use Types	Video Sampling and Observation Motion Activated Camera (Pathway)	Stratified Random Sampling Stratified Random Sampling of Census Data (Pathway)	▪ Granite and North entrances ▪ Shared use pathway near Moose
6. Bicycle Movement Patterns	GPS Tracking	Stratified Random Sampling	▪ Granite entrance ▪ North entrance
7. Number of Pedestrians on Trails	Infrared trail counters (TRAFx and Diamond types)	Continuous	11 locations: ▪ Murie Ranch Trail (TRAFx) ▪ Sawmill Ponds Overlook Trail (TRAFx) ▪ Death Canyon Trailhead (TH) (Diamond) ▪ LSR Preserve Center Parking Lot (at foot Bridge) (TRAFx) ▪ LSR Preserve trails (near trails near waterfall) (Diamond) ▪ LSR Preserve Lake Creek Trail MWR crossing (Diamond) ▪ LSR Preserve Woodland Trail MWR Crossing (Diamond) ▪ LSR Preserve East Lake Trail (Diamond) ▪ LSR Preserve West Lake Trail (Diamond) ▪ Granite Canyon TH (Diamond) ▪ Valley Trail near south park boundary/Teton Village (TRAFx)
8. Pedestrian Movement Patterns and Use Densities	GPS tracking	Stratified Random Sampling	▪ Granite Canyon TH ▪ LSR Preserve ▪ Death Canyon TH
9a. Parking Lot Accumulation	Observation	Stratified Random Sampling	▪ Granite Canyon TH ▪ Poker Flats Horse Use Parking ▪ LSR Preserve ▪ Death Canyon TH ▪ Sawmill Ponds/Overlook
9b. Overflow Parking Accumulation	Observation	Stratified Random Sampling	▪ Granite Canyon TH ▪ Death Canyon TH ▪ Poker Flats Horse Use Parking

10. Use Levels on Levee Road and Murie Ranch	Infrared Counters & Motion Activated Camera	Census	▪ Levee Access Road ▪ Murie Ranch Road
Impacts to the Natural Environment			
11a. Visitor-created parking areas along roadways- location and extent	Sub-meter GPS; ocular estimation	Census along roadways early season and rapid assessment in October	▪ M-W Road; Death Canyon TH road
11b. Overflow parking and visitor created trails at designated parking locations	Sub-meter GPS; ocular estimation	Census at select locations	▪ Granite Canyon TH ▪ LSR Preserve ▪ Death Canyon TH
12. Backcountry visitor created sites and trails	Sub-meter GPS	Census at high priority locations in study area	• Phelps Lake southern lake shore, "Jump Rock" area ▪ Phelps Lake Overlook ▪ Phelps Lake outlet area shoreline ▪ Sawmill ponds overlook

*These results from the automatic license plate recognition will be combined with the 2014 automatic license plate data and are not reported on in this document.

Figure 3: Field technician, Jess Anderson, preparing to hand out GPS units at the Granite entrance of the Moose-Wilson corridor (photo by Ashley D'Antonio).

DATA COLLECTION METHODOLOGY:

1. VEHICLE USE LEVELS

Number of vehicles on roads was recorded with MetroCount directional tube counters placed at each end, at intermediate points along Moose-Wilson Road, and on side roads to Death Canyon trailhead and the LSR Preserve (see Figure 2) (MetroCount, 2014; Xia and Arrowsmith, 2008). Data was collected 24 hours per day during the study period. Tube counters were provided and installed by Grand Teton National Park, but the data download and data summary were managed by Utah State University. MetroCount software was used to produce summary data that was then compiled by Utah State University. The MetroCount counter on the LSR Preserve road was downloaded by GRTE and provided to Utah State University for summary.

Figure 4: Field technician, Annie Weiler, downloading data from the tube counter on Death Canyon Road (photo by Ashley D'Antonio).

2. VEHICLE TYPE

Video sampling was conducted with Miovision Scout cameras (Miovision, 2014; Xia and Arrowsmith, 2008). Turning movement counts and vehicle classifications (including bicycle counts) were conducted at the intersection of the Moose-Wilson Road and the Teton Park Road, the intersection of the LSR Preserve and the Moose-Wilson Road, and at the Granite entrance station. Video sampling used a stratified random sample at select times during the study period to ensure a representative sample of weekends, weekdays, and times of day. Data was analyzed using manual and automated video analysis methods to report vehicles by type.

Automatic license plate recognition (ALPR) cameras were placed at each end of the Moose-Wilson Road, and 3 days of license plate data was collected. The ALPR data from Summer 2013 is still being analyzed and these 2013 results will be combined with ALPR data from Summer 2014 in the Summer 2014 Technical Report. No ALPR results are summarized in this report.

3. VEHICLE MOVEMENT PATTERNS

Vehicle movement/use patterns were determined using GPS-based methodologies (D'Antonio et al., 2010; Hallo et al., 2012). Garmin eTrex 100 units were deployed to a random sample of visitors in their vehicles as they entered the corridor from either end of the road. Sampling was conducted using a random sample, stratified by sampling period, to ensure representative sample of weekends, weekdays, and times of day. A set number of GPS units were handed out, randomly, during each sampling hour to ensure an even distribution of GPS units across the sampling day. Information about number of individuals in the vehicle, local versus non-local vehicle, and rental vehicle status was recorded. Due to limitations in the size of the research staff, vehicle tracking did not occur on days when pedestrian tracking was occurring. Motorists returned the GPS units upon leaving Moose-Wilson road to field technicians or to drop boxes located at both road exits. Erroneous data points were eliminated from the GPS data before analysis.

Figure 5: Field technician, Eden Williams, intercepting a random visitor at the Granite entrance of the Moose-Wilson corridor and asking them to carry a GPS unit during their visit (photo by Ashley D'Antonio).

Turning patterns at the LSR Preserve and Teton Park Road intersections were determined by video data collection using the Miovision Scout units (Miovision, 2014). License plate recognition was used to determine vehicle duration on the roadway. Video from the Miovision Scout cameras was manually analyzed to determine levels of use and duration of travel for local (WY-22) traffic. The ALPR data from Summer 2013 is still being analyzed and these 2013 results will be combined with ALPR data from Summer 2014 in the Summer 2014 Technical Report. No ALPR results are summarized in this report.

4. BICYCLE USE LEVELS

MOOSE-WILSON ROAD METHOD

Video sampling was used to determine bicycle use numbers. Miovision Scout cameras were placed at each end of Moose-Wilson Road, and sampling occurred using a stratified random approach throughout the study period (Miovision, 2014). This ensured a representative sample of weekends, weekdays, and times of day.

BIKE PATH METHOD

Automatic infrared counters were placed by GRTE on the bike path near Moose (Pettebone et al., 2010; TRAFx, 2014; Xia and Arrowsmith, 2008). These automatic counters ran continuously throughout the study period. A random sample of this census data, stratified by sampling period, was used to calibrate the counter using observational techniques in order to determine bicycle use type (see data collection method #5 below) and counter error. Calibrations were also used to distinguish estimates of bicycle use from pedestrian use and bicycle group size.

Figure 6: Pair of road cyclists using the pathway near the Snake River bridge in Moose, WY (photo from motion-activated camera).

5. BICYCLE USE TYPE

MOOSE-WILSON ROAD METHOD

Video sampling, with Miovision Scout cameras placed at each end of Moose-Wilson Road, was conducted to determine bicycle use type. Video sampling was conducted using a stratified random sample throughout the study period while ensuring a representative sample of weekends, weekdays, and times of day. Videos were manually analyzed to determine bicycle use types.

BIKE PATH METHOD

A motion-activated camera was placed in combination with the infrared camera on the bike path near the Snake River Bridge in Moose (Reconyx, Inc., 2014; Conlon, 2014). The camera took a photo of every use on the pathway. These photos were manually analyzed and user types (bicyclists and pedestrians) were identified.

Figure 8: View of Moose-Wilson Road and Teton Park Road intersection in Moose, WY (photo from Miovision turning movement camera).

6. BICYCLE MOVEMENT PATTERNS

Bicycle use patterns were assessed using GPS-based methodologies (D'Antonio et al., 2010; Hallo et al., 2012). Garmin eTrex 100 GPS units were handed out to all visitors on bicycles that were willing to participate in the study as they approached the corridor access points during vehicle sampling periods. Sampling was conducted using a stratified random sample to ensure a representative sample of weekends, weekdays, and times of day. Information about type of user and number in the cycling group was recorded. Bicyclists returned the GPS units upon leaving Moose-Wilson Road to field technicians or to a drop box which was located at both road exits. GPS tracks were cleaned of erroneous points before data analysis.

7. PEDESTRIAN USE LEVEL

Visitor use counts were collected using trail counters. Trail counters (both Diamond brand and TRAFx counters) were already in place at trailheads and at important trail junctions (Table 1) and provided by GRTE (Diamond Traffic Products, 2014; TRAFx, 2014; Xia and Arrowsmith, 2008). Trail counters collected data continuously throughout the study period. Data was aggregated into hourly bins. Utah State University (USU) field technicians calibrated the counters in hourly periods, randomly, throughout the sampling periods (Pettebone et al., 2010). These observational calibration techniques were used to determine counter error. GRTE staff downloaded the trail counter data, and the raw data was delivered to USU for analysis.

Figure 9: TRAFx counter (on the back of the sign post) located on the LSR Preserve bridge near the LSR Preserve parking lot (photo by Ashley D'Antonio).

8. PEDESTRIAN MOVEMENT PATTERNS

Pedestrian use patterns were examined using GPS-based methodologies (D'Antonio et al., 2010; Hallo et al., 2012). Garmin eTrex 100 GPS units were handed out to a random selection of visitors at Granite Canyon Trailhead, Death Canyon Trailhead, and the LSR Preserve (past the Preserve Center where the Woodland and Lake Creek Trails split) when the visitors started their hike. Combining all sampling locations, a total of between 20 and 30 GPS units were handed out per day. Sampling was conducted using a stratified random sample to ensure representative sample of weekends, weekdays, and times of day. Due to limitations in research staff size, visitor GPS-tracking did not occur on days when vehicle GPS-tracking occurred. Pedestrians returned the GPS units upon leaving the trail system they were hiking on to research technicians or to drop boxes that were located at both road exits (same drop box for vehicle GPS-tracking). GPS tracks were cleaned of erroneous points before data analysis.

9. PARKING ACCUMULATION AND OVERFLOW

Data on level of use in parking lots within the Moose-Wilson corridor were collected in accord with similar studies (Lawson et al., 2003). Designated parking lots are parking areas that were designated, installed, and maintained by GRTE. Overflow or visitor-created parking areas are locations where visitors are parked anywhere outside of this designated area. Data collection protocols and instruments were designed to be similar to the current parking lot data collection occurring at the LSR Preserve so that comparisons can be made among all designated parking lots along the Moose-Wilson road. Parking lot data at the LSR Preserve designated parking lot was collected by the park and delivered to Utah State University for inclusion in this report. An hourly count of number of parked vehicles, number of local vehicles, number of bicycles present, and number of any overflow parking was collected at all designated parking areas along the Moose-Wilson Road Corridor. Overflow parking (also referred to as visitor-created) parking areas referred to locations where vehicles were parked outside of designated parking areas. At some designated parking lots, additional information was collected (see list below). Sampling days were determined using a stratified random sample to ensure a representative sample of weekdays, weekends, and times of day. The location and condition of maintenance features (fences, parking logs, etc.) at designated parking was recorded with a sub-meter Trimble XT GPS and described.

Designated Parking Lots Additional Data Collection:

- Poker Flats Parking Area (number of horses, horse trailers, and direction of travel for horses as they left or entered the parking lot)
- Granite Canyon Trailhead (photographs of the parking area and overflow parking when full)
- Death Canyon Trailhead (photographs of the parking area and overflow parking when full)
- Sawmill Ponds/Overlook Parking Area (documentation of visitor behavior was also be recorded)

10. USE ON THE LEVEE ACCESS ROAD AND MURIE RANCH ROAD

Two infrared counters and motion activated camera pairs were installed by GRTE on the levee access road (north and south ends) to examine the levels and patterns of use on the roadway (Pettebone et al., 2010). Utah State University summarized the data from the levee road counters and also analyzed the camera data to determine visitor type and use levels on the levee access road (Reconyx, Inc., 2014; Conlon, 2014). Data already being collected by the Murie Center at the main office was combined with data from a GRTE-installed trail counter on the trail that connects the ranch to the Craig Thomas Discovery & Visitor Center to determine levels of visitation to the Murie Ranch. USU researchers conducted trail calibrations at the Murie Ranch trail counter. An electromagnetic induction vehicle counter was also installed on the gravel Murie Ranch Road in order to collect vehicle use data (Xia and Arrowsmith, 2008). This vehicle counter collected census data batched in hourly bins similar to that of the other tube based roadway counters in this study.

11. RESOURCE CONDITION OF OVERFLOW/VISITOR-CREATED PARKING AREAS

The location and extent of selected resource changes resulting from overflow and visitor-created parking that were found through ground searches were mapped with a Trimble GPS with sub-meter accuracy (D'Antonio et al., 2013). Measurements included: 1) areas of impact resulting from the parking of vehicles (mapped as area features (polygons) and line features (trails)), and 2) visitor-created trails and sites emanating from overflow and visitor-created parking areas. All features were assessed for resource condition using scale-based ratings systems. Scales included assessments of vegetation cover, soil exposure, and overall condition class. Refer to Table 2 for the condition class rating system, developed specifically for this study, for overflow and visitor-created parking (polygons and trails). Large areas of parking impacts were sometimes mapped as multiple polygons, with an additional layer being added as condition class changed throughout the polygon. Maintenance features (such as rocks or logs) associated with the overflow or visitor-created parking areas were also mapped and identified.

Figure 10: Visitors parked in a visitor-created parking area along the Death Canyon Road (photo by Ashley D'Antonio).

Table 2: Overflow and visitor-created parking area condition class definitions

Condition Class	Vegetation Damage	O Horizon* Loss	Mineral Soil Exposure	Erosion	Presence of Road Substrate
1	Very slight <1%	None	None	None	None
2	Slight <10%	Surface scuffing- some loss evident	Slight <10%	None	None
3	Moderate 10-50%	Moderate loss evident- 10-50%	Moderate 10-50%	Slight	Slight
4	Considerable 51-90%	Considerable 51-90%	Considerable 51-90%	Some	Some
5	Total Loss of cover >90%	Total Loss of Organic Matter	Most of site >90%	Considerable	Considerable

* Surface layer of the soil which contains mostly organic material made up of dead plant and animal residues in various stages of decomposition.

12. ASSESSMENT OF VISITOR-CREATED SITES AND TRAILS

Observable resource impact features were mapped with a Trimble GPS with sub-meter accuracy (D'Antonio et al., 2013). Impact features were defined as: 1) small areas less than 25 m^2 mapped as points; 2) areas of impact > 25 m^2 mapped as polygons, and 3) visitor-created trails mapped as lines. All features were found using ground searches and assessed for resource conditions using scale-based ratings systems. Scales included assessments of vegetation cover, soil exposure, condition class, and susceptibility to recreation use. Refer to Tables 3 and 4 for the condition class rating system used for informal trails and sites.

Areas of Interest:

- Phelps Lake "jump-off" rock area
- Phelps Lake Overlook
- Phelps Lake outlet area shoreline
- Sawmill Ponds Overlook

Table 3: Visitor-created sites condition class definitions

Condition Class	Vegetation Damage	O Horizon* Loss	Mineral Soil Exposure	Erosion
1	Very slight <1%	None	None	None
2	Slight <10%	Surface scuffing- some loss evident	Slight <10%	None
3	Moderate 10-50%	Moderate loss evident- 10-50%	Moderate 10-50%	Slight
4	Considerable 51-90%	Considerable 51-90%	Considerable 51-90%	Some
5	Total Loss of cover >90%	Total Loss of Organic Matter	Most of site >90%	Considerable

* Surface layer of the soil which contains mostly organic material made up of dead plant and animal residues in various stages of decomposition.

Figure 11: Ashley D'Antonio mapping resource impacts at "Jump Rock" on the east shore of Phelps Lake (photo by Annie Weiler).

Table 4: Visitor-created trails condition class definitions

Condition Class	Definition
1	Trail distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter
2	Trail obvious; vegetation cover lost and/or organic litter pulverized in primary use areas
3	Vegetation cover lost and/or organic litter pulverized within the center of the tread, some bare soil exposed
4	Nearly complete or total loss of vegetation cover and organic litter within the tread, bare soil widespread.
5	Soil erosion obvious, as indicated by exposed roots and rocks and/or gullying

ADDITONAL DATA COLLECTION

WILDLIFE BRIGADE

In order to be able to relate vehicle movement and stopping patterns with the presence of wildlife jams, the GRTE Wildlife Brigade collected additional information as part of the project. The Wildlife Brigade is a crew of volunteers that help to manage human-wildlife interactions in GRTE; one of their main purposes is to manage crowds and vehicles at wildlife jams. USU provided the southern volunteers of the Wildlife Brigade with a Trimble GPS unit. At all wildlife jams in the Moose-Wilson Road corridor, the Wildlife Brigade volunteers carried the GPS unit while working at the jam and also entered a few basic pieces of data for each jam into the GPS unit (including the type of animal, duration of jam, and visual estimation of the max number of vehicles in the jam).

RESULTS

1. VEHICLE USE LEVELS

Tube counters were deployed by GRTE at the beginning of June and removed before the first snowfall at the end of October. Utah State University maintained the tube counters and analyzed all data.

Figure 1.1: Tube counter used to determine vehicle use levels on the Death Canyon Road (photo by Ashley D'Antonio).

PEAK HOUR FOR VEHICLE USE

The most frequent peak hour for each tube counter was determined using MetroCount software summaries (Tables 1.1-1.5). For the northern-most tube counter, near Sawmill Ponds, the most frequent peak hour for weekends varied between 3:00pm and 5:00pm with 4:00pm being most common (Table 1.1). On weekdays, the peak hour varied widely across sampling periods from 11:00am in July to as late at 5:00pm in September. On Death Canyon road, the peak hour of use was most often at 11:00am across all sampling periods with the exception of August 1st-15th and October; 2:00pm and 10:00am, respectively (Table 1.2). The weekend most frequent peak hour at Death Canyon ranged between 11:00am and 2:00pm.

On the road to the LSR Preserve, weekday peak hour ranged from 11:00am to 2:00pm and on weekends varied between 11:00am and 12:00pm (Table 1.3). At the counter placed near where the Woodland Trail crosses the Moose-Wilson Road, the peak hour for use on the road on weekdays varied between 4:00pm to 5:00pm (Table 1.4). On weekends during the summer, peak use was always seen during the 4:00pm hour. In September the peak hour begins at 11:00am and at 1:00pm in October. For the tube counter near Poker Flats, the most southern tube counter, 5:00pm was the most frequently observed weekday peak hour throughout all summer sampling periods (Table 1.5). On weekends, the peak hour varied between 11:00am in October to 5:00pm in July and September.

Table 1.1: Peak hour of the day for vehicular traffic at the tube counter on Moose-Wilson Road just north of Sawmill Ponds Overlook (24hr time). The time reported in the table is the beginning of the peak hour and the value in parentheses is the number of times over the sampling period when that peak hour was observed.

Most Frequent Peak Hour: Sawmill Ponds		
Sampling Period	**Weekday**	**Weekend**
June	4:00pm (8)	4:00pm (3)
July	11:00am (5)	3:00pm (3)
August 1-15	12:00pm (3)	4:00pm (2)
August 16-31	4:00pm (4)	4:00pm (2)
September	5:00pm (4)	4:00pm (4)
October	12:00pm (5)	5:00pm (3)

Table 1.2: Peak hour of the day for vehicular traffic at the Death Canyon road tube counter (24hr time). Counter placed right before where Death Canyon road turns to dirt. The time reported in the table is the beginning of the peak hour and the value in parentheses is the number of times over the sampling period when that peak hour was observed.

Most Frequent Peak Hour: Death Canyon		
Sampling Period	**Weekday**	**Weekend**
July	11:00am (7)	12:00pm (2)
August 1-15	2:00pm (3)	2:00pm (2)
August 16-31	11:00am (4)	12:00pm (2)
September	11:00am (7)	11:00am (3)
October	10:00am (3)	2:00pm (2)

Table 1.3: Peak hour of the day for vehicular traffic on the road to the LSR Preserve (24hr time). The time reported in the table is the beginning of the peak hour and the value in parentheses is the number of times over the sampling period when that peak hour was observed.

Most Frequent Peak Hour: LSR Preserve Road		
Sampling Period	**Weekday**	**Weekend**
June	2:00pm (5)	12:00pm (4)
July	11:00am (8)	1:00pm (4)
August 1-15	12:00pm (3)	11:00am (3)
August 16-31	2:00pm (3)	1:00pm (2)
September	11:00am (7)	11:00am (3)
October	N/A	N/A

Table 1.4: Peak hour of the day for vehicular traffic at the Woodland road counter (24hr time). Counter placed on the Moose-Wilson Road near where the Woodland trail crosses the Moose-Wilson Road. The time reported in the table is the beginning of the peak hour and the value in parentheses is the number of times over the sampling period when that peak hour was observed.

Most Frequent Peak Hour: Woodland		
Sampling Period	**Weekday**	**Weekend**
July	4:00pm (6)	4:00pm (3)
August 1-15	5:00pm (4)	4:00pm (2)
August 16-31	4:00pm (4)	4:00pm (2)
September	5:00pm (6)	11:00am (4)
October	9:00am (5)	1:00pm (2)

Table 1.5: Peak hour of the day for vehicular traffic near the Poker Flats parking lot (24hr time). Counter placed on Moose-Wilson Road just north of Poker Flats parking area. The time reported in the table is the beginning of the peak hour and the value in parentheses is the number of times over the sampling period when that peak hour was observed.

Average Peak Hour: Poker Flats		
Sampling Period	**Weekday**	**Weekend**
June	5:00pm (5)	3:00pm (5)
July	5:00pm (7)	5:00pm (3)
August 1-15	5:00pm (3)	4:00pm (2)
August 16-31	5:00pm (4)	4:00pm (2)
September	5:00pm (7)	5:00pm (6)
October	5:00pm (5)	11:00am (2)

AVERAGE AND TOTAL VEHICLE COUNTS

Use at the tube counter just north of Sawmill Ponds ranged from an average of 184 vehicles per day in October to 2,351 vehicles per day during the August 1st-15th sampling period (Table 1.6 and Figure 1.2). At Death Canyon road, average vehicle use per day varied between 18 vehicles in October to 277 vehicles per day during the August 1st-15th sampling period (Table 1.6 and Figure 1.3). The August 1st-15th sampling period also had the highest average vehicles per day for both the Woodland tube counter (2,209 vehicles/day) and the tube counter just north of Poker Flats (2,190 vehicles/day) (Table 1.6 and Figures 1.5 and 1.6). Average daily use at the road into the LSR Preserve did not vary substantially between sampling periods. The lowest level of use was observed during the August 16th-31st sampling period with approximately 222 cars per day (Table 1.6 and Figure 1.4). The highest observed average use on the LSR Preserve road was during September with approximately 262 vehicles per day.

Table 1.6: Average number of vehicles per day (± 1 standard deviation) at each tube counter location in the Moose-Wilson Corridor reported by sampling period. Outliers were removed before calculating these averages.

Sampling Period	Sawmill Ponds	Death Canyon	LSR Preserve	Woodland	Poker Flats
July	2243 (± 243)	222 (± 43)	245 (±23)	2028 (±413)	2011 (±397)
August 1-15	2351 (± 129)	277 (±26)	259 (±22)	2209 (±142)	2190 (±152)
August 16-31	2167 (±117)	180 (±50)	222 (±24)	1855 (+/- 251)	1837 (±259)
September	2033 (±293)	146 (± 37)	262 (± 35)	1698 (±273)	1584 (±388)
October	185 (± 237)	19 (± 26)	N/A	146 (± 703)	208 (±219)

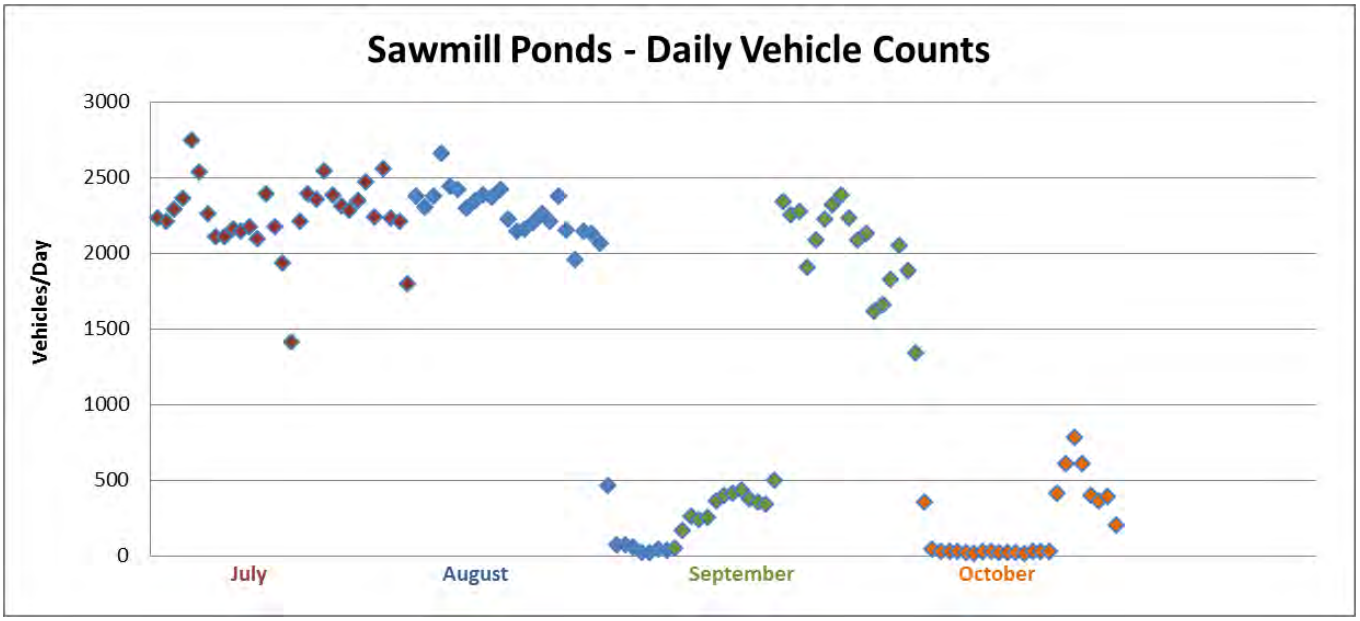


Figure 1.2: Daily vehicle counts across the study period for the tube counter placed just north of Sawmill Ponds. Low values observed at the end of August and the beginning of September were due to counter malfunction. Zero values at the beginning of October were due to the government shutdown.

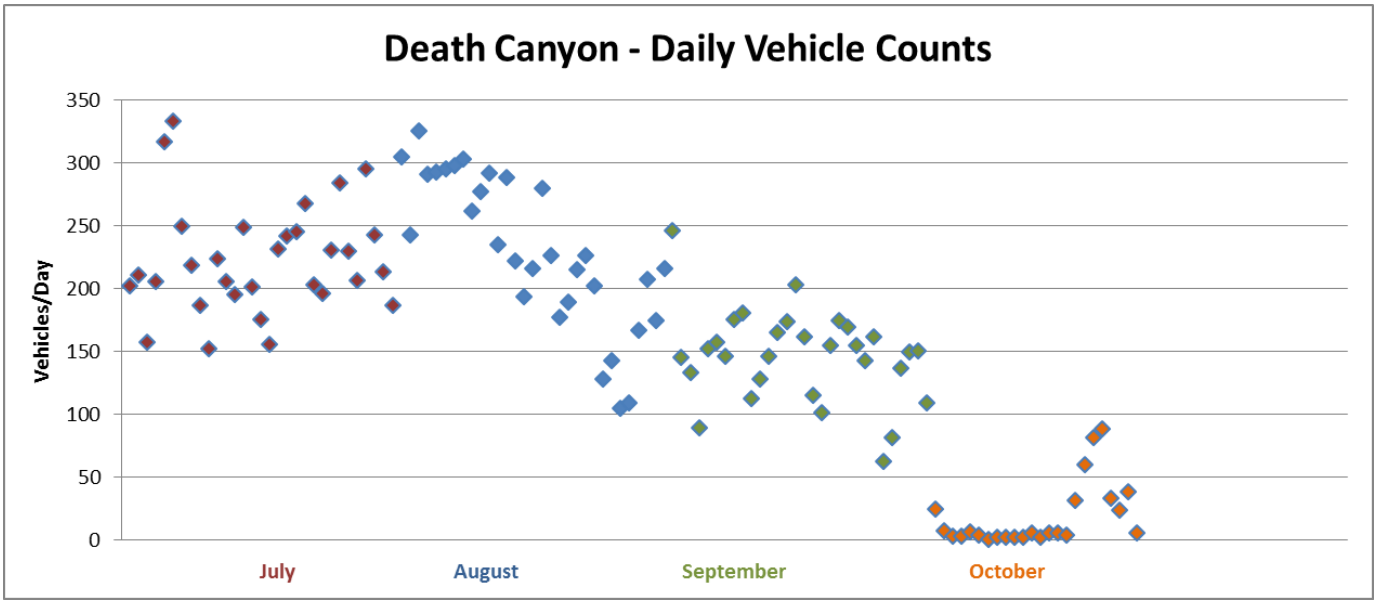


Figure 1.3: Daily vehicle counts across the study period for the tube counter placed just before the beginning of the dirt section of Death Canyon road. Zero values at the beginning of October were due to the government shutdown.

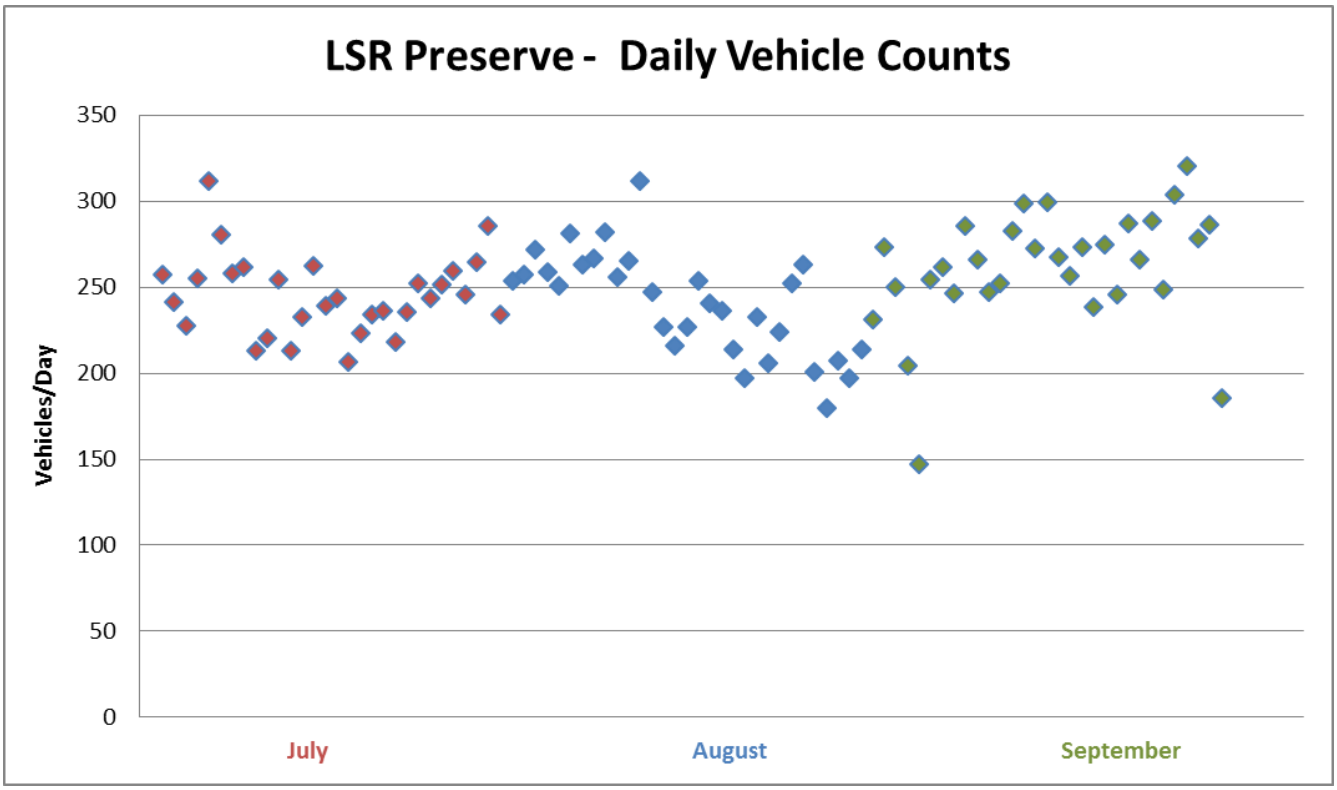


Figure 1.4: Daily vehicle counts across the study period for the tube counter placed on the LSR Preserve Road. GRTE only provided data through the end of September.

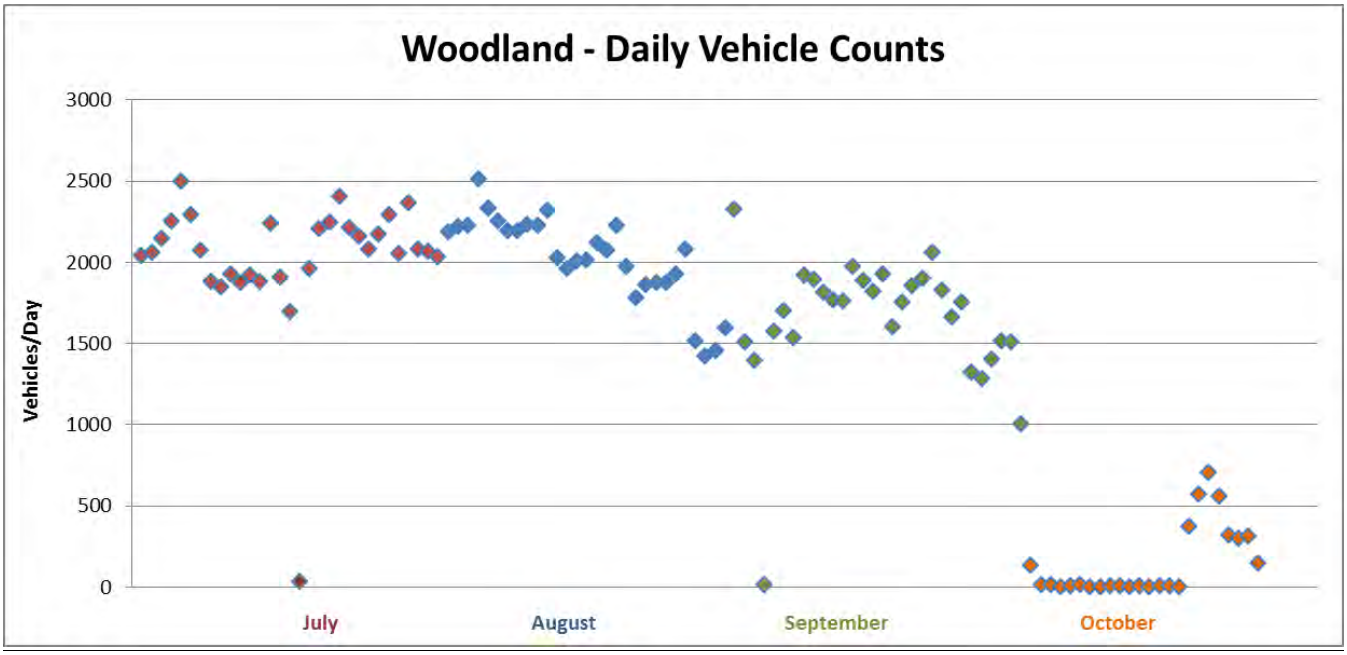


Figure 1.5: Daily vehicle counts across the study period for the tube counter placed on the Moose-Wilson Road near where the Woodland trail crosses the road. Zero values at the beginning of October were due to the government shutdown.

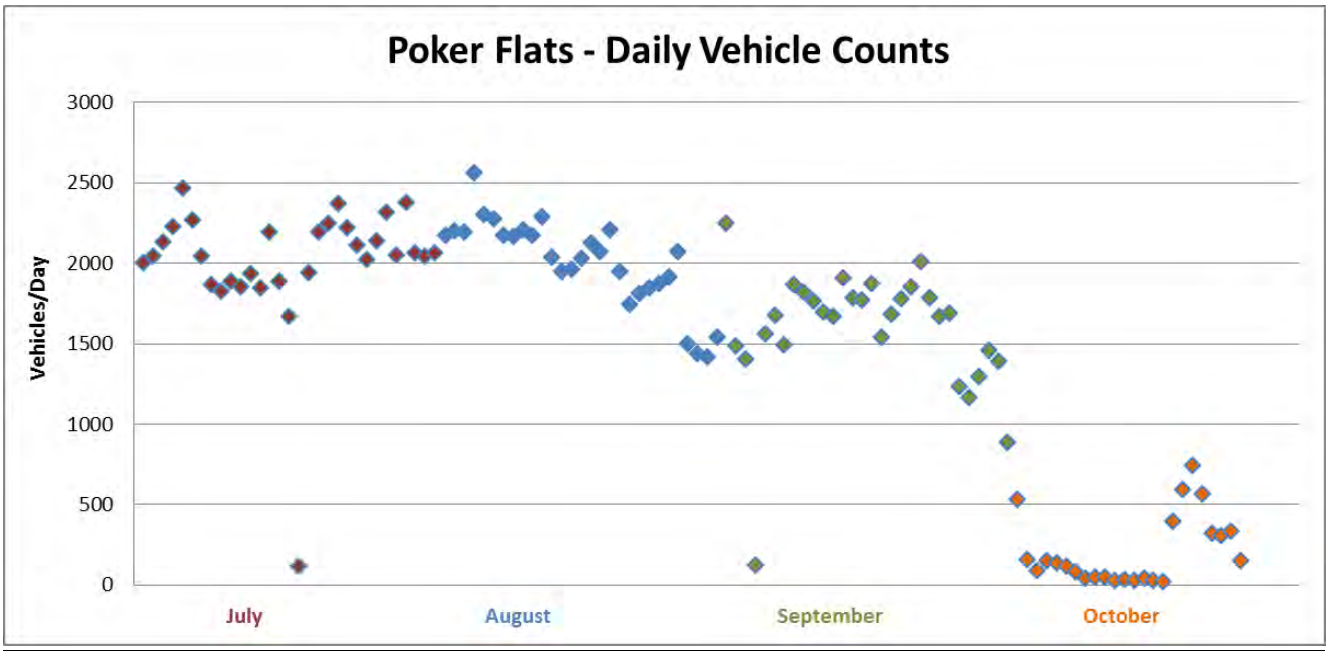


Figure 1.6: Daily vehicle counts across the study period for the tube counter placed on the LSR Preserve road between the intersection with Moose-Wilson Road and the LSR Preserve parking lot. Zero values at the beginning of October were due to the government shutdown.

DIRECTIONAL TRAFFIC FLOW

Figures of daily directional flow for each individual counter along the Moose-Wilson and Death Canyon roads for each sampling period can be found in Appendix B. Presented here are average hourly vehicle counts by direction (northbound and southbound) for all tube counters placed in the Moose-Wilson corridor (Figures 1.7 through 1.16). Across all sampling periods and both weekends and weekdays, on average northbound traffic on the Moose-Wilson Road was at its highest between approximately 8:00am and 10:00am, at which point northbound traffic levels began to decrease and southbound traffic began to increase. On average, southbound traffic levels were at their highest levels between 2:00pm and into the evening (around 6:00pm). Average traffic to and from the LSR Preserve roughly mimicked that of the traffic on the Moose-Wilson Road, with traffic to the LSR Preserve peaking between 8:00am and 10:00am and traffic leaving the LSR Preserve peaking between 2:00pm and 6:00pm. On Death Canyon Road, average traffic levels towards the Death Canyon Trailhead peaked in the morning between 10:00am and 12:00pm, and traffic leaving Death Canyon Road peaked between 2:00pm and 6:00pm.

Data from the tube counters placed on Moose-Wilson, LSR Preserve, and Death Canyon roads were also separated by northbound and southbound traffic for weekdays and weekend days across all sampling periods. In general, traffic levels were nearly equal in both directions at all counters (see Appendix B). During some sampling periods, for the three counters placed on Moose-Wilson Road, northbound traffic was slightly higher than southbound traffic. Rarely was southbound traffic flow higher than northbound traffic flow and, if so, only by a small margin. Although Death Canyon is a “dead-end” road, data from the tube counter indicates that for many days in the sampling periods northbound traffic levels were much greater than southbound traffic levels (see Appendix B). Given the nature of Death Canyon Road being a dead-end, these results seem unlikely. The tube counters used in this study are designed to work on pavement; the Death Canyon Road tube counter had to be placed on a narrow road where the pavement met the dirt section of Death Canyon Road. The placement of the Death Canyon tube counter on the edge of the pavement may have resulted in some counter error. Therefore, while total counts from Death Canyon appear to be accurate, directional flow results may be less accurate when compared to tube counters placed on Moose-Wilson Road. Traffic on the LSR Preserve Road was also approximately equal each direction with northbound traffic being slightly higher during most sampling periods. Like the Death Canyon Road, the LSR Preserve Road is a “dead-end” road, and any large discrepancies between north- and southbound traffic is likely due to counter error.

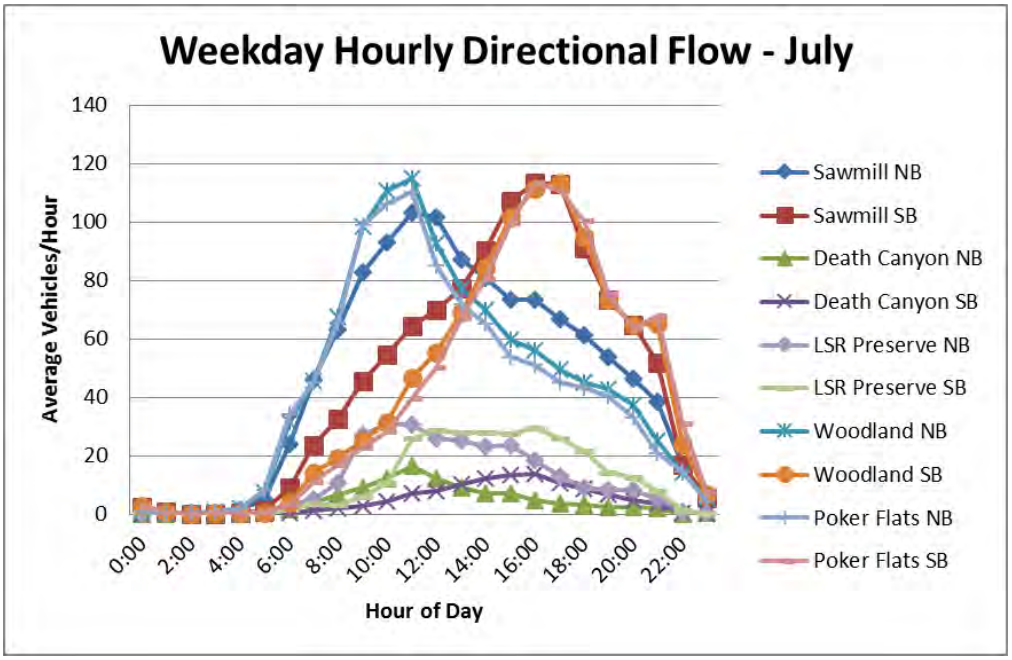


Figure 1.7: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekdays in July. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

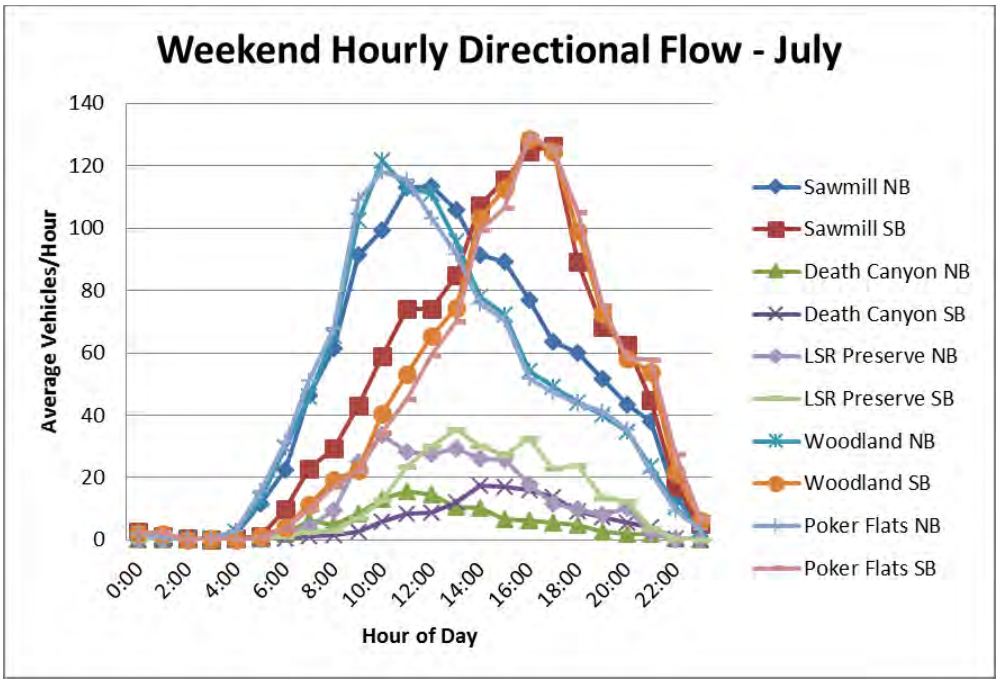


Figure 1.8: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekends in July. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

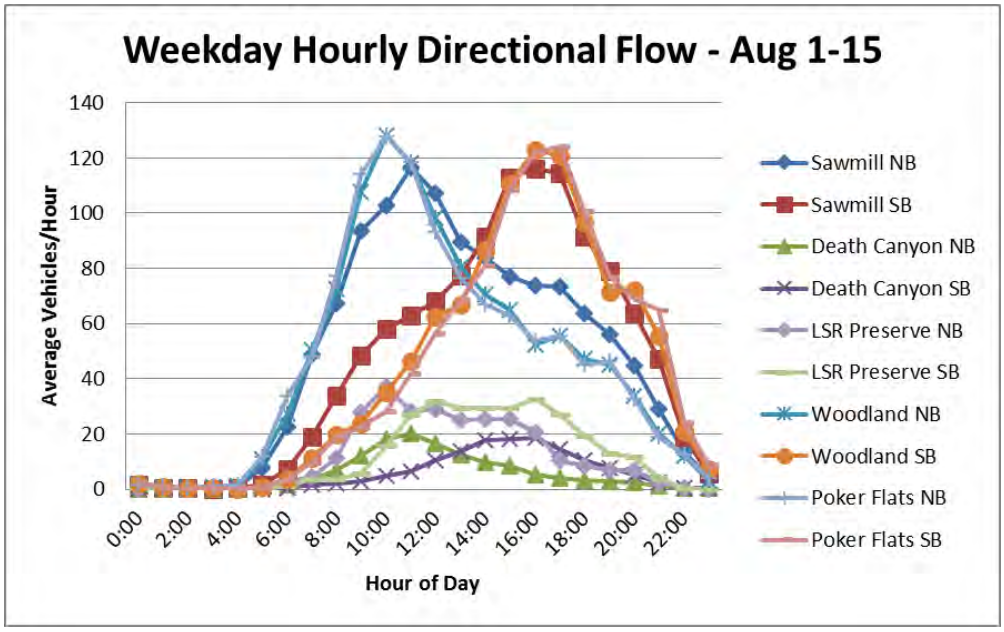


Figure 1.9: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekdays in the first sampling period of August. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

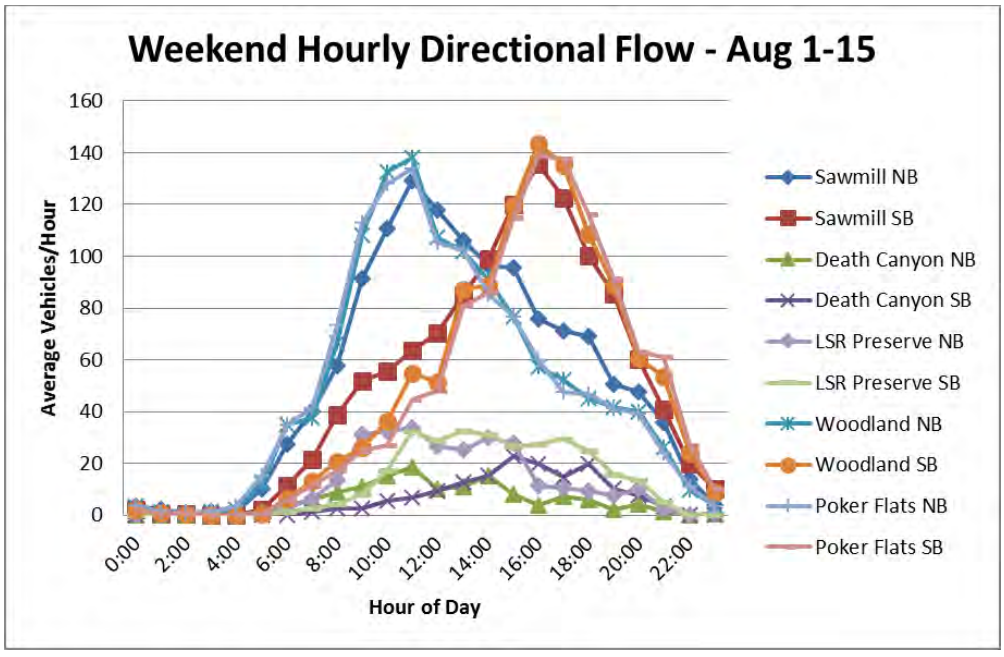


Figure 1.10: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekends in the first sampling period of August. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

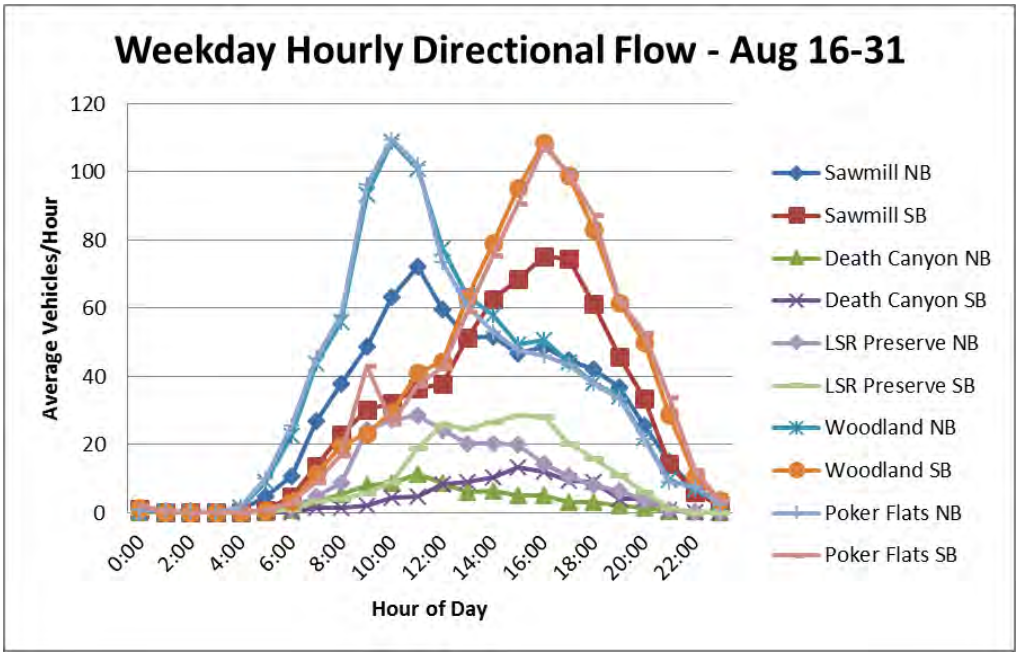


Figure 1.11: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekdays in the second sampling period of August. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

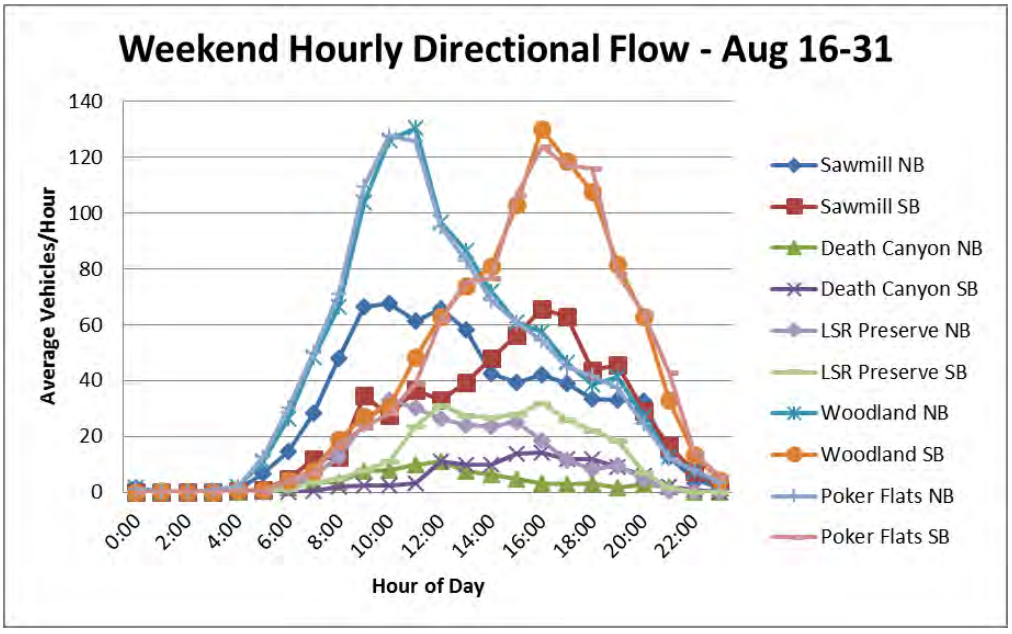


Figure 1.12: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekends in the second sampling period of August. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

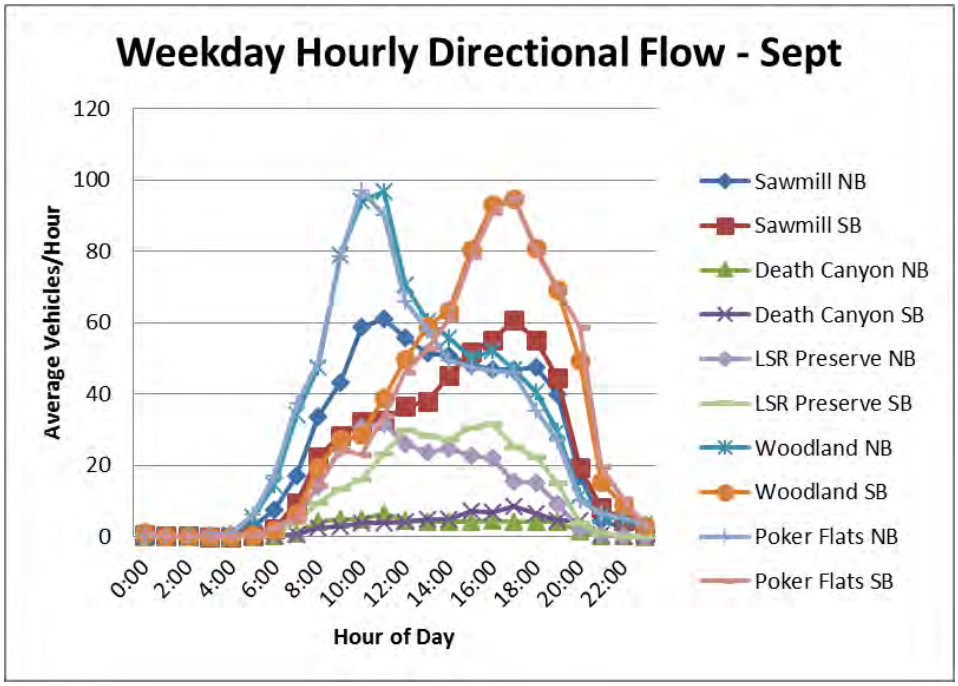


Figure 1.13: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekdays in September. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

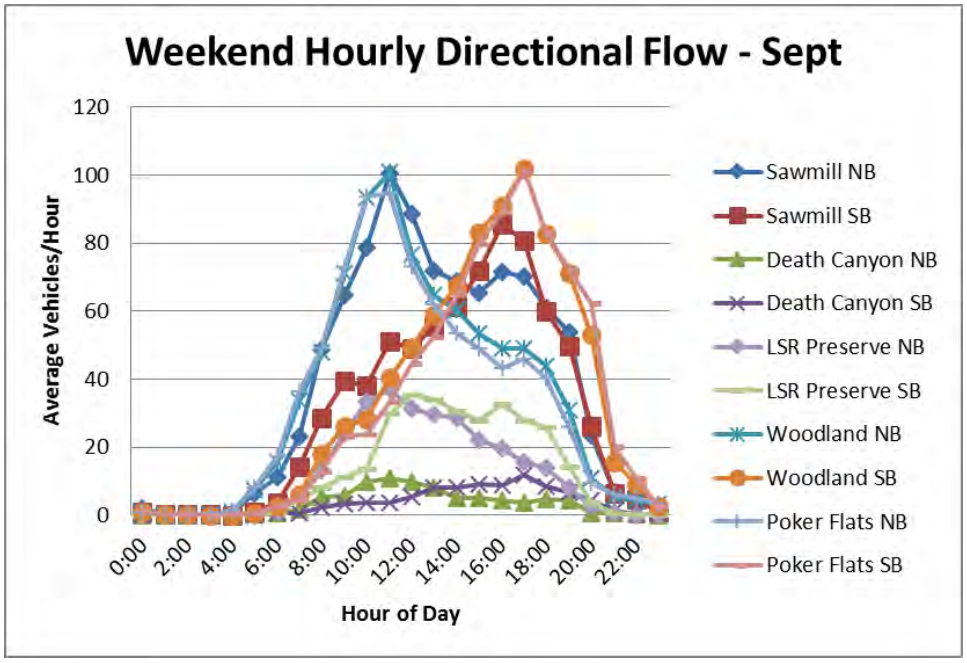


Figure 1.14: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekends in September. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead, and "NB" for the LSR Preserve is towards the LSR Preserve parking lot.

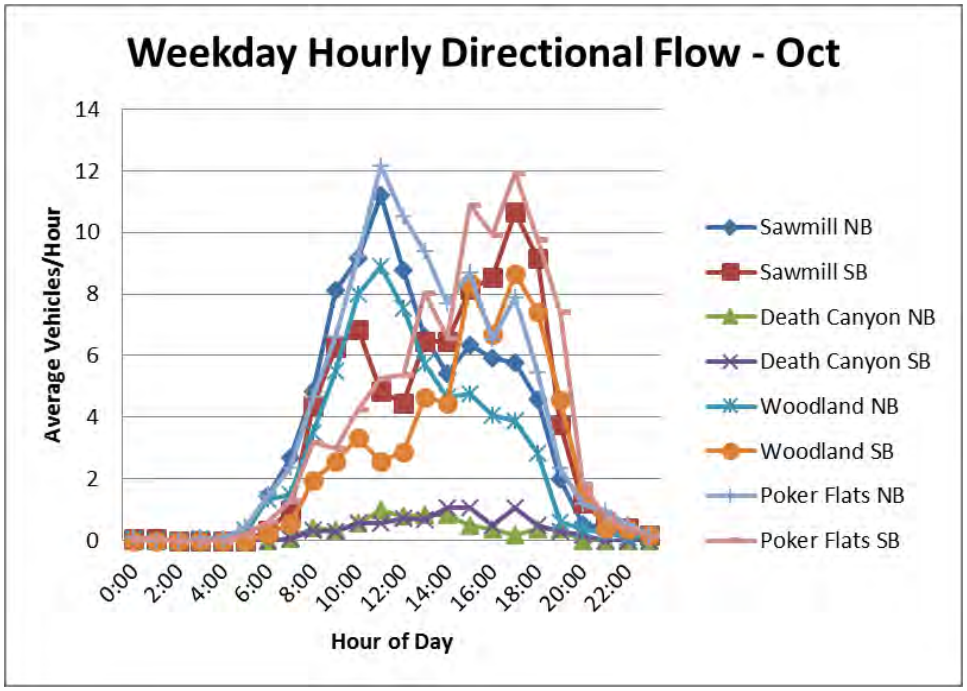


Figure 1.15: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekdays in October. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead. The LSR Preserve Road did not have October data.

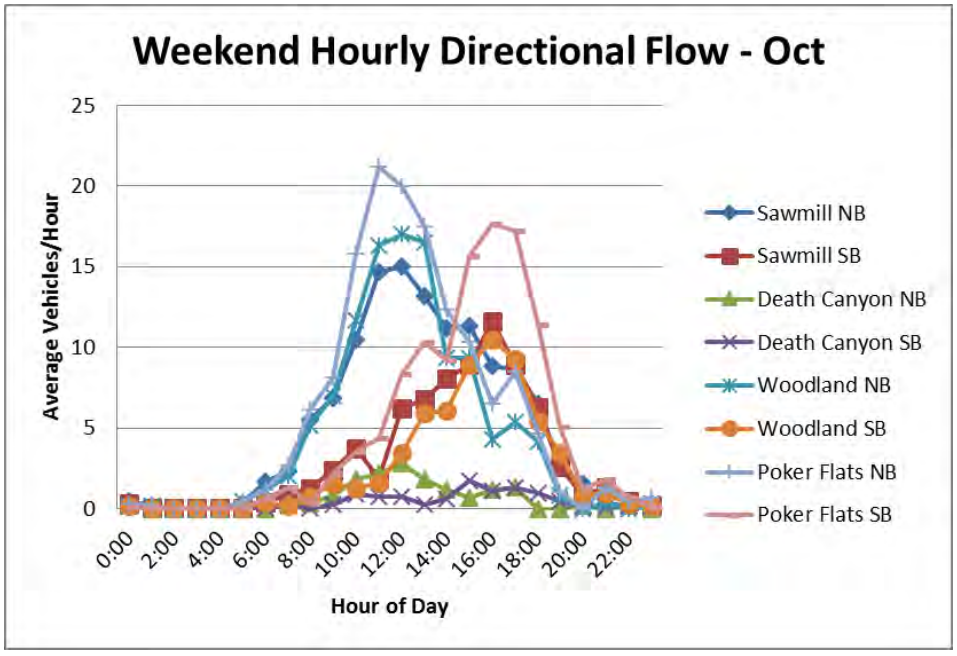


Figure 1.16: Average hourly directional counts for all tube counters in the Moose-Wilson Road Corridor for weekends in October. NB = northbound, SB = southbound. "NB" for Death Canyon is towards the trailhead. The LSR Preserve Road did not have October data.

VEHICLE USE LEVEL CHANGES OVER TIME

Historical average vehicle use levels on the Moose-Wilson Road corridor were pulled from the Moose-Wilson Corridor Adaptive Management Plan for three years (McGowen et al., 2009). These values, from 2006 through 2008, were than compared to average daily vehicle use levels from similar locations on the Moose-Wilson Road from the Summer of 2013 sampling periods (Table 1.7). This comparison indicates that average use on the Moose-Wilson Road has increased over time for all sampling periods.

Table 1.7: Percent change of average daily vehicle use levels on the Moose-Wilson Road over time

	Average Daily Vehicle Use Level				
Month	**2006***	**2007**	**2008**	**2013***	**Percent Change since 2006**
July	1,668	1,740	1,870	2,094	26%
August	1,616	1,695	1,170	2,102	30%
September	1,110	1,267	1,355	1,772	60%

*Data in 2006, 2007, and 2008 from counters 1, 4, and 5 in McGowen et al. (2009). Data collected 2013 at similar locations (Sawmill Ponds, Woodland, and Poker Flats).

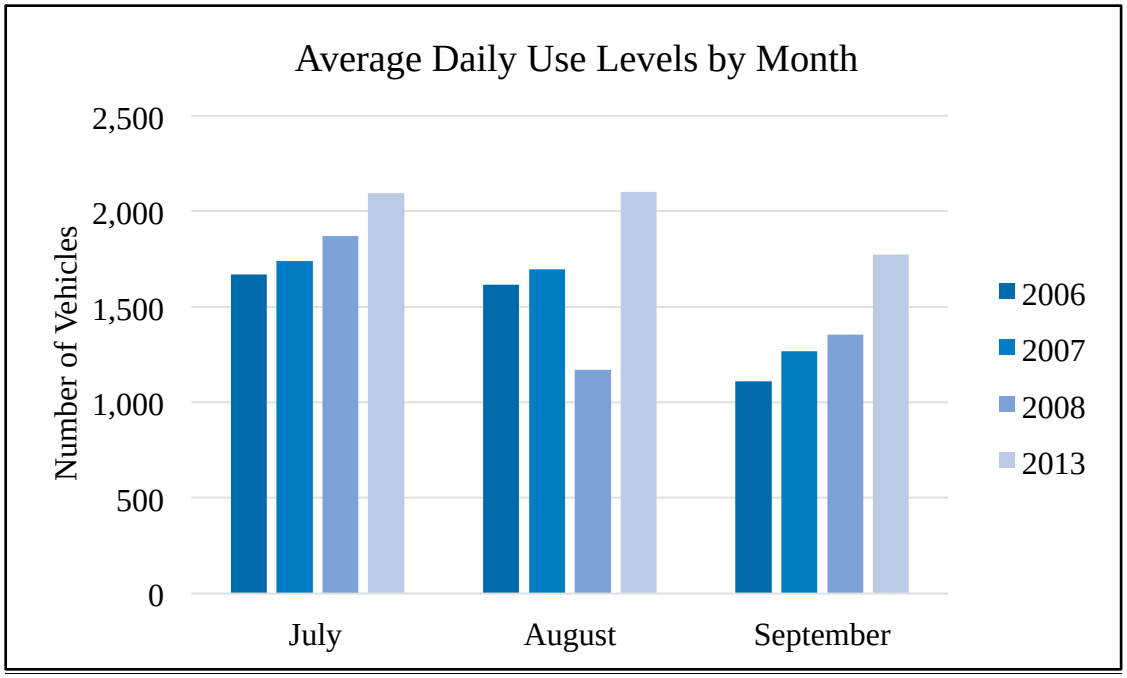


Figure 1.17: Percent change of average daily vehicle use levels on the Moose-Wilson Road over time. Historical data from WTI Report.

2. VEHICLE TYPE

There were two turning movement count (TMC) locations and one automatic traffic recording (ATR) for volume count location. The two TMC locations were at the intersection of Moose-Wilson Road and Teton Park Road and the intersection of Moose-Wilson Road and the LSR Preserve entrance. The volume count was located near the entrance to Granite Canyon and was installed during the same periods as the TMC. Over the three-month study period, sixteen days were designated for TMC and ATR data collection (Table 2.1). Table 2.1 below summarizes the amount of TMC and ATR data collected. For the TMC and ATR studies, a minimum of 12 hours of data was set to be collected for each location.

Table 2.1: Summary of TMC and ATR Data Collection Days

Sampling Period	TMC: Moose-Wilson Road & LSR Preserve	TMC: Moose-Wilson Road & Teton Park Road	ATR: Granite Canyon Entrance
July	28, 29, 30, 31	28, 29, 30, 31	28, 29, 30, 31
Aug 1-15	9, 10, 11	9, 10, 11	9, 10, 11
Aug 16-31	-	27, 28, 29, 30	-
Sept	14, 15, 16, 18	14, 15, 16, 18	14, 15, 16, 18

Figure 2.1: Photo taken with turning movement camera placed at the intersection of the Moose-Wilson Road with the LSR Preserve Road.

The ATR was conducted north of the Granite Canyon entrance, capturing only northbound (northbound) and southbound (southbound) volumes (Tables 2.2-2.3). The following tables summarize the ATR collected for the Granite Canyon entrance. Cars include passenger vehicles and SUVs and "all good vehicle (AGV)" includes trucks and vans. Across the July and August sampling periods, the majority of use both northbound and southbound at Granite Canyon entrance was from vehicles. Bicycle use varied from 2%-3% northbound and 2%-3% southbound. Slightly more northbound than southbound traffic was observed in July and August (Tables 2.2 and 2.3).

Table 2.2: Summary of ATR Volume Collection at Granite Canyon entrance for July. AGV = trucks and vans

July				
Northbound				
	Car	**AGV**	**Bike**	**Total**
Average	1,039	4	18	1,061
%	98%	0%	2%	100%
Southbound				
	Car	**AGV**	**Bike**	**Total**
Average	987	5	21	1,013
%	97%	0%	2%	100%

Table 2.3: Summary of ATR Volume Collection at Granite Canyon entrance for Aug 1-15. AGV = trucks and vans

August 1-15				
Northbound				
	Car	**AGV**	**Bike**	**Total**
Average	982	8	28	1,018
%	96%	1%	3%	100%
Southbound				
	Car	**AGV**	**Bike**	**Total**
Average	912	7	25	944
%	97%	1%	3%	100%

ANALYSIS OF VEHICLE TURNING MOVEMENT

The first TMC peak-hour data presented is the intersection of Teton Park Road and Moose-Wilson Road, which is a four-leg un-signalized intersection with stop signs on the northbound and southbound directions. Moose-Wilson Road is a two-way road with two lanes at the approach of the intersection while Teton Park Road is a three-lane road with a left turn lane on each eastbound and westbound direction.

Figures 2.3 through 2.7 illustrate the complete volume by study dates. At Teton Park Road and Moose-Wilson Road for the complete duration of the study, approximately 95% of the volume movement within the intersection was classified as a car (includes personal SUVs and related passenger vehicles), 3% was classified as an all good vehicle (AGV) which includes vans and medium to heavy trucks, 0.5% of the volume was classified as a pedal bike, and 2% was classified as a motorized bike.

Nearly three-quarters of the turning movement for each time period was due to eastbound and westbound “thru” movements on Teton Park Road. The average movement for the entire TMC study at that location showed that approximately 72% of the movement in the intersection was due to eastbound and westbound “thru” movements on Teton Park Road (Figure 2.7). Of the traffic turning onto the Moose-Wilson Road at the Teton Park Road intersection, on average 52% entered westbound, 42% entered eastbound, and only 6% entered southbound (Figure 2.7). On average 54% of the traffic northbound on Moose-Wilson Road made a right turn towards the visitor center, and 40% made a left turn towards Jackson Lake (Figure 2.7).

Figure 2.2: View of the Moose-Wilson Road and Teton Park Road intersection from the TMC camera.

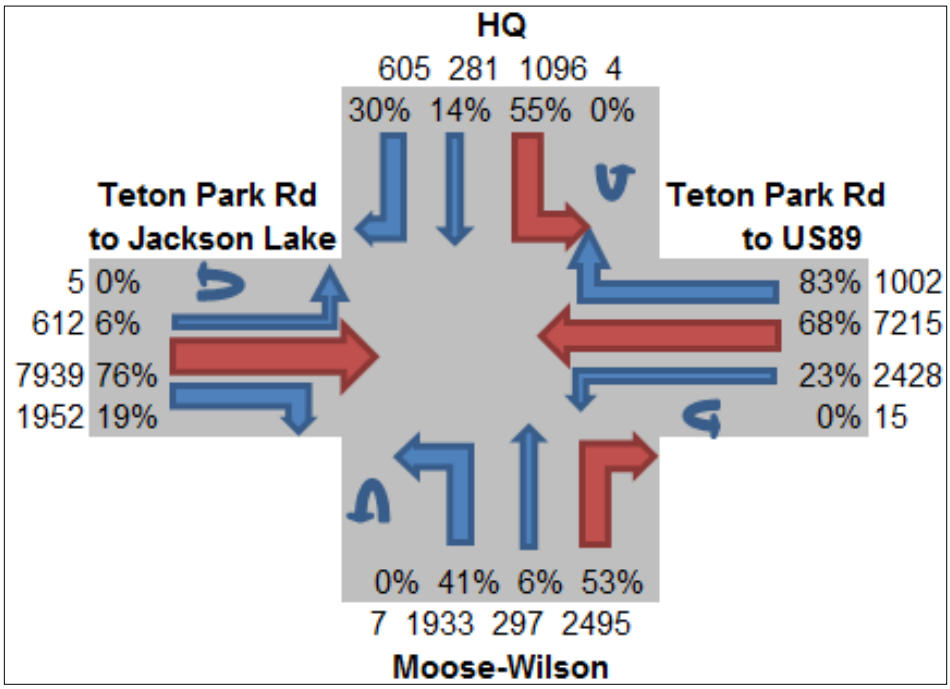


Figure 2.3: Total TMC Movement at Moose-Wilson Road and Teton Park Road for July.

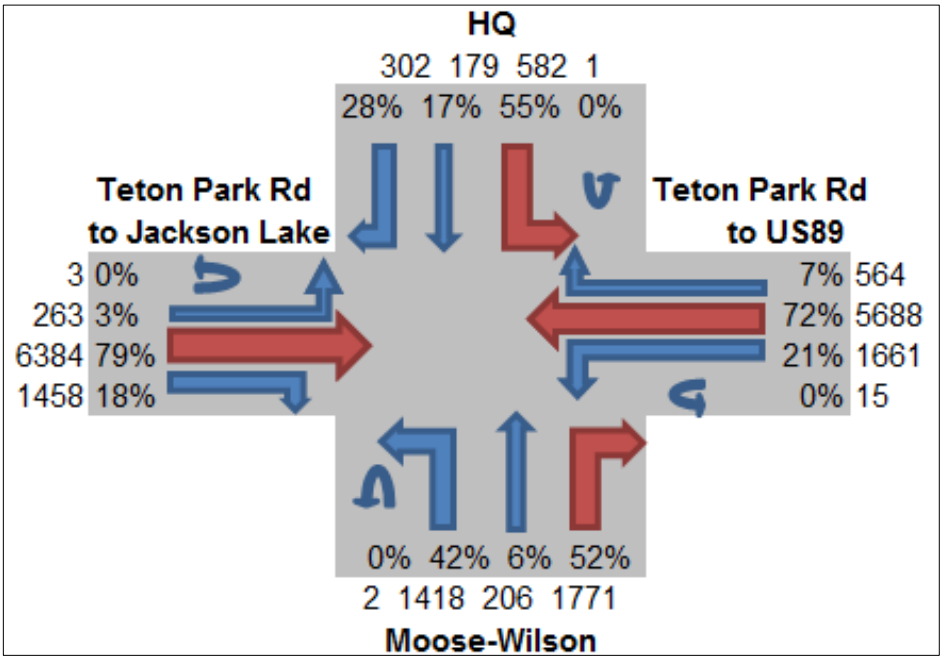


Figure 2.4: Total TMC Movement at Moose-Wilson Road and Teton Park Road for Aug 1-16.

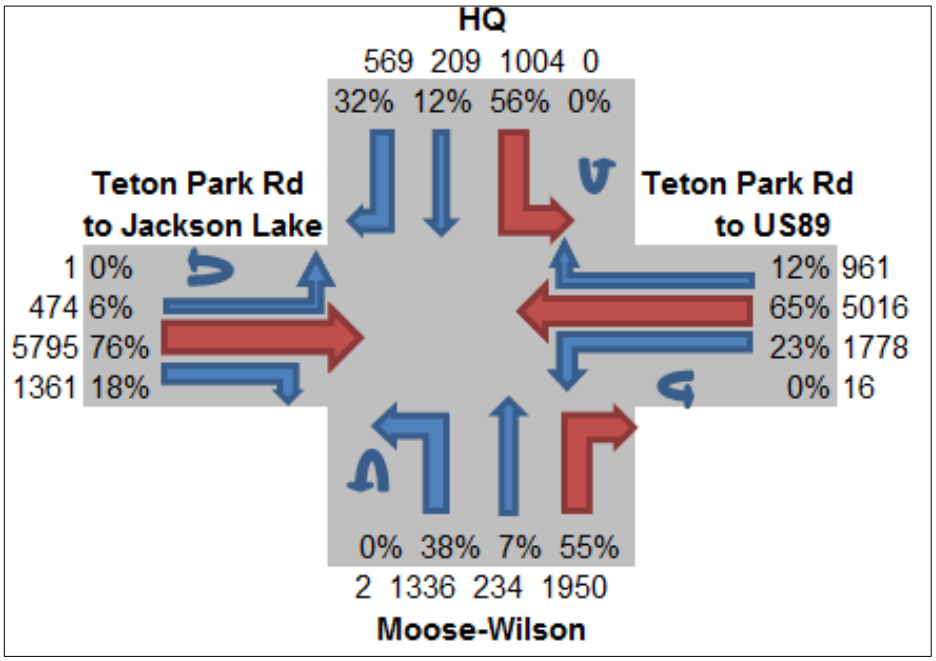


Figure 2.5: Total TMC Movement at Moose-Wilson Road and Teton Park Road for Aug 15-31.

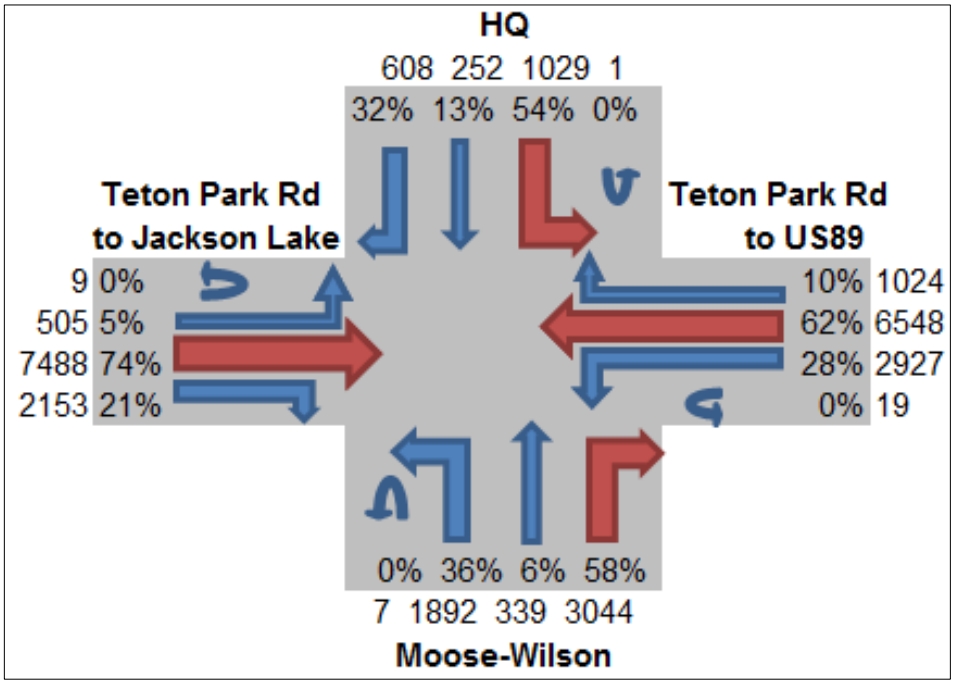


Figure 2.6: Total Average TMC Movement at Moose-Wilson Road and Teton Park Road for Study Duration.

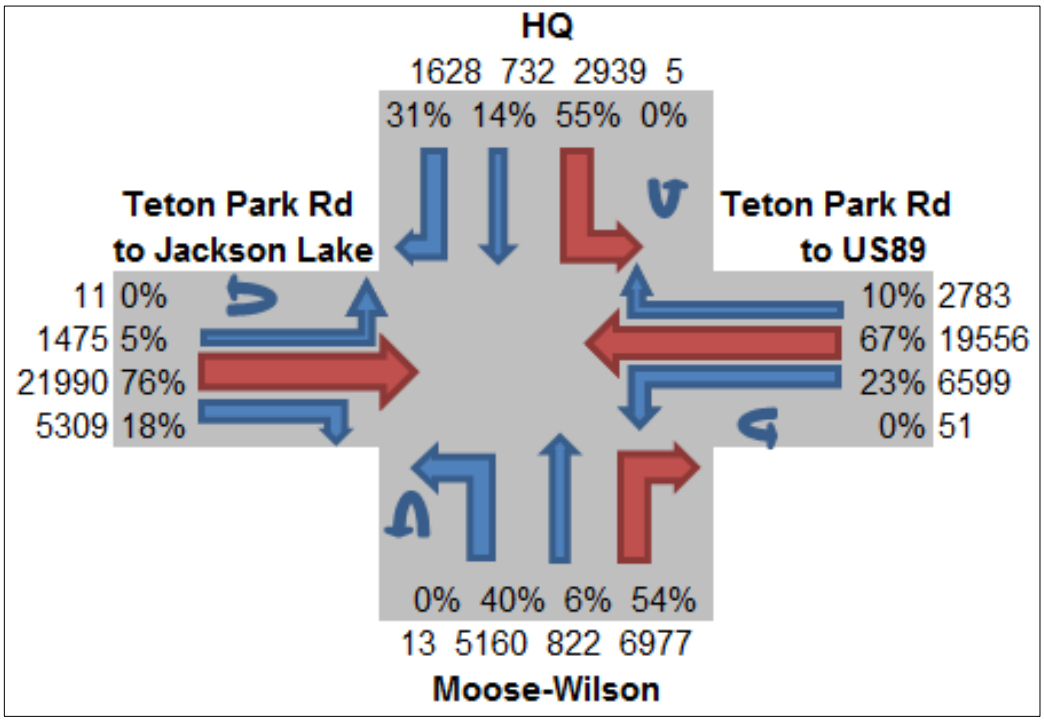


Figure 2.7: Total TMC Movement at Moose-Wilson Road and Teton Park Road for September.

The second TMC data presented is the intersection of Moose-Wilson Road and the LSR Preserve entrance. This intersection is a three-leg intersection with two lanes in the northbound and southbound direction, and two lanes on the eastbound and westbound direction. The intersection has stop signs on the westbound approach, while the traffic remains free in the northbound and southbound direction.

Figures 2.8 through 2.11 illustrate the complete volume by designated study dates. At Moose-Wilson Road and the LSR Preserve entrance for the complete duration of the study, approximately 97% of the volume movement within the intersection was classified as a car, 0.3% was classified as an all good vehicle (AGV) which includes medium to heavy trucks, 1.6% of the volume was classified as a pedal bike, and 0.8% was classified as a motorized bike.

The majority of the volume was shown to have a movement of northbound and southbound as approximately 83% of the traffic on the Moose-Wilson Road traveled in the northbound and southbound direction (Figure 2.11). On average, 8% of the northbound traffic made a right turn into LSR Preserve, while 8% of the southbound traffic made a left turn into LSR Preserve. The traffic movement out of LSR Preserve showed, on average, 62% making a right turn northbound heading towards the Teton Park Road and Moose-Wilson Road intersection while 38% turned left southbound heading towards the Granite entrance. Appendix C illustrates more detailed TMC peak hour information for each location as well as the ATR summary studies.

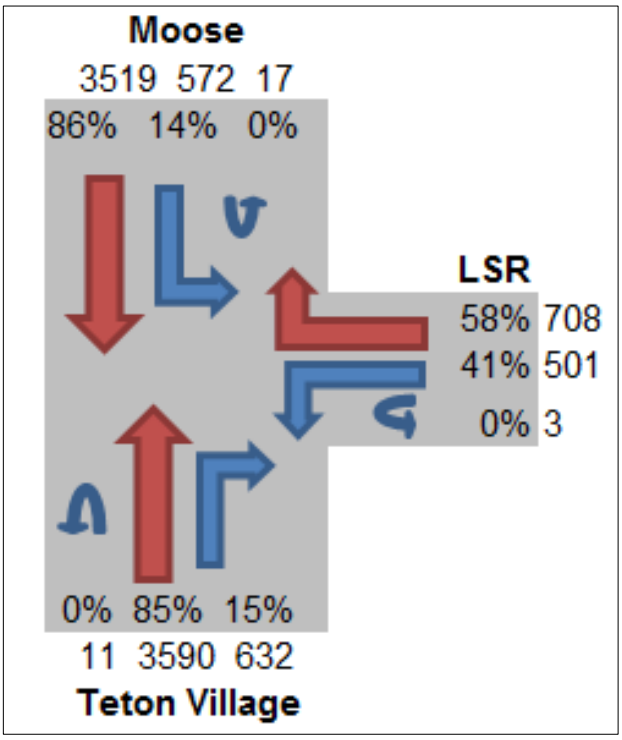


Figure 2.8: Total TMC Movement at Moose-Wilson Road and LSR Preserve Road for July.

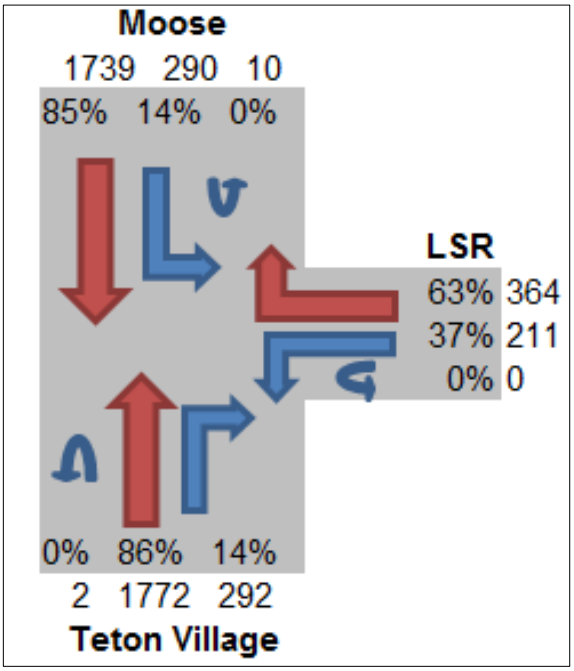


Figure 2.9: Total TMC Movement at Moose-Wilson Road and LSR Preserve Road for August 1-15.

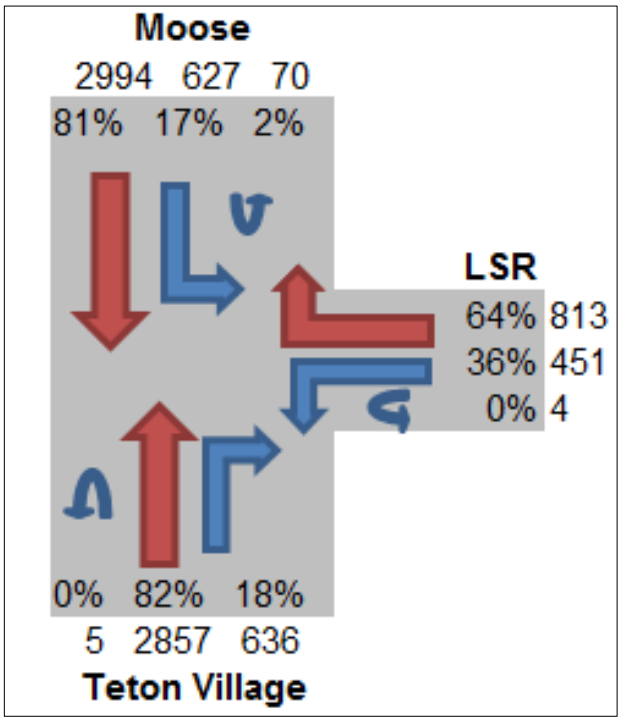


Figure 2.10: Total TMC Movement at Moose-Wilson Road and LSR Preserve Road for September.

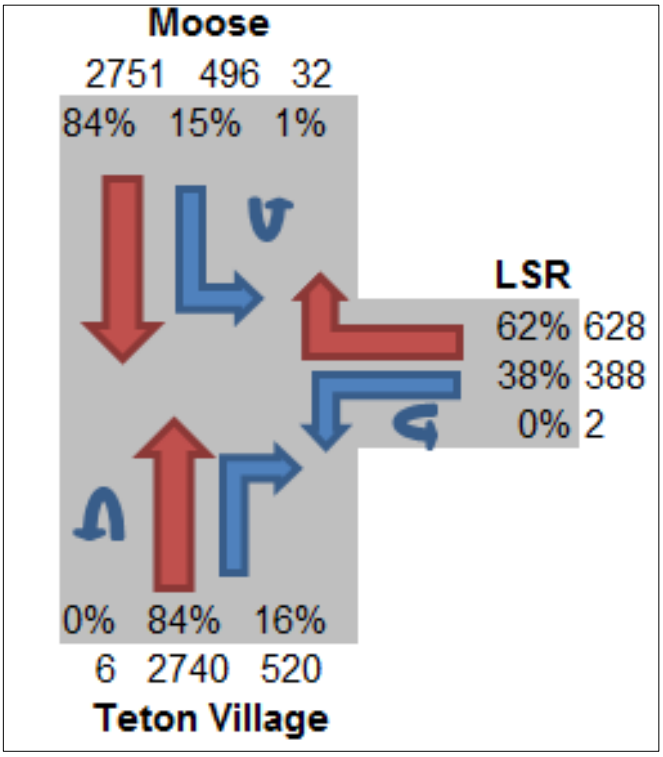


Figure 2.11: Total Average TMC Movement at Moose-Wilson Road and LSR Preserve Road for Study Duration.

GPS-TRACKING DATA COLLECTION SUMMARY

Garmin eTrex 100 units were handed out to a random sample of vehicles as they entered the Moose-Wilson Road from the Moose Junction (to the north) or at the South Fee Station (Table 3.1). Visitors were instructed to keep the GPS unit in their vehicles for the duration of their trips to the Moose-Wilson Corridor. Vehicles returned the GPS units to researchers or to a drop box at the end of the trip in the Moose-Wilson corridor. See Appendix D for maps of overall use patterns from the GPS-tracked vehicles and vehicle density maps. Similar numbers of tracks were collected at each end of the road for a total of 583 collected tracks and a 92% acceptance rate (Table 3.2). Erroneous points were removed from individual tracks but no entire tracks were discarded completely due to error. “Local visitors” were defined as vehicles with a local (WY-22 county) license plate without a rental company sticker attached to the vehicle. Local rental car companies confirmed that they universally use a bar code sticker to identify vehicles and these vehicles are considered non-local visitors.

The average number of persons per vehicle ranged between 2.2 and 2.8 people (Table 3.2). All non-“WY-22” license-plated vehicles were considered non-local visitors. This methodology was used for all counts where local and non-locals were differentiated, including parking lot accumulation. A total of 83 tracks were collected from individuals with WY-22 plates driving non-rental vehicles (defined as local visitors) and 38 tracks were collected from vehicles with WY-22 plates and rental vehicle stickers (Figure 3.2). Local visitor vehicles made up between 16-22% and non-local visitors (defined as any vehicle with any license plate *other* than a WY-22 plate) made up the other 78-84% of the total vehicles sampled across the sampling periods. Of the non-local visitors, locally plated rental vehicles made up 6-9% of all GPS-tracked vehicles across all sampling periods.

Figure 3.1: Field technicians intercepting visitors for the GPS-tracking portion of the study at the Moose end of the Moose-Wilson Road.

Table 3.1: Total number of GPS-tracks collected from vehicles, stratified by month, for each sampling location.

Sampling Period	South Fee Station	North Moose Junction	Total Sampled
July	114	122	236
August	120	132	252
Sept	43	52	95

Table 3.2: Summary of information collected on GPS-tracking logs including acceptances, rejections, average number of people in the vehicle (± 1 standard deviation), and information on local vehicles (93% acceptance rate).

	South Fee Station	North Moose Junction	Total
Acceptances	277	306	583
Rejections*	29	16	44
Average Group Size	2.8 (±1.3)	2.7 (±1.5)	2.7 (±1.4)
Average Group Size (Sept)	2.2 (±0.8)	2.2 (±0.8)	2.2 (±0.8)
WY-22, Not Rental	37	46	83
Non-Local	240	260	500

*The majority of rejects for GPS-tracking of vehicles were due to language barriers with the visitors.

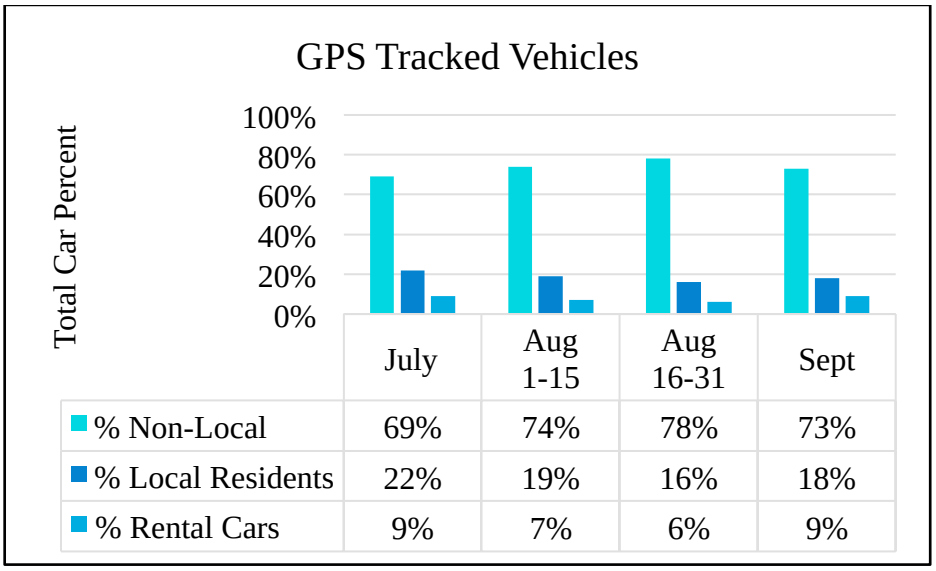


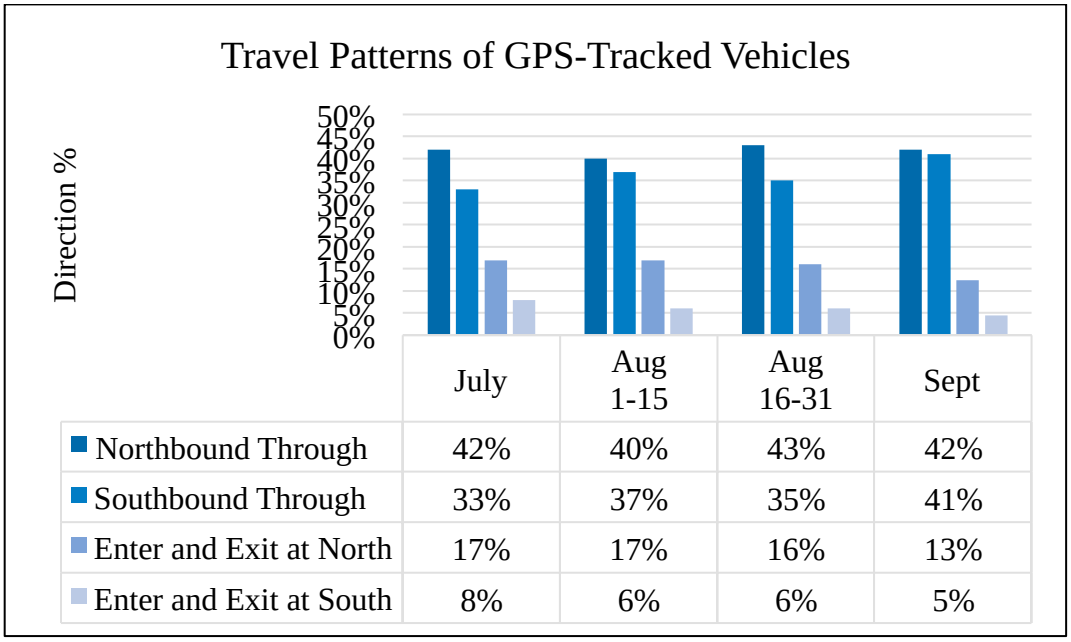
Figure 3.2: Percentage of local residents (WY-22, non-rental vehicles), non-local (any vehicle plate other than WY-22), and rented vehicle (WY-22 license plate but rental sticker) tracked with GPS units stratified by sampling period.

ENTRANCE AND EXIT PATTERNS OF GPS-TRACKED VEHICLES

Individual tracks were closely examined in GIS to better understand vehicle use patterns. The entrance and exit location and time of day at entrances and exits were examined for each GPS track for each vehicle and summarized (Table 3.3 and Figure 3.3). Across all sampling periods, the north entrance was the most popular entrance and exit location (Table 3.3). When examined individually, by track, the most common entrance and exit pattern across all sampling periods was northbound through, with vehicles entering via the South Fee Station and exiting North at Moose (Figure 3.3). Location and time of day for entrances of vehicles varied across sampling periods (Figures 3.4 and 3.5). In July, the majority of vehicles entered by the North entrance of the Moose-Wilson road before noon and exited by the North entrance after noon. During the first sampling period of August (1^{st}-15^{th}), the same frequency of vehicles entered the North and South entrance after noon, and the majority exited by the north entrance after noon. During the second sampling period of August (16^{th}-31^{st}), the highest frequency of vehicles was observed entering the North entrance before noon and exiting the North entrance after noon. During September, slightly more vehicles entered by the North entrance before noon and left by the North entrance after noon.

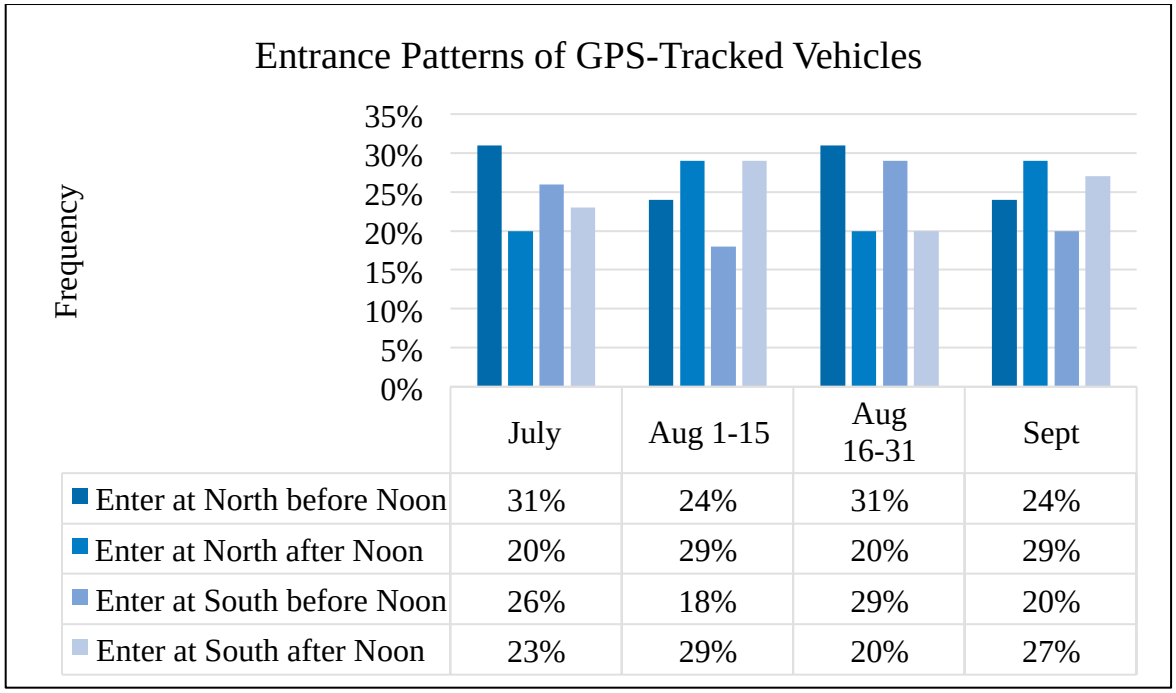
Table 3.3: Frequencies of use for vehicle entrances and exits to the Moose-Wilson Road by sampling period, determined by noting entrance and exit location for each individual vehicle track. North is the Moose Junction and south is the Granite entrance.

Vehicle Travel Pattern	July	August 1-15	August 16-31	Sept
Entrance at North	51%	54%	51%	53%
Entrance at South	49%	46%	49%	47%
Exit at North	59%	57%	59%	55%
Exit at South	41%	43%	41%	45%



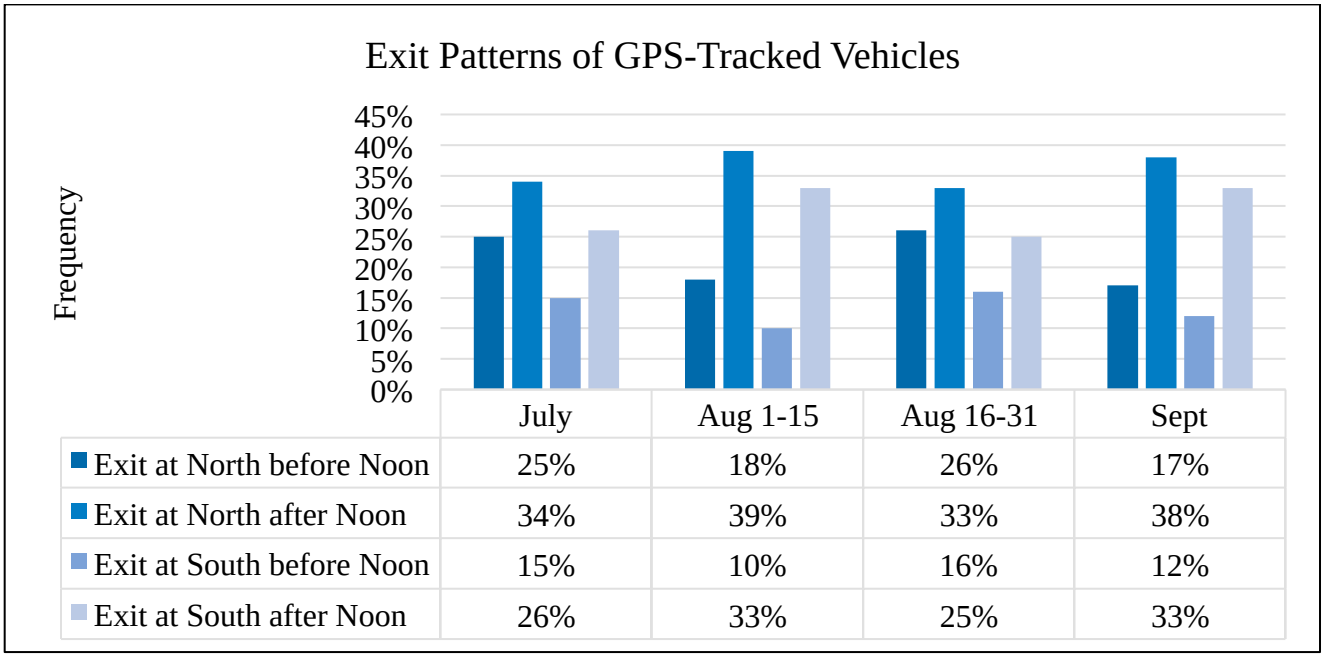
	July	Aug 1-15	Aug 16-31	Sept
Northbound Through	42%	40%	43%	42%
Southbound Through	33%	37%	35%	41%
Enter and Exit at North	17%	17%	16%	13%
Enter and Exit at South	8%	6%	6%	5%

Figure 3.3: Overall entrance and exit patterns of use for vehicles on the Moose-Wilson Road by sampling period, determined by examining the entrance and exit location of each individual track. North is the Moose Junction and south is the Granite entrance.



	July	Aug 1-15	Aug 16-31	Sept
Enter at North before Noon	31%	24%	31%	24%
Enter at North after Noon	20%	29%	20%	29%
Enter at South before Noon	26%	18%	29%	20%
Enter at South after Noon	23%	29%	20%	27%

Figure 3.4: Patterns of use for vehicle entrances to the Moose-Wilson Road by time of day and sampling period, determined by examining the time stamp on GPS-tracks from vehicles and noting entrance location for that vehicle track. North is the Moose Junction and south is the Granite entrance.



	July	Aug 1-15	Aug 16-31	Sept
Exit at North before Noon	25%	18%	26%	17%
Exit at North after Noon	34%	39%	33%	38%
Exit at South before Noon	15%	10%	16%	12%
Exit at South after Noon	26%	33%	25%	33%

Figure 3.5: Patterns of use for vehicle exits of the Moose-Wilson Road by time of day and sampling period, determined by examining the time stamp on GPS-tracks from vehicles and noting exit location for that vehicle track. North is the Moose Junction and south is the Granite entrance.

VEHICLE STOPPING AND PARKING BEHAVIOR

Of the GPS-tracked vehicles, the most popular parking area across all sampling periods was Sawmill Ponds followed by the LSR Preserve (Table 3.4 and Figure 3.5). Far more vehicles parked in the overflow or visitor-created parking areas of the Death Canyon Road rather than the Death Canyon designated parking lot. Granite Canyon and Poker Flats saw similar levels of use with less than 10% of vehicles stopping in these locations across all sampling periods.

Vehicle tracks were examined by overall pattern of behavior while in the corridor, including individual stops and stopping at multiple locations (Table 3.5). Across all sampling periods, almost half of all GPS-tracked vehicles drove straight through the Moose-Wilson corridor without stopping. The LSR Preserve Center and Sawmill Ponds were the second most popular stopping destinations, and approximately 15% of all vehicles, during each sampling period, stopped at multiple locations.

Table 3.4: Percentage of GPS-tracked vehicles that visited specific parking areas within the Moose-Wilson corridor. Vehicles could have stopped at multiple parking areas, and frequencies do not equal 100% since not all vehicles stopped while traveling the corridor.

Parking Area Location	July	Aug 1-15	Aug 16-31	Sept
Sawmill Ponds	45%	35%	37%	48%
Death Canyon Designated	0.02*%	0.01*%	4%	5%
Death Canyon Overflow	4%	8%	13%	9%
LSR Preserve	22%	18%	20%	23%
Granite Canyon	6%	5%	7%	3%
Poker Flats	4%	3%	5%	3%

*In July, only 8 GPS-tracked vehicles parked in the designated lot at Death Canyon. In August, only 6 GPS-tracked vehicles parked in the designated lot at Death Canyon.

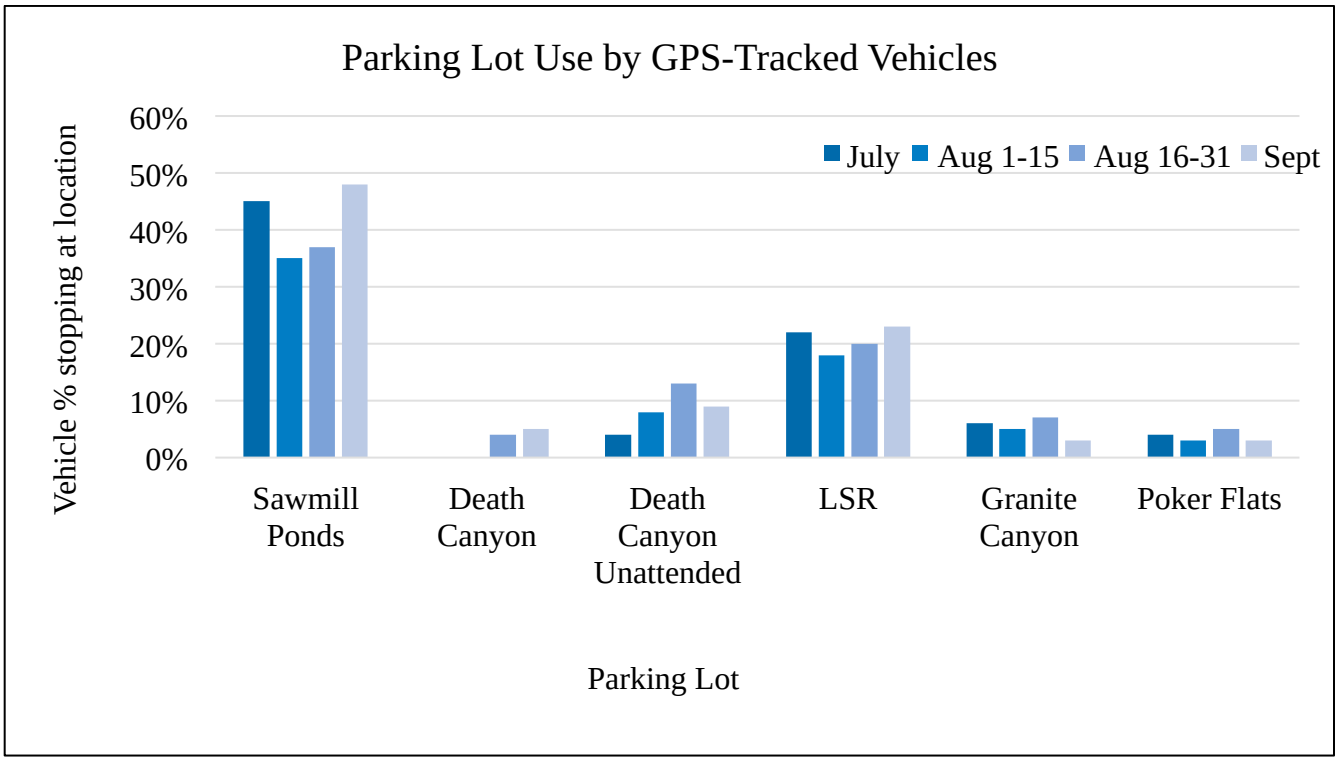
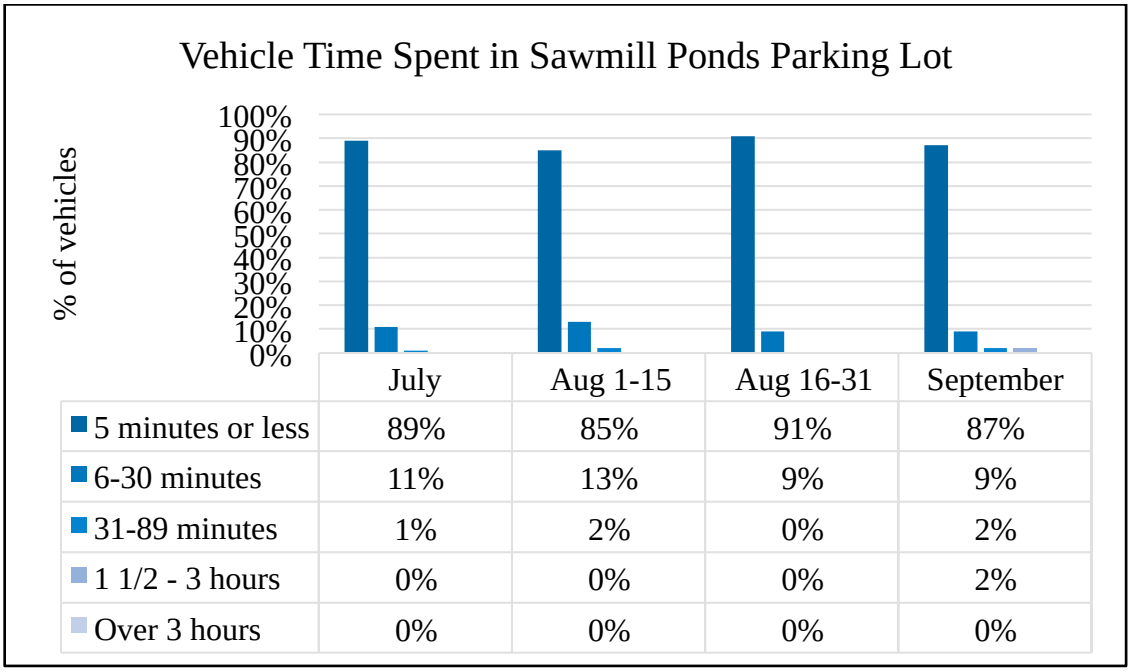


Figure 3.5: Percentage of GPS-tracked vehicles that visited specific parking areas within the Moose-Wilson corridor. Vehicles could have stopped at multiple parking areas, and frequencies do not equal 100% since not all vehicles stopped while traveling the corridor.

Table 3.5: Percentage of GPS-tracked vehicles that visited specific areas of interest within the Moose-Wilson corridor. Frequencies do not equal 100% since not all vehicles stopped while traveling the corridor, and some vehicles made multiple stops while within the corridor.

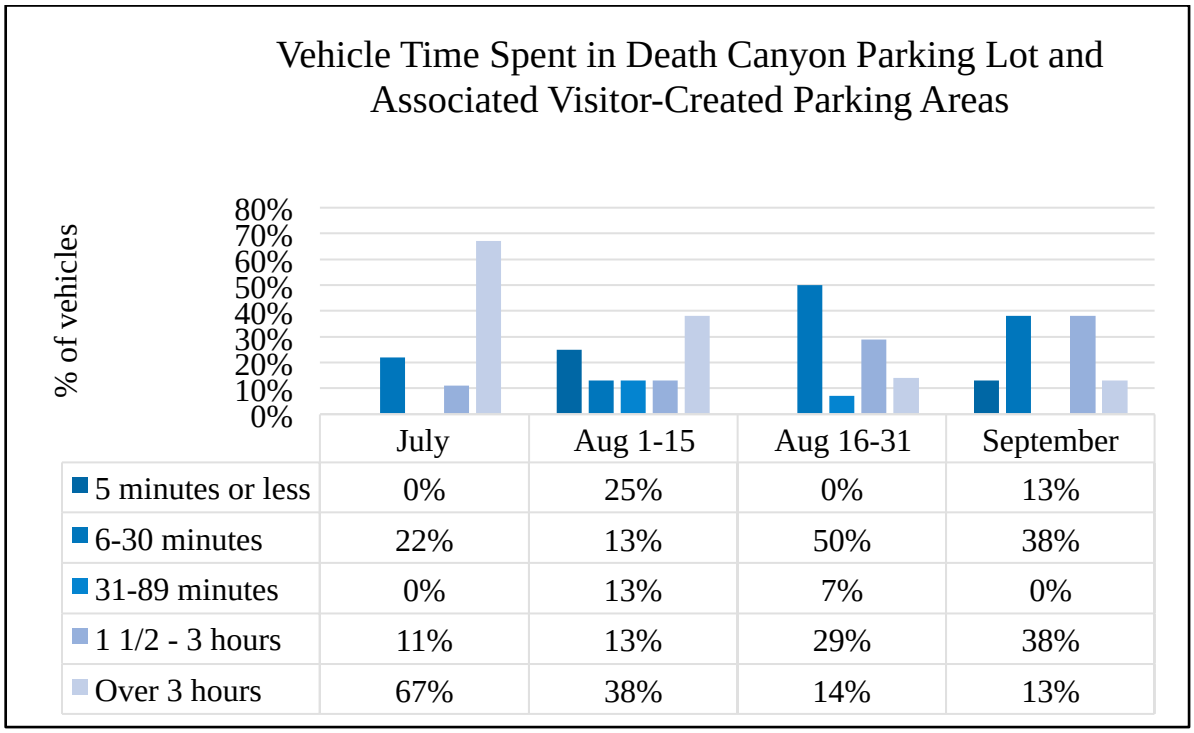
	Frequency of Vehicle Visitation to Sites			
Location	**July**	**August 1-15**	**August 16-31**	**Sept**
Sawmill Ponds Overlook	36.2%	22.7%	23%	38.6%
Death Canyon Trailhead	6.9%	9.2%	14.8%	10.2%
LSR Preserve Center	22%	20.2%	21.3%	22.7%
Granite Canyon	5.5%	5.9%	5%	4.5%
Poker Flats Parking Area	2%	1.7%	4.1%	1.1%
Drive Straight Through	45.4%	56.3%	51%	43.2%
Multiple Stops at Above Locations	15.1%	15.1%	16.4%	14.8%

For GPS-tracked vehicles that stopped in parking lot areas in the Moose-Wilson corridor, the total time the vehicle spent parked/stopped was calculated (Figures 3.6-3.11 and Table 3.6). The Sawmill Ponds and Poker Flat parking areas had the shortest duration of stay with most vehicles spending less than 5 minutes in these parking lots (Figures 3.6 and 3.10). The average amount of time vehicles spent in the Sawmill Ponds parking lot ranged from 2 minutes to 6 minutes across sampling periods and 1 minute to 10 minutes in the Poker Flats parking lot (Figure 3.11 and Table 3.6). The majority of vehicles also spent less than 5 minutes in the Granite Canyon parking area; however, average duration time in the parking lot varied across sampling periods from 3 minutes to 1 hour and 20 minutes (Figures 3.9 and 3.11; Table 3.6). Duration of stay at the LSR Preserve parking area averaged 1 hour and 20 minutes (Figure 3.11 and Table 3.6) with most vehicles spending either less than 5 minutes in the parking lot or 1 hour and 30 minutes to 3 hours (Figure 3.8). In the Death Canyon parking area, duration of stay varied by sampling periods (Table 3.6 and Figure 3.11) with an average of 1 hour and 20 minutes to 2 hours and 30 minutes.



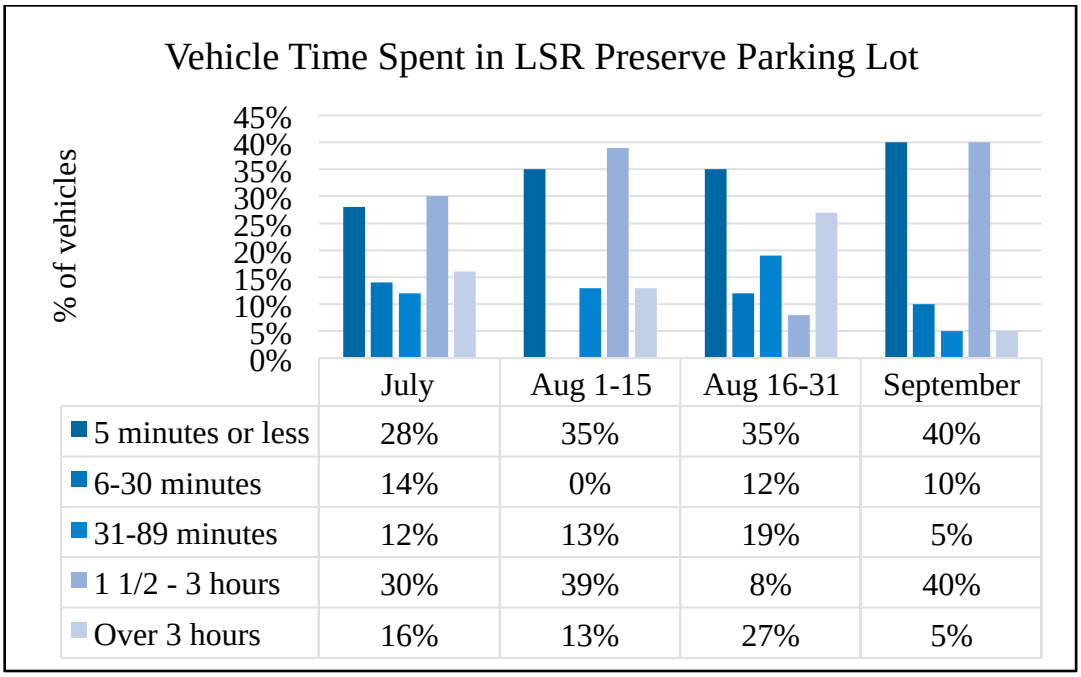
	July	Aug 1-15	Aug 16-31	September
5 minutes or less	89%	85%	91%	87%
6-30 minutes	11%	13%	9%	9%
31-89 minutes	1%	2%	0%	2%
1 1/2 - 3 hours	0%	0%	0%	2%
Over 3 hours	0%	0%	0%	0%

Figure 3.6: Frequencies of amount of time GPS-tracked vehicles spent in the Sawmill Ponds Parking Lot. N = 312



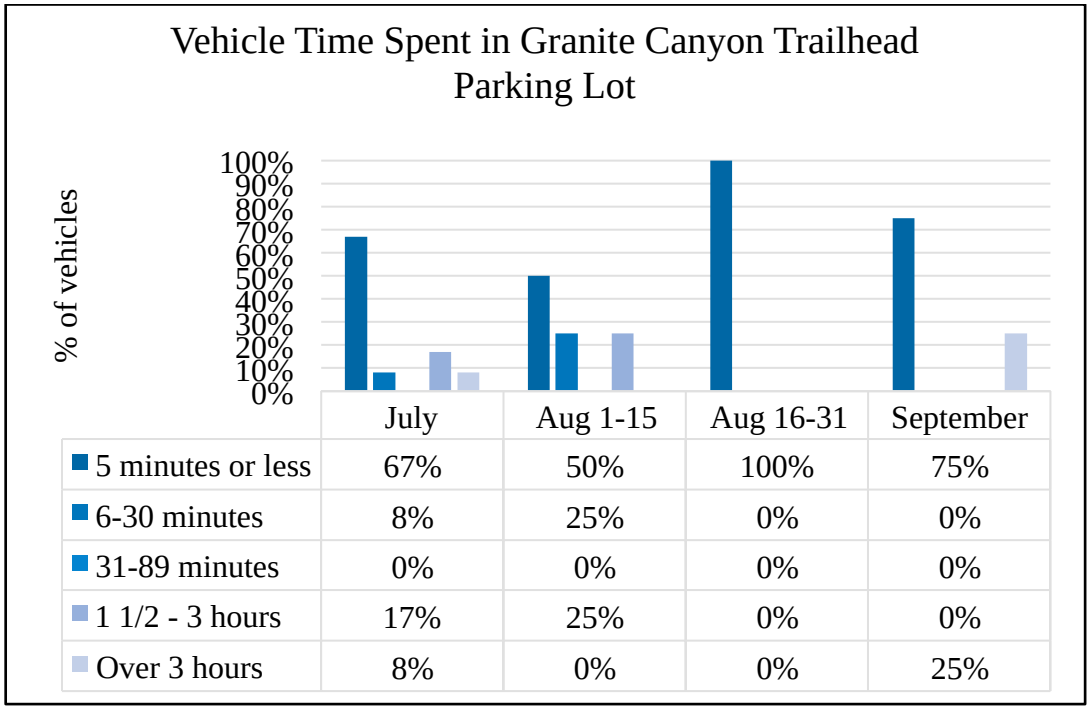
	July	Aug 1-15	Aug 16-31	September
5 minutes or less	0%	25%	0%	13%
6-30 minutes	22%	13%	50%	38%
31-89 minutes	0%	13%	7%	0%
1 1/2 - 3 hours	11%	13%	29%	38%
Over 3 hours	67%	38%	14%	13%

Figure 3.7: Frequencies of amount of time GPS-tracked vehicles spent in the Death Canyon Parking Lot. N = 39; visitor-created parking areas were treated as part of the overall "parking lot."



	July	Aug 1-15	Aug 16-31	September
5 minutes or less	28%	35%	35%	40%
6-30 minutes	14%	0%	12%	10%
31-89 minutes	12%	13%	19%	5%
1 1/2 - 3 hours	30%	39%	8%	40%
Over 3 hours	16%	13%	27%	5%

Figure 3.8: Frequencies of amount of time GPS-tracked vehicles spent in the LSR Preserve Parking Lot. N = 120



	July	Aug 1-15	Aug 16-31	September
5 minutes or less	67%	50%	100%	75%
6-30 minutes	8%	25%	0%	0%
31-89 minutes	0%	0%	0%	0%
1 1/2 - 3 hours	17%	25%	0%	0%
Over 3 hours	8%	0%	0%	25%

Figure 3.9: Frequencies of amount of time GPS-tracked vehicles spent in the Granite Canyon Trailhead Parking Lot. N = 27

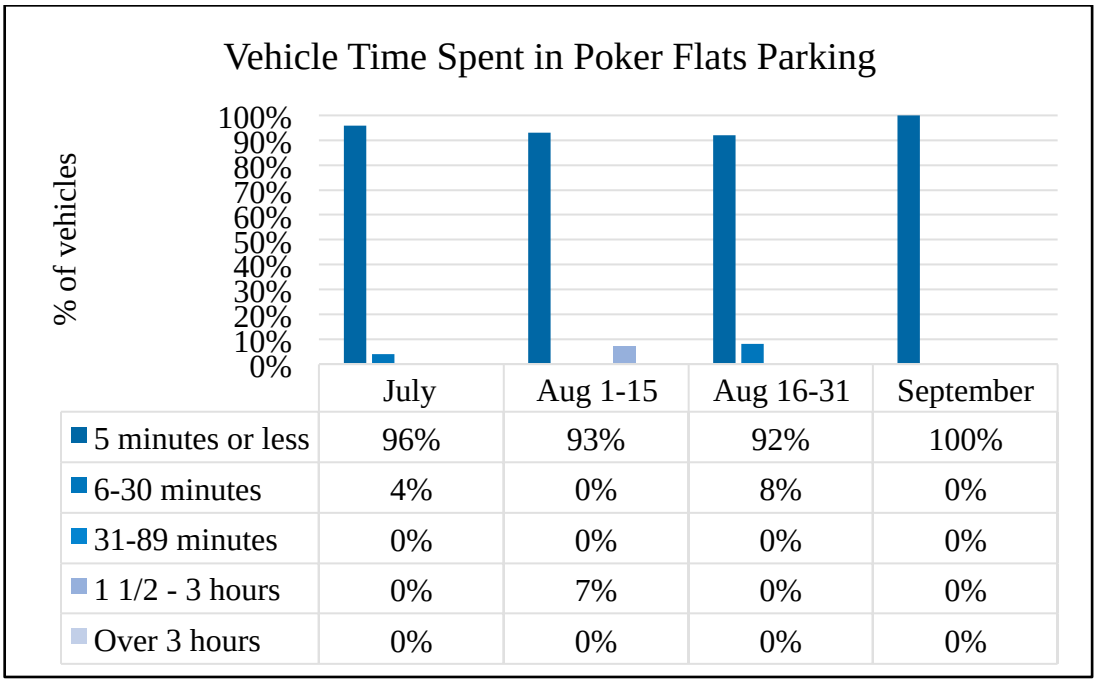


Figure 3.10: Frequencies of amount of time GPS-tracked vehicles spent in the Poker Flats Parking Lot. N = 61

Table 3.6: Average amount of time (in minutes ± 1 standard deviation) GPS-tracked vehicles spent stopped/parked in parking lots within the Moose-Wilson corridor. For Death Canyon, visitor-created parking areas were treated as part of the overall "parking lot."

	Average Time Stopped in Minutes			
Parking Area Location	**July**	**Aug 1-15**	**Aug 16-31**	**Sept**
Sawmill Ponds	3.2 (± 5.1)	2.9 (± 5.0)	2.4 (± 3.6)	6 (± 19.7)
Death Canyon	166.1 (± 96.9)	115.4 (± 115.0)	91.3 (± 112.3)	86.1 (± 91.3)
LSR	83.8 (± 83.6)	89 (± 86.4)	88.8 (± 106.7)	65.9 (± 69.2
Granite Canyon	47.8 (± 107.6)	33.8 (± 53.7)	3 (± 1.7)	83.8 (± 162.8)
Poker Flats	1.4 (± 1.1)	10.3 (± 41.0)	1.9 (± 2.6)	1.1 (± 0.4)

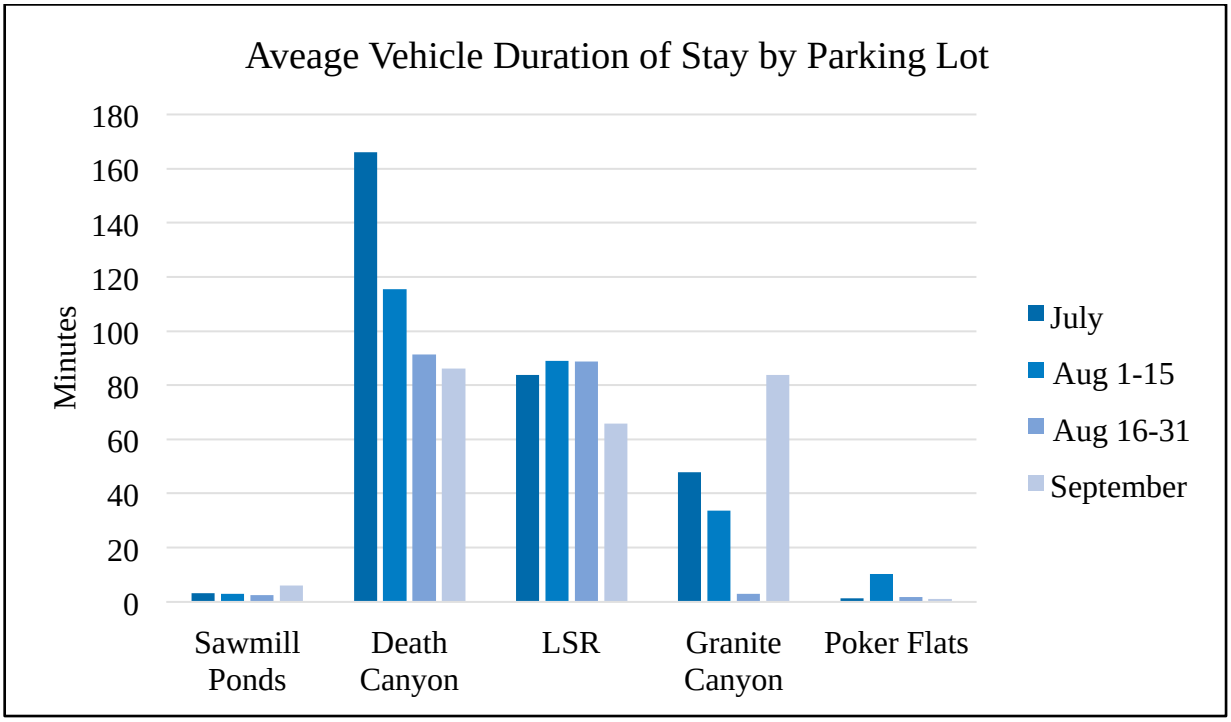


Figure 3.11: Average amount of time GPS-tracked vehicles spent stopped/parked in parking lots within the Moose-Wilson corridor. For Death Canyon, visitor-created parking areas were treated as part of the overall "parking lot."

TIME SPENT IN THE MOOSE-WILSON CORRIDOR

The total time each GPS-tracked vehicle spent in the Moose-Wilson corridor was calculated individually from the GPS track. For all sampling periods, the average time spent in the corridor was approximately 1 hour (Table 3.6). However, a wide range of variability was seen amongst tracks. The median value of time spent in the corridor ranged from 24-29 minutes (Table 3.7). Frequencies of time spent in the corridor shows that, across all sampling periods, over half of the vehicles tracked spent less than 30 minutes within the Moose-Wilson Corridor (Table 3.8). Of the vehicle trips less than 30 minutes, the most frequent trip time was 18 minutes (Figure 3.6).

Table 3.6: Average duration of time (± 1 standard deviation) spent in the Moose-Wilson corridor for all vehicles that were tracked with GPS units. Findings are stratified by sampling period. Overall average: 1 hour, 5 minutes.

	July	August 1-15	August 16-31	Sept
All Vehicles	1 hr, 6 Min (± 88 min)	1 hr, 10 Min (± 103 min)	1 hr, 5 min (± 88 min)	1 hr, 1 min (±71 min)

Table 3.7: Median duration of time (with range of times observed) spent in the Moose-Wilson corridor for all vehicles that were tracked with GPS units. Findings are stratified by sampling period.

	July	August 1-15	August 16-31	Sept
All Vehicles	27 min (6 min - 12 hrs 12 min)	24 min (9 min - 10 hrs 3 min)	26 min (12 min - 7 hrs 28 min)	29 min (17 min - 5 hrs 53 min)

Table 3.8: Frequencies of duration time in the Moose-Wilson corridor for GPS-tracked vehicles. Determined by examining the start and end time for the cleaned GPS-tracks.

Vehicle Duration of Stay	July	Aug 1-15	Aug 16-31	Sept
<30 minutes	53%	60%	53%	51%
30-59 minutes	22%	14%	21%	26%
1-3 hours	12%	17%	15%	14%
>3 hours	13%	9%	11%	10%

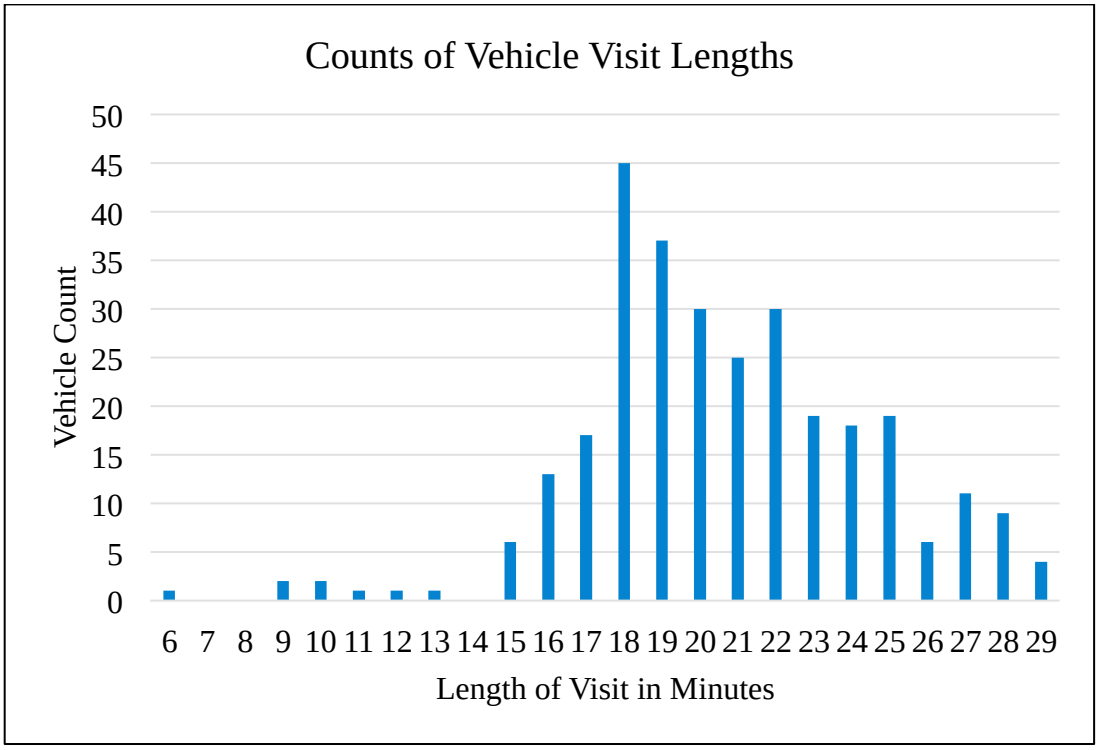


Figure 3.6: Counts of vehicle visit lengths (in minutes) that were less than 30 minutes.

4. BICYCLE USE LEVELS

MOOSE-WILSON ROAD

Data collected by the TMC and the ATR studies included counts of bicycle use on the Moose-Wilson Road (Table 4.1). Results from TMC and ATR are re-summarized below to focus only on bicycle use levels on the Moose-Wilson Road. Please refer to Section 2 for more information about the TMC and ATR data collection, including specific sampling days and hours of sampling days.

The majority of bicycle users entering the Moose-Wilson road were doing so from either the Granite entrance (156 total counts) or by bicycling through the Moose-Wilson and Teton Park Road intersections from park headquarters (208 total counts). It is important to note that the bike path is located on the park headquarters side of the intersection. Very few bicyclists entered the Moose-Wilson Road from Teton Park Road. More bicyclists exited the Moose-Wilson Road at the Teton Park Road intersection (183 total counts) versus heading southbound out of the Granite entrance gate (161 total counts).

Table 4.1: Summary of bicycle use levels collected using the TMC and ATR camera methodologies. The data for this table is derived from data tables in Section 2.

Sampling Period	North-bound	South-bound	Exiting	Entering from Administration	Entering from East	Entering from West
July	71	85	42	48	8	2
August 1-15	85	76	64	78	3	4
August 16-31	N/A	N/A	31	43	7	0
Sept	N/A	N/A	46	39	7	8
Total	**156**	**161**	**183**	**208**	**25**	**14**

BIKE PATH

A trail counter on the bike path in Moose was used to observe visitor use levels. Both pedestrians and bicyclists and any other use group (such as roller-bladers) were captured with the trail counter. Visitor use on the bike path near the Snake River Bridge in Moose varied across sampling periods with the most total use observed in July and the lowest total use observed in September (Table 4.2). Average use per day was highest during the August 1st-15th sampling period with an estimated 569 visitors/day on the bike path. In general, average weekend use was higher than average weekday use with the exception of the July sampling period (only slightly higher average use on weekdays).

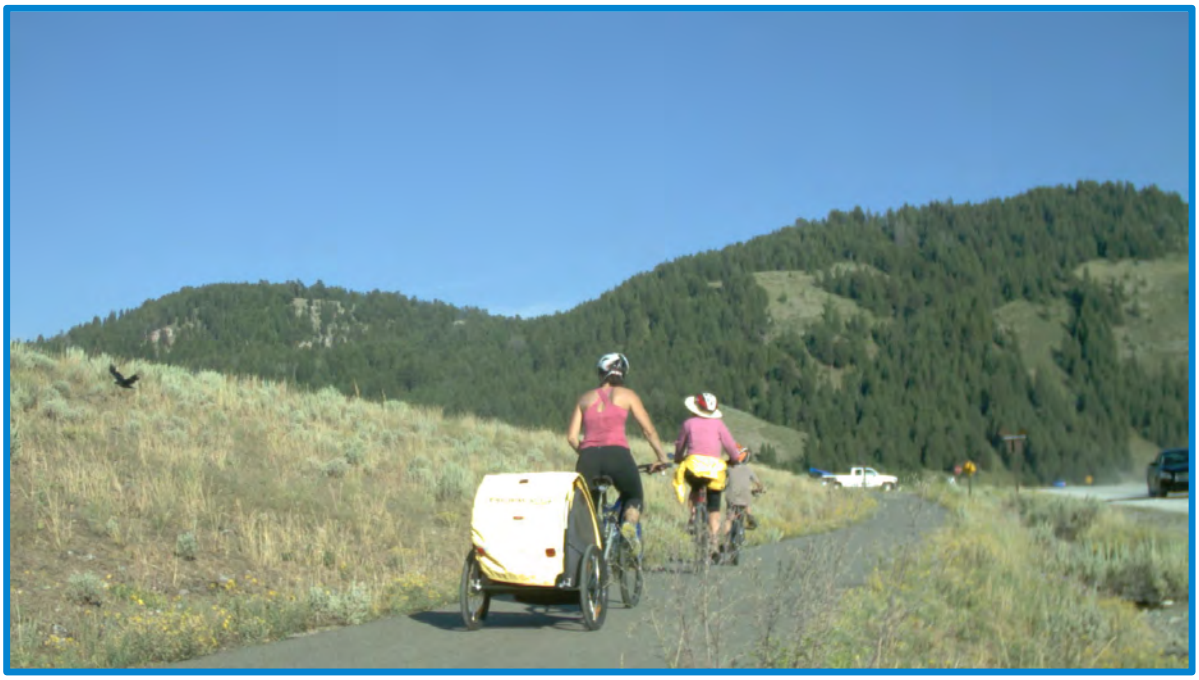


Figure 4.1: Group of adults with children biking on the pathway near the Snake River bridge in Moose (photo taken with motion-activated camera).

Table 4.2: Corrected visitor use levels for all user types observed on the Snake River Bridge location. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park. Analysis of photos taken at this counter throughout the study indicate that 83% of use at this counter was bicycles.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
June[1]	5,121[2]	366	309	505
July	15,158	489	503	453
Aug 1-15	8,529	569	540	559
Aug 16-31	2,948	184	151	259
September	479	17	9	31
October	1,172	38	33	52
November[3]	2	2	2	0

[1]June sampling period started on the 17th.

[2]Numbers are corrected estimates using the calibration weight value (2.36).

[3]November sampling period ended on the 2nd.

5. BICYCLE USE TYPE

MOOSE-WILSON ROAD

Video from TMC cameras was manually analyzed to determine bicycle use types at the Moose-Wilson Road and Teton Park Road intersection. The TMC cameras were positioned in such a way that the pathway could not be seen on the video, only the road intersection (Figure 8). Manual video analysis indicates that the most common bicycle type observed at the Moose-Wilson Road and Teton Park Road intersection were single bicyclists followed by bike groups of 2 or 3 individuals (Table 5.1). The frequency of single bicyclists increased at the Moose-Wilson Road and Teton Park Road intersection in August from 57% of bicyclists being single riders in July to 77% in the first sampling period of August (Table 5.1).

Table 5.1: Frequencies of different user groups observed at the intersection of the Moose-Wilson Road and Teton Park Road. A motion-activated camera was used to capture images of users, and these images were sampled, analyzed manually, and summarized by frequencies of observed individual specific user group.

Users by Type at Moose-Wilson Road and Teton Park Road Intersection	July	August 1-15	August 16-31	September
Single Bike	57%	77%	N/A	N/A
Bike group of 2-3	43%	16%	N/A	N/A
Bike group of 4-6	0%	3%	N/A	N/A
Bike group of 7+	0%	0%	N/A	N/A
Bicycling Adults with Children	0%	0%	N/A	N/A

The TMC cameras placed at the intersection of the Teton Park Road and Moose-Wilson Road and the intersection of the LSR Preserve Road and the Moose-Wilson Road also captured the turning movement of bicycles. Figures 5.1-5.9 illustrate the complete volume broken down for bicycles only into their designated study dates. The majority of bicycles (over 80% across all sampling periods) that entered the Moose-Wilson Road from the Teton Park Road intersection came from the administration road by traveling southbound. The average movement for the entire TMC study at that location showed that approximately 74% of the bicycle movement in the intersection was due southbound “thru” movements from the administration road to the Moose-Wilson Road (Figure 5.5). It is important to note that the multi-use pathway in Moose crosses the administration road. Bicycle movement from the pathway and onto the administration road could not be seen by the TMC cameras. Of the bicycles turning onto the Moose-Wilson Road from the Teton Pak Road intersection, on average 7% entered westbound and 5% entered eastbound (Figure 5.5). On average, 57% of the bicycle traffic northbound on Moose-Wilson Road traveled “straight thru” to the administration road (and towards the pathway), 33% made a right turn towards the visitor center, and 11% made a left turn towards Jackson Lake (Figure 5.5).

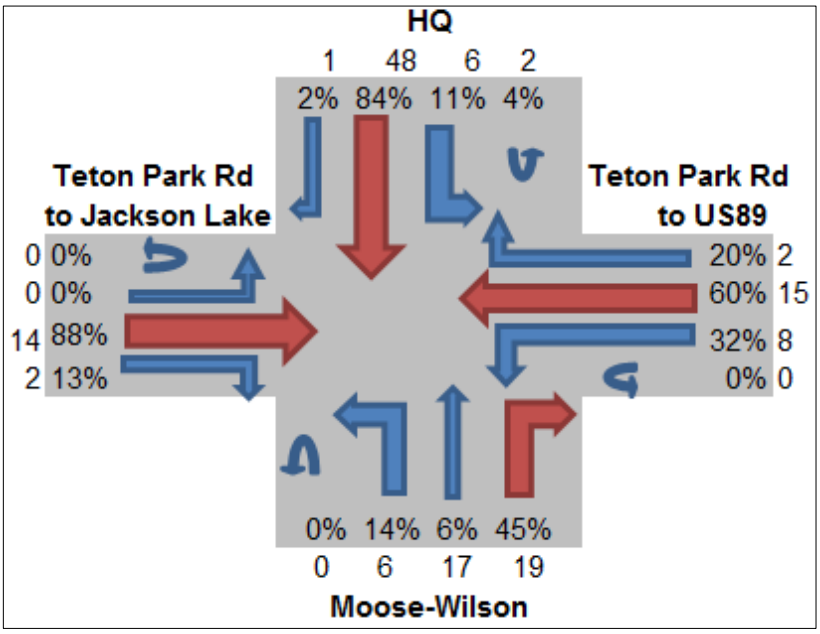


Figure 5.1: Moose-Wilson Road and Teton Park Road – July Bicycle Movement Volume.

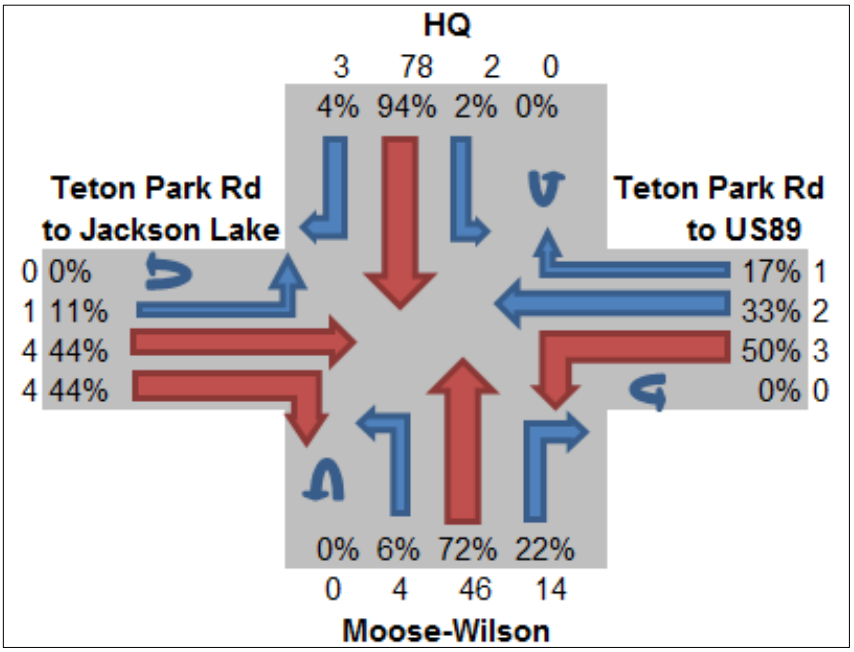


Figure 5.2: Moose-Wilson Road and Teton Park Road – August 1-15 Bicycle Movement Volume.

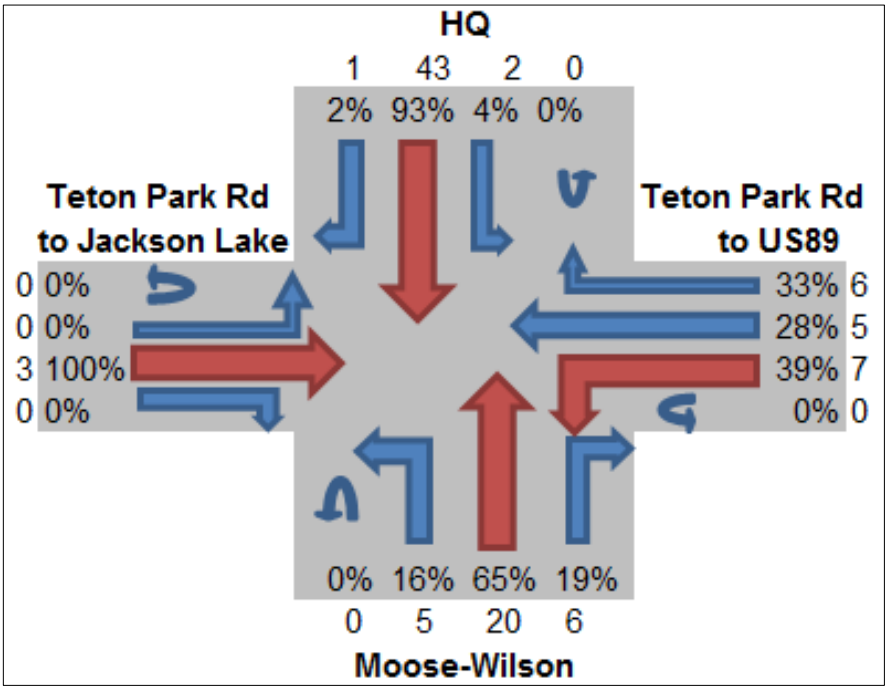


Figure 5.3: Moose-Wilson Road and Teton Park Road – August 15-31 Bicycle Movement Volume.

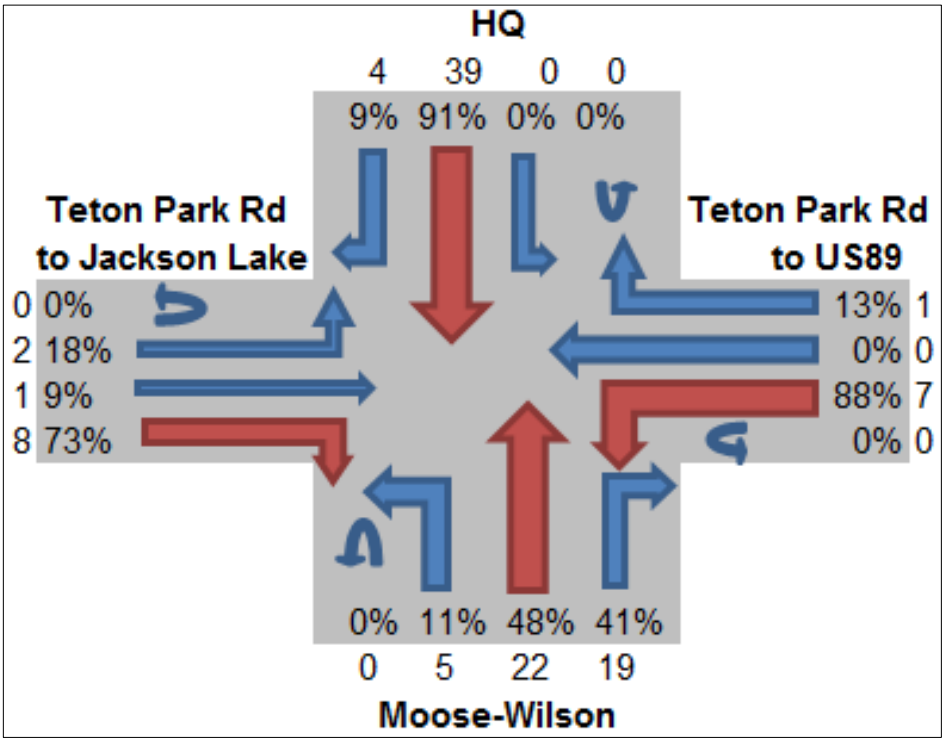


Figure 5.4. Moose-Wilson Road and Teton Park Road – September Bicycle Movement Volume.

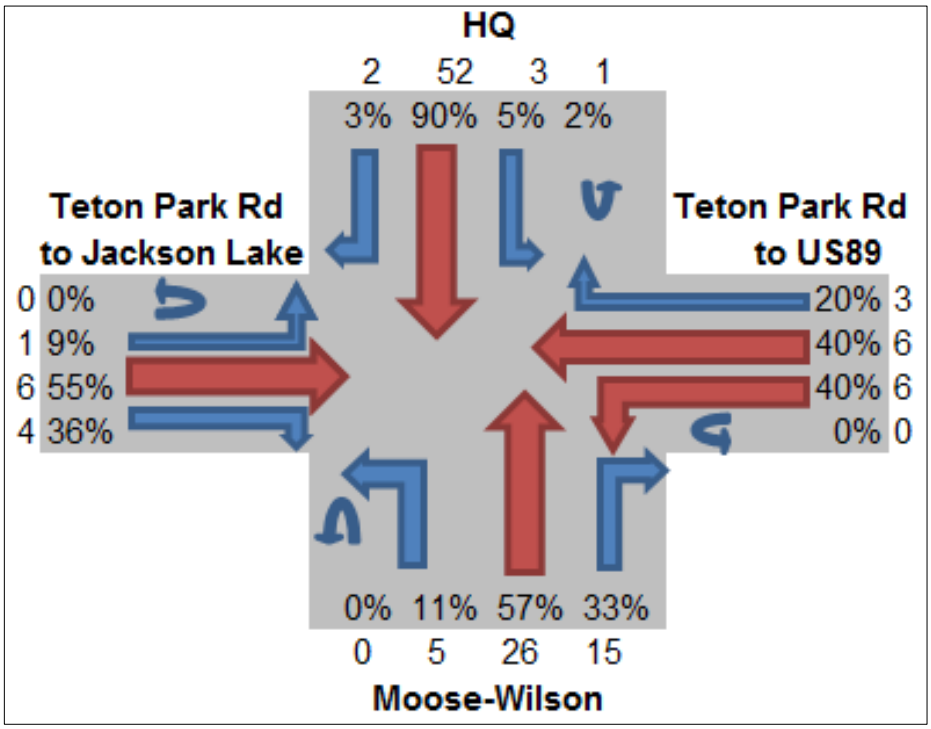


Figure 5.5. Moose-Wilson Road and Teton Park Road – Average Bicycle Movement Volume.

The second TMC data presented is the intersection of Moose-Wilson Road and the LSR Preserve entrance. Figures 5.6 through 5.9 illustrate the complete volume broken down for bicycles into their designated study dates. The majority of the bicycle volume was shown to have a movement of northbound and southbound as approximately 81% of the bicycle traffic on the Moose-Wilson Road traveled in the northbound and southbound direction (Figure 5.9). On average, 4% of the northbound bicycle traffic made a right turn into LSR Preserve, while 7% of the southbound bicycle traffic made a left turn into LSR Preserve. The average bicycle traffic movement out of LSR Preserve showed 50% making a right turn northbound heading towards the Teton Park Road and Moose-Wilson Road intersection while 50% turned left southbound heading towards the Granite entrance.

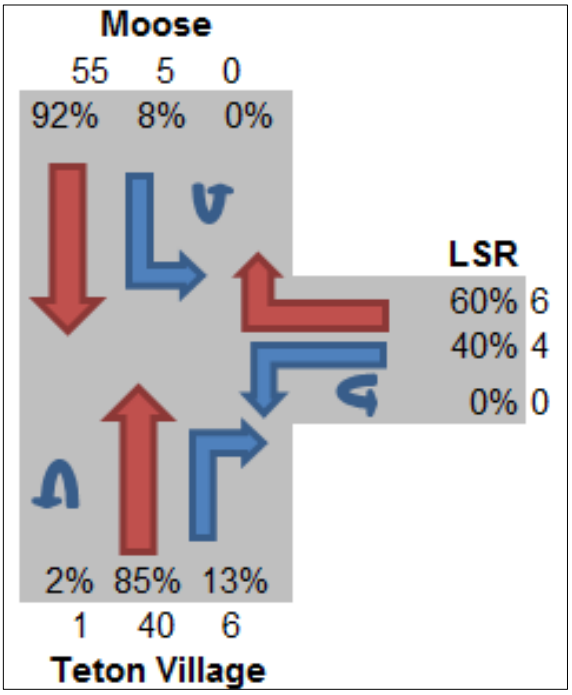


Figure 5.6. Moose-Wilson Road and LSR Preserve Road – July Bicycle Movement Volume.

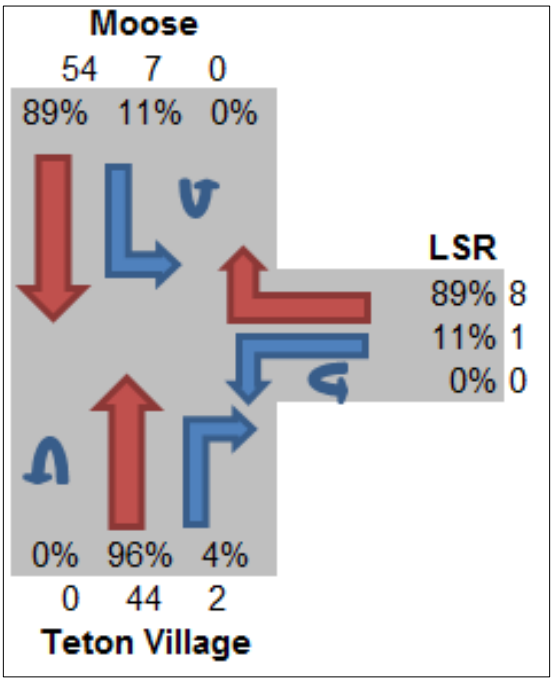


Figure 5.7. Moose-Wilson Road and LSR Preserve Road – August 1-15 Bicycle Movement Volume.

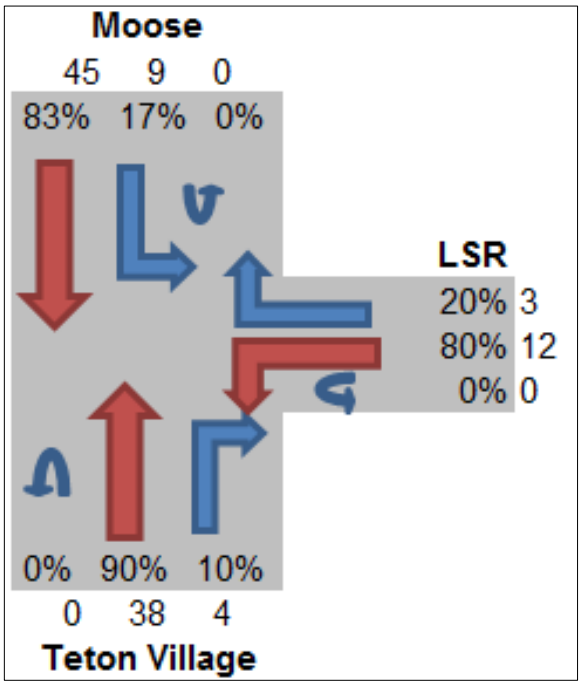


Figure 5.8. Moose-Wilson Road and LSR Preserve Road – September Bicycle Movement Volume.

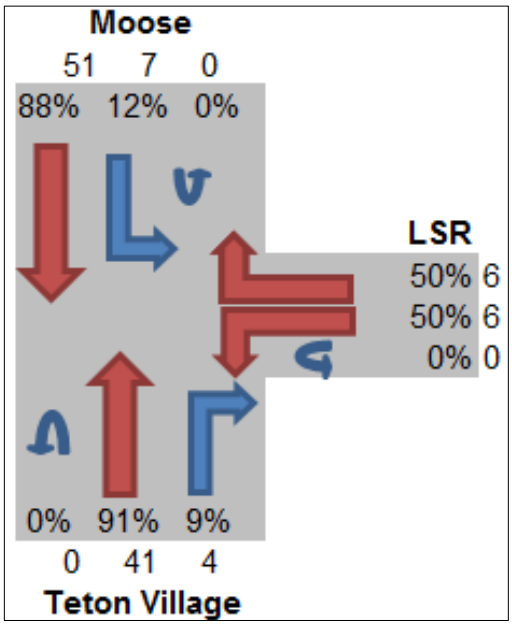


Figure 5.9. Moose-Wilson Road and LSR Preserve Road – Average Bicycle Movement Volume.

BIKE PATH

A motion-activated camera, placed just east of the Snake River Bridge in conjunction with the trail counter on the bike path in Moose, was used to determine visitor use types (bicyclist versus pedestrians). In order to make manual analysis of the photographs feasible, all photographs collected on two randomly selected weekdays and two randomly selected weekend days from each sampling period were taken from the total collection of photographs. This random sampling resulted in a total of 5,537 photos being manually analyzed (representing from 10%-14% of any individual sampling period).

Counts of user groups indicate that 83% of all user groups across the study period were bicycling groups while 17% were pedestrian groups (Table 5.2). August 16th-31st was the sampling period with highest use by bicycle groups while July was the sampling period with the highest use by pedestrian groups. In July, the highest type of bicycling group was made up of 2-3 cyclists while the most common pedestrian group was adults with children (Table 5.3). During both August sampling periods and September, single bicyclists were the most common bicycle group type while the most common pedestrian types were single pedestrians (Table 5.4). Manual calibrations that took place in order to determine counter error corroborate the results from the manual photo analysis; single pedestrians and single bicycles were the most frequently observed groups during calibrations (Table 5.4).

Table 5.2: Counts of different user groups observed on the bike path in Moose to the east of the Snake River Bridge. A motion-activated camera was used to capture images of users, and these images were sampled, analyzed manually, and summarized by frequencies of observed individual user group type.

Sampling Period	Bike Groups	Pedestrian Groups	Total Groups
July	147	99	246
August 1-15	137	8	145
August 16-31	234	9	243
Sept	204	35	239
Total User Group Types	**722**	**151**	**873**
Percentages	**83%**	**17%**	

Table 5.3: Frequencies of different user groups observed on the bike path in Moose to the east of the Snake River Bridge. A motion-activated camera was used to capture images of users, and these images were sampled, analyzed manually, and summarized by frequencies of observed individual specific user group type.

Users by Type on Pathway at Moose Bridge	July	August 1-15	August 16-31	September
Single Bike	30%	43%	49%	41%
Bike Group of 2-3	33%	29%	34%	26%
Bike Group of 4-6	0%	5%	2%	8%
Bike Group of 7+	1%	1%	1%	0%
Bicycling Adults with Children	3%	16%	9%	1%
Runner	1%	2%	1%	5%
Single Pedestrian	5%	0%	4%	9%
Pedestrian Adults with Children	28%	2%	1%	8%
Other	0%	2%	0%	1%

Table 5.4: Summary of calibration techniques (observational counts) for trail counter located on the bike path in Moose to the east of the Snake River Bridge.

Counter Location	Single Bike	2-3 Bike Group	4-6 Bike Group	7+ Bike Group	Bike Family	Single Ped.	Ped. Family	Run	Other	Total Observed	Total Counter	Correction Value
Snake River Bridge	166	148	24	2	21	37	15	5	12	766	553	**2.36**
Percent Of Total Observed	**39%**	**34%**	**6%**	**0%**	**5%**	**9%**	**3%**	**1%**	**3%**			

6. BICYCLE MOVEMENT PATTERNS

GPS-TRACKING DATA COLLECTION SUMMARY

All bicyclists that entered the Moose-Wilson corridor during the vehicle GPS-tracking sampling days were approached and asked to carry a GPS unit. A total of 82 bicycle tracks were collected during the summer sampling period; no bicyclists were observed during vehicle sampling in September. Of all bicyclists approached, 81% accepted a GPS unit. Group size for bicyclists averaged at 1.7 people per group (Table 6.1).

Figure 6.1: Photo of the GPS unit drop box at the Granite entrance where visitors could return the GPS units if they were unable to locate the field technicians (photo by Ashley D'Antonio).

Table 6.1: Summary of information collected on GPS-tracking logs including acceptances, rejections, and average number of people in bicycling groups (± 1 standard deviations) (81% acceptance rate).

	South Fee Station	North Moose Junction	Total
Acceptances	31	51	82
Rejections*	13	6	19
Average Group Size	2.1 (±1.5)	1.5 (±1)	1.7 (±1.2)

*The most common reason for rejection for GPS-tracking of bicyclists was that the visitor did not have time to stop and take a GPS unit.

ENTRANCE AND EXIT PATTERNS OF GPS-TRACKED BICYCLISTS

Individual bicycle tracks were examined to determine entrance and exit locations (Table 6.2). During July and the first sampling period for August (1^{st}-15^{th}), the majority of bicyclists traveled southbound through the Moose-Wilson corridor. During the second sampling period of August (16^{th}-31^{st}), approximately half of the bicyclists traveled through the road starting at the Moose end and the other half traveled through the Moose-Wilson corridor by starting at the South Fee Station.

Table 6.2: Frequencies of use for bicycle entrances and exits to the Moose-Wilson Road by sampling period, determined by noting entrance and exit location for each individual bicycle track. North is the Moose entrance and south is the Granite entrance.

Bicycle Travel Patterns	July	Aug 1-15	Aug 16-31
Northbound through	29%	14%	46%
Southbound through	55%	64%	46%
Enter and Exit North	6%	11%	4%
Enter and Exit South	10%	11%	4%

BICYCLE STOPPING BEHAVIOR

Each individual bicycle track was examined to determine what destinations in the Moose-Wilson Corridor were visited by the bicyclist (Table 6.3). During July and the first sampling period of August (1^{st}-15^{th}), an overwhelming majority of bicyclists rode straight through the corridor, 84% and 79%, respectively. During the second sampling period of August (16^{th}-31^{st}), half of the bicyclists rode straight through the Moose-Wilson corridor.

Table 6.3: Percentage of GPS-tracked bicycles that visited specific areas of interest within the Moose-Wilson corridor. Frequencies do not equal 100% since not all bicyclists stopped while traveling the corridor and some bicycles made multiple stops while within the corridor.

	Frequency of Bicycle Visitation to Sites		
Location	**July**	**August 1-15th**	**August 16-31**
Sawmill Ponds Overlook	7%	7%	35%
Death Canyon Trailhead	0%	7%	0%
LSR Preserve Center	10%	7%	8%
Granite Canyon TH	0%	11%	0%
Poker Flats	0%	0%	0%
Through Ride - No Stops	84%	79%	58%
Stop at Multiple of Above Locations	0%	4%	0%

TIME SPENT IN THE MOOSE-WILSON CORRIDOR

The total time each GPS-tracked bicycle spent in the Moose-Wilson corridor was calculated individually from the GPS track (Tables 6.4-6.6). For all sampling periods, the average time spent in the corridor was under 1 hour (Table 6.4). The median time spent in the Moose-Wilson corridor ranged from 34 minutes to 49 minutes (Table 6.5). Frequencies of time spent in the corridor show that during July and the first half of August, between 43% and 48% of the bicycles spent less than 30 minutes in the corridor while the majority spent between 30 minutes and 1 hour in the Moose-Wilson corridor (Table 6.6). During the second August sampling period (August 16th-31st), half of the bicyclists spent between 30 minutes and 1 hour in the corridor while 35% spent less than 30 minutes in the Moose-Wilson corridor.

Table 6.4: Average duration of time (± 1 standard deviation) spent in the Moose-Wilson corridor for all bicycles that were tracked with GPS units. Findings are stratified by sampling period.

	July	August 1-15	August 16-31
All Bikes	34 min (± 13 min)	52 min (+/- 62 min)	45 min (+/- 32 min)

Table 6.5: Median (and range) for time spent in the Moose-Wilson corridor for all bicycles that were tracked with GPS units. Findings are stratified by sampling period.

	July	August 1-15	August 16-31
All Bikes	34 min (8 min – 1 hr 3 min)	36 min (6 min - 4 hr 39 min)	49 min (21 min - 2 hr 57 min)

Table 6.6: Frequencies of duration time in the Moose-Wilson corridor for GPS-tracked bicycles. Determined by examining the start and end time of GPS-tracks.

Bike Duration of Stay	July	Aug 1-15	Aug 16-31
<30 min	48%	43%	35%
30 min- 59 min	45%	46%	50%
1-3 hours	7%	4%	15%
>3 hours	0%	7%	0%

See Appendix E for maps of overall use patterns from the GPS-tracked bicycles and bicycle density maps.

7. PEDESTRIAN USE LEVEL

CALIBRATIONS

Pedestrian counters were placed throughout the Moose-Wilson Corridor trail system by the park (see Figure 2). The data from these counters were downloaded by the park, and the raw data was provided to Utah State University for analysis and summary. During each sampling period, Utah State University calibrated each counter to determine the level of error associated with the counter. Calibration techniques involved manually counting pedestrians at each counter and comparing the manual counts to the electronic counts from the counter. A correction value was calculated for each counter, with the exception of the counter at the parking lot of the LSR Preserve, and used to weight the total counts provided by the park. Correction values close to 1 mean the counter has low error, values below 1 mean the counter is overestimating use, and values above 1 indicate that the counter is underestimating use. Calibration rank values are included as a footnote on each counter table (Tables 7.2-7.11). Raw values and the calibration weight calculations can be found in Appendix I.

Figure 7.1: Granite Canyon Trailhead, one of the locations where a counter was located to help estimate visitor use to this destination (photo by Ashley D'Antonio).

USE LEVELS

Tables 7.2 through 7.11 below show total use, average use, and average weekend and weekday use at each counter in the study. Table 7.1 shows a ranking of counter locations by calibration corrected visitor use level. The raw values and values adjusted by the correction values (from Table 7.1) are both included in the tables. Data collection for most, but not all, counters lasted from May through early November. Data for collection periods outside of the official sampling periods (July, August 1-15, August 16-31, September, and October) were included in the tables since the data was provided to Utah State University.

The counter located at the bridge just past the LSR Preserve (Table 7.4) parking lot received the highest level of use while the counter placed on the Valley Trail (Table 7.11) towards Teton Village received the lowest level of use. For all counters—with the exception of the Sawmill Pond, Phelps Lake East, and the Valley Trail counters—the first sampling period in August (1^{st}-15^{th}) had the highest level of average visitors per day. For Sawmill Ponds (Table 7.2), Phelps's Lake East (Table 7.8), and the Valley Trail (Table 7.11) counters, July was the sampling period with the highest average number of visitors per day. For all counters, October has the overall lowest level of use, most likely due to the government shutdown that occurred in early October 2013. When a consistent pattern was observed between weekday and weekend use levels, weekends were busier than weekdays. Most of these differences were relatively small, indicating that in most cases visitor use levels do not vary much from weekdays to weekends.

Table 7.1: Rank of counters based on *calibration corrected* visitor use levels with 1 = counter with highest use level and 10 = counter with lowest use level.

Rank	Counter Location
1	LSR Preserve Trail Bridge
2	LSR Preserve Parking Lot
3	Death Canyon
4	Lake Creek
5	Woodland
6	Huckleberry Point
7	Phelps Lake East
8	Granite Trailhead
9	Sawmill Ponds
10	Valley Trail

Table 7.2: Corrected visitor use levels observed on the old road trail near Sawmill Ponds. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
June[1]	160[2]	33	38	27
July	2,031	66	62	78
Aug 1-15	708	47	50	41
Aug 16-31	684	44	45	40
September	1,919	64	60	72
October	170	8	6	10
November[3]	4	2	0	2

[1] June sampling period started on the 26th.

[2]Numbers are corrected estimates using the calibration correction value (1.20).

[3]November sampling period ended on the 3rd.

Table 7.3: Corrected visitor use levels observed on the Death Canyon trail. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
July[1]	17,879[2]	639	614	702
Aug 1-15	12,144	807	826	851
Aug 16-31	8,028	474	563	545
Sept	8,524	284	257	347
October[3]	74	8	9	3

[1]July sampling period started on the 4th.

[2]Numbers corrected estimates using the calibration correction value (1.57).

[3]October sampling period ended on the 10th.

Table 7.4: Visitor use levels observed at the parking lot at the LSR Preserve. This counter captures use to the LSR Preserve Center and the LSR Preserve trail system. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
July	26,268	847	858	817
Aug 1-15	13,122	875	861	912
Aug 16-31	11,165	698	656	790
Sept[1]	13,945	634	614	677

[1]September sampling period ended on the 22nd.

Table 7.5: Corrected visitor use levels observed on the trail, at the bridge, just past the LSR Preserve Center. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
May[1]	5,098[2]	317	298	385
June	27,389	914	885	970
July	38,062	1,228	1,250	1,164
Aug 1-15	19,098	1,273	1,257	1,318
Aug 16-31	16,113	1,008	924	1,140
September	22,593	753	693	873
October[3]	839	84	105	2

[1]May sampling period started on the 16th.

[2]Numbers are corrected estimates using the calibration correction value (1.78).

[3]October sampling period ended on the 10th.

Table 7.6: Corrected visitor use levels observed on the Lake Creek trail after it crossed Moose-Wilson Road. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
May[1]	1,341[2]	84	76	106
June	7,942	265	250	296
July	10,663	344	351	323
Aug 1-15	5,230	349	340	373
Aug 16-31	4,634	290	271	333
September	6,121	204	193	231
October[3]	16	2	3	1

[1]May sampling period started on the 16th.

[2]Numbers are corrected estimates using the calibration correction value (1.09).

[3]October sampling period ended on the 10th.

Table 7.7: Corrected visitor use levels observed on the Woodland trail right after the trail crosses the Moose-Wilson Road. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
May[1]	1,147[2]	72	68	82
June	6,685	253	212	244
July	10,369	335	340	321
Aug 1-15	5,583	373	369	383
Aug 16-31	4,482	281	251	345
September	5,209	174	160	208
October[3]	13	1	1	1

[1]May sampling period started on the 16th.

[2]Numbers are corrected estimates using the calibration correction value (1.02).

[3]October sampling period ended on the 10th.

Table 7.8: Corrected visitor use levels observed on the Phelps Lake East trail. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
May[1]	1,144[2]	84	79	95
June	4,173	139	133	152
July	6,706	217	206	246
Aug 1-15	2,178	146	145	146
Aug 16-31	1,659	104	96	122
September	2,372	80	75	90
October[3]	456	29	31	24

[1]May sampling period started on the 15th.

[2]Numbers are corrected estimates using the calibration correction value (1.39).

[3]October sampling period ended on the 16th.

Table 7.9: Corrected visitor use levels observed at the counter on the Huckleberry Point trail. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
May[1]	1,125[2]	70	65	90
June	4,241	141	121	182
July	5,630	182	187	165
Aug 1-15	3,089	206	206	122 [208]
Aug 16-31	2,588	162	145	202
September	3,667	123	114	143
October[3]	106	7	7	5

[1]May sampling period started on the 16th.

[2]Numbers are corrected estimates using the calibration correction value (1.70).

[3]October sampling period ended on the 16th.

Table 7.10: Corrected visitor use levels observed at Granite Trailhead. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
May[1]	286[2]	18	19	14
June	1,666	55	55	56
July	5,078	83	83	82
Aug 1-15	1,505	100	105	87
Aug 16-31	1,212	76	79	70
September	1,454	48	49	46
October[3]	38	4	4	3

[1]May sampling period started on the 15th.

[2]Numbers are corrected estimates using the calibration correction value (1.02).

[3]October sampling period ended on the 10th.

Table 7.11: Corrected visitor use levels observed on the Valley Trail heading towards Teton Village. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
June[1]	93[2]	15	15	19
July	796	26	23	33
Aug 1-15	261	18	17	20
Aug 16-31	332	21	24	17
September	500	17	17	21
October	515	12	19	18
November[3]	2	2	1	2

[1]June sampling period started on the 26th.

[2]Numbers are corrected estimates using the calibration correction value (1.37).

[3]November sampling period ended on the 3rd.

BACKCOUNTRY PERMITS AND LSR PRESERVE GUIDED HIKES

GRTE provided raw data of backcountry use levels (from permit numbers) and the number of guided hikes given at the LSR Preserve (Tables 7.12 and 7.13). Utah State University summarized these data based on sampling periods. Significantly more, over double, the amount of backcountry permits were given for Death Canyon than Granite Canyon. The most backcountry permits were given in August (with the first sampling period having a higher number of issued permits than the second sampling period in August) and the lowest number were issued in October (Table 7.12). Like the backcountry permits, the highest number of participants in LSR Preserve guided hikes was observed in August (Table 7.13).

Table 7.12: Total number of overnight backcountry permits given to visitors for locations within the Moose-Wilson corridor. Data was provided by the park.

Overnight Backcountry Use per Trailhead		
Sampling Period	**Granite Canyon**	**Death Canyon**
July	120	264
August 1st-15th	76	170
August 16th-31st	55	132
September	45	93
October	1	6

Table 7.13: Total number of participants in guided hikes leaving from the LSR Preserve Center. Data was provided by the park.

LSR Preserve Guided Hike Participation	
Sampling Period	**Total Number of Participants**
July	212
August	228
September	185
October	0

GPS-TRACKING DATA COLLECTION SUMMARY

Garmin eTrex 100 GPS units were handed out to a random sample of pedestrians planning on hiking within the Moose-Wilson Corridor. GPS units were handed out at Granite Canyon Trailhead, Death Canyon Trailhead, and the LSR Preserve (just past the LSR Preserve Center) (Table 8.1). Backpackers were excluded from the study due to logistical difficulties with GPS battery life, and complications with field logistics and data analysis. Upon completion of their day hike, pedestrian visitors returned the GPS units to field technicians at the trailhead or to GPS drop boxes located on each end of the Moose-Wilson Road. GPS tracks were cleaned of any obvious outliers, and calibration techniques were used to determine the level of positional error associated with the Garmin eTrex 100 units. Overall error was determined to be 1.71 (+/- 1.98) meters. A total of 569 GPS tracks were collected during the summer/fall 2013 field season with an acceptance rate of 93% (Table 8.2). More tracks were collected in August than July or September, and more tracks were collected at the LSR Preserve than at Death Canyon or Granite Canyon. Total average group size for hikers across the study was approximately 3 people with a slightly higher average group size observed at the LSR Preserve.

Table 8.1: Total number of GPS tracks collected from pedestrians (hikers), stratified by month, for each sampling location.

Sampling Period	Death Canyon	LSR Preserve	Granite Canyon	Total Sampled
July	87	115	41	243
August	96	121	40	257
Sept	29	33	7	69

Table 8.2: Summary of information collected on GPS-tracking logs including acceptances, rejections, average number of people in a group (± 1 with standard deviation) (93% acceptances rate).

	Death Canyon	LSR Preserve	Granite Canyon	Total
Acceptance	212	269	88	569
Rejection*	8	17	17	42
Average Group Size	2.9 (± 1.6)	3.4 (±2.0)	2.7 (±1.6)	3.1 (±1.8)

*The two most common reasons for rejections for GPS-tracking of hikers were language barriers or that the visitor was backpacking or overnighting.

PEDESTRIAN VISITATION BEHAVIOR

The most frequently visited location by pedestrians, across all sampling periods, was any section of the Valley Trail (over half of all people tracked found themselves on the Valley Trail at some point during their hike) (Table 8.3 and Figure 8.2). During all sampling periods, the Phelps Lake Area (primarily the Eastern shoreline) was the second most popular location for hikers to visit. Over one-third of all visitors tracked visited Phelps Lake Overlook across all sampling periods. The least visited location was the section of the Valley Trail which terminates at Teton Village, followed by Open Canyon with, at most, 1% of visitors entering Open Canyon during any of the sampling periods. The majority of visitors spent between 1 and 3 hours hiking at their destination in the Moose-Wilson corridor (Table 8.4 and Figure 8.3). The average amount of time spent hiking in the Moose-Wilson corridor by GPS-tracked pedestrians was approximately 2 hours and 30 minutes (Table 8.5).

Figure 8.1: A visitor with a GPS unit strapped to their backpack as they hiked to Phelps Lake Overlook (photo by Ashley D'Antonio).

Table 8.3: Percentage of GPS-tracked pedestrians that visited specific areas of interest within the Moose-Wilson corridor. Frequencies do not equal 100% since pedestrians could have visited multiple locations. The "Valley Trail" destination includes any section of the Valley Trail in the corridor while the "Valley Trail (Teton Village)" destination includes just the section of the Valley Trail which terminates at Teton Village.

Destination	July	Aug 1-15	Aug 16-31	Sept
Phelps Lake Overlook	31%	31%	39%	36%
Phelps Lake Area	46%	46%	52%	39%
"Jump Rock"	11%	21%	15%	6%
Valley Trail (west of Phelps Lake Overlook)	52%	58%	50%	52%
Granite Canyon	18%	23%	10%	11%
Open Canyon	1%	0%	0%	1%
Death Canyon Access Trail	21%	19%	24%	26%
Valley Trail (Teton Village)	0%*	0%	0%*	0%

*One GPS-tracked visitor hiked this trail during each of the July and August 16-31 sampling periods.

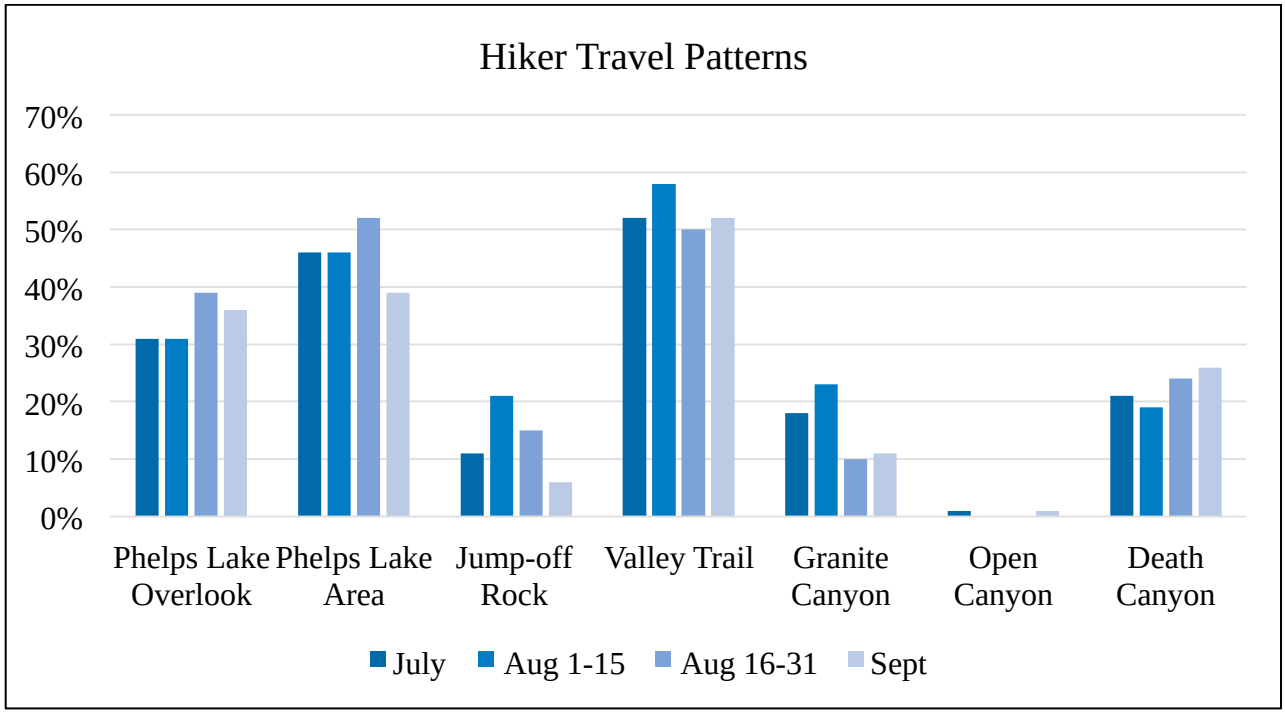


Figure 8.2: Percentage of GPS-tracked pedestrians that visited specific areas of interest within the Moose-Wilson corridor. Frequencies do not equal 100% since pedestrians could have visited multiple locations. The "Valley Trail" destination includes any section of the Valley Trail in the corridor.

Table 8.4: Frequency of duration of time that GPS-tracked pedestrians spent hiking in the Moose-Wilson Corridor across sampling period.

Hiker Duration of Stay	July	Aug 1-15	Aug 16-31	Sept
<30 min	4%	2%	3%	6%
30 min-59 min	4%	3%	5%	9%
1-3 hours	60%	64%	65%	59%
>3 hours	32%	32%	27%	26%

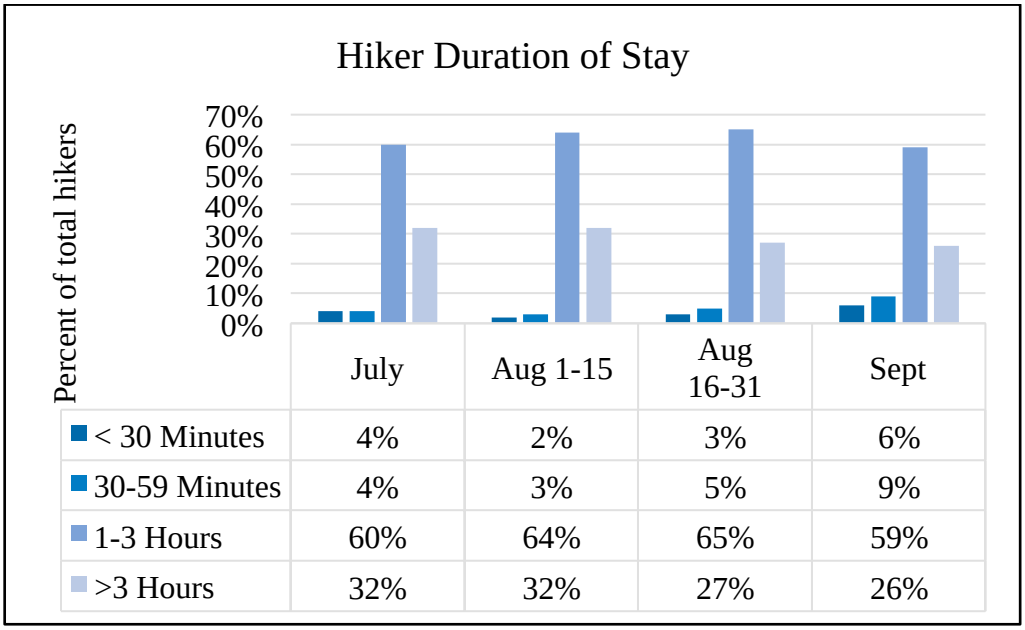


Figure 8.3: Frequency of duration of time that GPS-tracked pedestrians spent hiking in the Moose-Wilson corridor across sampling period.

Table 8.5: Average duration of stay for GPS-tracked pedestrians in the Moose-Wilson corridor.

	July	Aug 1-15	Aug 16-31	Sept
Duration of Stay	2 hrs 40 min (± 1 hr 37 min)	2 hrs 37 min (± 1 hr 30 min)	2 hrs 28 min (± 1 hr 31 min)	2 hrs 30 min (± 1 hr 43 min)

See Appendix F for maps of overall patterns of GPS-tracked pedestrian use and hiker densities.

9. PARKING LOT ACCUMULATION AND OVERFLOW

Designated parking lots are parking areas that were designated, installed, and maintained by GRTE. Overflow or visitor-created parking areas are locations where visitors are parked anywhere outside of this designated area. See Figure 9.1 for map of designated parking areas. The LSR Preserve parking lot is the only parking lot in the Moose-Wilson Corridor with a formal capacity of approximately 54-55 vehicles. The Poker Flats parking area was designed for horse trailer use and does not have a formal capacity but at times held as many at 5 horse trailers at one time. The Sawmill Ponds parking area and Granite Canyon Trailhead parking area also do not have a formal capacity but can accommodate approximately 15 to 25 vehicles. The formal parking area at the end of Death Canyon Road can accommodate approximately 30 vehicles; however, the entire length of the road is used for informal parking. These informal parking areas have an approximate capacity of between 70 and 90 vehicles.

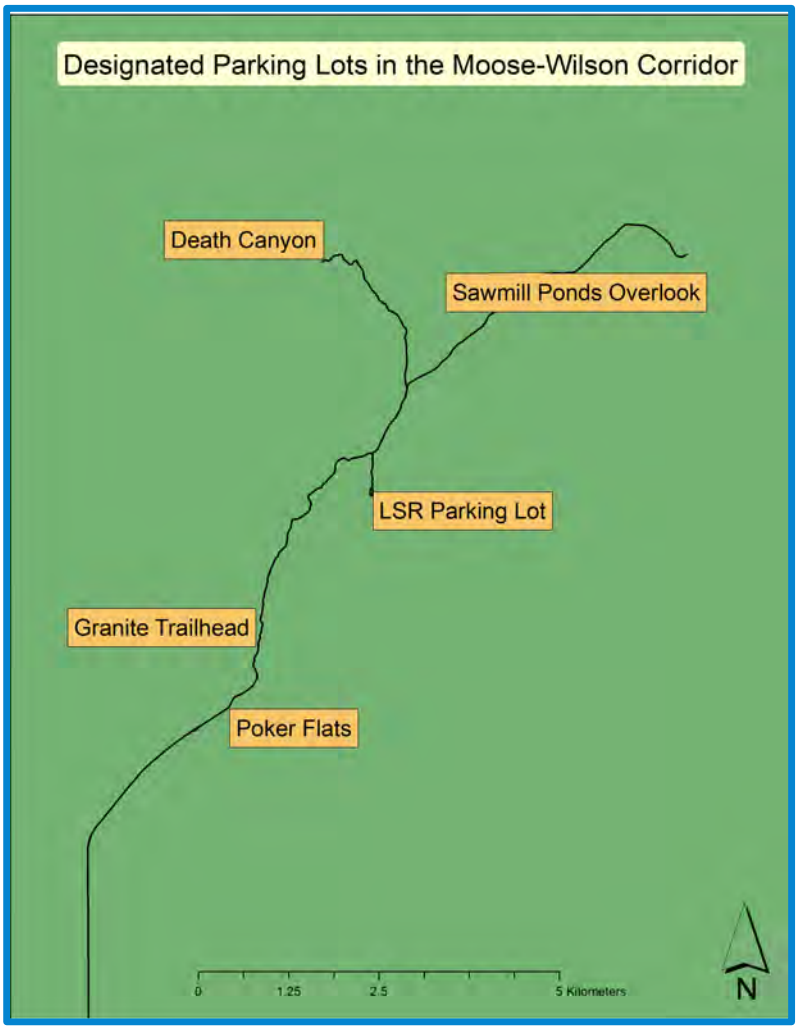


Figure 9.1: Locations of designated parking lots where data was collected for this study.

TOTAL WEEKDAY AND WEEKEND AVERAGES FOR DESIGNATED PARKING LOTS

The total number of vehicles observed in each parking lot each day was stratified by weekend and weekdays and then averaged across sampling period (Tables 9.1-9.5). This data can indicate levels of use at each parking lot across the study period. The designated parking lot at the LSR Preserve had the highest observed average of vehicles for both weekends and weekdays (Table 9.3). Average total use on weekdays ranged from 37-45 vehicles and on weekends ranged from 42-47 vehicles at the LSR Preserve. The least busy parking lot for both weekdays and weekends was the Poker Flats parking area (ranging from 1 to 3 vehicles) (Table 9.5). With a few exceptions, weekends were busier than weekdays and designated parking lots generally showed highest use during the August 1st-15th sampling period.

Figure 9.2: Granite Canyon Trailhead designated parking lot on a moderately busy day but not at full capacity (photo by Ashley D'Antonio).

Table 9.1: Average number of vehicles observed (± 1 standard deviation) in Sawmill Ponds designated parking area per day for each study period stratified by weekdays and weekends.

Sawmill Ponds	Weekdays	Weekends
July	3.9 (±4)	4.1 (±2)
Aug 1-15	2.8 (±3)	2.9 (±2)
Aug 16-31	6.8 (±6)	5.1 (±2)
Sept	4.9 (± 4)	N/A

Table 9.2: Average number of vehicles observed (± 1 standard deviation) in Death Canyon designated parking area per day for each study period stratified by weekdays and weekends.

Death Canyon	Weekdays	Weekends
July	13.6 (±5)	19.3 (±7)
Aug 1-15	18.3 (±4)	23.6 (±6)
Aug 16-31	11.1 (±4)	16.5 (±6)
Sept	N/A	13.7 (± 5)

Table 9.3: Average number of vehicles observed (± 1 standard deviation) in LSR Preserve designated parking area per day for each study period stratified by weekdays and weekends.

LSR Preserve	Weekdays	Weekends
July	43.3 (±11)	42.9 3 (±11)
Aug 1-15	45.0 3 (±11)	46.9 3 (±9)
Aug 16-31	38.8 3 (±14)	45.2 3 (±12)
Sept	37.0 3 (±13)	41.5 3 (±11)

Table 9.4: Average number of vehicles observed (± 1 standard deviation) in Granite Canyon designated parking area per day for each study period stratified by weekdays and weekends.

Granite Canyon	Weekdays	Weekends
July	13.4 (±4)	14.7 (±4)
Aug 1-15	14.1 (±4)	10.1 (±2)
Aug 16-31	11.5 (±4)	13.8 (±5)
Sept	7 (± 3)	3.7 (±2)

Table 9.5: Average number of vehicles observed (± 1 standard deviation) in Poker Flats designated parking area per day for each study period stratified by weekdays and weekends.

Poker Flats	Weekdays	Weekends
July	1.8 (±1)	2.3 (±1)
Aug 1-15	2.5 (±1)	N/A
Aug 16-31	2.6 (±2)	3.3 (± 2)
Sept	1.9 (±1)	1

MAXIMUM USE OF DESIGNATED AND OVERFLOW PARKING AREAS:

The maximum number of vehicles observed at one time within a sampling period for both designated and overflow/visitor-created parking areas was noted (Tables 9.6 and 9.7). The LSR Preserve designated parking area showed the highest observed number of vehicles at one time with 55 vehicles during July. Poker Flats had the lowest maximum of vehicles observed in the designated parking lot with 5 vehicles seen each sampling period. Death Canyon had the highest observed number of vehicles parking in overflow or visitor-created parking with 85 vehicles observed during July. There were significantly more cars (over double) parked in the visitor-created overflow parking areas along Death Canyon Road than were in the designated trailhead lot. All other parking areas had much lower maximum observed parking in overflow or visitor-created areas.

Table 9.6: Maximum number of vehicles observed at one time in the designated parking lots.

Parking Lot	July	Aug 1-Aug 15	Aug 16-Aug 31	Sept
Sawmill Ponds	20	7	20	15
Death Canyon	33	31	25	22
LSR Preserve	55	54	54	53
Granite Canyon	20	20	21	10
Poker Flats	5	5	5	5

Table 9.7: Maximum number of vehicles observed at one time in overflow parking areas.

Parking Lot	July	Aug 1-Aug 15	Aug 16-Aug 31	Sept
Sawmill Ponds	0	0	2	0
Death Canyon	85	76	42	30
LSR Preserve	N/A	N/A	N/A	N/A
Granite Canyon	3	3	2	0
Poker Flats	3	0	1	2

Figure 9.3: Sawmill Ponds Overlook designated parking lot during a time of low use (photo by Ashley D'Antonio).

LOCAL USE IN DESIGNATED PARKING AREAS

Vehicles with WY-22 license plates were noted while recording parking lot accumulation counts (Table 9.8). The percentages of local vehicles observed during the entire sampling period was summarized by designated parking areas. Use of designated parking areas by locals (defined by the presence of WY-22 plates and no rental sticker) varied greatly by parking lot and by sampling period. Sawmill Ponds and Granite Canyon saw the highest local use in September while the LSR Preserve and Poker Flats had the highest percentage of local use during the Aug 16th-31st sampling period. Death Canyon had fairly consistent local use throughout the sampling periods, ranging from 25% of observed vehicles to 30% of observed vehicles having local plates.

Table 9.8: Total percent of local vehicles observed in designated parking areas by sampling period.

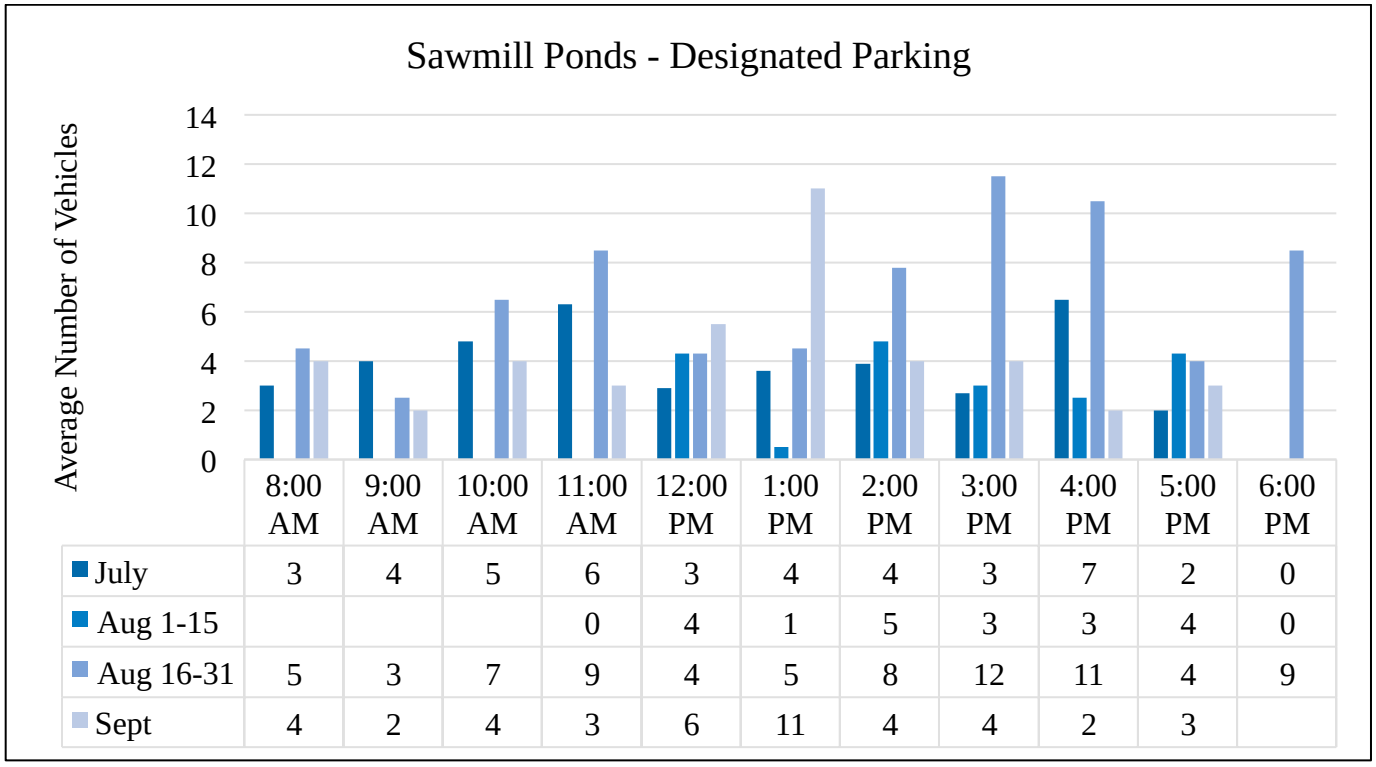
Parking Lot	July	Aug 1-15	Aug 16-31	Sept
Sawmill Ponds	6.2%	13.7%	8.4%	32.2%
Death Canyon	25%	30.3%	28.8%	29.1%
LSR Preserve	18.5%	18.5%	20.3%	16.6%
Granite Canyon	20.4%	26.7%	15.2%	40%
Poker Flats	20%	25.5%	61.8%	33.3%

PARKING LOT USE BY HOURS OF THE DAY

At each hour, the total number of vehicles was recorded. These totals were averaged across the sampling period to show how use of both designated and visitor-created parking areas varied across a day (Figures 9.5 through 9.12). Across all sampling periods, vehicle use of the Granite (Figure 9.9), Death Canyon (Figure 9.6), and Poker Flats (Figure 9.11) designated parking lots was greatest during midday, from around 11am to 2 or 3pm. At Sawmill Pond, use was not consistent and no obvious pattern can be seen. At the LSR Preserve, use increased until 11am, remained high, and dropped off only slightly after 2pm (Figure 9.8). The LSR Preserve was the busiest of the parking lots examined during the later parts of the day (4pm-6pm).

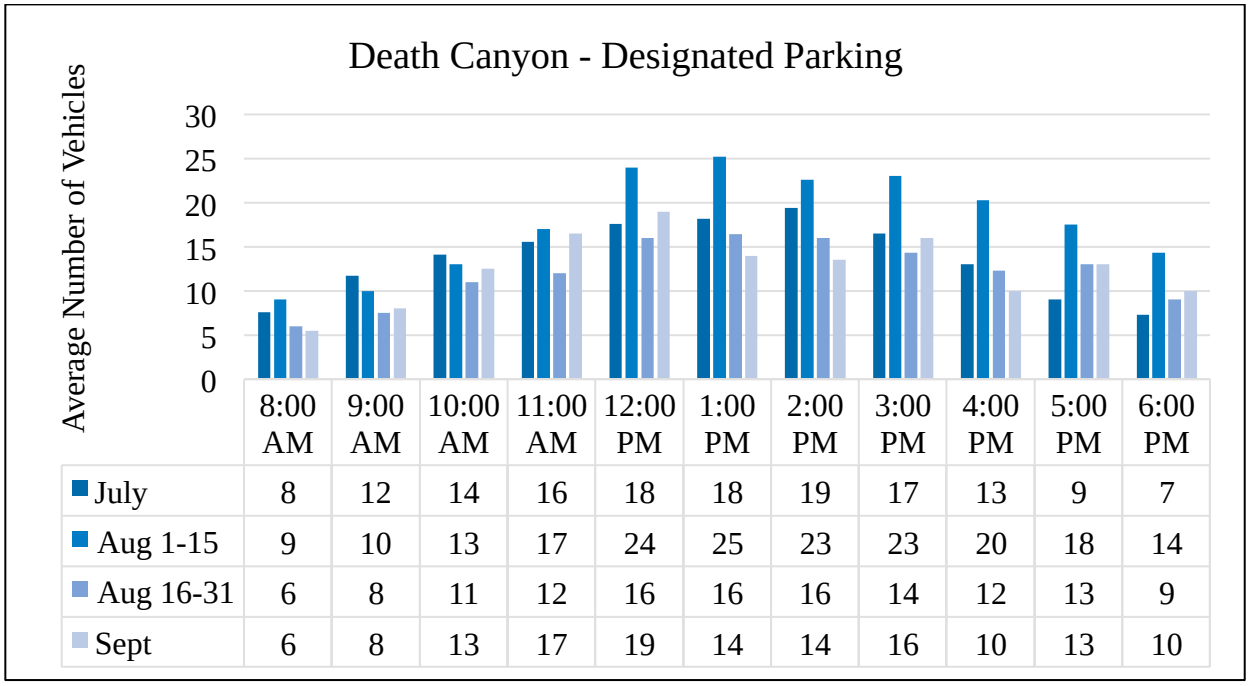
For Death Canyon (Figure 9.7), Granite Canyon (Figure 9.10), and Poker Flats (Figure 9.12), hourly use of overflow and visitor-created parking was also examined. Hourly use of overflow parking areas was not consistent at Poker Flats. Death Canyon and Granite Canyon both saw the highest use of overflow and visitor-created parking areas in the afternoons (from approximately noon-3pm). Additionally, at Death Canyon, high levels of use of overflow and visitor-created parking areas were seen throughout the August 1-16 sampling period. The tables accompanying the graphs are shown with standard deviations in Appendix G.

Figure 9.4: The LSR Preserve parking lot early in the morning before the parking lot begins to fill (photo by Ashley D'Antonio).



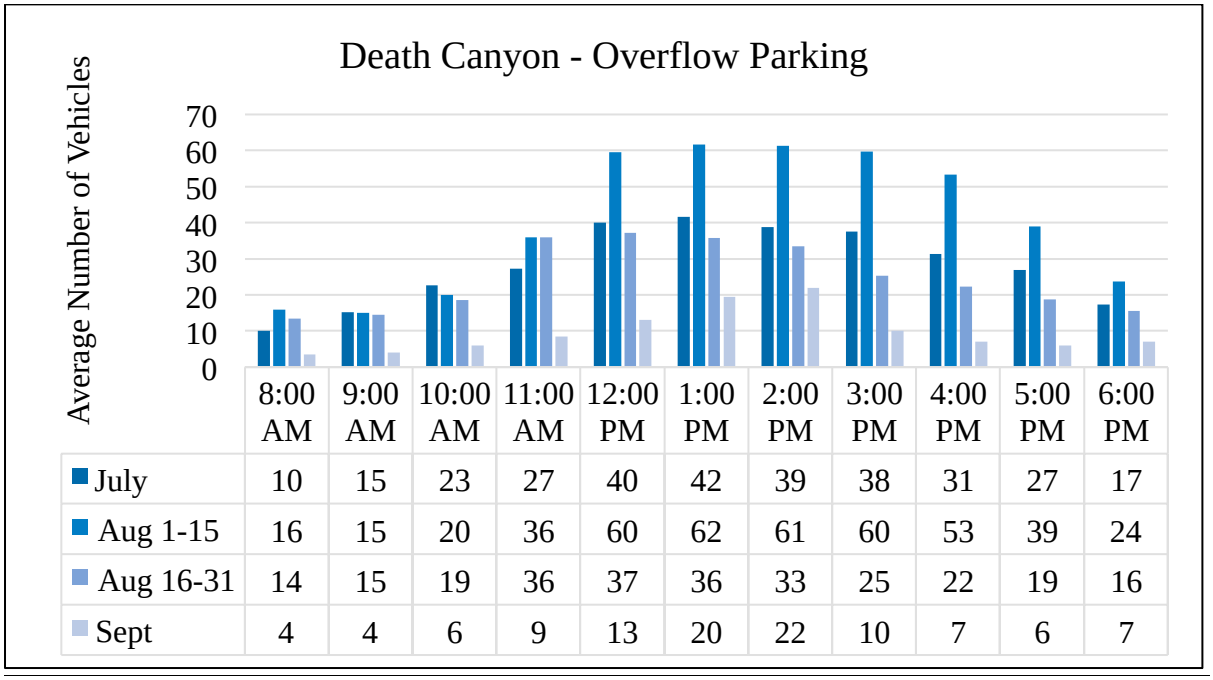
	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
July	3	4	5	6	3	4	4	3	7	2	0
Aug 1-15				0	4	1	5	3	3	4	0
Aug 16-31	5	3	7	9	4	5	8	12	11	4	9
Sept	4	2	4	3	6	11	4	4	2	3	

Figure 9.5: Average number of vehicles observed at each hour of the day in designated parking area by sampling period for Sawmill Ponds parking area. Blanks indicate that we had missing data for that time period during that sampling period.



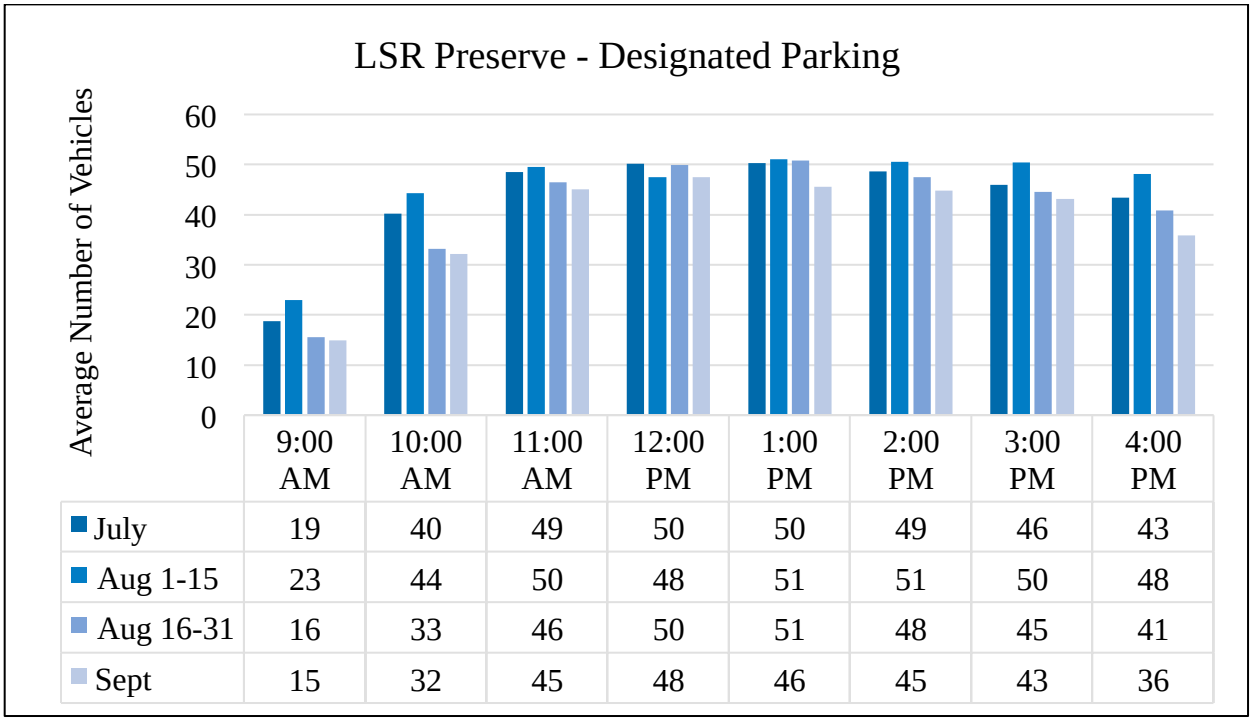
	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
July	8	12	14	16	18	18	19	17	13	9	7
Aug 1-15	9	10	13	17	24	25	23	23	20	18	14
Aug 16-31	6	8	11	12	16	16	16	14	12	13	9
Sept	6	8	13	17	19	14	14	16	10	13	10

Figure 9.6: Average number of vehicles observed at each hour of the day in designated parking area by sampling period for Death Canyon parking area.



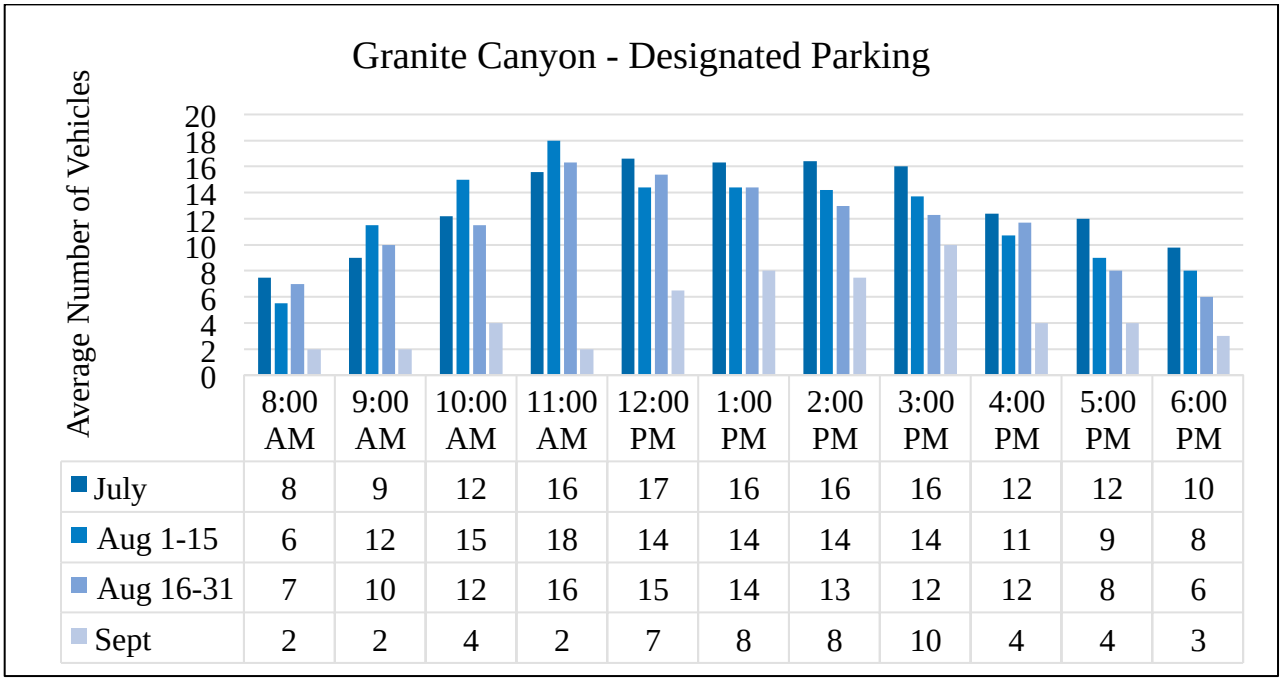
	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
July	10	15	23	27	40	42	39	38	31	27	17
Aug 1-15	16	15	20	36	60	62	61	60	53	39	24
Aug 16-31	14	15	19	36	37	36	33	25	22	19	16
Sept	4	4	6	9	13	20	22	10	7	6	7

Figure 9.7: Average number of vehicles observed at each hour of the day in overflow and visitor-created parking areas by sampling period for Death Canyon Road.



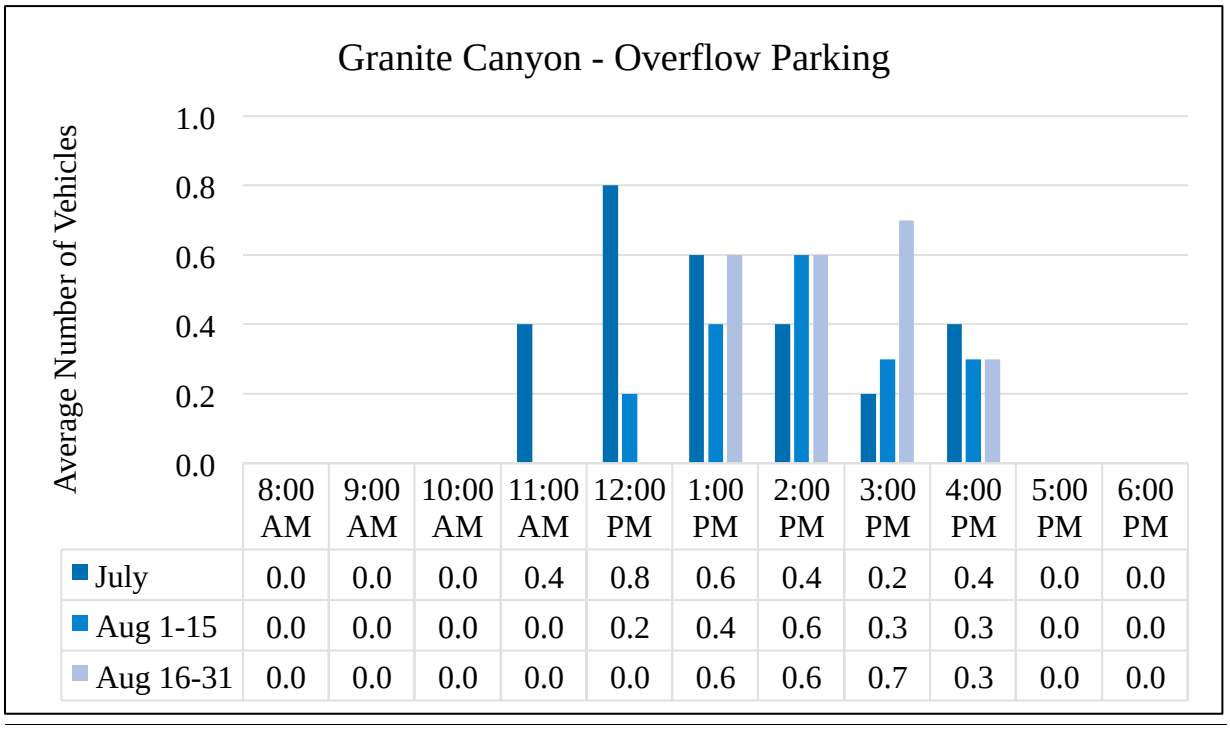
	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM
July	19	40	49	50	50	49	46	43
Aug 1-15	23	44	50	48	51	51	50	48
Aug 16-31	16	33	46	50	51	48	45	41
Sept	15	32	45	48	46	45	43	36

Figure 9.8: Average number of vehicles observed at each hour of the day in designated parking area by sampling period for LSR Preserve parking area. The LSR Preserve parking lot data was collected by GRTE staff and therefore sampling only occurred during LSR Preserve Center hours.



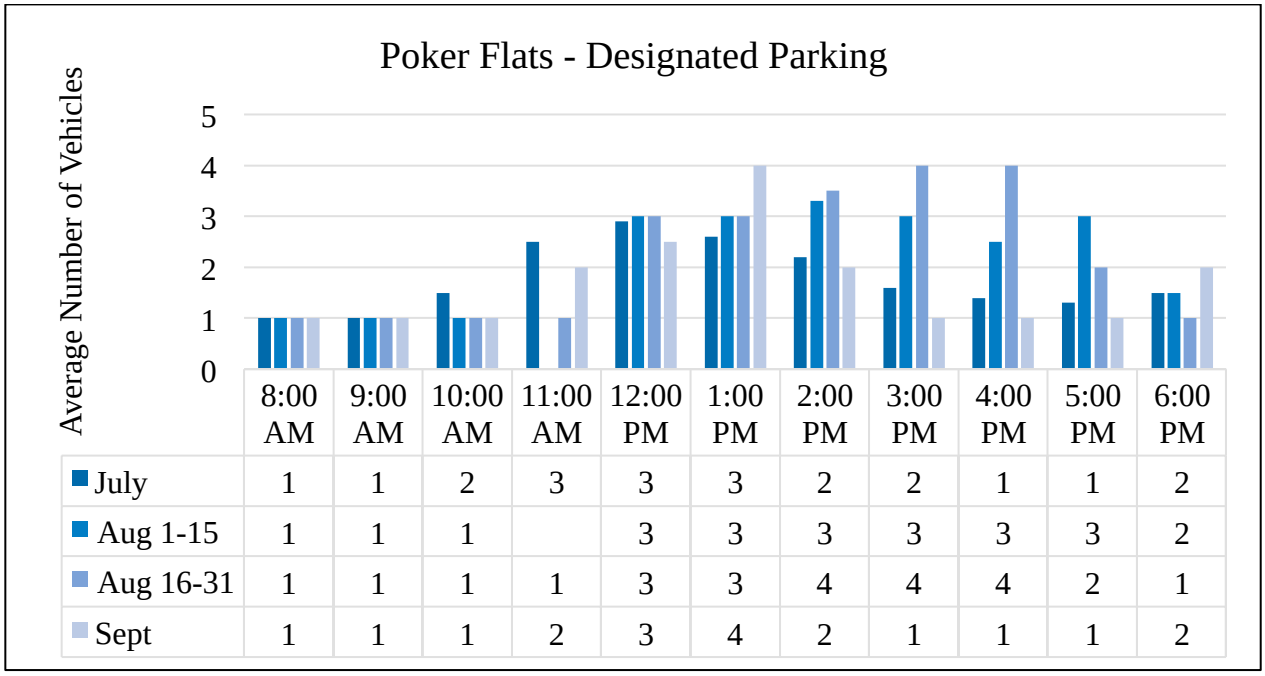
	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
July	8	9	12	16	17	16	16	16	12	12	10
Aug 1-15	6	12	15	18	14	14	14	14	11	9	8
Aug 16-31	7	10	12	16	15	14	13	12	12	8	6
Sept	2	2	4	2	7	8	8	10	4	4	3

Figure 9.9: Average number of vehicles observed at each hour of the day in designated parking area by sampling period for Granite Canyon parking area.



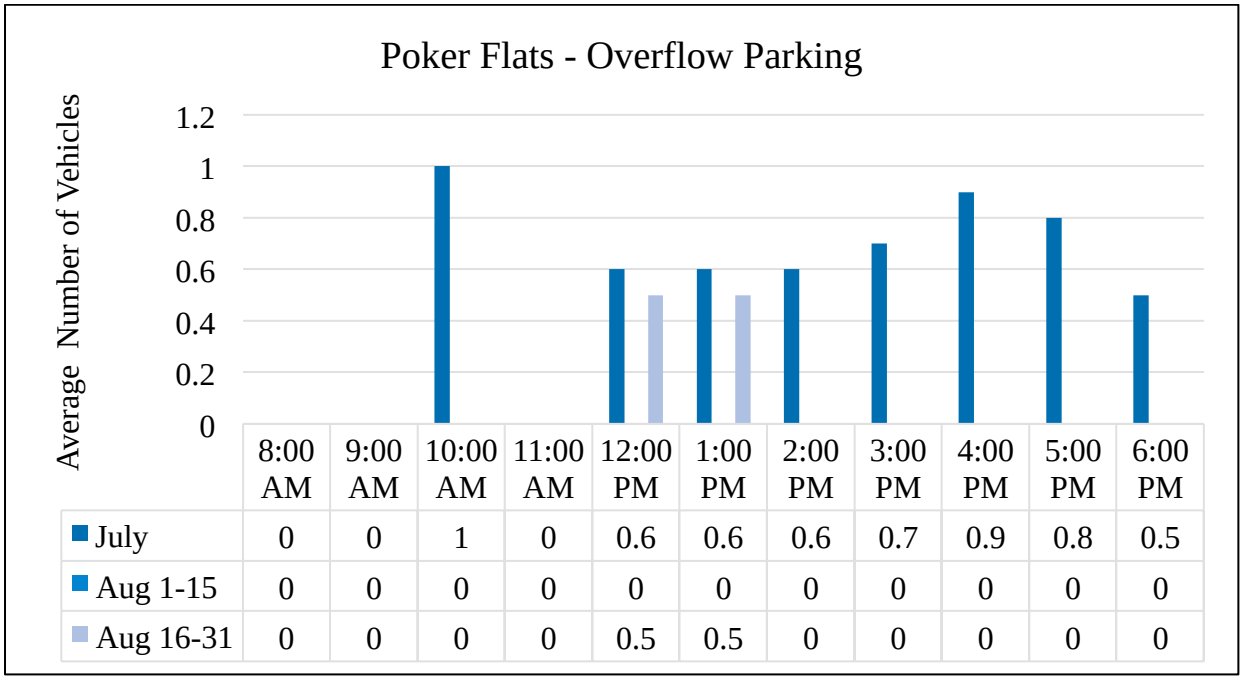
	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
July	0.0	0.0	0.0	0.4	0.8	0.6	0.4	0.2	0.4	0.0	0.0
Aug 1-15	0.0	0.0	0.0	0.0	0.2	0.4	0.6	0.3	0.3	0.0	0.0
Aug 16-31	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.7	0.3	0.0	0.0

Figure 9.10: Average number of vehicles observed at each hour of the day in overflow and visitor-created parking areas by sampling period for Granite Canyon Trailhead area.



	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
July	1	1	2	3	3	3	2	2	1	1	2
Aug 1-15	1	1	1		3	3	3	3	3	3	2
Aug 16-31	1	1	1	1	3	3	4	4	4	2	1
Sept	1	1	1	2	3	4	2	1	1	1	2

Figure 9.11: Average number of vehicles observed at each hour of the day in designated parking area by sampling period for Poker Flats parking area.

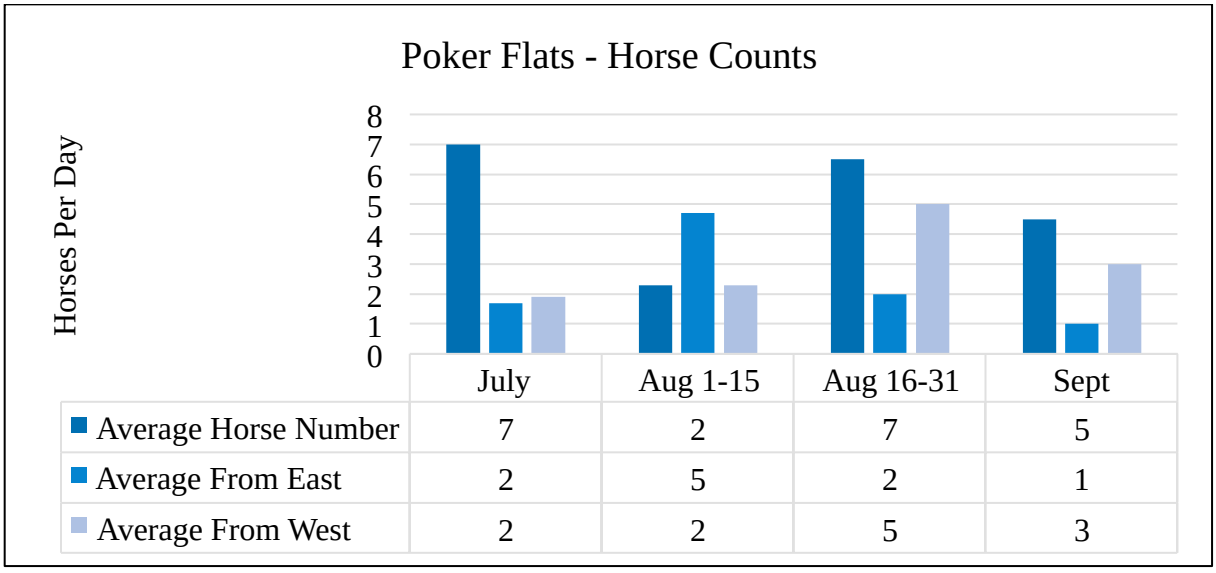


	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
July	0	0	1	0	0.6	0.6	0.6	0.7	0.9	0.8	0.5
Aug 1-15	0	0	0	0	0	0	0	0	0	0	0
Aug 16-31	0	0	0	0	0.5	0.5	0	0	0	0	0

Figure 9.12: Average number of vehicles observed at each hour of the day in overflow and visitor-created parking areas by sampling period for Poker Flats area.

ADDITIONAL DATA COLLECTION AT POKER FLATS AND SAWMILL PONDS

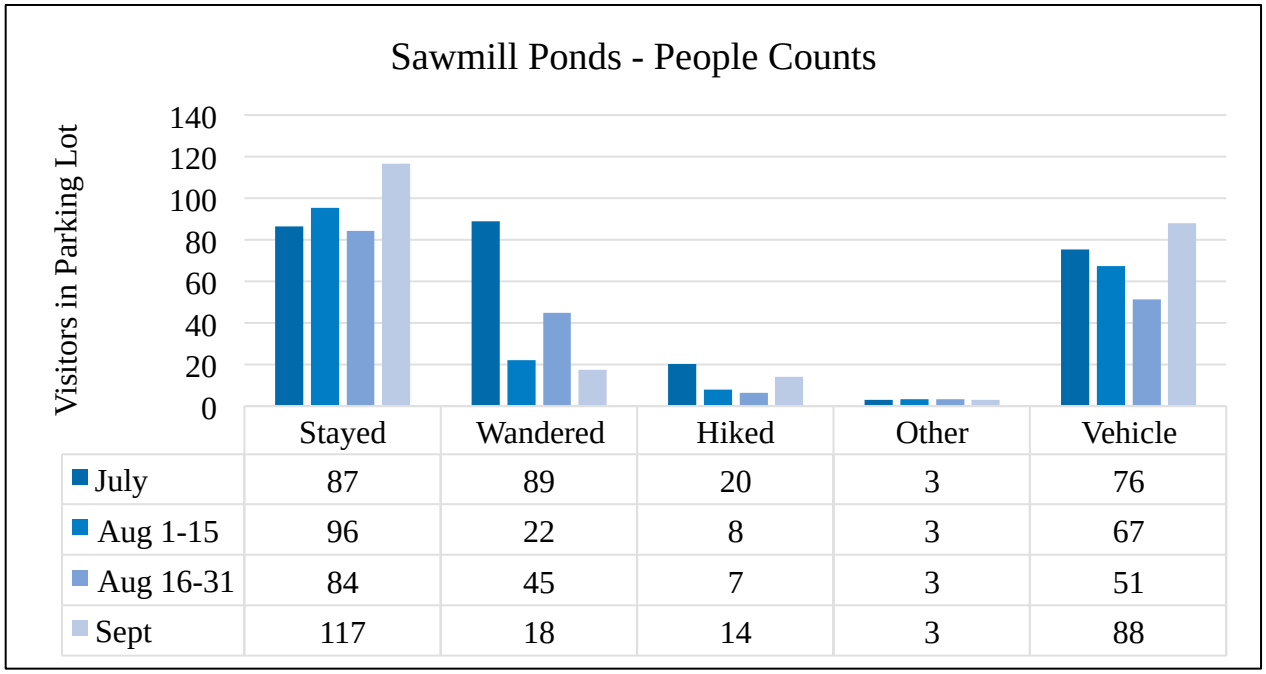
At Poker Flats and Sawmill Ponds, additional observational data was collected to better understand how the designated and overflow parking areas were being used by visitors. At Poker Flats (Figure 9.13), the number of horses observed when doing parking lot accumulations was recorded, as well as the direction the horses traveled away from the parking lot. On average, 2-7 horses were observed in the Poker Flats parking area with no preferred direction of travel. At Sawmill Ponds, the behavior of any visitor that entered the parking lot was documented and summarized (Table 9.11). The majority of visitors using Sawmill Ponds (Figure 9.15) either did not leave their vehicle or did not travel far from their vehicle while using the Sawmill Ponds area. The tables accompanying the graphs are shown with standard deviations in Appendix G.



	July	Aug 1-15	Aug 16-31	Sept
Average Horse Number	7	2	7	5
Average From East	2	5	2	1
Average From West	2	2	5	3

Figure 9.13: Additional data collected related to horse use emanating from the Poker Flats parking area. "Average From East" indicates the average number of horses that headed to or came from the east into the parking lots, and "Average From West" indicates the average number of horses that headed to or came from the west into the parking lot.

Figure 9.14: Horse trailers parked in the Poker Flats designated parking lot (photo by Ashley D'Antonio).



	Stayed	Wandered	Hiked	Other	Vehicle
July	87	89	20	3	76
Aug 1-15	96	22	8	3	67
Aug 16-31	84	45	7	3	51
Sept	117	18	14	3	88

Figure 9.15: Additional data collected related to visitor use emanating from the Sawmill Ponds parking area. "Stayed" indicates visitors who remained within the boundaries of the parking lot area. "Wandered" indicates visitors who left the parking lot area but remained on the perimeter. "Hiked" indicates visitors who left the parking area and hiked down the "old road" trail, and "Vehicle" indicates vehicles that pulled into the Sawmill Ponds parking area and either did not fully park or parked briefly and then left.

10. USE ON THE LEVEE ACCESS ROAD AND MURIE RANCH

LEVELS OF USE ON THE LEVEE ROAD

Trail counters were placed at the north and south ends of the Levee Road. The data from these two trail counters was delivered to Utah State University by the Park. Utah State summarized the data by sampling period. Counter calibrations were not conducted at the Levee Road South counter. The highest level of visitor use for the Levee Road North counter was observed in July (Table 10.1). Overall, average visitors per day at this counter varied from 4 to 17 visitors. There were no consistent patterns between weekend and weekday use, with some months having weekdays with higher average use and some months showing weekdays with higher average use. For the Levee Road South counter, the highest level of use was observed during the month of August (Table 10.2). Overall, August had the highest level of use with the second half of August (16^{th}-31^{st}) having almost the same level of use as the entire month of July. Per day, use varied between an average of 6 and 19 visitors. Like the North counter, there were no consistent patterns between weekend and weekday use, with some months having weekdays with higher average use and some months showing weekdays with higher average use.

Images from the motion activated cameras placed on the north and south ends of the Levee Road were manually analyzed, and all observed vehicles or persons were categorized by use type. Results were summarized across the entire study period and not stratified by weekends or weekdays. The most common use types observed on the north end of the Levee Road were government vehicles, non-government vehicles (including the Utah State research vehicle), and non-NPS employed hikers (Table 10.3). The most common use types observed on the south Levee Road was by horses and hikers (Table 10.4). Over 100 bicycles and fishermen were also observed, although bicycle use is prohibited on the levee and on its access road. The same use types were also averaged per day.

Figure 10.1: Two fishermen on bicycles on the south end of the Levee Road (photo captured by motion-activated camera).

Table 10.1: Visitor use levels observed on the Levee Road North location. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
June[1]	32	6	6	7
July	529	17	21	6
Aug 1-15	86	6	7	3
Aug 16-31	122	8	8	2
September	301	10	11	8
October	127	4	4	4
November[2]	25	8	1	12

[1]June sampling period started on the 26th.

[2]November sampling period ended on the 3rd.

Table 10.2: Visitor use levels observed on the Levee Road South location. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
June[1]	32	6	3	11
July	310	10	11	9
Aug 1-15	224	15	17	11
Aug 16-31	297	19	12	33
September	230	8	8	8
October	169	6	6	5
November[2]	17	6	4	7

[1]June sampling period started on the 26th.

[2]November sampling period ended on the 3rd.

Table 10.3: Total counts of different use types observed by the Levee Road motion activated cameras; summarized across the entire study period (sampling period from June 26th, 2013-September 25th, 2013).

Use Type	North Levee Road	South Levee Road
Vehicles (Non-Government)	53	37
Vehicles (Government)	116	34
Hikers	51	238
Hikers (NPS)	18	2
Illegal Bicyclists	5	102
Equestrians	0	400
Swimmers	0	58
Photographers	11	8
Runners	8	66
Fishermen	0	107
Dogs	0	27
OHV	0	14
Tractors	0	7

Table 10.4: Average level of different use types per day observed by the Levee Road motion activated cameras; summarized across the entire study period (sampling period from June 26th, 2013 – September 25th, 2013).

Use Type	North Levee Road	South Levee Road
Vehicles (Non-Government)	1.4	0.4
Vehicles (Government)	3.1	0.4
Hikers	1.4	2.6
Hikers (NPS)	0.5	.02
Bicyclists	0.1	1.1
Equestrians	0	4.4
Swimmers	0	0.6
Photographers	0.3	0.1
Runners	0.2	0.7
Fishermen	0	1.2
Dogs	0	0.3
OHV	0	0.2
Tractors	0	0.1

LEVELS OF USE AT THE MURIE RANCH

A traffic counter was placed on the road to Murie Ranch and a trail counter, calibrated by Utah State University, was placed on the trail between the Murie Ranch and the Craig Thomas Discovery and Visitor Center. For the Murie Ranch Road, August showed the highest level of use, followed by September (Table 10.6). Use on the Murie Ranch Road varied from 40 to 163 vehicles per day. There were no consistent patterns between weekend and weekday use, with some months having weekdays with higher average use and some months showing weekdays with higher average use.

July was the busiest month for use on the trail, with use levels declining through the end of the sampling period for this counter (November) (Table 10.5). The NPS did not conduct ranger-led walks to the Murie Ranch on this trail during 2013 due to budget constraints. There was not a substantial difference seen between weekday and weekday use. Overall, use on the trail averaged between 2 and 31 visitors per day. Data on the number of visitors to the Murie Ranch main office and the number of guided trips was provided to Utah State University by the park (Tables 10.7 and 10.8). These data can be combined to understand use patterns at the Murie Ranch. July appears to be the busiest month observed in 2013 at the Murie Ranch with the highest number of visitors to the main office and the highest number of visitors on the trail.

Table 10.5: Visitor use levels observed on the trail to Murie Ranch from the Craig Thomas Discovery and Visitor Center. Data was collected by a trail counter, summarized by sampling period, calibrated by Utah State University, and raw data was provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
June[1]	97 [89][2]	19 [18]	8 [8]	37 [35]
July	952 [867]	31 [28]	32 [30]	26 [24]
Aug 1-15	373 [349]	25 [23]	25 [23]	24 [22]
Aug 16-31	282 [257]	18 [17]	20 [18]	12 [11]
September	427 [389]	14 [13]	14 [13]	16 [15]
October	70 [64]	2 [1]	2 [1]	4 [3]
November[3]	9 [8]	3 [2]	0 [0]	5 [4]

[1]June sampling period started on the 26th.

[2]Numbers in the brackets are corrected estimates using the calibration weight value (0.91).

[3]November sampling period ended on the 3rd.

Table 10.6: Visitor use levels observed on the road to Murie Ranch collected by a TRAFx road counter, summarized by sampling period, and provided by the park.

Month	Total Use (# of visitors)	Overall Average (visitors/day)	Weekday Average (visitors/day)	Weekend Average (visitors/day)
June[1]	258	52	42	66
July	2,471	80	82	74
Aug 1-15	2,442	163	178	122
Aug 16-31	1,644	103	100	110
September	3,096	103	106	96
October[2]	120	40	40	0

[1]June sampling period started on the 26th.

[2]October sampling period ended on the 3rd.

Table 10.7: Visitor use levels observed at the main office at the Murie Ranch summarized by month and provided by the park. The data provided by the park was not stratified by sampling period.

Sampling Period	Number of Visitors to Main Office
July	300
August	275
September	275
October	200

Table 10.8: Total number of visitors using the trail between the Murie Ranch and the Craig Thomas Discovery and Visitor Center stratified by sampling period. A trail counter was used to count the number of unguided visitors, and there were no guided trips on this trail during the 2013 sampling period.

Sampling Period	Number of Unguided Visitors	Number of Guided Visitors
July	952	0
August 1-15	373	0
August 16-31	282	0
September	427	0
October	70	0

11. RESOURCE CONDITION OF OVERFLOW/VISITOR-CREATED PARKING AREAS

A high accuracy Trimble GPS unit was used to collect resource condition data on all areas of overflow or visitor-created parking. These areas of resource change were located using foot and vehicle searches along the Moose-Wilson Road and the Death Canyon Road. Each location was mapped as either a polygon or line feature ("trail") based on the width of the area. For each overflow or visitor-created parking area, various characteristics were also recorded including condition class (1 through 5, with 1 being the lowest level of resource change and 5 being the highest level of resource change), vegetation cover on-site and off-site, level of mineral soil exposure, soil type, level of soil erosion, and presence or absence of trash. See "Data Collection Methodology" section for detailed description of condition class ratings.

Figure 11.1: Examples of resource impacts resulting from visitor parking along the Moose-Wilson or Death Canyon Road. Right photo is a site near Sawmill Ponds Overlook that has experienced vegetation loss. Left photo shows a site along the Death Canyon Road that has experienced vegetation loss and the loss of organic matter in the top soil layers (photos by Ashley D'Antonio).

Within the Moose-Wilson corridor, a total of 183 discrete sites of overflow parking or visitor-created parking were found (Table 11.1). Of the 183, 125 of these sites were found along the Moose-Wilson Road, and 58 sites were located along the Death Canyon Road. Total area of resource change from visitor-created parking in the Moose-Wilson corridor was approximately 8608 m^2 (equal to about 2 acres of land) with 6230 m^2 (70%) along the Moose-Wilson Road and approximately 2586 m^2 (30%) along the Death Canyon Road. Average condition class rating ranged from 2.81 to 3.43 with an overall average of 3.2. The highest average condition class rating was seen in the polygons along the Moose-Wilson road. There were no sites rated condition class 5 (Figure 11.2).

Average cover on-site ranged from approximately 8% to 17% with average cover-loss on the overflow/visitor-created parking sites ranging from 53% vegetation loss to 65% vegetation loss (Table 11.1). Overall average cover-loss was 59% with 61% overall average mineral soil exposure. The total length of linear parking impacts equaled 1530m and the total area of polygons equaled 7857 m^2. The polygon parking sites along Death Canyon Road had the largest average area. A higher density of sites was found along Death Canyon Road (Figure 11.4).

Table 11.1: Summary of all overflow and visitor-created parking areas located within the Moose-Wilson corridor. Most areas were mapped as polygons but some very narrow areas of vehicle impact were mapped as linear features. Condition class ratings ranged from 1 (lowest impact) – 5 (highest impact).

	Average						
Overflow or Visitor-Created Parking Type	**Condition Class**	**Cover On-Site**	**Cover Off-Site**	**Cover-Loss**	**Mineral Soil Exposed**	**Length (m) or Area (m^2)**	**Total Parking Areas**
MW Road - Linear	2.8	17%	69%	53%	55%	36.25	38
MW Road - Polygons	3.4	11%	75%	65%	66%	37.89	87
DC Road - Linear	2.7	8%	58%	54%	54%	11.78	13
DC Road - Polygons	3.1	14%	69%	55%	60%	46.45	45
Overall Average or Total	3.2	13%	72%	59%	61%	1530 m & 7857 m^2	183

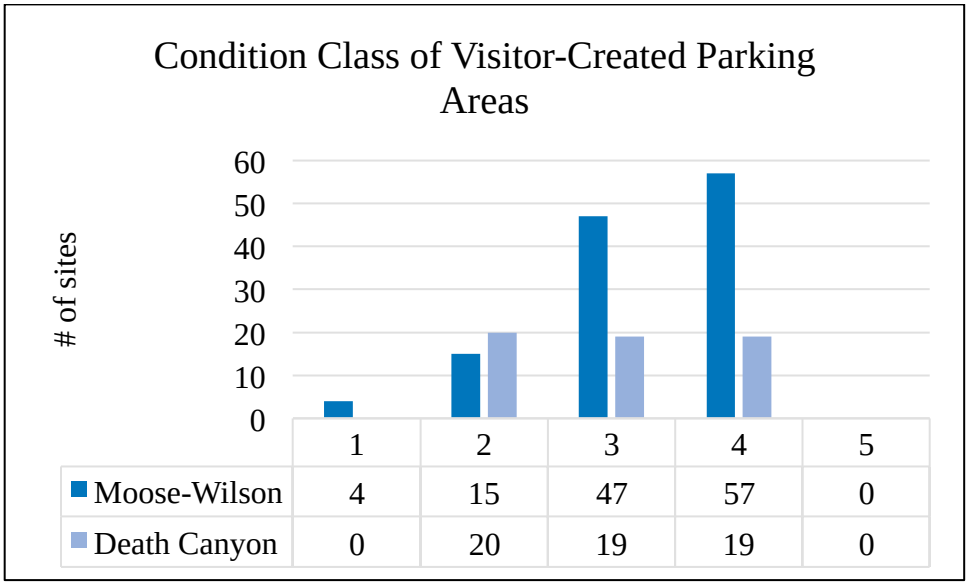


Figure 11.2: Number of overflow or visitor-created parking areas in each condition class category for Death Canyon and Moose-Wilson Road. Descriptions of condition class ratings can be found in "Data Collection Methodology" section.

The most common soil substrate observed in the overflow and visitor-created parking areas was a mixture of gravel and mineral soil along the Moose-Wilson Road and a mixture of organic material and mineral soil along Death Canyon Road (Table 11.2). Soil erosion and root exposure were not a concern at most overflow/visitor-created parking areas, and very few areas had trash present.

See Appendix H for a table showing summaries from all overflow/visitor-created parking areas and maps of these areas.

Table 11.2: Counts from various categories of information collected at each overflow/visitor-created parking area. The most common category is bolded.

Overflow and Visitor-Created Parking Location	Soil Substance	Soil Erosion	Root Exposed	Site with Trash
Moose-Wilson Road	**Gravel/Mineral= 73** Organic soil= 2 Organic Mineral= 26 Gravel= 13 Mineral Soil= 1 Undefined= 1	**None/Slight= 115** Moderate= 1	**None/Slight= 115** Moderate= 1	Some= 10 Much= 1 **None= 105**
Death Canyon Road	Gravel/Mineral= 23 Mineral soil= 1 **Organic Mineral= 34**	**None/Slight= 56** Moderate= 2	**None/Slight= 57** Moderate= 1	Some= 11 Much= 1 **None= 46**

Figure 11.3: Photos show other examples of visitor-created parking areas. Left photo is a large visitor-created parking area on the Death Canyon Road that has experienced complete loss of vegetation and organic matter and soil erosion. Right photo is a less impacted visitor-created parking area showing some vegetation loss but the organic soil layer remains intact (photos by Ashley D'Antonio).

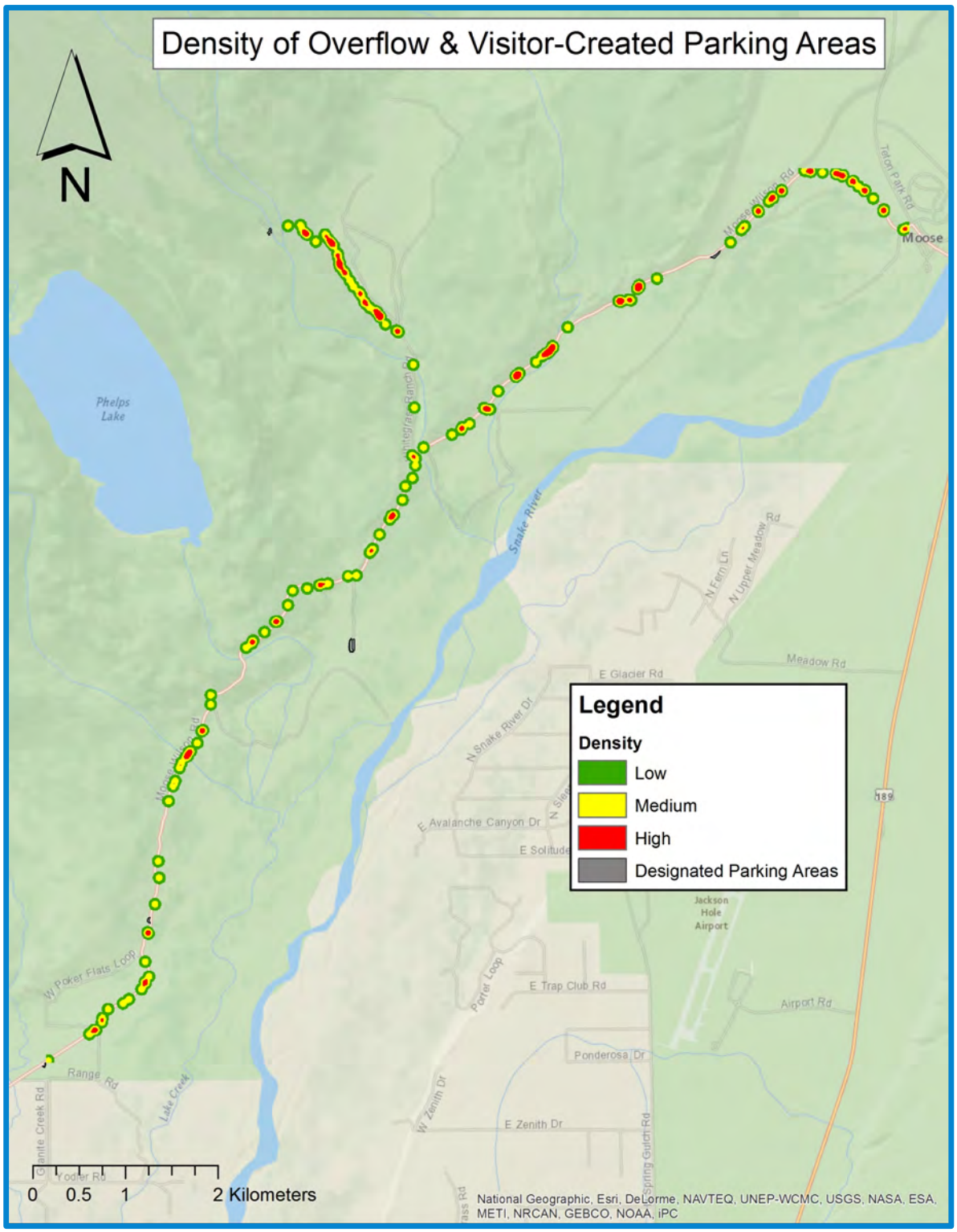


Figure 11.4: Density of overflow/visitor-created parking areas along the Moose-Wilson and Death Canyon Roads.

12. ASSESSMENT OF VISITOR-CREATED SITES AND TRAILS

A high accuracy Trimble GPS unit was used to collect resource condition data in several visitor use areas. These areas of resource change were located using foot searches at Phelps Lake Overlook, the "Jump Rock" area of Phelps Lake, the outlet area shoreline of Phelps Lake, and the Sawmill Ponds Overlook area. Each resource impact was mapped as either a polygon (area of dispersed visitor use), line feature ("trail"), or point (visitor-created site). For each recreation-related resource impact, various characteristics were also recorded including condition class (1 through 5, with 1 being the lowest level of resource change and 5 being the highest level of resource change), vegetation cover on-site and off-site, level of mineral soil exposure, soil type, level of soil erosion, and presence or absence of trash. See "Data Collection Methodology" section for detailed description of condition class ratings.

Figure 12.1: Examples of recreation-related resource change in the form of visitor-created sites at Phelps Lake Overlook (top photo) and "Jump Rock" on the shore of Phelps Lake (bottom photo). Both sites show almost complete vegetation loss and significant levels of erosion as evident by the exposed tree roots (photos by Ashley D'Antonio).

Very few small visitor-created sites were found at the visitor use areas in the Moose-Wilson corridor (Table 12.1). One highly impacted small visitor site was found at “Jump Rock” (Figure 12.3). Areas of dispersed visitor use were found at all sites except Sawmill Ponds (Figure 12.5), and the sites located on the shoreline of Phelps Lake (Figure 12.4) were hardened. Phelps Lake Overlook (Figure 12.2) and “Jump Rock” both had two areas of dispersed visitor use. The two areas of dispersed use at “Jump Rock,” while smaller than the areas found at Phelps Lake Overlook, were highly impacted with an average condition class rating of 4 and an average vegetation loss of 89%. At Phelps Lake Overlook, the two areas of dispersed visitor use were larger than those observed at “Jump Rock,” had a slightly lower average condition class rating of 3.5, and slightly lower average vegetation loss at 72% (Table 12.1).

All analysis areas contained visitor-created trails. Phelps Lake shoreline had the highest number of visitor-created trails but a lower average condition class rating of 2.7 (Table 12.1). Phelps Lake Overlook had the lowest number of visitor-created trails but a higher average condition class rating of 3.3. Sawmill Ponds Overlook had the largest total length of visitor-created trails but also a lower average condition class rating at 2.7. “Jump Rock” had 13 visitor-created trails with an average condition class rating of 3.3 and, overall, had the lowest total length of visitor-created trails. All locations contained visitor-created trail spurs (trails less than or equal to 5 meters in length). The most visitor-created trail spurs were found at Sawmill Ponds Overlook, while all remaining analysis areas each contained 6 visitor-created trail spurs.

Table 12.1: Summary of recreation-related impacts observed and mapped at various visitor use locations in the Moose-Wilson Corridor.

Analysis Area	Number of Sites or Trails	Total Area (m^2) or Length (m)	Mean Condition Class	Mean Area (m^2) or Length (m)	Mean Veg Loss
Small and Medium Sites:					
Phelps Lake Overlook	0	N/A	N/A	N/A	N/A
"Jump Rock"	1	3	4	N/A	83%
Phelps Lake Shoreline	0	N/A	N/A	N/A	N/A
Sawmill Ponds Overlook	0	N/A	N/A	N/A	N/A
Areas of Dispersed Use:					
Phelps Lake Overlook	2	218	3.5	109	72%
"Jump Rock"	2	13	4	7	89%
Phelps Lake Shoreline	4*	N/A	N/A	N/A	N/A
Sawmill Ponds Overlook	0	N/A	N/A	N/A	N/A
Visitor-Created Trails:					
Phelps Lake Overlook	7	259	3.3	37	N/A
"Jump Rock"	13	184	3.3	185	N/A
Phelps Lake Shoreline	24	297	2.7	37	N/A
Sawmill Ponds Overlook	16	738	2.7	46	N/A
Visitor-Created Trail Spurs:					
Phelps Lake Overlook	6	N/A	N/A	N/A	N/A
"Jump Rock"	6	N/A	N/A	N/A	N/A
Phelps Lake Shoreline	6	N/A	N/A	N/A	N/A
Sawmill Ponds Overlook	23	N/A	N/A	N/A	N/A

*Hardened sites

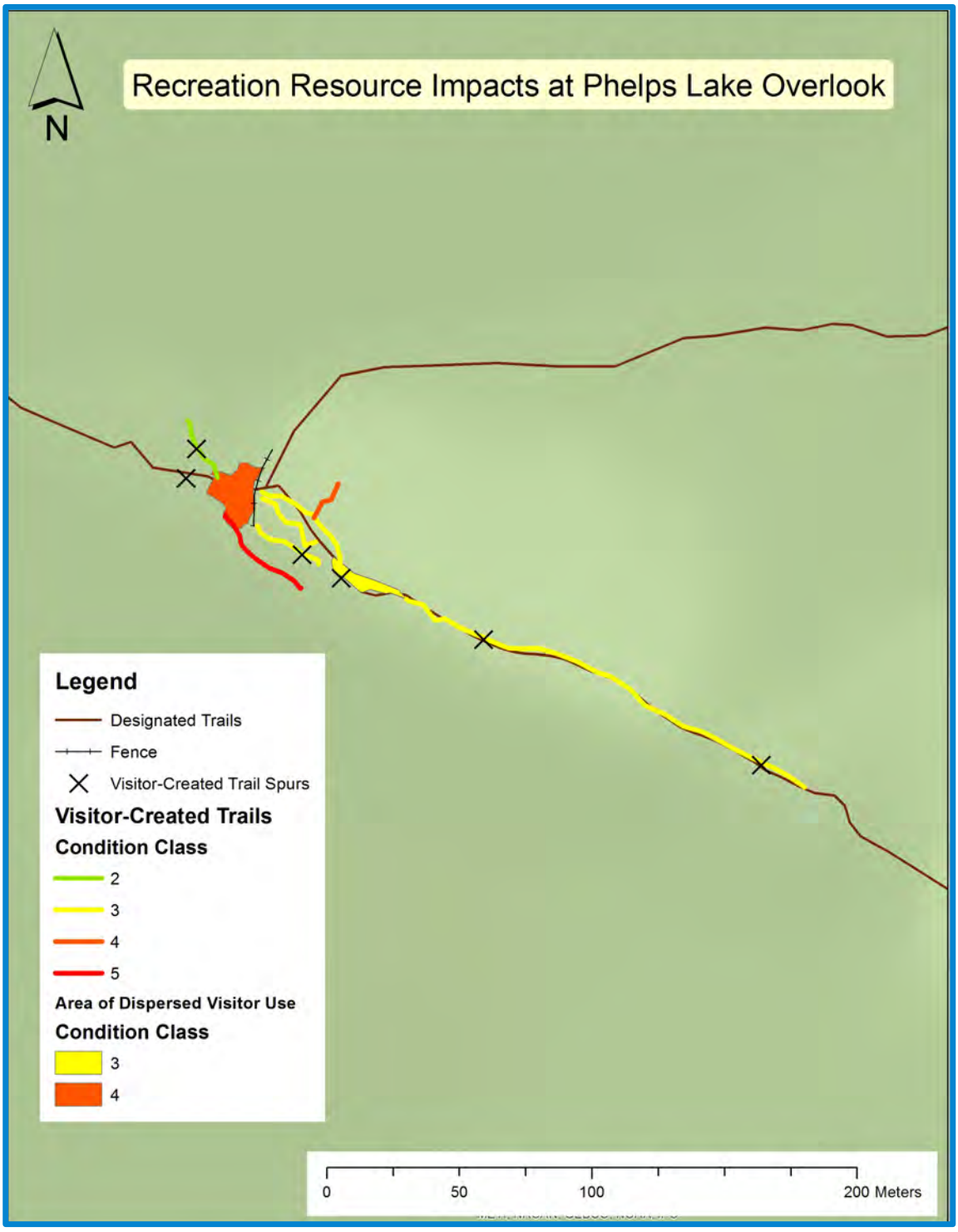


Figure 12.2: Recreation-related impacts, coded by condition class, at Phelps Lake Overlook.

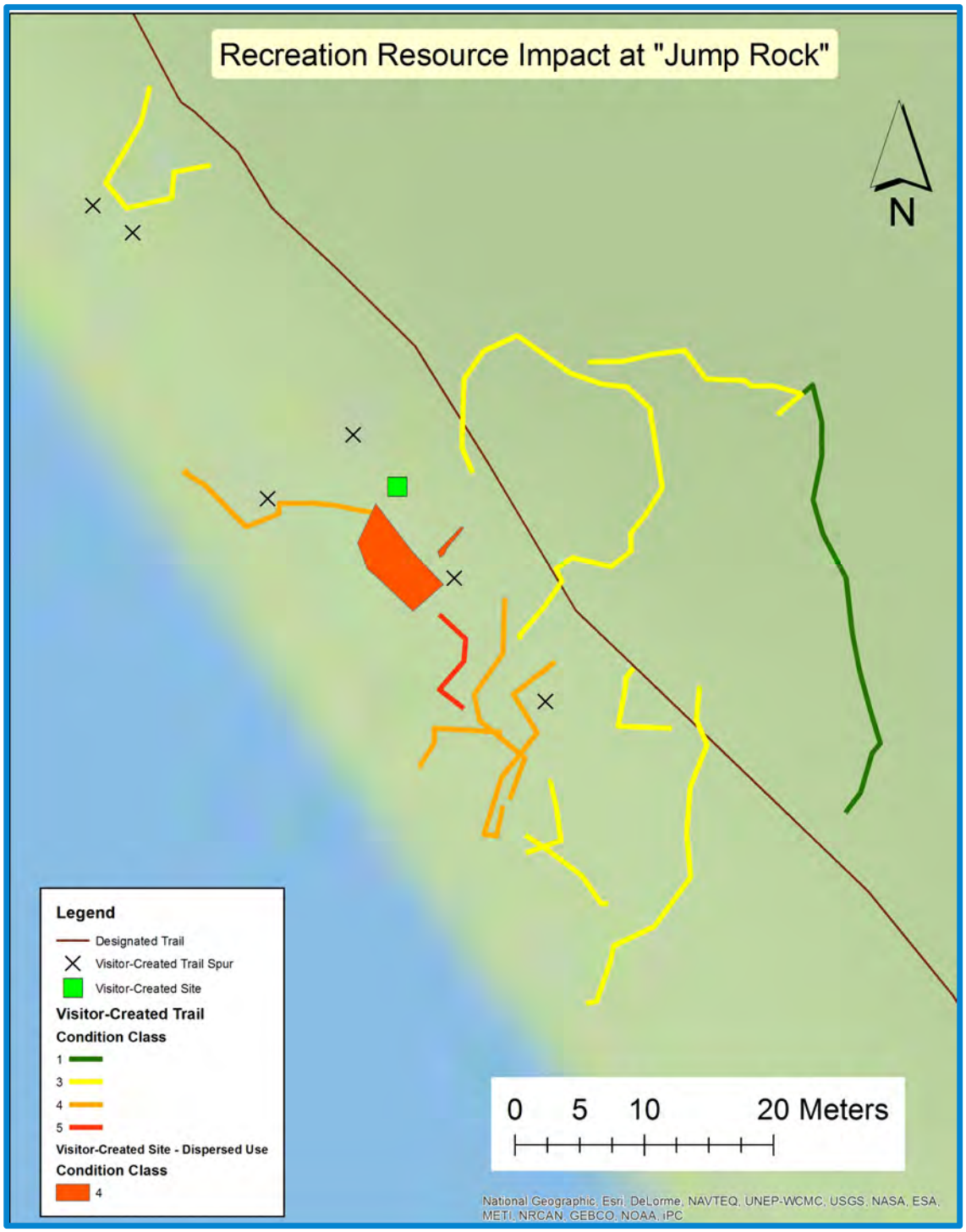


Figure 12.3: Recreation-related impacts, coded by condition class, at the "Jump Rock" location at Phelps Lake.

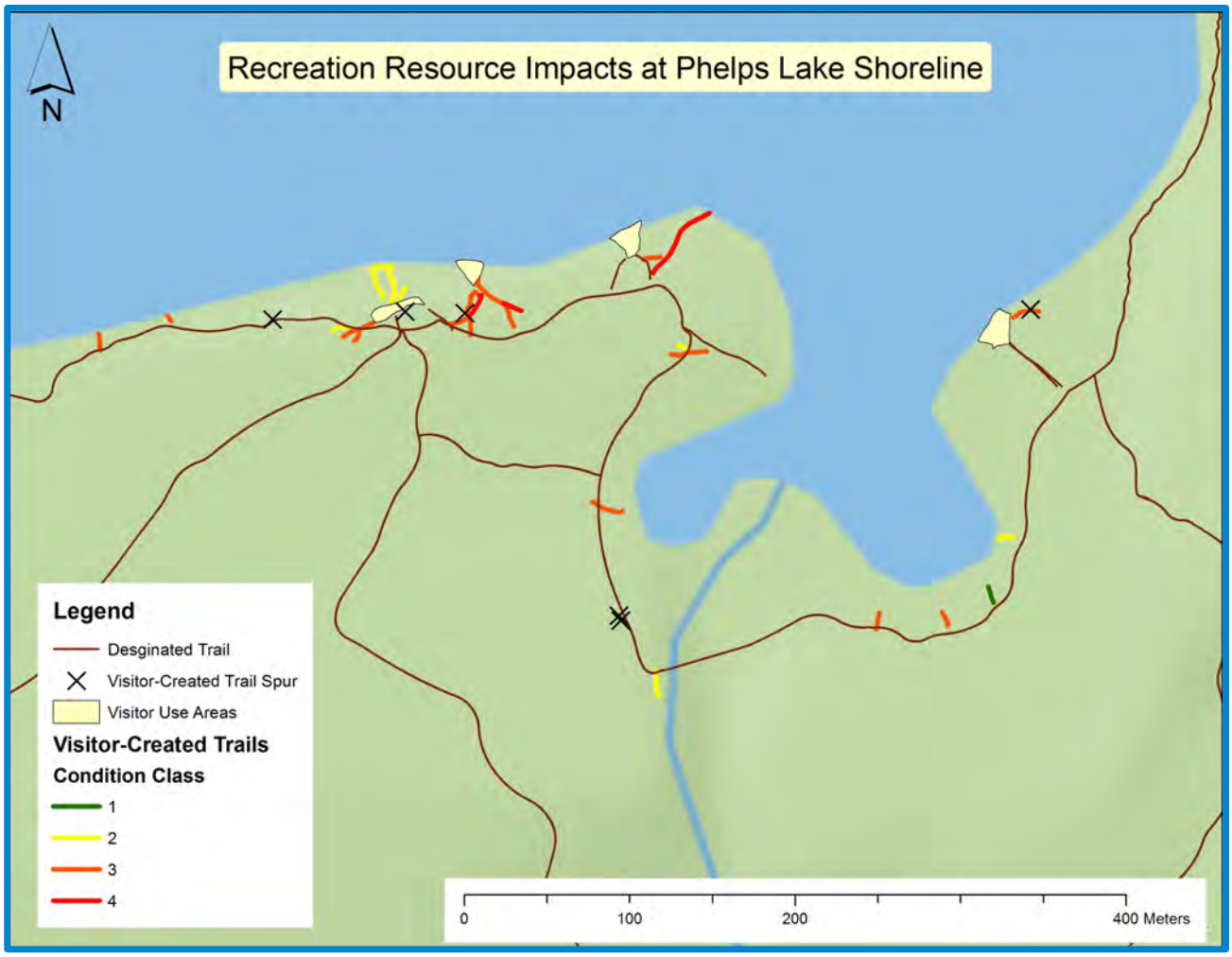


Figure 12.4: Recreation-related resource impacts, coded by condition class, at the Phelps Lake outlet area shoreline. Visitor use areas were areas that appeared to be designated and/or hardened by management.

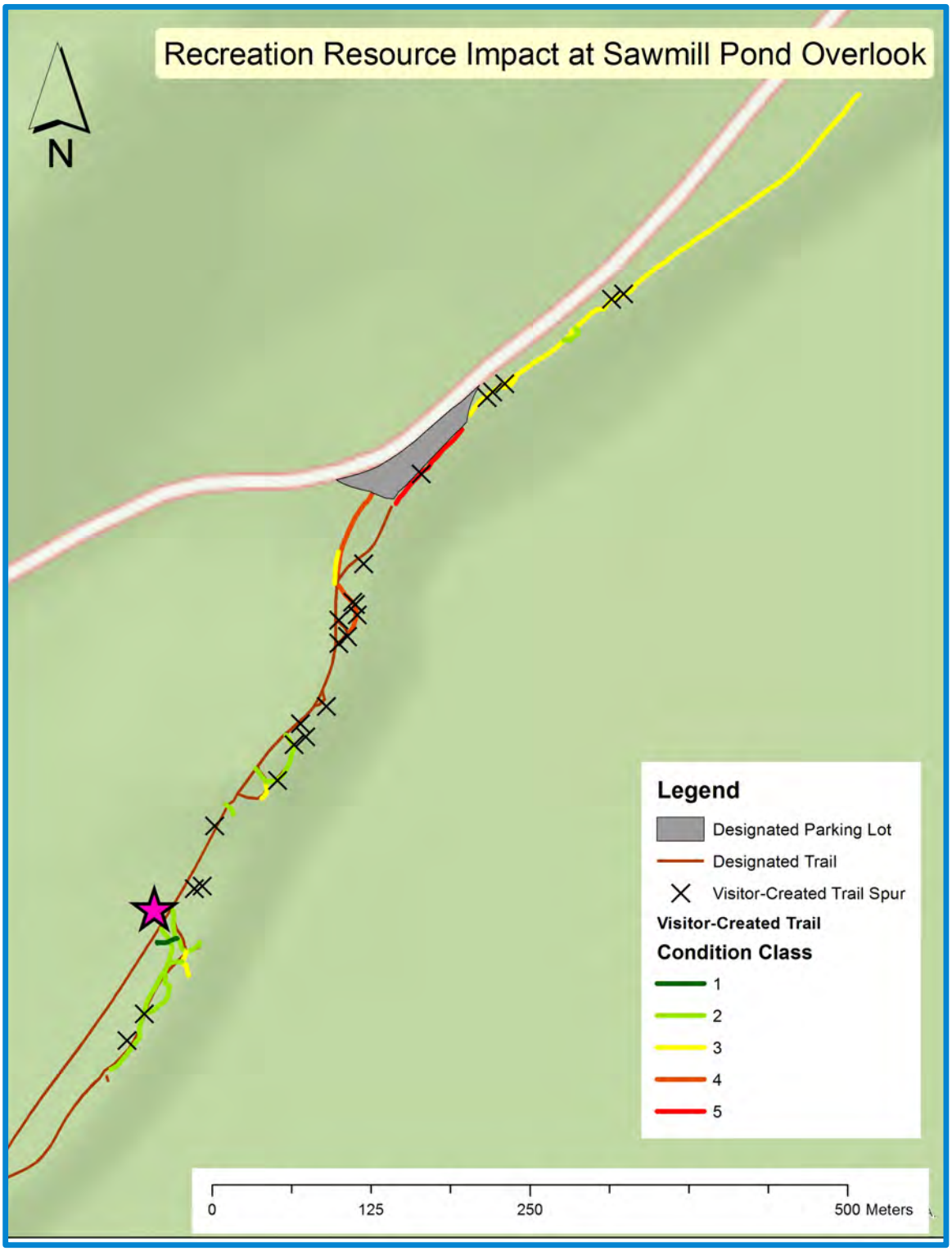


Figure 12.5: Recreation-related impacts, coded by condition class, at Sawmill Ponds Overlook area. Purple star shows the approximate location of the visitor use counter placed at Sawmill Ponds Overlook.

ADDITIONAL DATA COLLECTION

WILDLIFE BRIGADE

USU provided the southern volunteers of the Wildlife Brigade with a Trimble GPS unit. At all wildlife jams in the Moose-Wilson Road corridor, the Wildlife Brigade volunteers carried the GPS units while working at the jam and also entered a few basic pieces of data for each jam into the GPS unit (including the type of animal, duration of jam, and visual estimation of the max number of vehicles in the jam). The GPS data and associated attributes were downloaded by USU, and wildlife jam activity on the Moose-Wilson Road from July through October was summarized. The most wildlife jams occurred in September (Figure 1), and the majority of wildlife jams that occurred in September were due to bear activity (Figures 5 and 6). In July, the month with the lowest number of wildlife jams recorded, all of the jams were due to moose (Figure 2). During August, there were both bear and moose jams (Figures 3 and 4). Overall, bears caused the most wildlife jams across the entire sampling season (Figure 7). The size and duration of the wildlife jams varied widely (Figures 8 and 9). However, most jams lasted between 30 minutes and 1 hour (Figure 8), and the most common estimated size of jams was either 20 or 50 cars (Figure 9). Maps of the location and density of the wildlife jams recorded by the Wildlife Brigade can be found in Appendix J. The Wildlife Brigade also provided USU with summary information for all wildlife jams that occurred in the Moose-Wilson Road from July through September. These data did not have GPS locations associated with it; the summaries of the non-georeferenced data provided by the Wildlife Brigade is also included in Appendix J. These data include the occurrence of any wildlife jams that may not have been GPS-recorded by the Wildlife Brigade in the field.

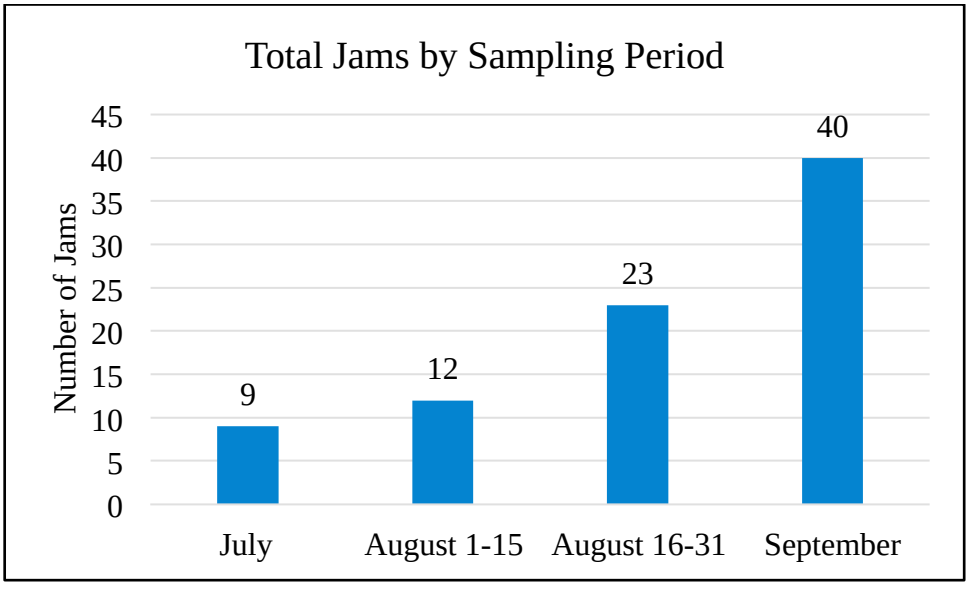


Figure 1: Total number of wildlife jams recorded by the Wildlife Brigade by sampling period for the Moose-Wilson Road.

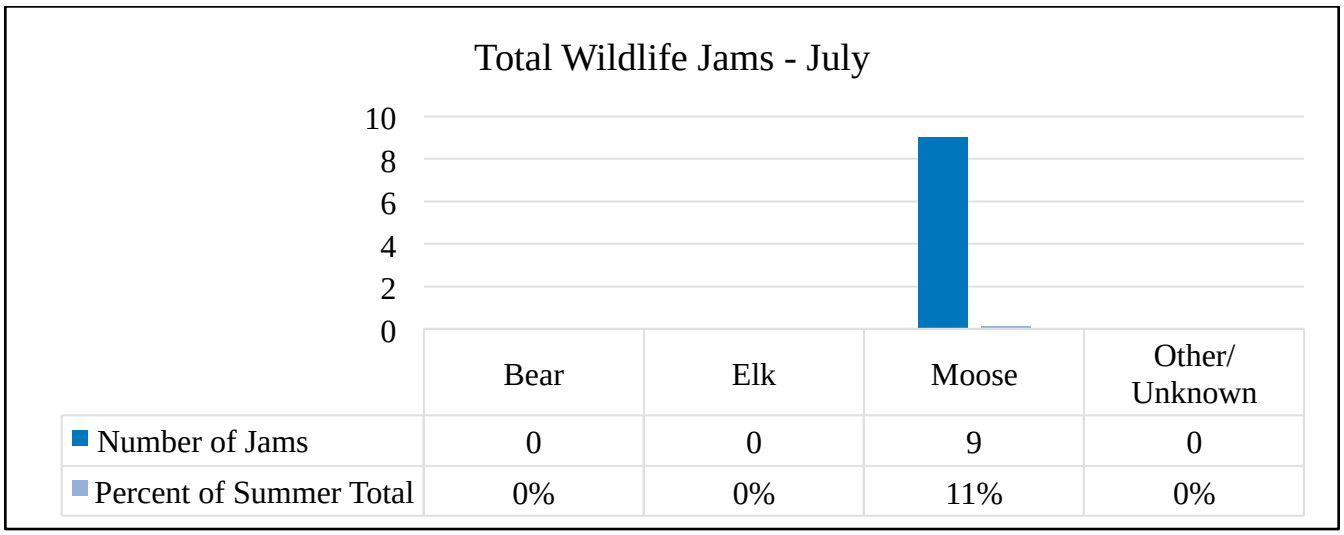


Figure 2: Total number and frequency of wildlife jams by species recorded by the Wildlife Brigade in July for the Moose-Wilson Road.

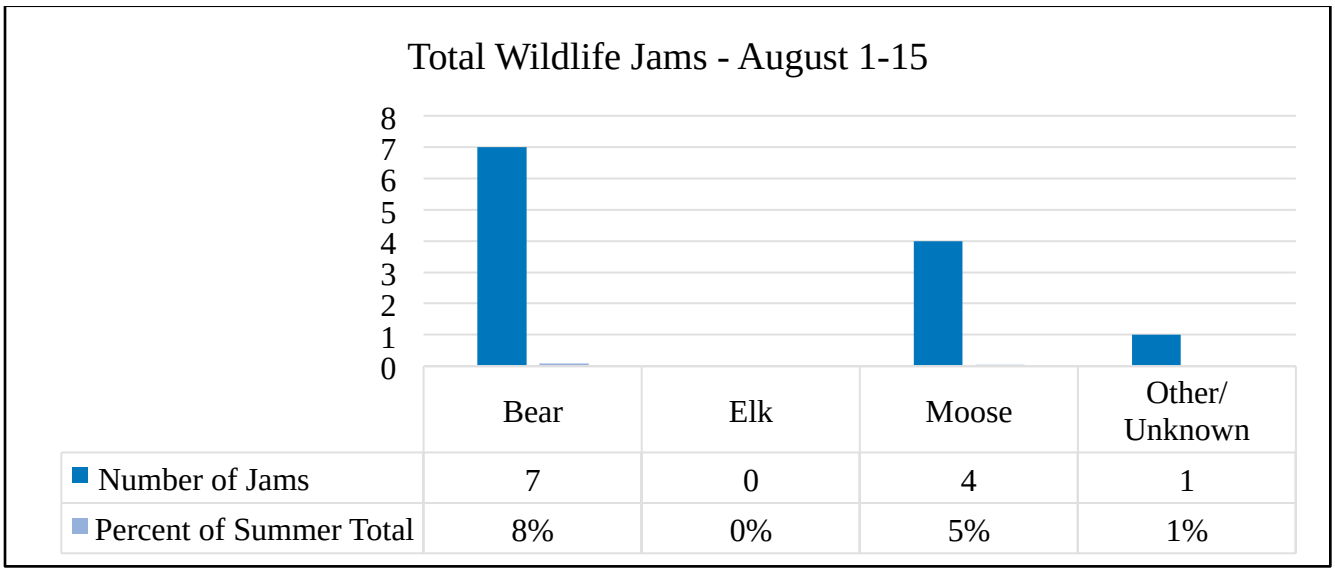


Figure 3: Total number and frequency of wildlife jams by species recorded by the Wildlife Brigade in the first half of August for the Moose-Wilson Road.

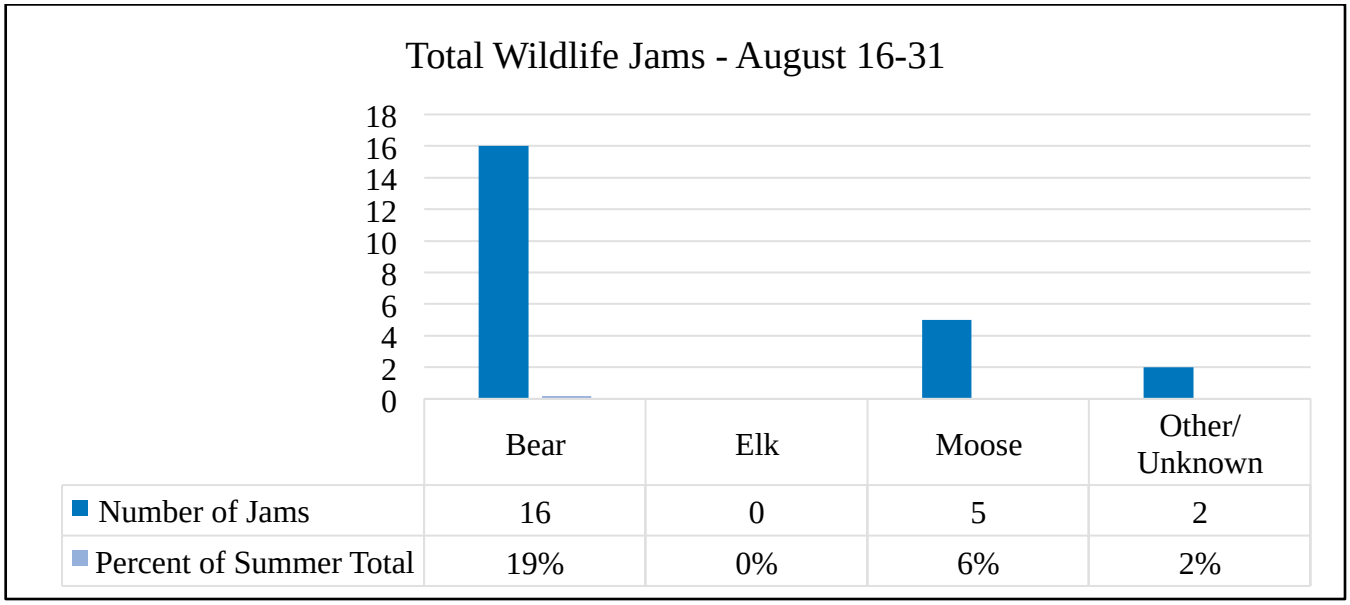


Figure 4: Total number and frequency of wildlife jams by species recorded by the Wildlife Brigade in the second half of August for the Moose-Wilson Road.

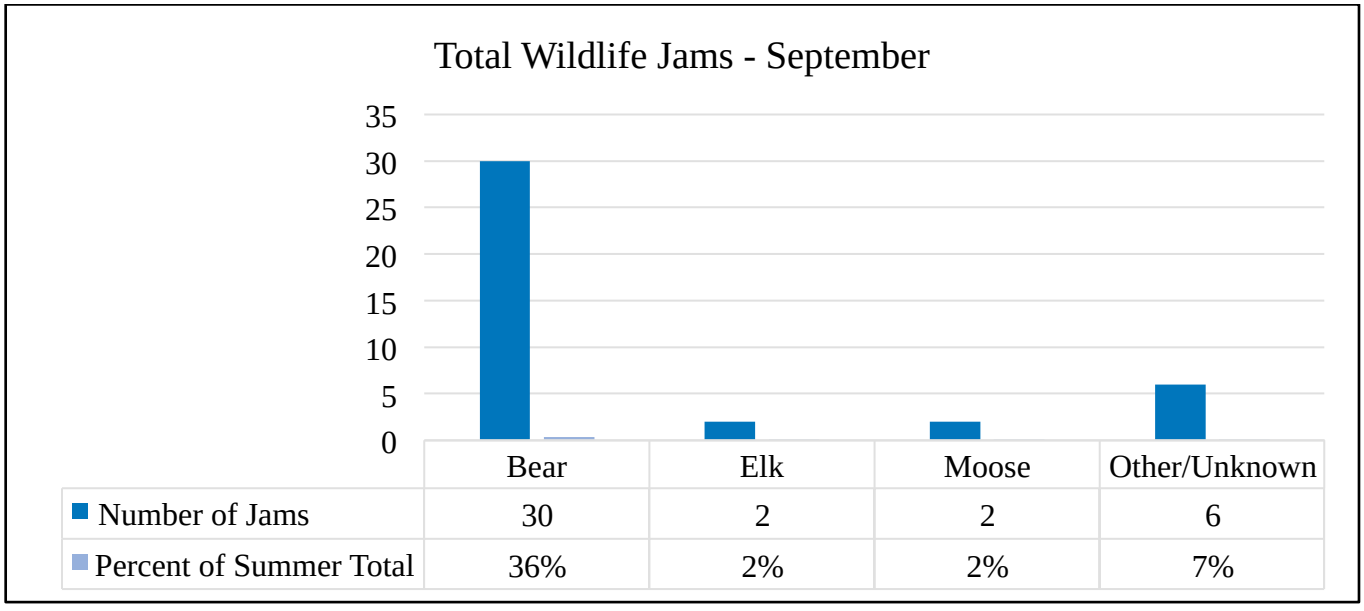


Figure 5: Total number and frequency of wildlife jams by species recorded by the Wildlife Brigade in September for the Moose-Wilson Road.

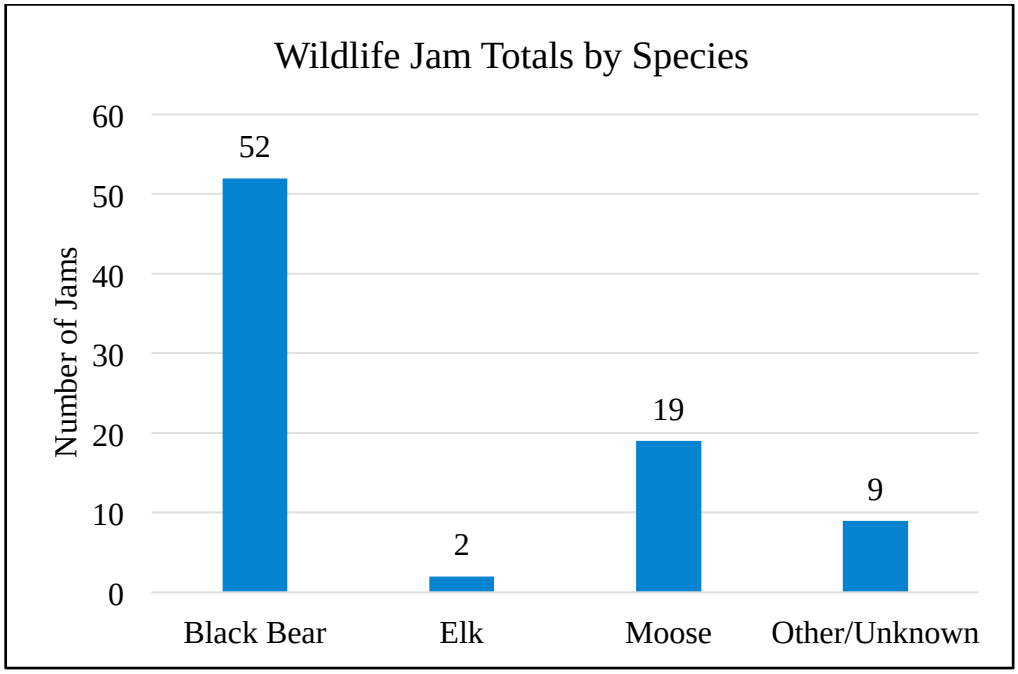


Figure 6: Total number of wildlife jams by species recorded by the Wildlife Brigade for the entire sampling season for the Moose-Wilson Road.

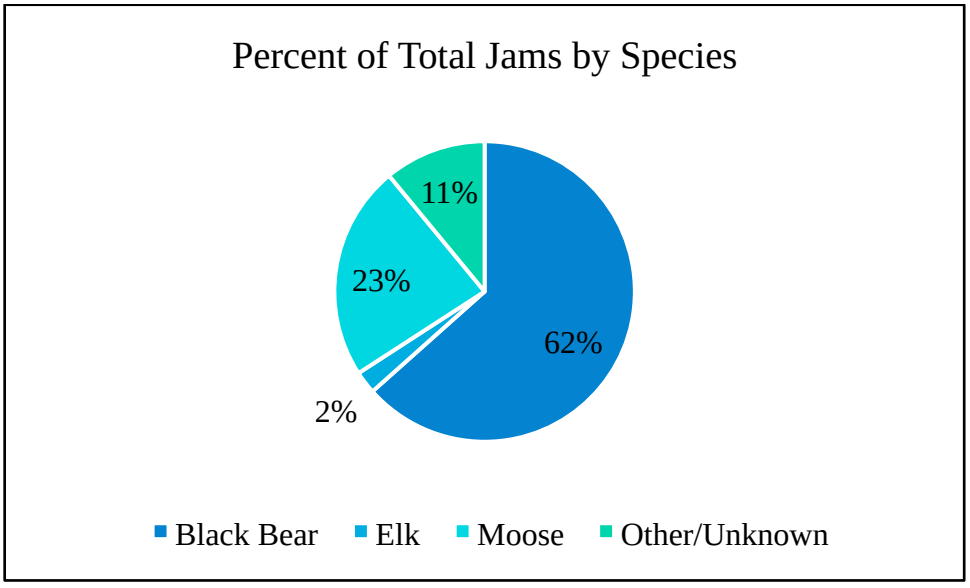


Figure 7: Frequency of wildlife jams by species recorded by the Wildlife Brigade for the entire sampling season for the Moose-Wilson Road.

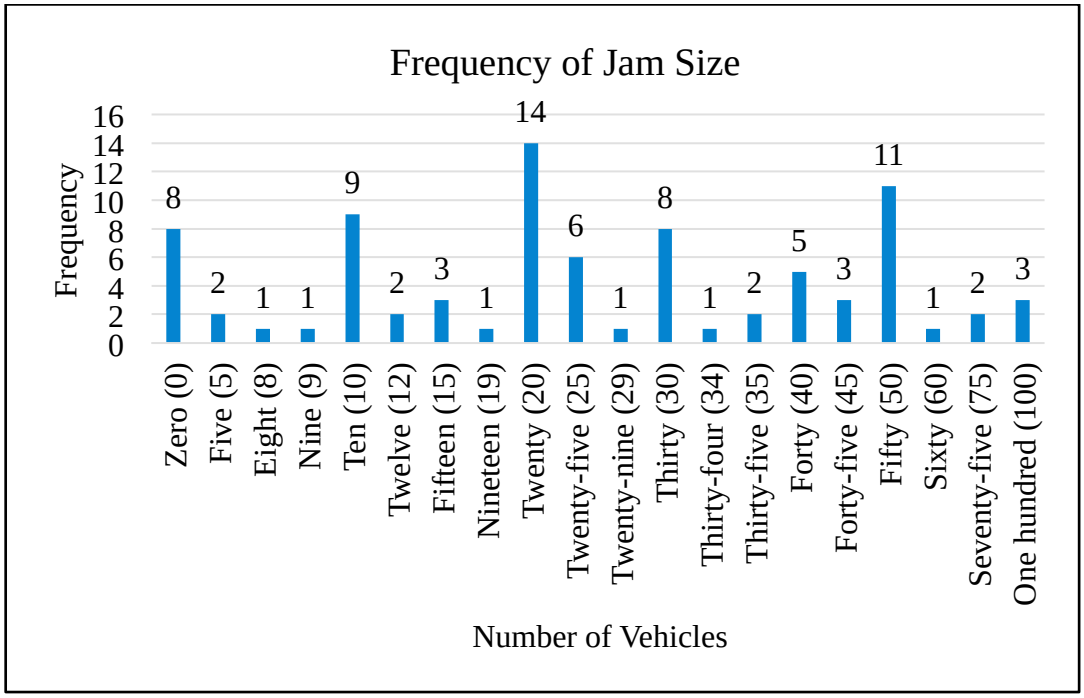
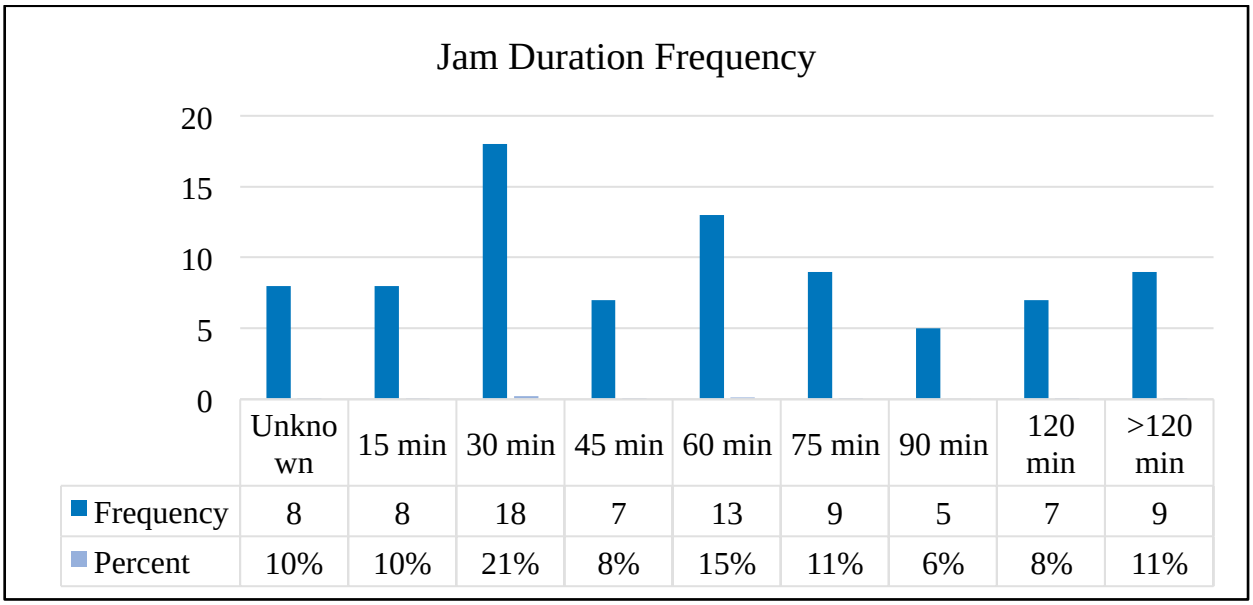


Figure 8: Frequency of wildlife jam size recorded by the Wildlife Brigade for the entire sampling season for the Moose-Wilson Road.



	Unknown	15 min	30 min	45 min	60 min	75 min	90 min	120 min	>120 min
Frequency	8	8	18	7	13	9	5	7	9
Percent	10%	10%	21%	8%	15%	11%	6%	8%	11%

Figure 9: Frequency of wildlife jam length recorded by the Wildlife Brigade for the entire sampling season for the Moose-Wilson Road.

SUMMARY OF FINDINGS

- *Overall Use:* The first half of August (1st-15th) was the busiest sampling period throughout the study. For much of the season, the Moose-Wilson Road sees approximately 2,000 vehicles per day with side roads, Death Canyon and the LSR Preserve Road, having use levels of approximately 200 vehicles per day. Given that, on average, each vehicle contain 2.7 visitors, total use on the Moose-Wilson Road per day can be estimated at around 5,400 visitors. Peak use in the Moose-Wilson corridor occurs between 11am and 2pm-3pm. At the intersection of Moose-Wilson Road and Teton Park Road, on average, 21% of traffic from Teton Park Road turns onto the Moose-Wilson Road.

- *Vehicle Use Patterns:* The majority of visitors (54%) in vehicles using the Moose-Wilson Corridor drive through the corridor without stopping, spending less than 30 minutes total in the corridor. Vehicles have median use time of approximately 27 minutes and 40 minutes for bicyclists. The level of northbound through-traffic is slightly greater than the level of southbound through-traffic. The north end of the road was the most popular location for the entrance and exit of vehicles. This pattern is the result of much of the traffic in the Moose-Wilson corridor traveling in a northbound direction and a higher number of north entrance/exit loops than south entrance/exit loops. For the minority of vehicles that stopped within the Moose-Wilson Corridor, the LSR Preserve and Sawmill Ponds were the most popular stopping locations.

- *Bicycle Use Levels/Patterns:* Like overall use, the highest level of bicycle use was observed during the first sampling period in August (1st-15th). More bicycles entered the Moose-Wilson Corridor by the Moose-Wilson Road and Teton Park Road intersection, and most bicyclists traveled straight through in a southbound direction. Bicyclists on average spent between 30 minutes and 1 hour in the corridor.

- *Recreation-related Resource Impacts:* A total of 183 overflow/visitor-created parking areas were found in the Moose-Wilson Corridor. Death Canyon Road had the highest use of these overflow/visitor-created parking by vehicles. The density of overflow/visitor-created parking was higher along Death Canyon Road than the Moose-Wilson Road. Overall, the overflow/visitor-created parking areas were of moderate level of impact with about 50% vegetation loss. The most popular destinations for hikers in the Moose-Wilson Corridor were Phelps Lake Overlook and the shore of Phelps Lake. Resource impacts were found at these two locations and all visitor sites of interest. The highest level of impact was found at Phelps Lake Overlook and “Jump Rock.” Hardening on the shore of Phelps Lake has helped to reduce and contain impacts in certain locations.

Figure 11: Annie Weiler at Phelps Lake early in the morning before a day of mapping recreation resource impacts (photo by Ashley D'Antonio).

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APPENDICES

- A: Moose-Wilson Corridor Use Study Sampling Schedule
- B: Directional Traffic Flow from Tube Counters
- C: Detailed Tables from TMC and ATR Studies
- D: Overall and Density Maps from GPS-tracked Vehicles
- E: Overall and Density Maps from GPS-tracked Bicycles
- F: Overall and Density Maps from GPS-tracked Pedestrians
- G: Averages and Standard Deviations from Parking Lot Graphs
- H: Tables and Maps for Overflow/Visitor-Created Parking Areas
- I: Summary of Counter Calibrations and Raw Values
- J: Summary Maps of Wildlife Jams and Data Provided by Wildlife Brigade
- K: Data Handling Procedures (Forthcoming, September 2014)

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