

Pacific Northwest National Scenic Trail: 2018 Trail Monitoring Report



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Introduction

In 2009, Congress designated the Pacific Northwest Trail as one of America's 11 National Scenic Trails. The Pacific Northwest National Scenic Trail (PNNST) offers outstanding opportunities for long-distance non-motorized recreation throughout its 1200 mile route. The PNNST crosses a diverse landscape, beginning at the Continental Divide at Chief Mountain Trailhead in Glacier National Park, Montana and finishing at the Pacific Ocean on Cape Alava in Olympic National Park, Washington. Seven national forests and three national parks account for 70% of the PNNST and more than 300 miles of the trail cross through six wilderness areas. Sixty-seven percent of the PNNST is on trails and 33% is on roads; one goal of the USFS is to work toward a continuous, non-motorized trail route to meet the intent for National Scenic Trails in the National Trails System Act. The PNNST not only provides users with access to, travel within, and enjoyment and appreciation of open-air, outdoor areas, it also grants opportunities for users to experience the history and culture of the American West.

When the PNNST gained its National Scenic Trail status, Congress required the USFS to develop a Comprehensive Plan that would provide various land management agencies with a common vision for the long-term development and management of the trail. The required components of a comprehensive plan are 1) objectives and practices for the management of the trail, including an identified carrying capacity and a plan for its implementation, 2) an acquisition or protection plan for lands along the trail, and 3) general and site-specific development plans. This monitoring report serves to inform the identification of carrying capacity and other objectives and practices for management of the trail.

Throughout the summer of 2018, the University of Montana (UM) conducted a visitor monitoring of the number and timing of hiking visits using various sections of the PNNST. These sections are located in the Flathead National Forest (FNF) and Kootenai National Forest (KNF) in Montana. **Hiking visits** included trail use by:

- thru-hikers, who are completing an end-to end hike of the PNNST in one season
- section-hikers, who are traversing the length of the PNNST as a series of shorter trips usually over a longer time frame; and
- day hikers and overnight/multi-day backpackers whose visits are not part of an attempt to complete the PNNST (sometimes called "local users" to differentiate them from thru-hikers or section hikers, though they may or may not be from the local area).

Hiking visits include people on foot, and do not include people on bicycles or horses. Hiking visits are estimates based on calibration of raw data as described in the methods section below. In the case of an "out-and-back" hike where a hiker returns to the same trailhead from which

they started using the same trail (and passing by the same trail counter twice) either the same day or a different day, this is counted as two hiking visits.

This report details findings related to trail use during 2018 at the following locations: Whitefish Divide, Blue Sky Creek, Bluebird Lake, Green Mountain, Boulder Lake, Mt. Henry, Vinal Creek¹, Midge Creek, Garver Mountain, and Canuck Peak. More information about these sites, including the corresponding trail name and number, are in Appendix B.

¹ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.

Methods

This study replicated the methodology and site selection used in UM's initial monitoring project from the summer of 2017, allowing for the comparison of trail use data between 2017 and 2018. Data collection took place from June 11 to September 28, 2018. During this time, the researchers made eight trips into the field. Each trip lasted between two and three days. There were ten sites monitored, with nine in KNF and one in FNF. Data was gathered using infrared trail counters and software from the company TRAFx. The trail counters were calibrated using two types of trail cameras, one camera type took video and the other type took photographs. One trail camera was found destroyed several weeks after initial deployment, which left the team using four cameras for the duration of the monitoring period.

Information from these infrared counters can help determine the level of use along the trails at selected sites; however, there are limitations in how these counters record data that are typical and standard in similar kinds of studies. The counters have infrared detectors and register a count each time an individual or animal passes in its receptive range. A trail counter reading alone cannot distinguish between a count for an animal and a count for a hiker. We were able to differentiate people from wildlife and gain a sense of which trails might be frequented more by wildlife through the use of camera photos and video footage.

Photo and video cameras were shifted between the sites every two weeks, spending about 8 weeks in total at each site throughout the monitoring period. These cameras ensured that the movement throughout the trail was captured from several directions and the footage was later watched to calibrate the infrared counts. Although the team didn't have the cameras up all the time or go through all the footage when calibrating the counter data, they did provide valuable information with which to adjust the infrared counts. For example, Canuck Peak is frequented by wildlife, which when walking on a trail past a counter do get counted. Similarly, a hiker walking with a dog would have both the dog and the hiker counted. In some cases, hikers walking side by side would only be counted as one hiker. However, we were unable to have cameras up at all the sites throughout the study so the calibration of the infrared data is based on the sample days when the cameras were at that particular location.

To calibrate the raw counts from each site, the team selected the period of time with the highest counts that also had a camera present. While watching the footage, the team noted whether it was an animal, a hiker, biker, a horseback rider, trail crew, or phantom count that was registered by the counter as a count. The observed count of hikers was then divided by all infrared counts in the calibration period to yield a calibration factor. If the calibration factor remains constant over time, then multiplying the calibration factor by the infrared counts yields the observed count of hiking visits. This use of the calibration factors allows us to adjust for animal counts, biker counts, horseback rider counts, phantom counts and double counts of individuals by applying the assumed constant calibration factor.

The calibration factors in this study ranged from 0.09 to 0.74 as shown in Table 1. The fact that these trails receive low user traffic in general, that the monitoring periods were shortened by wildfires, and that there are wildlife that frequent these trails, could all be factors contributing to lower calibration factors. In addition, during the hot summer periods, some hikers prefer to travel at night. Unfortunately, the camera data is not always successful in distinguishing hikers from wildlife at night. Because the calibration factors are generated from a sample, we should formally refer to hiking visits as estimated hiking visits, but for brevity we will use the term hiking visits in most places.

Table 1. Calibration Dates and Calculated Calibration Factors

Site	Calibration Dates	Calibration Factor
Bluebird Lake	7/19-7/31	0.663616
Blue Sky	6/17-6/27; 8/5; 8/16	0.740741
Boulder Lake	6/16-6/30; 8/5-8/6; 8/9	0.2488
Canuck Peak	7/1-7/16	0.328358
Whitefish Divide	7/19-7/29	0.483871
Garver Mountain	7/2-7/16	0.52272
Green Mountain	7/18-7/31	0.666667
Gypsy Meadows	6/16-6/30	0.093023
Midge Creek	7/1-7/16	0.43859
Vinal Creek ²	6/16-6/30	0.214286

It is important to note that the infrared counters are not distinguishing between thru-hikers, section hikers, day users, and overnight/multi-day users. Neither the infrared data nor the camera data can distinguish between thru-hikers and other users, or between one-way and out-and-back hikers. Rather, the infrared counters are providing counts for overall use on the trail sections that are being monitored. Therefore, a hiker on an out-and-back hike who passes the infrared camera on the way in and then again on the way out is counted as two users. No information about direction of travel can be gleaned from the infrared counts. Qualitative data, like an electronic survey, or chronologically mapping hiker registrations, might be necessary to determine the number of thru-hikers and section hikers versus other users, as well as westbound versus eastbound PNNST thru-hikers. In some cases, researchers reviewing camera images observed differences in gear (such as the size and type of backpack) or party

² The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.

composition (such as families with young children) suggestive of day-use versus overnight use, and these patterns may be noted in the report.

This study does not address party size. Average and peak weekly hiking visits in this report do not equate to parties per week for grizzly bear habitat management purposes.

We were curious about how changes in weather (e.g. temperature, precipitation, and air quality) might influence visitor use of the different trail sites. In particular, we were eager to map the relationship between air quality, as an environmental indicator for wildfire, and visitor use of the trails. The closest weather stations with temperature and precipitation records were Yaak and Eureka and the closest air quality stations were in Kalispell and Eureka. We used the station closest to the monitoring site to represent weather and air quality. For example, the Whitefish Divide, Blue Sky Creek, Bluebird Lake, Whitefish Divide, and Green Mountain were closer to the Kalispell air quality than the Eureka air quality station. Eureka precipitation data was missing for many days, so Yaak precipitation data was used for all sites. The data in the weather graphs serves as a regional representation of the weather patterns. Therefore, we urge caution in drawing major conclusions about any significant relationships between visitor use in these sites and the weather information; however, weather does play a major factor in start/end times for thru-hikers on the trail. We did not take into account potential interrelationships among temperature, precipitation, and air quality.

Comparison across sites

Locations monitored include, from east to west: Whitefish Divide, Blue Sky Creek, Bluebird Lake, Green Mountain, Boulder Lake, Gypsy Meadows, Vinal Creek³, Midge Creek, Garver Mountain, and Canuck Peak. More information about these sites, including the corresponding trail name and number, are in Appendix B.

Figure 1 and Figure 2 display use across all sites in July and August 2018. Figure 1 didn't include Gypsy Meadows because the data was compromised (see page 30). Green Mountain only had 13 days of data in July, of which one day accumulated 21 counts. This day was removed from the Green Mountain data set because it was the first day of the data set and there is reason to believe that the high count might represent the research team while they were installing the counter. Bluebird Lake was not included in the graph because it demonstrated a trail count that was substantially higher than the rest of the monitored sites. The use of Bluebird Lake did not scale with the other sites, warranting its own graph of daily counts (see page 17). Figure 2 doesn't include Garver Mountain or Midge Creek because of insufficient data due to an early August wildfire in the area of those sites.

In many cases we have complete daily counts at a site for particular months. However, in some cases we have missing data for some days within a month, such as in September when counters were removed a few days before the end of the month. In cases where we have missing counts for a day those missing counts were replaced using the monthly average of the observed days that month in order to get a total based on a full month of observations. Totals for months with more than 19 days with missing observations were not calculated. This imputation was only used for creating monthly totals so that comparisons based upon a full month of observations could be made.

³ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.

Figure 1. Comparison of use across all sites in July 2018

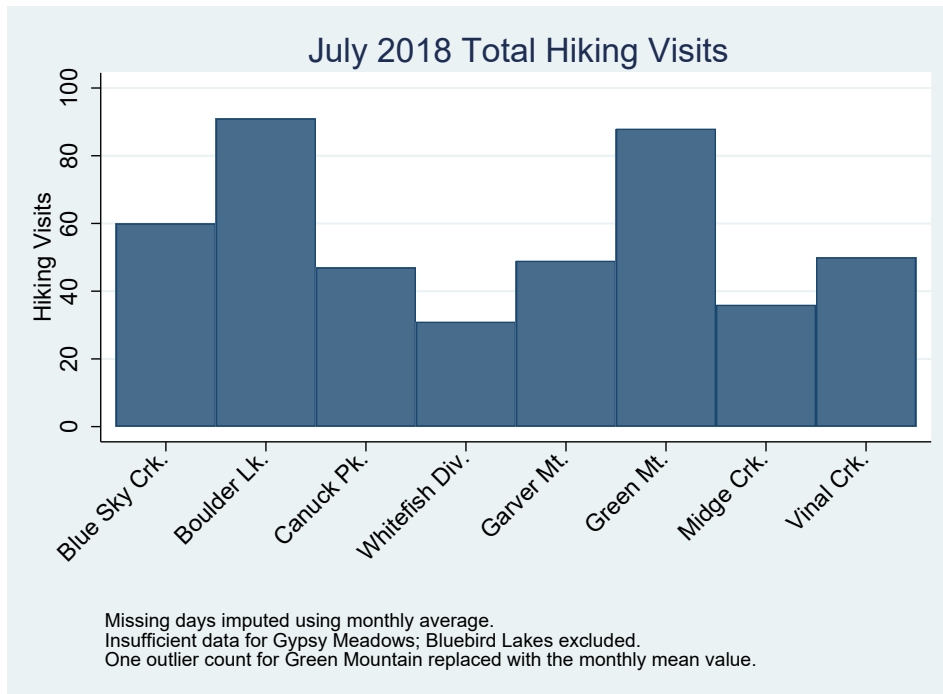


Figure 1 shows the number of hiking visits throughout the month of July 2018 in the monitored sites (excluding Bluebird Lake, which accrued a much higher count and has its own graph in the Use by trail section). In July 2018, Boulder Lake and Green Mountain had the highest use of the trails monitored while Whitefish Divide and Midge Creek experienced the lowest use.

Figure 2. Comparison of use across all sites in August 2018

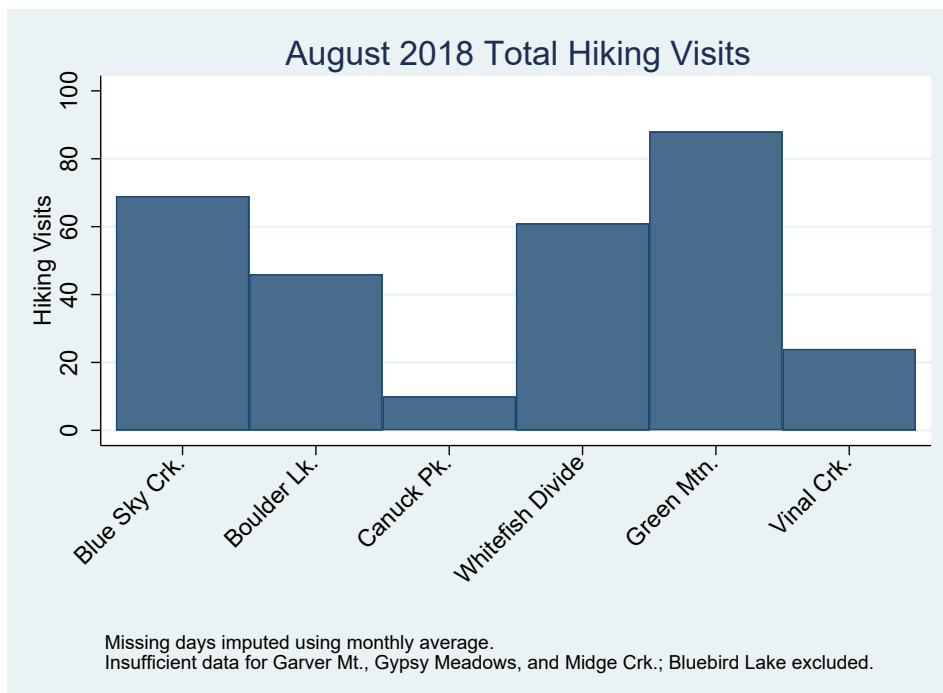


Figure 2 shows the number of hiking visits throughout the month of August 2018 in most of the monitored sites. In August 2018, Green Mountain and Blue Sky Creek had the highest use of the trails monitored while Canuck Peak and Vinal Creek⁴ experienced the lowest use.

Table 2. Mean Daily Counts for July, August, and September 2018.

Site	Month	Days Monitored	Count (Monthly)	Daily Average	Minimum (Daily)	Maximum (Daily)
Whitefish Divide	July	12	12	1.0	0	5
	August	31	61	2.0	0	9
	September	28	50	1.8	0	13
Blue Sky Creek	July	31	60	1.9	0	7
	August	31	69	2.2	0	17
	September	28	45	1.6	0	9
Bluebird Lake	July	13	289	22.2	1	64
	August	31	472	15.2	0	58
	September	28	264	9.5	0	50
Green Mountain	July	12	34	2.8	0	7
	August	31	88	2.8	0	15
	September	28	72	2.6	0	16
Boulder Lake	July	31	91	2.9	0	12
	August	31	46	1.5	0	8
	September	27	23	0.9	0	5
Gypsy Meadows	July	16	8	0.5	0	1
	August	10	0	0	0	0
	September	24	0	0	0	0
Vinal Creek	July	31	50	1.6	0	8
	August	31	24	0.8	0	5
	September	27	9	0.3	0	4

⁴ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.

Midge Creek	July	30	35	1.2	0	5
	August	1	0	0	0	0
	September	0				
Garver Mountain	July	30	47	1.6	0	4
	August	1	1	1.0	1	1
	September	0				
Canuck Peak	July	30	45	1.5	0	8
	August	31	10	0.3	0	4
	September	27	4	0.2	0	1

Use by trail

Whitefish Divide 2018

Figure 3 contains the weekly counts from the trail counter at the Whitefish Divide site. The week of August 27 to September 2 experienced the most use, with 31 hiking visits. A weekly average of 11.5 hiking visits were recorded at the Whitefish Divide site during the weeks monitored. Figure 4 includes the daily averages from the Whitefish Divide counter. The highest use days were Friday, Saturday, and Sunday, with an average of 3.3, 1.8, and 1.8 visitors per day respectively. Figure 5 shows a breakdown of the highest use week of this trail: August 27 to September 2. Within this week, Sunday demonstrated the most counts with 13 counts. Sunday was September 1, suggesting a substantial increase in use due to the Labor Day holiday.

Based on camera data, this trail was frequented by day hikers, which could account for the higher weekend traffic. There appears to be a gradual increase in use beginning on August 13 and peaking at August 27. The Whitefish Divide is the trail farthest east in this data set, and the majority of thru-hikers travel the PNNST from east to west. Therefore, most of the thru-hikers pass through the Whitefish Divide earlier in the hiking season. This is consistent with our thinking that the higher counts from mid to late-August appear to represent possible day-hiker use.

Figure 6 shows counts relative to the maximum temperature in Eureka. The pattern in this graph suggests that more hikers were on the trail when it was cooler than when the temperatures were highest during the season. Figure 7 shows counts as they correspond to precipitation levels in Yaak, which does not reveal a correlation between precipitation and visitor use of the Whitefish Divide. Figure 8 shows the counts relative to the air quality in Kalispell. This data suggests that air quality could be associated with visitor use. The large spike in air quality to an unhealthy level does appear to be associated with a period of lower counts on the trail. Potentially hikers avoided this trail when air quality was unhealthy.

During the months that the Whitefish Divide site was monitored, an estimated 123 hiking visits were recorded on the trail. We recommend continuing to monitor this trail as it is used primarily by thru-hikers early in the season and is currently the only site monitored in the Flathead National Forest.

Figure 3. Whitefish Divide Weekly Counts

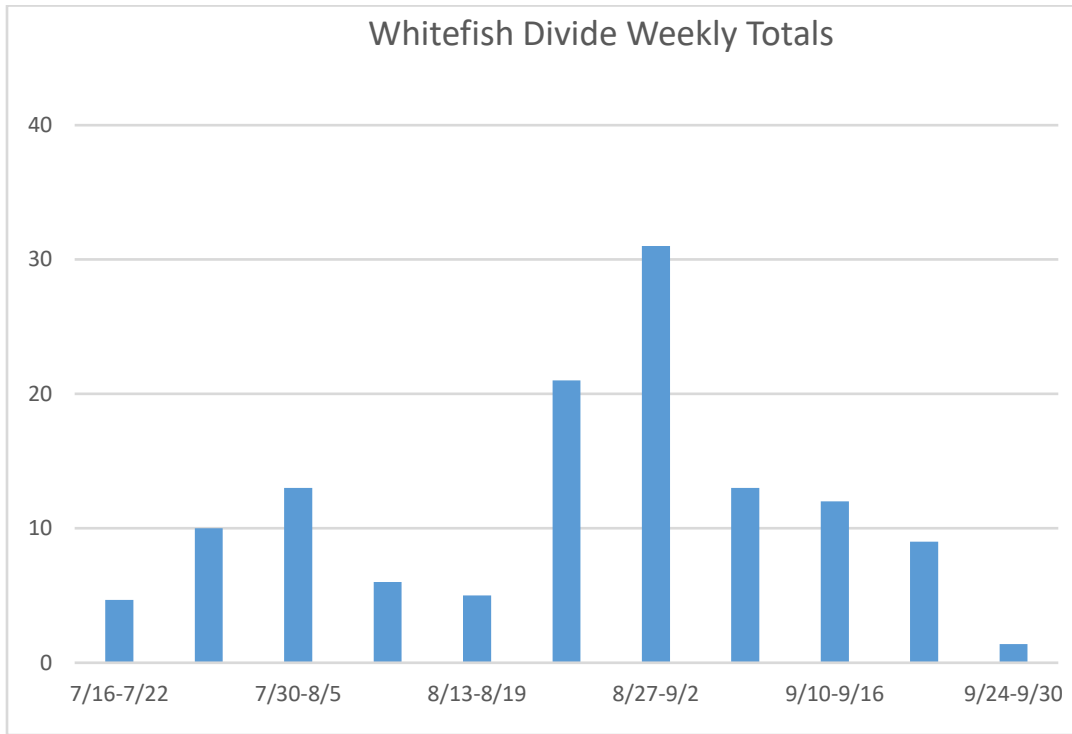


Figure 4. Whitefish Divide Daily Averages

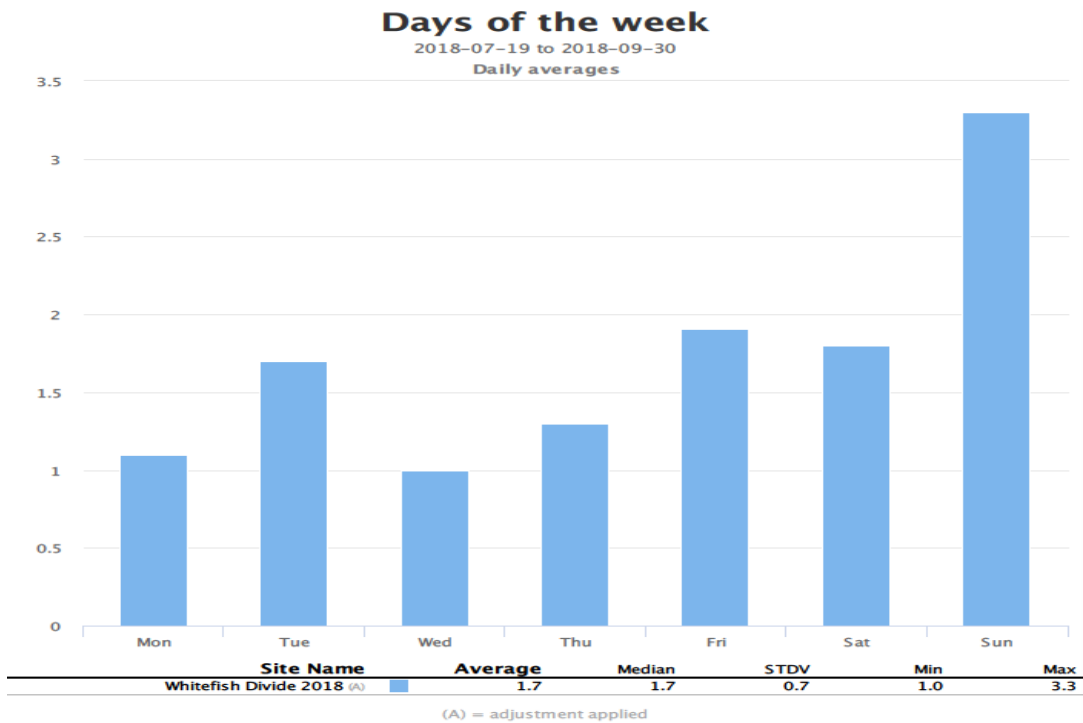


Figure 5. Whitefish Divide Highest Use Week

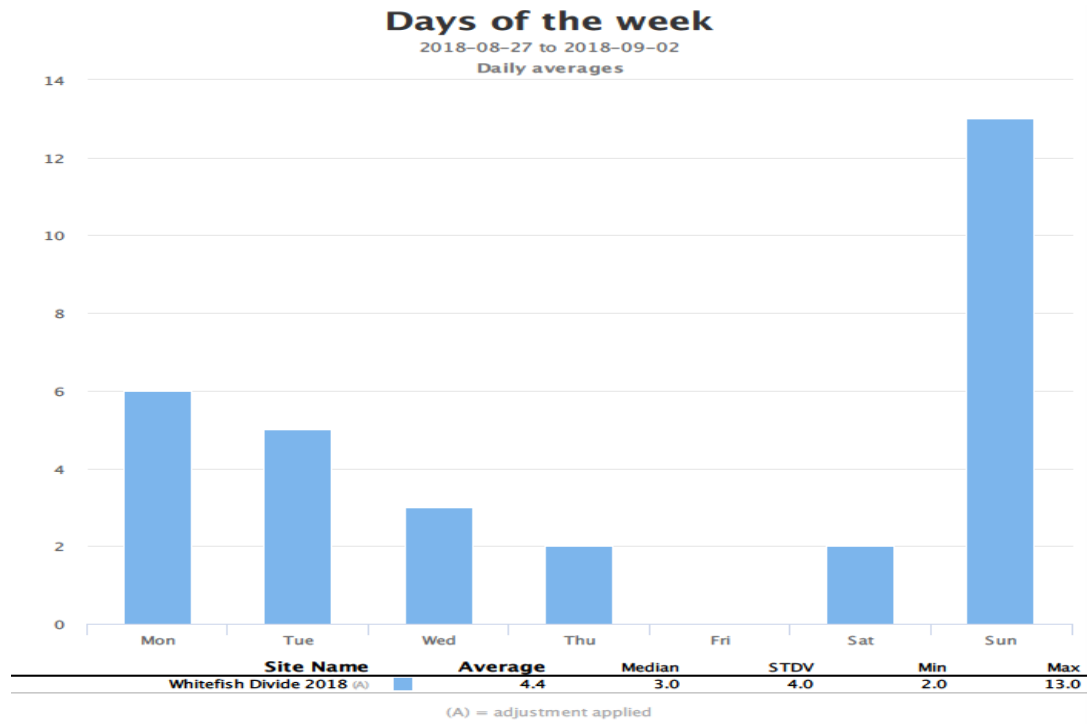


Figure 6. Whitefish Divide and Temperature

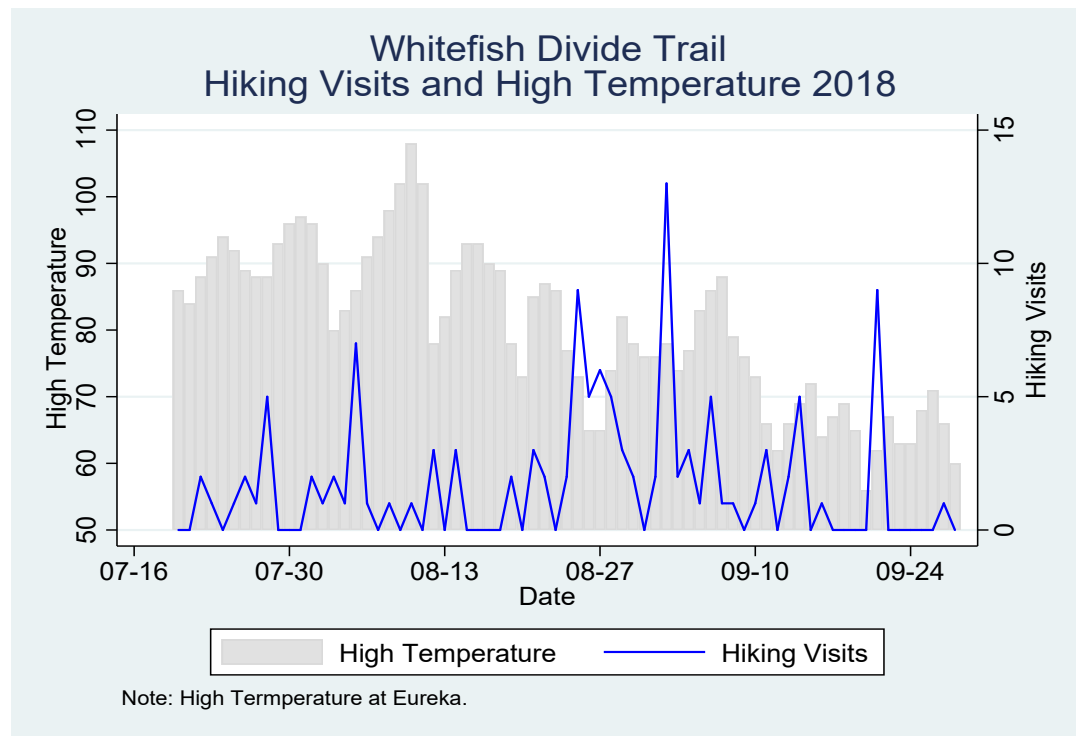


Figure 7. Whitefish Divide and Precipitation

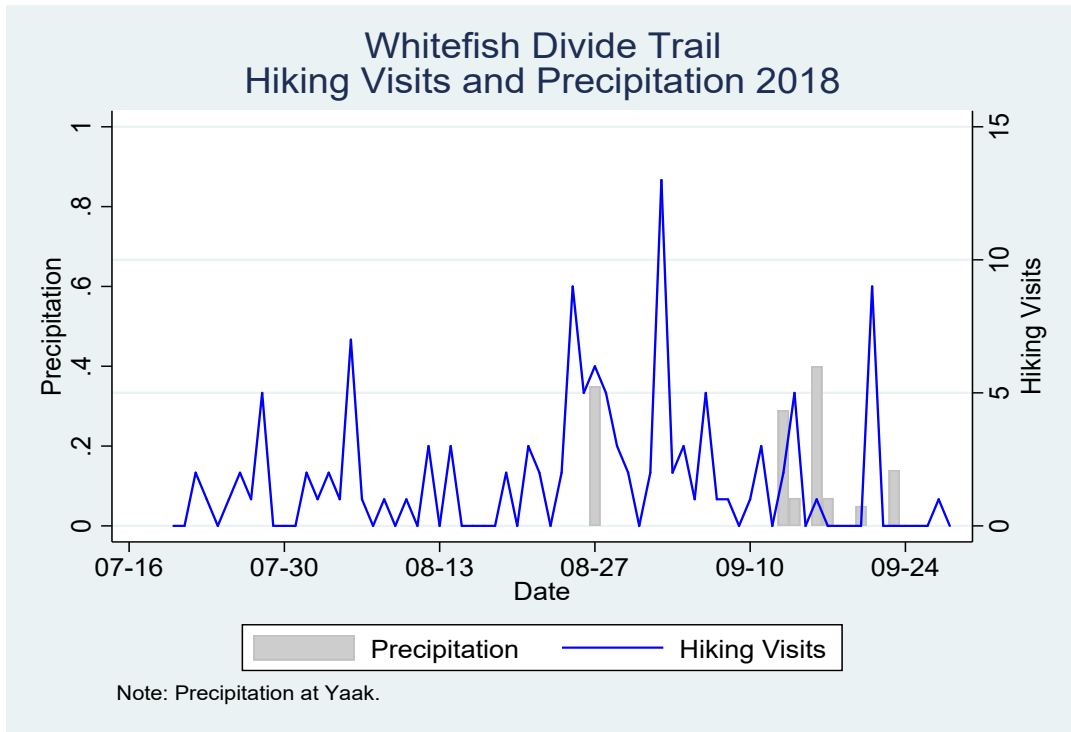
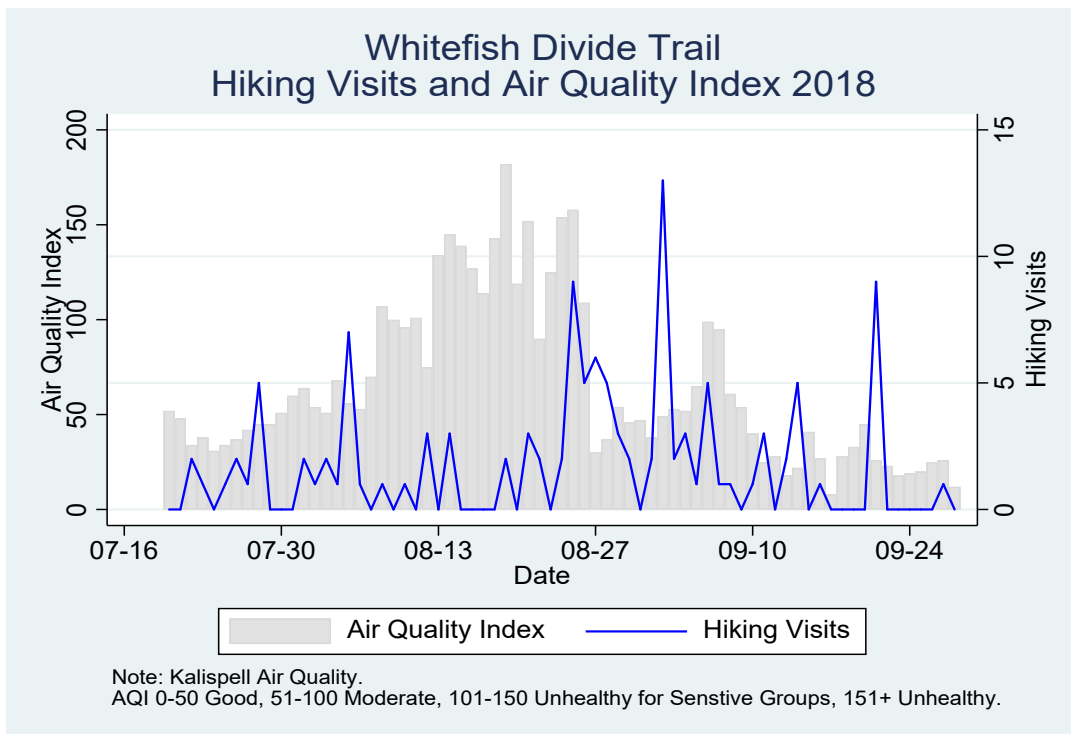


Figure 8. Whitefish Divide and Air Quality



Blue Sky Creek 2018

Figure 9 contains the weekly counts from the trail counter at the Blue Sky Creek site. The week of July 2-July 8 experienced the most use, with 25 hiking visits. A weekly average of 12 hiking visits were recorded at the Blue Sky Creek site during the weeks monitored. Figure 10 includes the daily averages from the trail counter at the Blue Sky Creek site. The highest use days were Friday and Sunday, with an average of 2.3 and 2.1 visitors per day respectively. Figure 11 shows a breakdown of the highest use week of this trail July 2 to July 8. Within this week, Wednesday, Thursday, and Saturday demonstrated the most counts with 7, 5, and 7 counts respectively. Wednesday and Thursday are July 4 and 5, suggesting a substantial increase in use due to the Fourth of July holiday.

Based on camera data, this trail was frequented by bikers, day hikers, and horse-riders on the weekends, which could account for the higher weekend traffic which is typical of day use patterns. Figure 12 shows counts relative to the maximum temperature in Eureka. The pattern in this graph suggests that more hikers were on the trail when it was cooler than when the temperatures were highest during the season. Figure 13 shows counts relative to precipitation levels in Yaak. Although there is not enough precipitation data to interpret in this monitoring period, this figure indicates that it could be possible that there were fewer hikers using the trail during the times of the season with the highest amount of precipitation. Figure 14 shows the counts relative to the air quality in Kalispell. This data suggests that air quality does not appear associated with trail use.

During the months that the Blue Sky Creek site was monitored, an estimated 189 hiking visits were recorded on the trail. We recommend continuing to monitor this trail as it is the gateway trail between Flathead and Kootenai National Forests and thru-hikers regularly pass through it during their PNNST hike.

Figure 9. Blue Sky Creek Weekly Counts

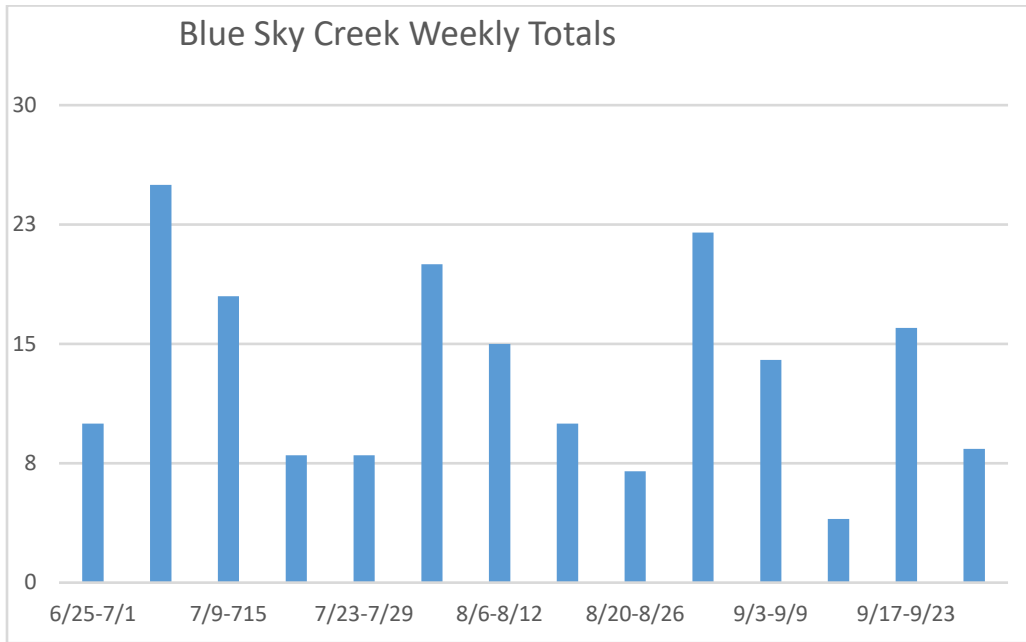


Figure 10. Blue Sky Creek Daily Averages

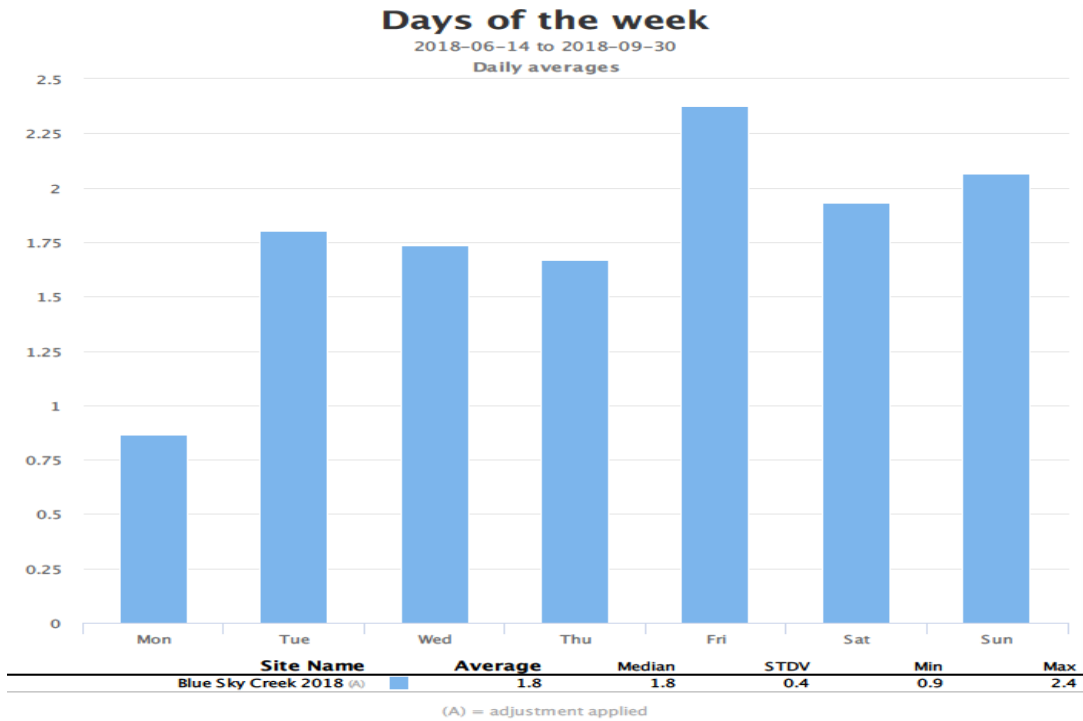


Figure 11. Blue Sky Creek Highest Use Week

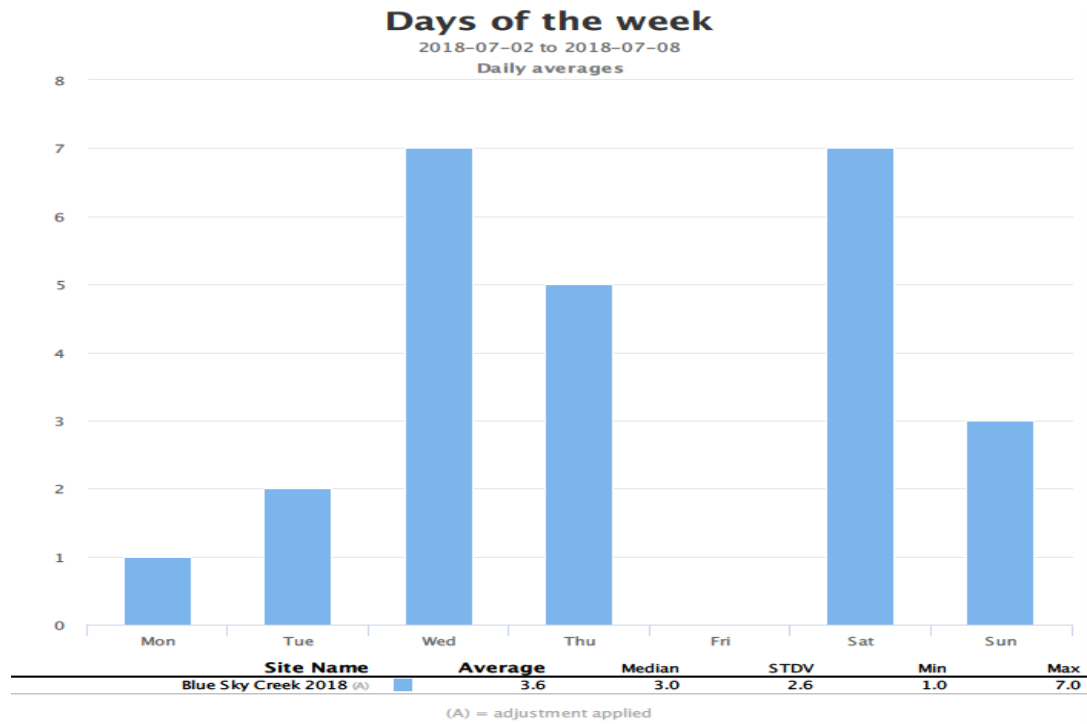


Figure 12. Blue Sky Creek and Temperature

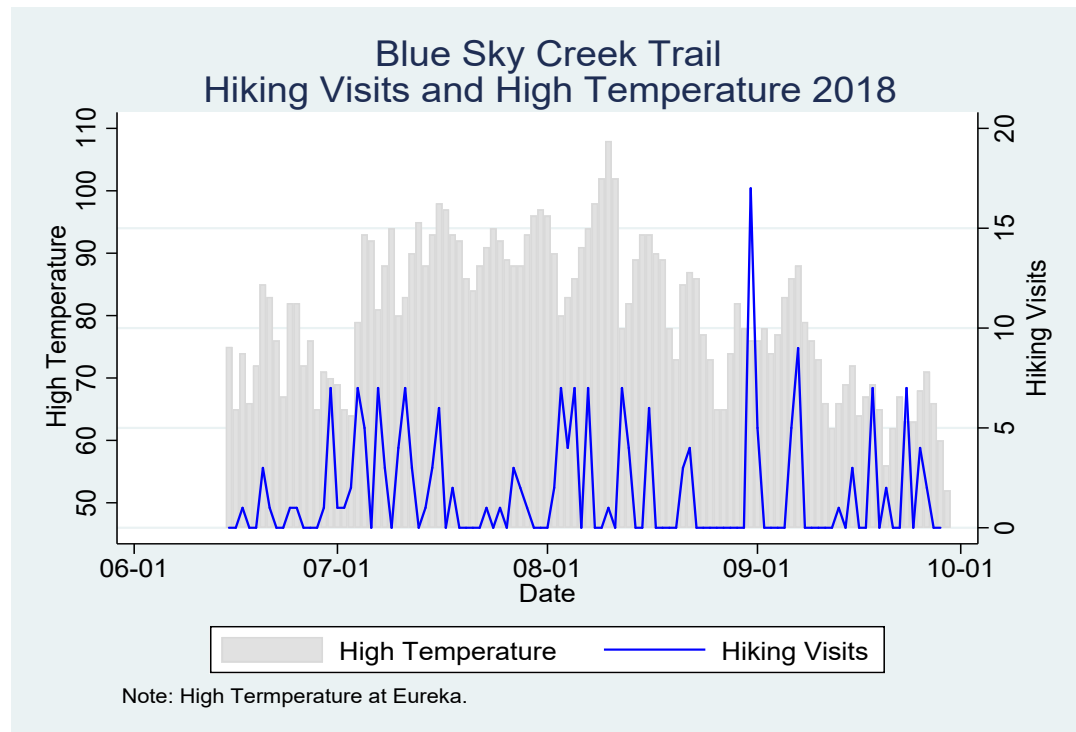


Figure 13. Blue Sky Creek and Precipitation

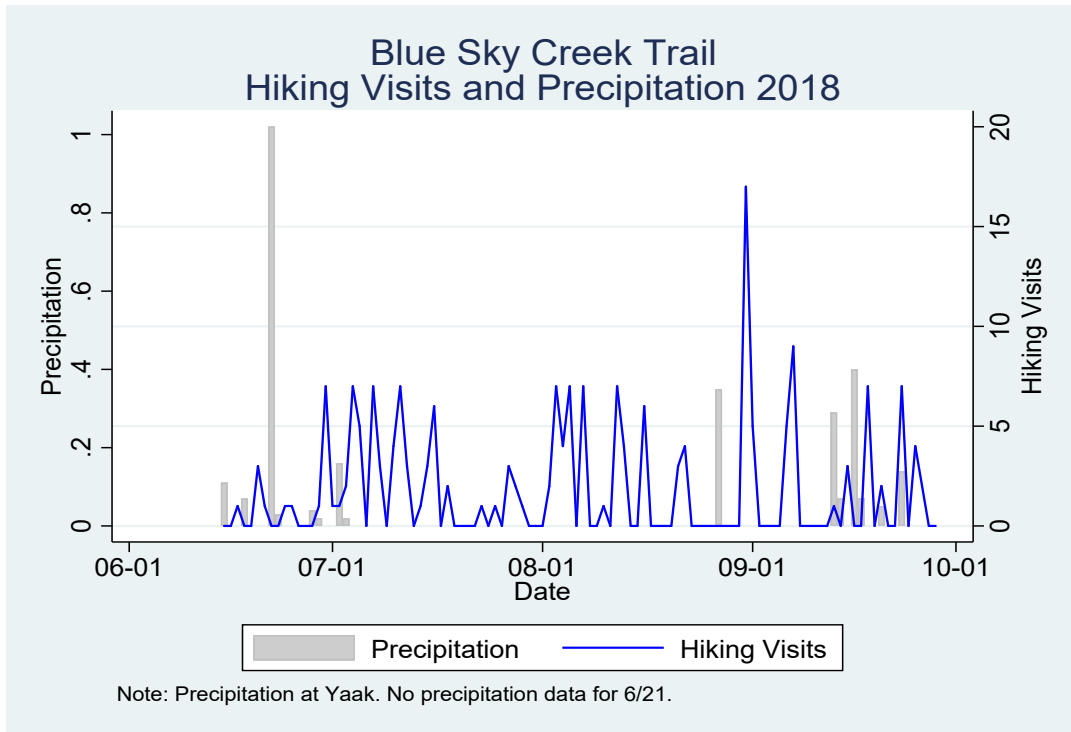
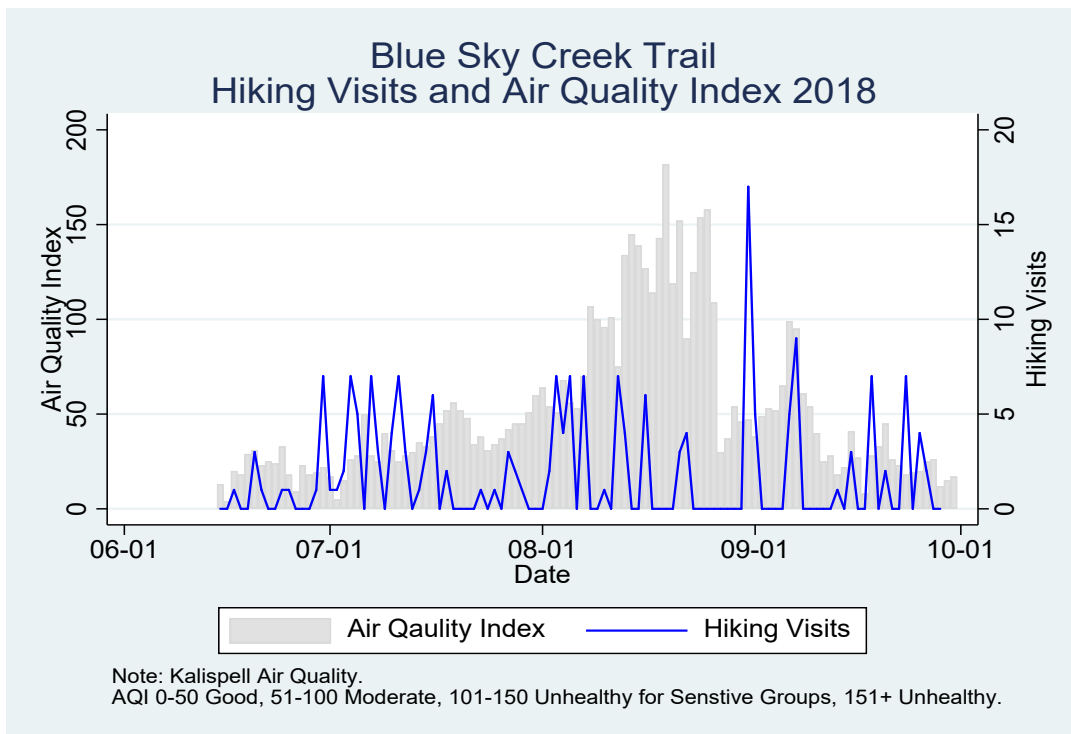


Figure 14. Blue Sky Creek and Air Quality



Bluebird Lake 2018

Figure 15 contains the weekly counts from the trail counter at the Bluebird Lake site. The week of July 23 to July 29 experienced the most use, with 192 hiking visits. A weekly average of 98.5 hiking visits were recorded at the Bluebird Lake site during the weeks monitored. Figure 16 includes the daily averages from the trail counter at the Bluebird Lake site. The highest use days were Saturday and Sunday, with an average of 31 and 27.5 hiking visits per day respectively. Figure 17 shows a breakdown of the highest use week of this trail: July 23 to July 29. Within this week, Saturday and Sunday demonstrated the most hiking visits with 46 and 64 respectively, suggesting a substantial spike on weekends, possibly from day use.

As mentioned above in the “Comparison Across Sites” section of the report, Bluebird Lake exhibited much higher use than the other trails as shown in Figure 18 which contains the daily counts from the trail counter at Bluebird Lake and the next busiest trail, Boulder Lake Trail. During the months that Bluebird Lake Trail was monitored, an estimated 1,161 hiking visits were recorded on the trail (using the monthly mean for missing). The day of highest use within the two months was Sunday, July 29th, with 64 hiking visits.

The data shows that Bluebird Lake is the most used trail within the summer hiking season out of all the trails monitored for this report. The trail’s proximity to Eureka might be a factor in relatively high use numbers and patterns. Bluebird Lake was the busiest trail while the trail with the next highest use was Boulder Lake, which had a total count of an estimated 137 hiking visits in July and August. Figure 18 shows Bluebird Lake counts compared to Boulder Lake.

Based on camera data, this trail was frequented by hikers with dogs, horses, and day hikers, which could account for the higher traffic in the month of July and the first half of the month of August. However, the calibration factor adjusts for the anomalies of use on the trail. Additionally, Bluebird Lake is near a campground that could account for increased hiking visits. The spikes in Figure 18 are suggestive of weekend day use.

Figure 19 shows counts as they correspond to the maximum temperature in Eureka. The pattern in this graph is not suggestive of a correlation between visitor use and high temperature. Figure 20 shows counts for the trail counter relative to precipitation levels in Yaak, which also does not reveal a correlation between precipitation and visitor use of the Bluebird Lake. Figure 21 shows the counts relative to the air quality in Kalispell. This data suggests that air quality could be associated with trail use. The large spike in air quality to an unhealthy level does appear to be associated with lower counts on the trail. Potentially hikers avoided this trail when air quality was unhealthy.

Figure 15. Bluebird Lake Weekly Counts

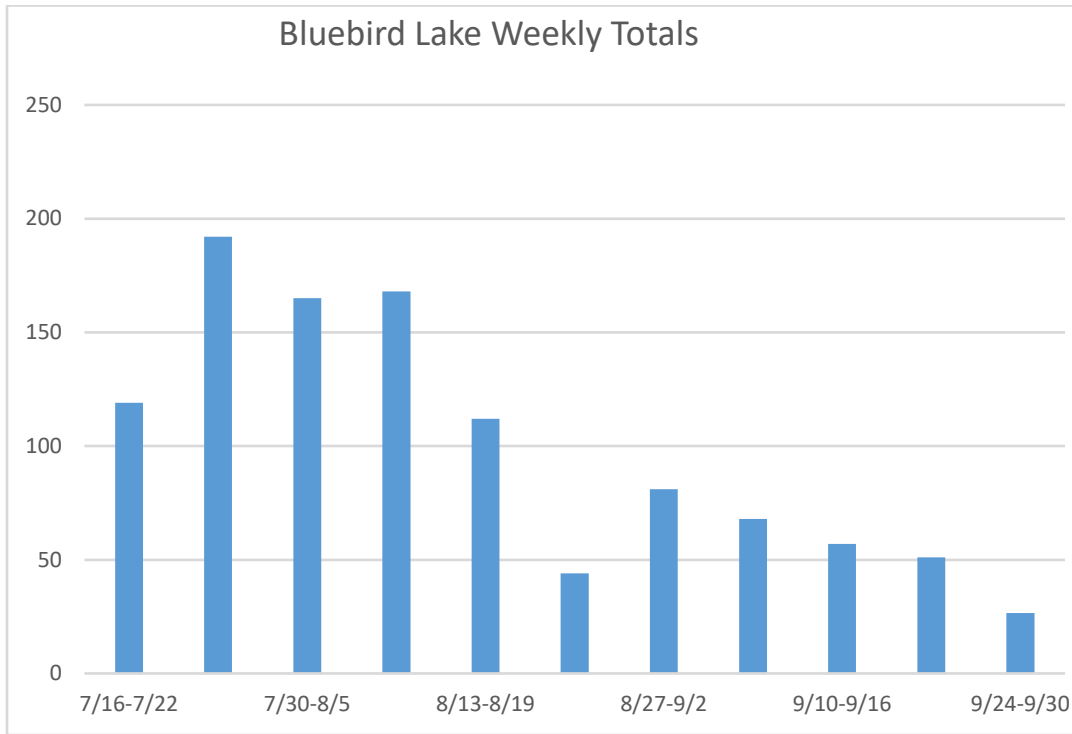


Figure 16. Bluebird Lake Daily Averages

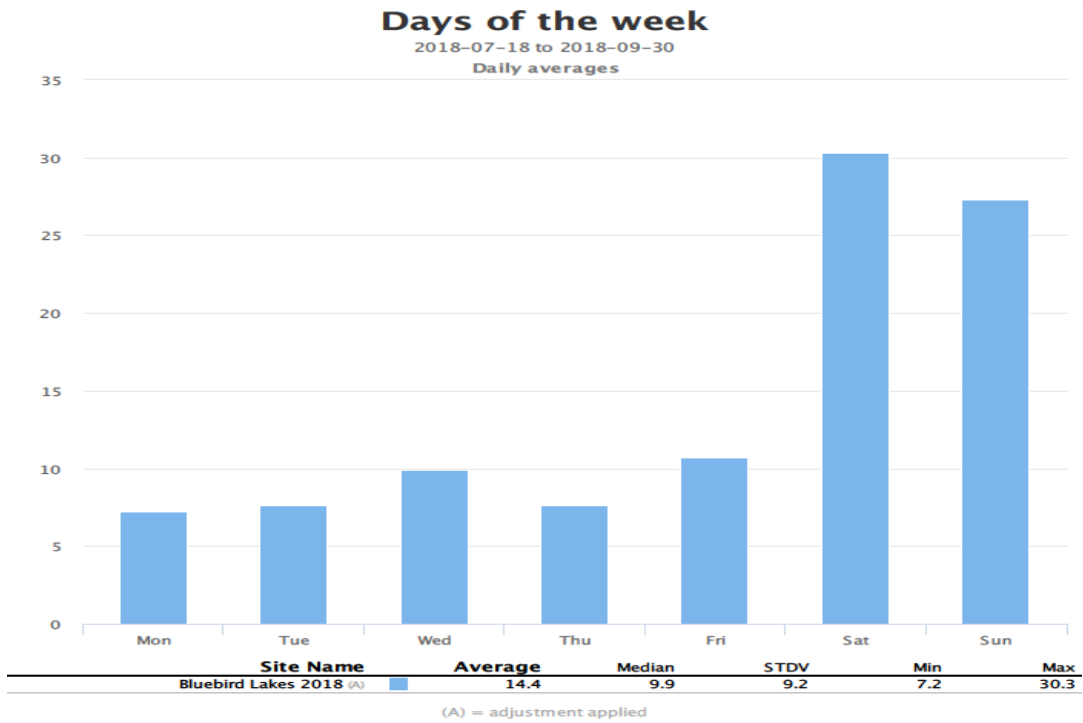


Figure 17. Bluebird Lake Highest Use Week

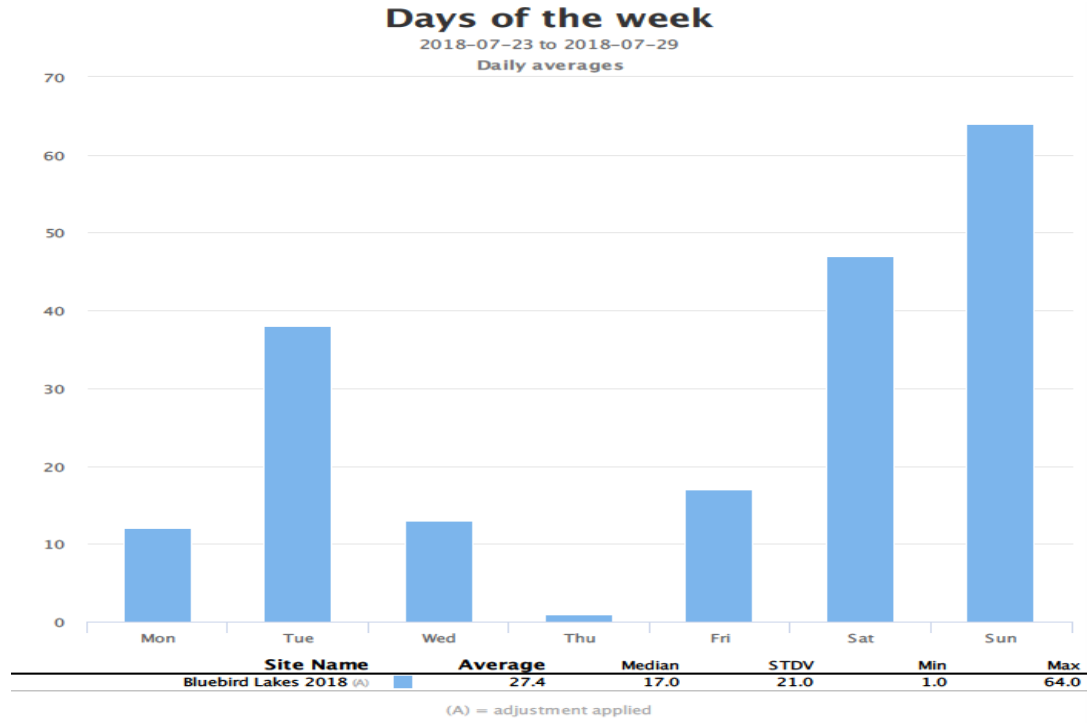


Figure 18. Bluebird Lake Daily Hiking Visits

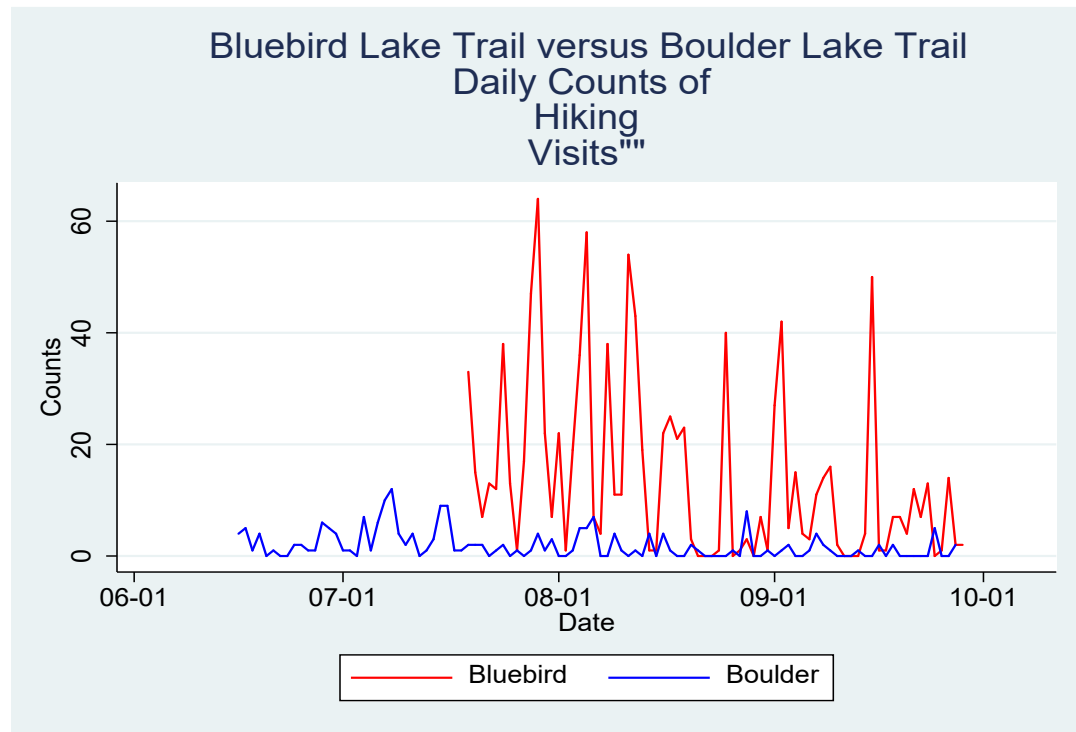


Figure 19. Bluebird Lake and Temperature

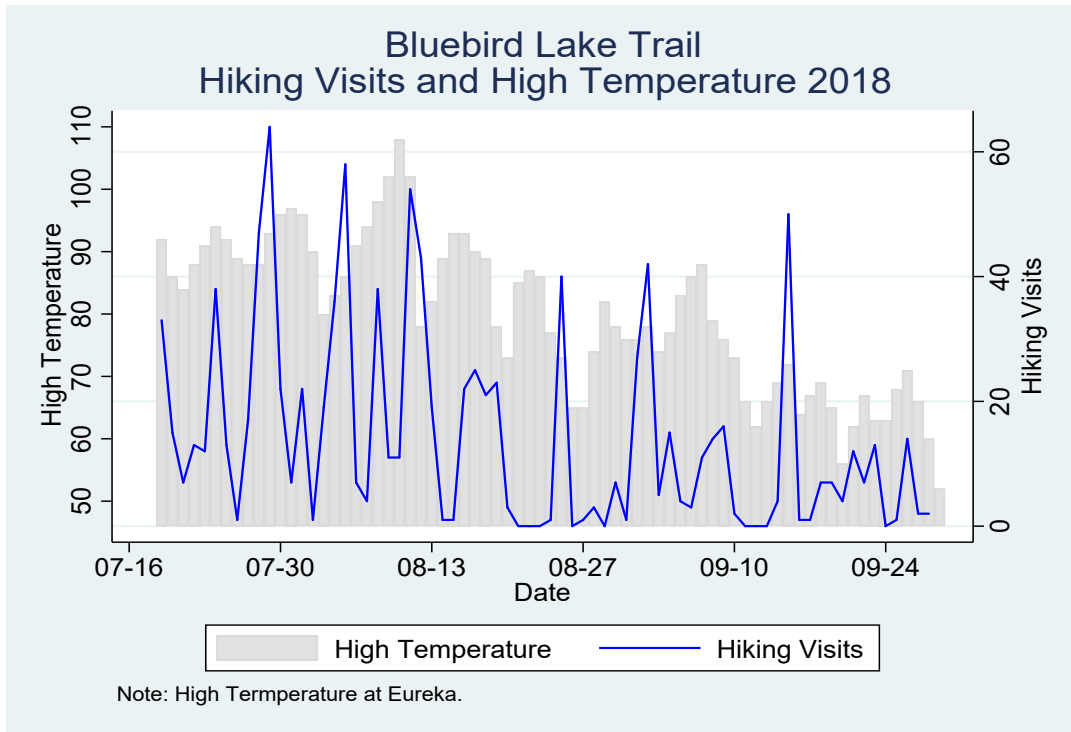


Figure 20. Bluebird Lake and Precipitation

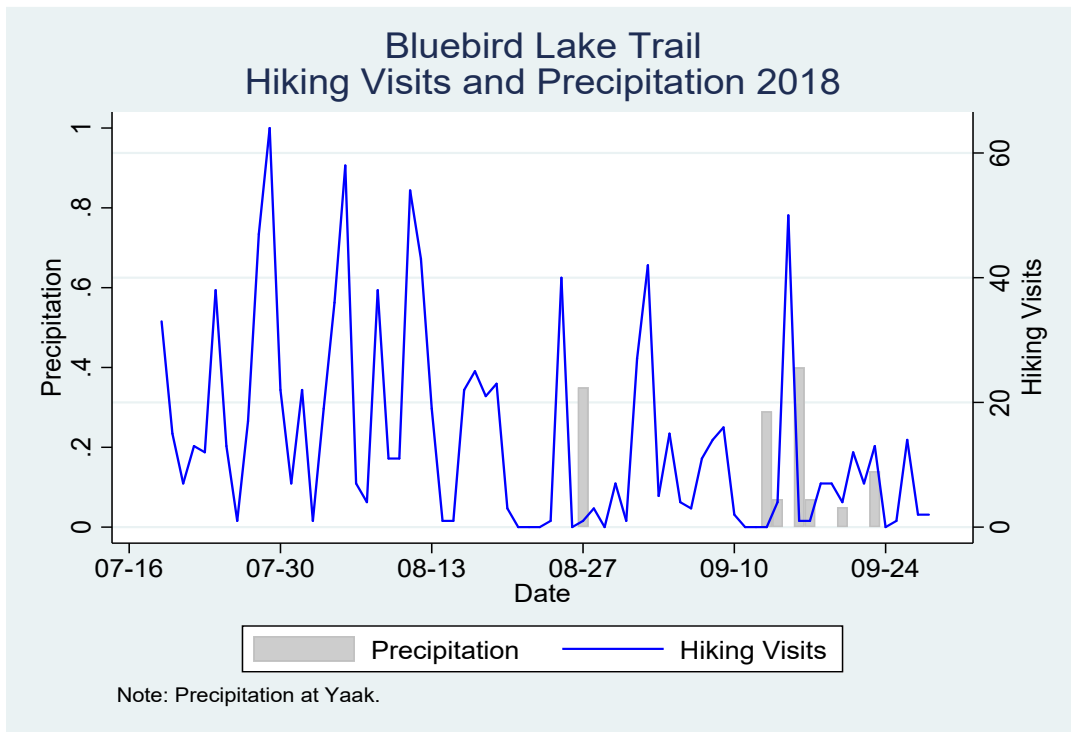
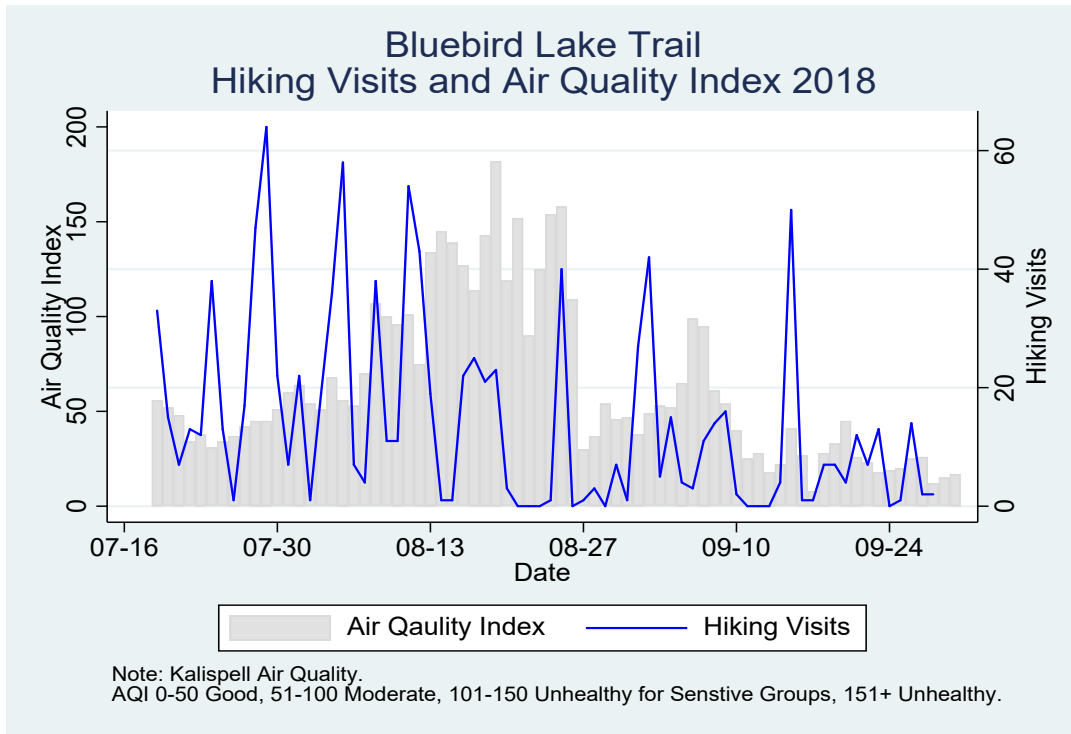


Figure 21. Bluebird Lake and Air Quality



Green Mountain 2018

The first week of data was excluded from the Green Mountain graphs due to data irregularity, so the data set in the graphs represents the monitoring season at Green Mountain from July 23 to September 28. Figure 22 contains the weekly counts from the trail counter on the trail at Green Mountain. The week of September 17 to September 23 experienced the most use, with 31 hiking visits. A weekly average of 22.2 hiking visits were recorded at the Green Mountain site during the weeks monitored. Figure 23 includes the daily averages from the trail counter at the Green Mountain site. The highest use days were Saturday and Sunday with an average of 7 and 4 visitors per day respectively. Figure 24 shows a breakdown of the highest use week of this trail: September 17 to September 23. During this time, September 17, 19, and 22 received the majority of counts, with 9, 5, and 11 counts respectively. September 17 and September 22 are Monday and Saturday, suggesting a substantial increase in weekends, potentially from day use. Based on camera data, this trail was frequented by bikers and day hikers, which could account for the higher weekend traffic. The calibration factor adjusts for these different uses when comparing camera and trail counter data.

Figure 25 shows counts relative to the maximum temperature in Eureka. The pattern in this graph suggests that more hikers were on the trail when it was cooler than when the temperatures were highest during the season. Figure 26 shows counts relative to precipitation levels in Yaak, which does not reveal a correlation between precipitation and visitor use of Green Mountain. Figure 27 shows the counts as they correspond to the air quality in Kalispell. This data suggests that air quality could be associated with low use on this trail. The large spike in air quality to an unhealthy level does overlap with a time when lower counts were observed on the trail. Potentially hikers avoided this trail when air quality was unhealthy.

During the months that Green Mountain was monitored, an estimated 215 hiking visits were recorded on the trail. We recommend continuing to monitor this trail, perhaps installing the counter earlier in the season if possible, to investigate the mid-July peak that the data indicates.

Figure 22. Green Mountain Weekly Counts

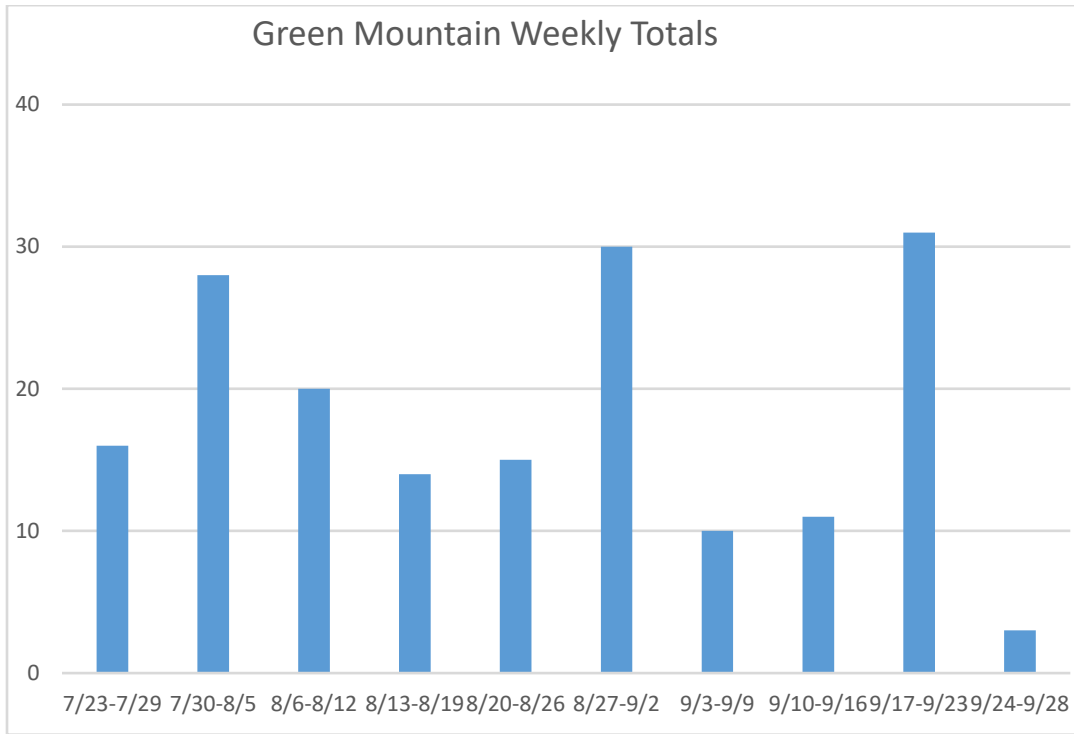


Figure 23. Green Mountain Daily Averages

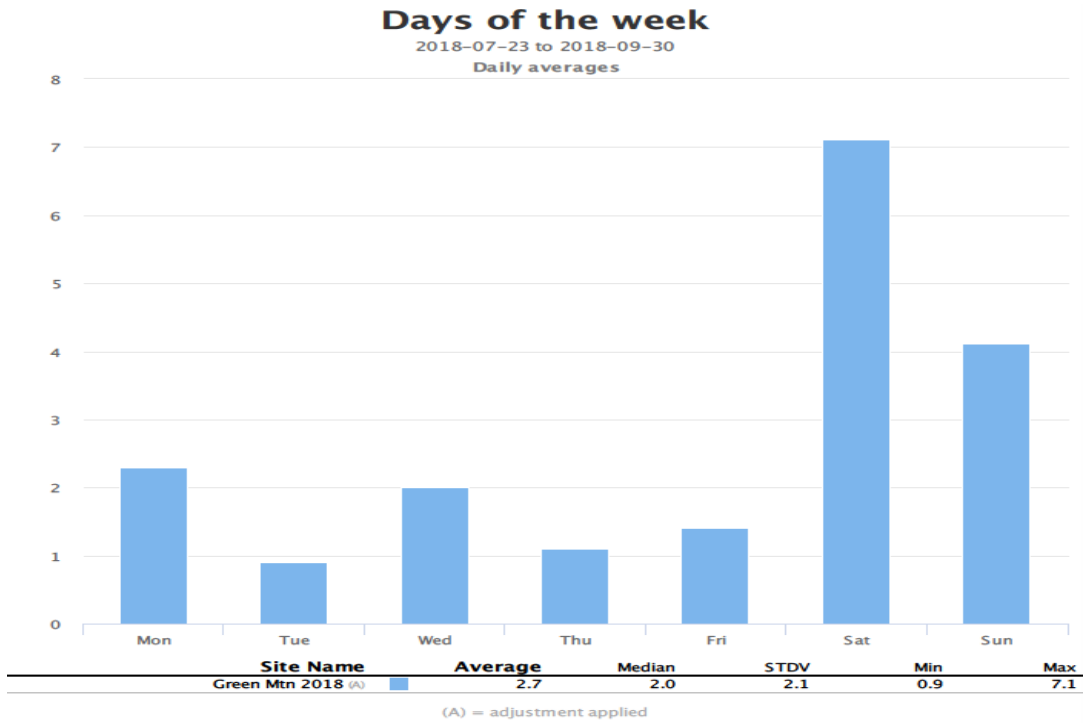


Figure 24. Green Mountain Highest Use Week

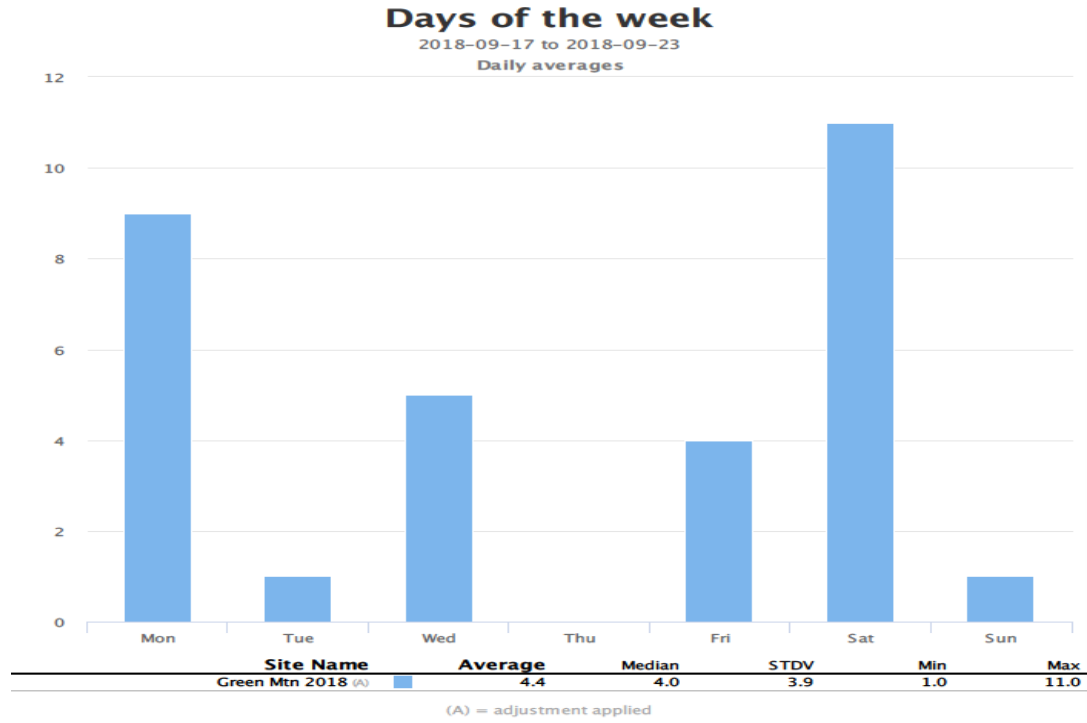


Figure 25. Green Mountain and Temperature

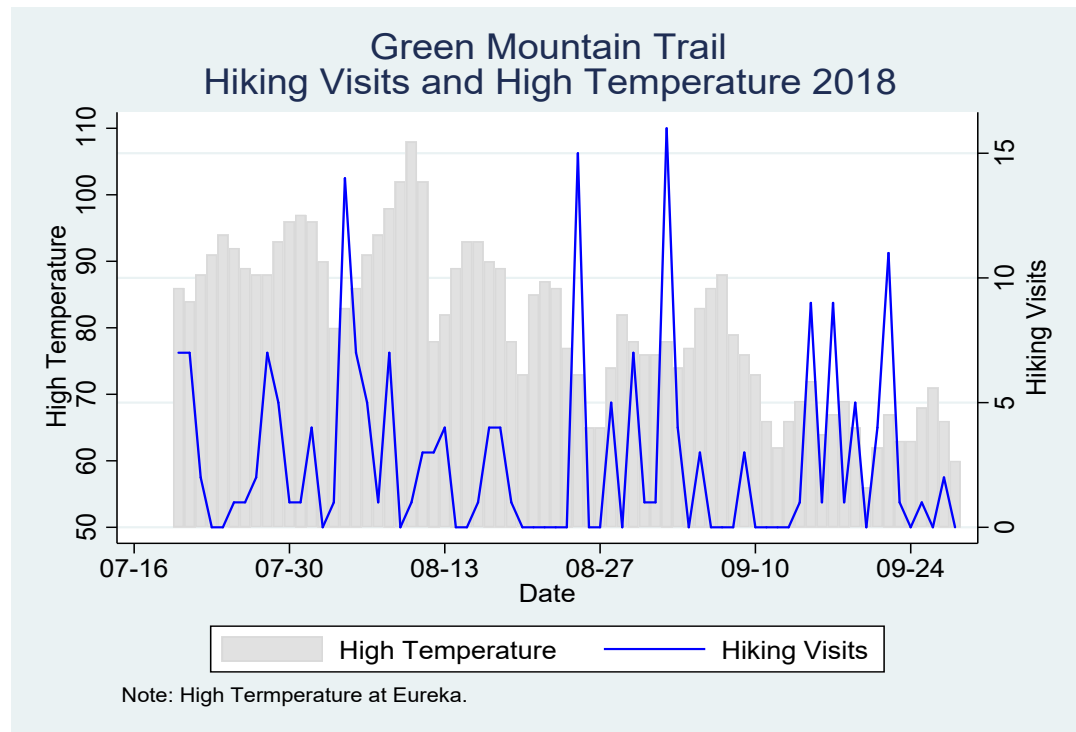


Figure 26. Green Mountain and Precipitation

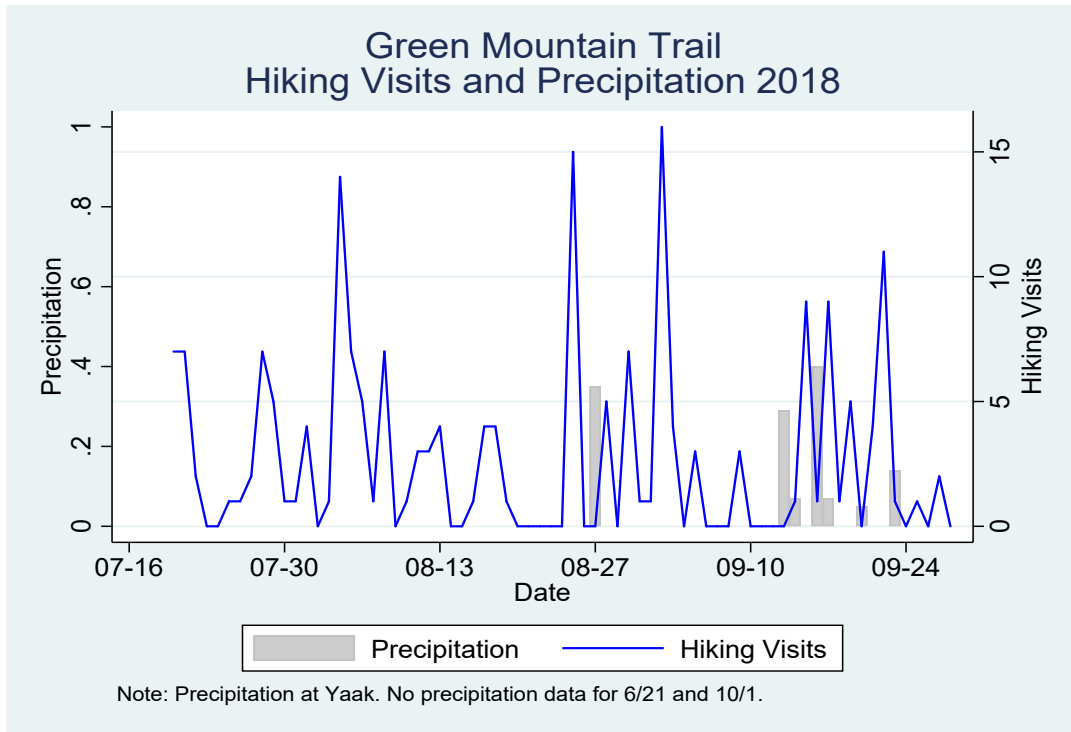
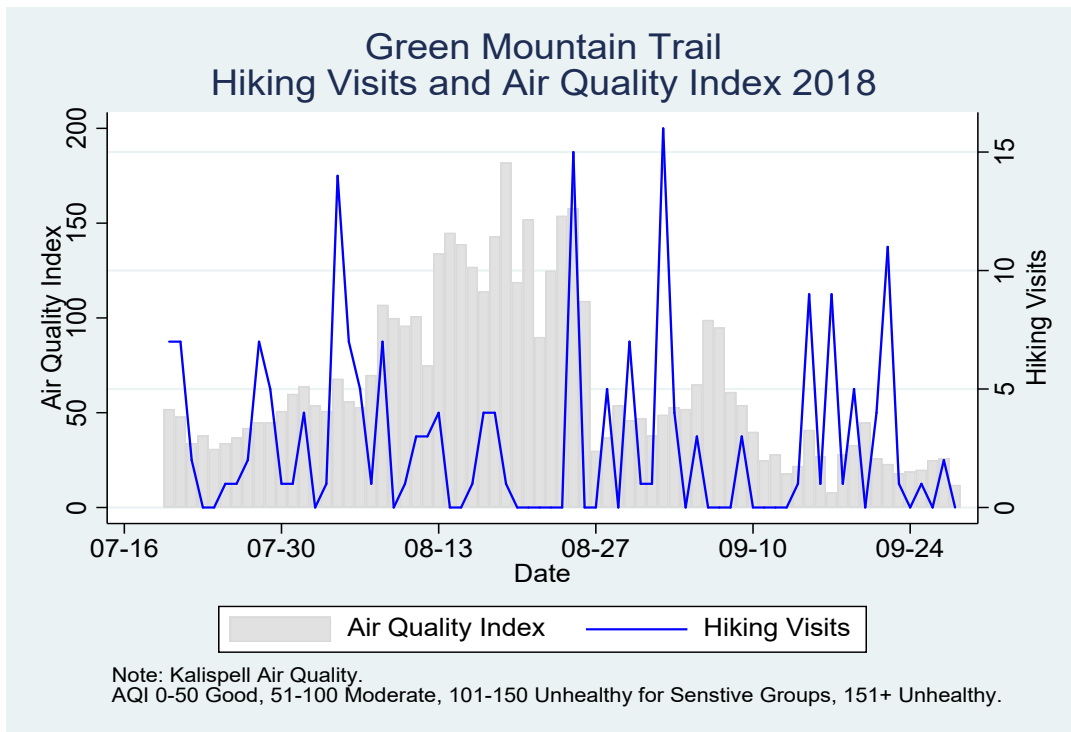


Figure 27. Green Mountain and Air Quality



Boulder Lake 2018

Figure 28 contains the weekly counts from the trail counter at the Boulder Lake site. The week of July 2 to July 8 experienced the most use, with 37 hiking visits. A weekly average of 14 hiking visits were recorded at the Boulder Lake site during the weeks monitored. Figure 29 includes the daily averages from the trail counter at the Blue Sky Creek site. The highest use days were Sunday, Monday, and Saturday, with an average of and 2.9, 2.3, and 2.05 visitors per day respectively. Figure 30 shows a breakdown of the highest use week of this trail July 2 to July 8. Within this week, Wednesday, Thursday, and Saturday demonstrated the most counts with 7, 10, and 12 counts respectively. Wednesday and Thursday are July 4 and 5, suggesting a substantial increase in use due to the Fourth of July holiday. Based on camera data this trail was frequented by fishermen, which could account for increased weekend travel.

Figure 31 shows counts relative to the maximum temperature in Yaak. The pattern in this graph suggests that more hikers were on the trail when it was cooler than when the temperatures were highest during the season. Figure 32 shows counts relative to precipitation levels in Yaak. Although there is not enough precipitation data to interpret in this monitoring period, this figure indicates that it could be possible that there were fewer hikers using the trail during the times of the season with the highest amount of precipitation. Figure 33 shows the counts as they correspond to the air quality in Eureka. This data suggests that air quality could be associated with low trail use. The large spike in air quality to an unhealthy level does match up with a period of lower counts. Potentially hikers avoided this trail when air quality was unhealthy.

During the months that the Boulder Lake site was monitored, an estimated 196 hiking visits on the trail. We recommend continuing to monitor this trail because it seemed important for both day hikers and thru-hiker use.

Figure 28. Boulder Lake Weekly Counts

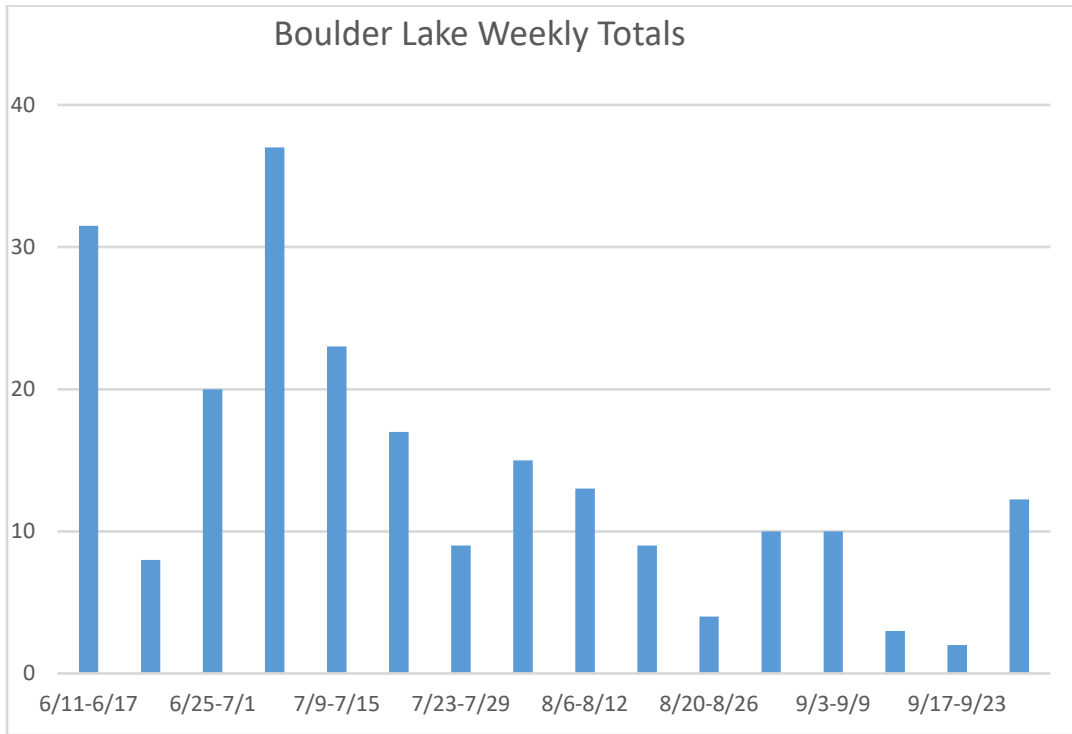


Figure 29. Boulder Lake Daily Averages

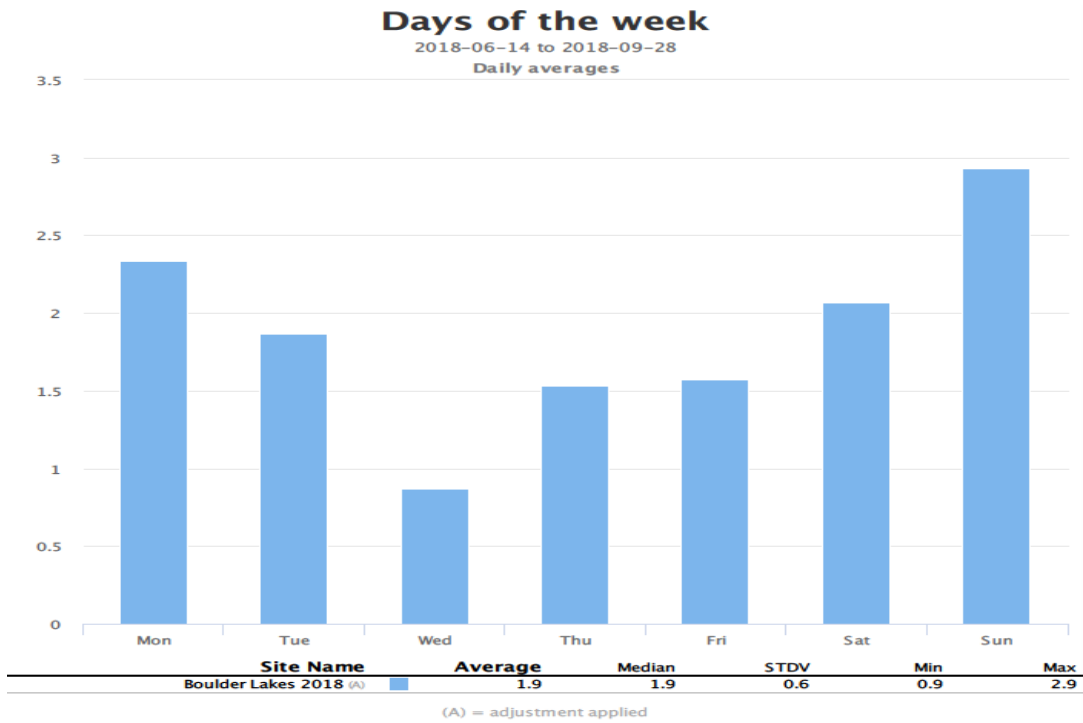


Figure 30. Boulder Lake Highest Use Week

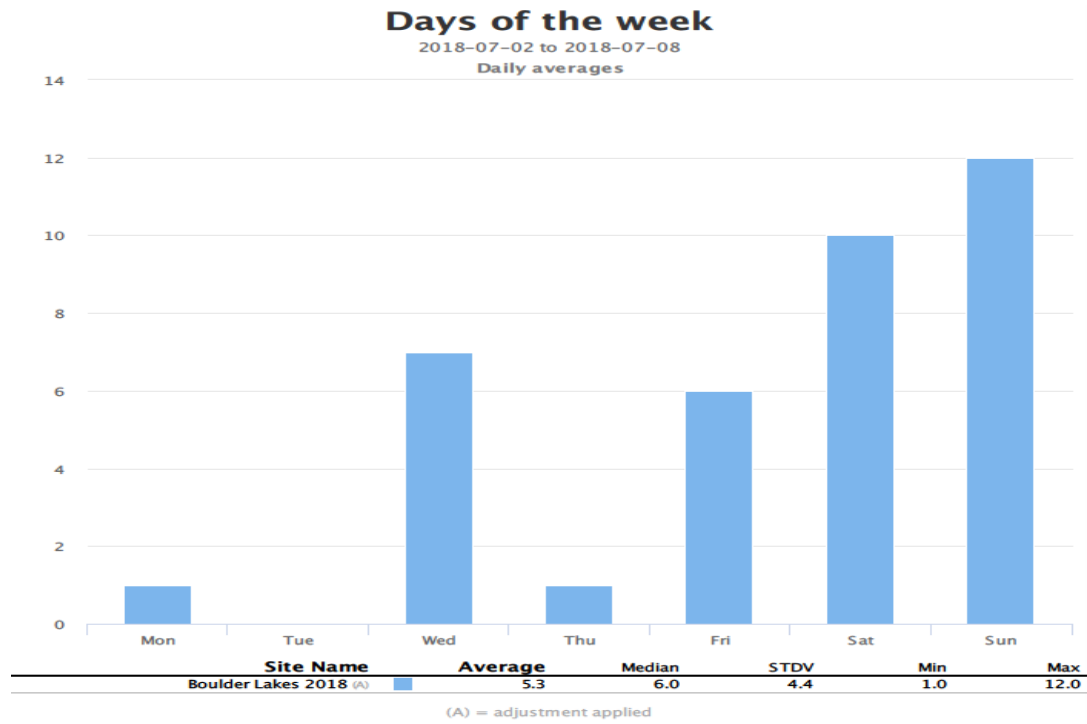


Figure 31. Boulder Lake and Temperature

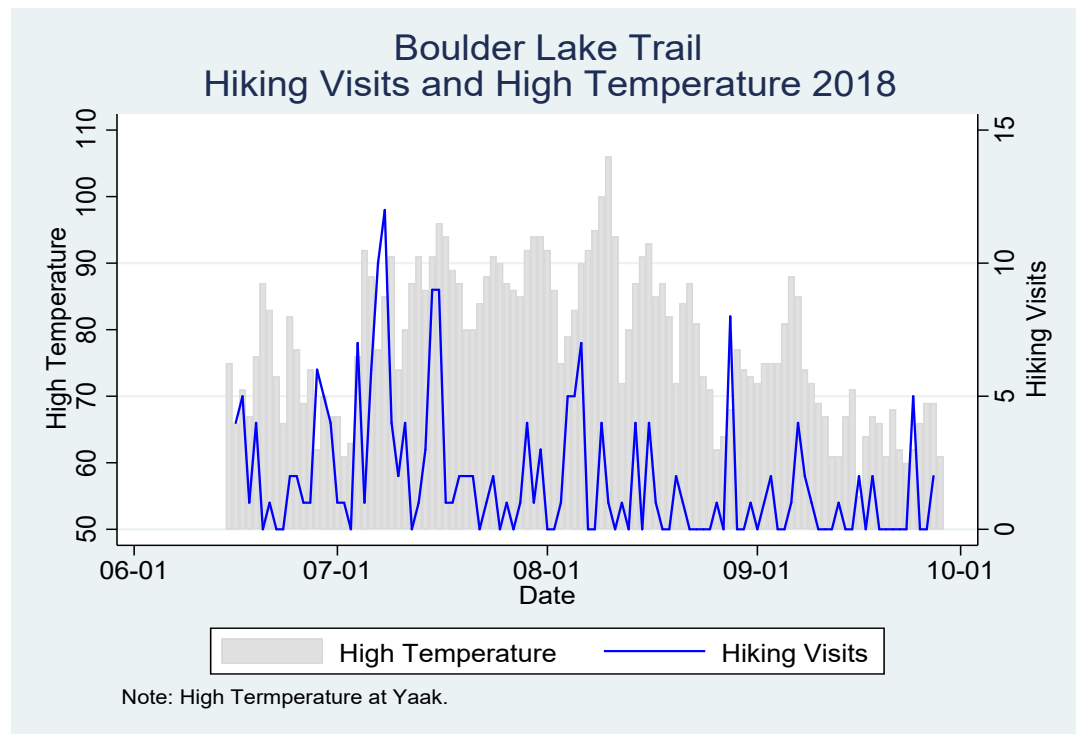


Figure 32. Boulder Lake and Precipitation

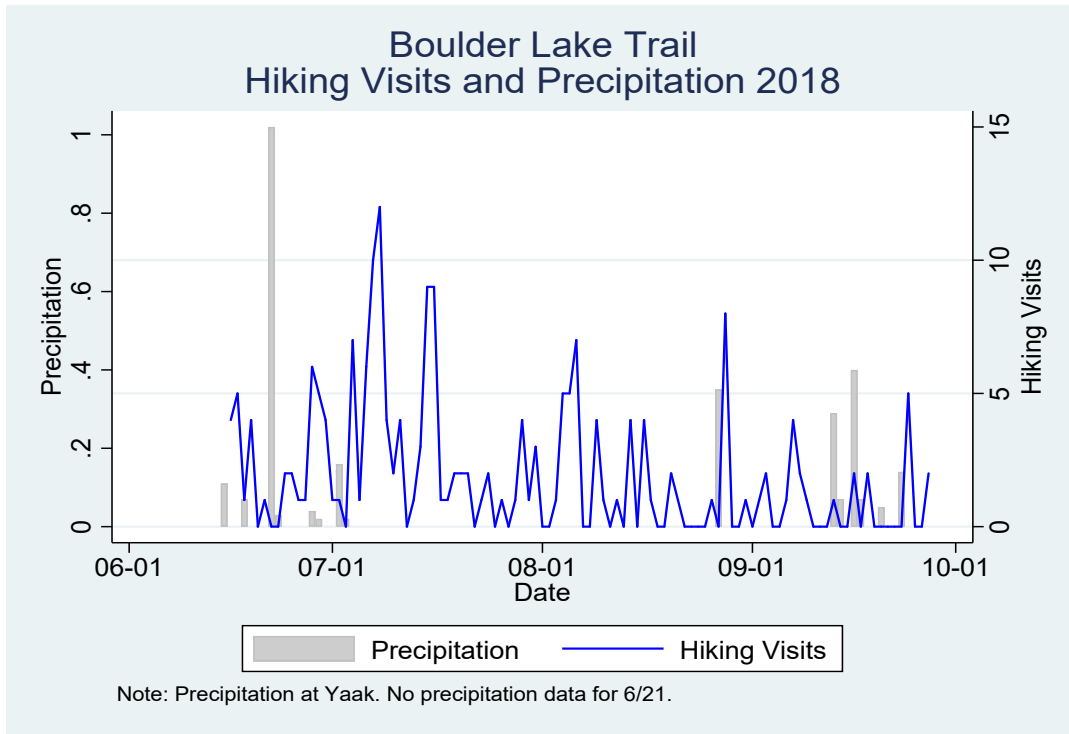
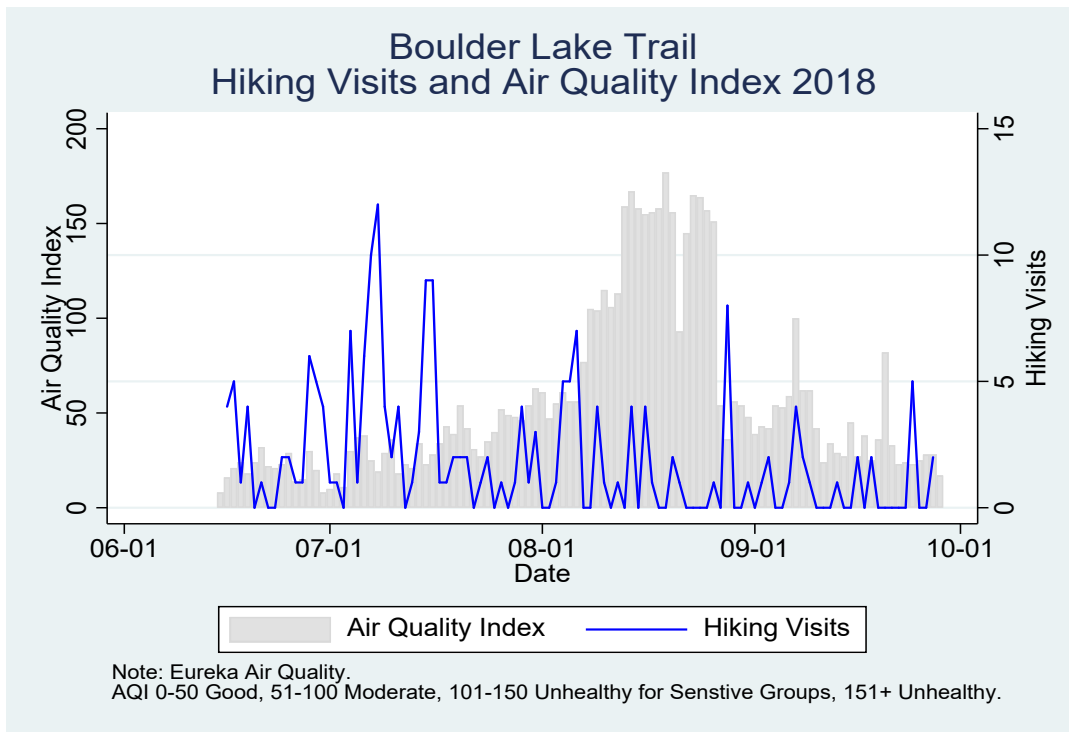


Figure 33. Boulder Lake and Air Quality



Gypsy Meadows 2018

Figure 34 contains the weekly counts from the trail counter at the Gypsy Meadows site. The week of July 16 to July 23 experienced the most use, with 7 hiking visits. A weekly average of 1.4 hiking visits at the Gypsy Meadows site during the weeks monitored. Figure 35 includes the daily averages from the trail counter at Gypsy Meadows. The highest use days were Monday and Friday, with an average of 0.3 and 0.23 visitors per day respectively. There was insufficient data at Gypsy Meadows to generate a highest week use graph.

The data may have been deleted as the research team was transferring information from counters to the team laptop, an incident that accounts for the missing data from July 23 to August 21. Although there is a missing set of data, the weekly count graph still illuminates some interesting trends. There appears to be a steady increase in counts beginning on June 18 which continues until July 17, when the counter data was lost. The period of August 20 until the counter was collected on September 24 indicates no counts, suggesting that Gypsy Meadows was used primarily in the early summer months and not at all in the later summer and early fall months. It is also possible that the zero counts were due to an error in data transfer or a counter malfunction.

Graphs comparing use to air quality, temperature, and precipitation were not included for Gypsy Meadows analysis due to compromised data. There is no estimated hiking visits for Gypsy Meadows because of the missing data. Although the counts are relatively low in comparison with other monitored sites, it may be useful to continue monitoring this site as the data set from this past season is not full due to the loss of data.

Figure 34. Gypsy Meadows Weekly Counts

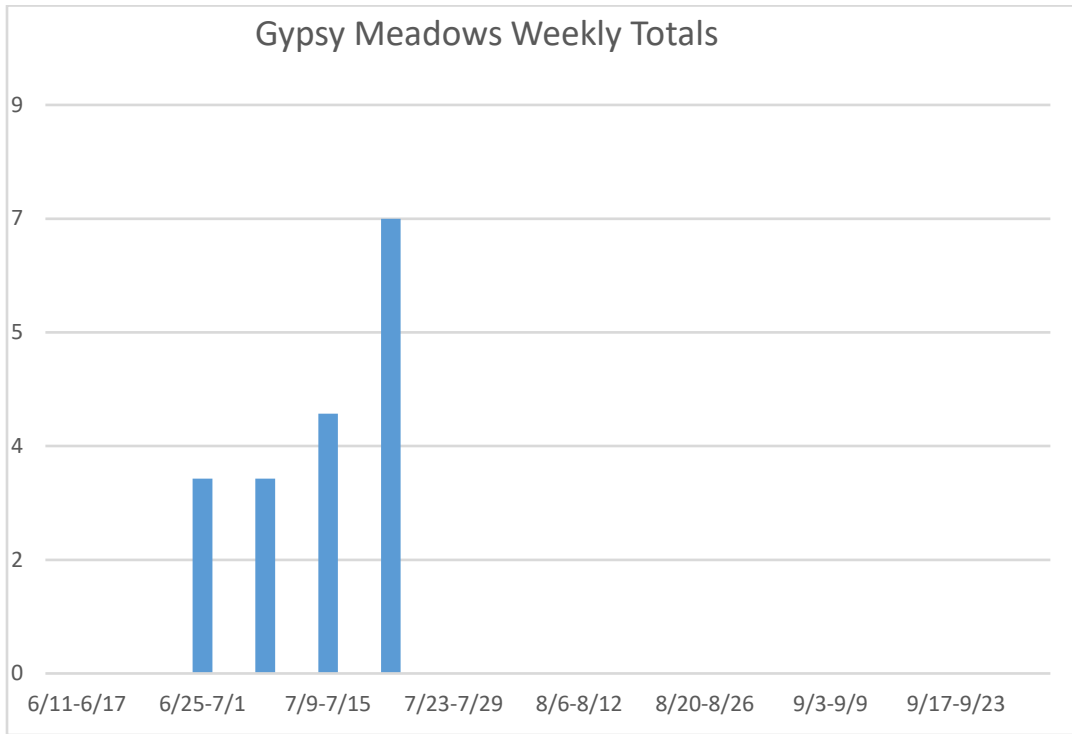
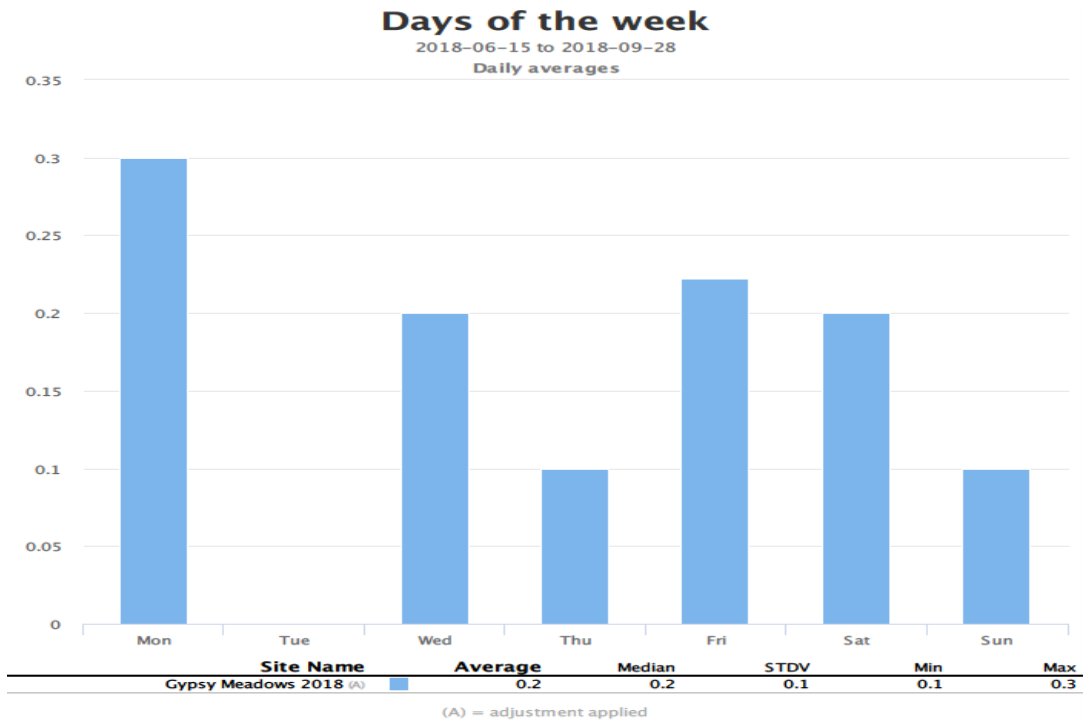


Figure 35. Gypsy Meadows Daily Averages



Vinal Creek 2018

The Vinal Creek monitoring site is not on the PNNST. The monitoring site is located on Vinal Creek Trail #9 and to the west of where the PNNST is co-located on this trail. Data presented for the Vinal Creek site is not PNNST use data.

Vinal Creek Trail #9 is part of the Vinal Creek/Mt. Henry National Recreation Trail. A portion of PNNST hikers may utilize the monitored section of the Vinal Creek #9 trail en route to stock up on supplies in Yaak, Montana, or to circumvent a section of the PNNST on Trail #41 between Fish Lakes and the Yaak River that climbs in elevation. Thus, the monitoring site may still provide useful information on some trail use patterns that are relevant to the PNNST. Additionally, Vinal Lake Trail #9 trail use from the trailhead to Fish Lakes is important to monitor for the Kootenai National Forest's grizzly bear management.

Figure 36 contains the weekly counts from the trail counter at the Vinal Creek site. The week of July 16 to July 22 experienced the most use, with 16 hiking visits. A weekly average of 6.6 hiking visits were recorded at the Vinal Creek site during the weeks monitored. Figure 37 includes the daily averages from the trail counter at the Vinal Creek site. The highest use days were Saturday, Sunday, and Monday, with an average of 1.8, 1.5, and 1 visitors per day respectively. Figure 38 shows a breakdown of the highest use week of this trail, July 16 to July 23. Within this week, Saturday and Sunday demonstrated the most counts with 8 and 7 counts respectively, suggesting an increase in weekend use from day hikers.

Based on camera data, this trail was frequented by day hikers, which could account for the higher weekend traffic. The decrease in counts from July 9, the week of highest use, is sustained throughout the week of August 6. This decrease is more gradual than the dramatic peak that indicates an especially popular week (such as July 2-8), which could indicate that the month of July 9 to August 6 experienced more regular use by day hikers.

Figure 39 shows counts relative to the maximum temperature in Yaak. The pattern in this graph is not suggestive of a correlation between visitor use and high temperature. Figure 40 shows counts relative to precipitation levels in Yaak. Although there is not enough precipitation data to interpret in this monitoring period, this figure indicates that it could be possible that there were fewer hikers using the trail during the times of the season with the highest amount of precipitation. Figure 41 shows the counts as they correspond to the air quality in Eureka. This data suggests that air quality could be associated with lower counts on this trail. The large spike in air quality to an unhealthy level is associated with a period of lower counts. Potentially hikers avoided this trail when air quality was unhealthy.

During the months that the Vinal Creek site was monitored, an estimated 93 hiking visits were recorded on the trail. We recommend continuing to monitor this trail as it seems to be mostly used by thru-hikers.

Figure 36. Vinal Creek⁵ Weekly Counts

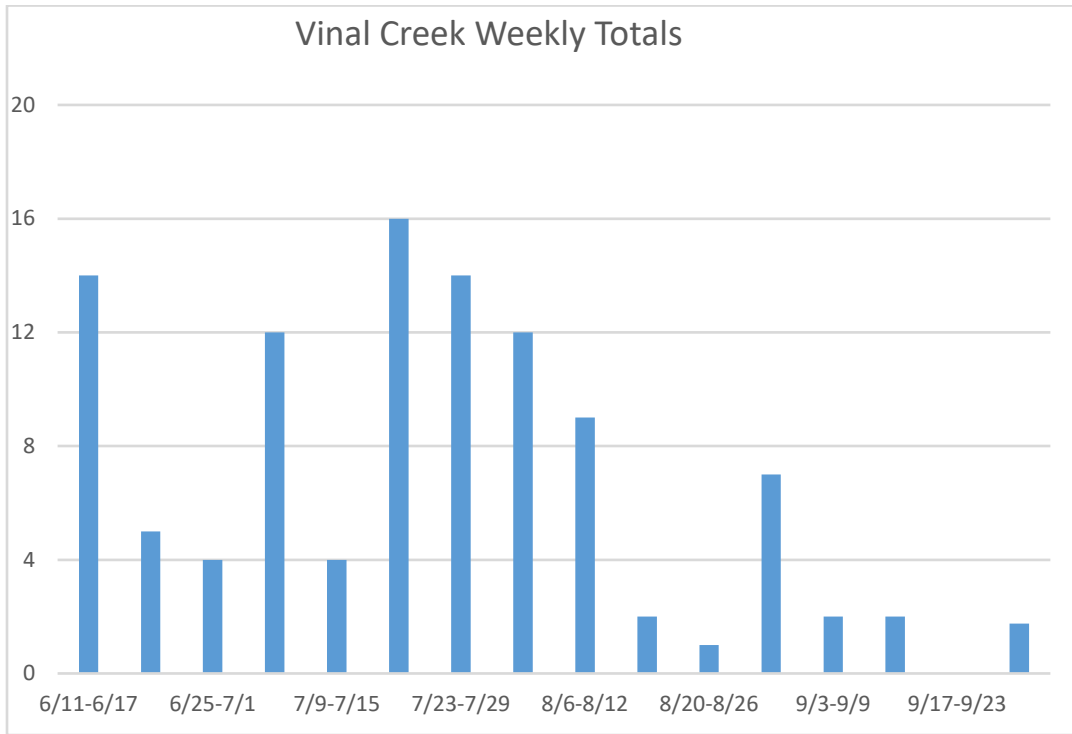
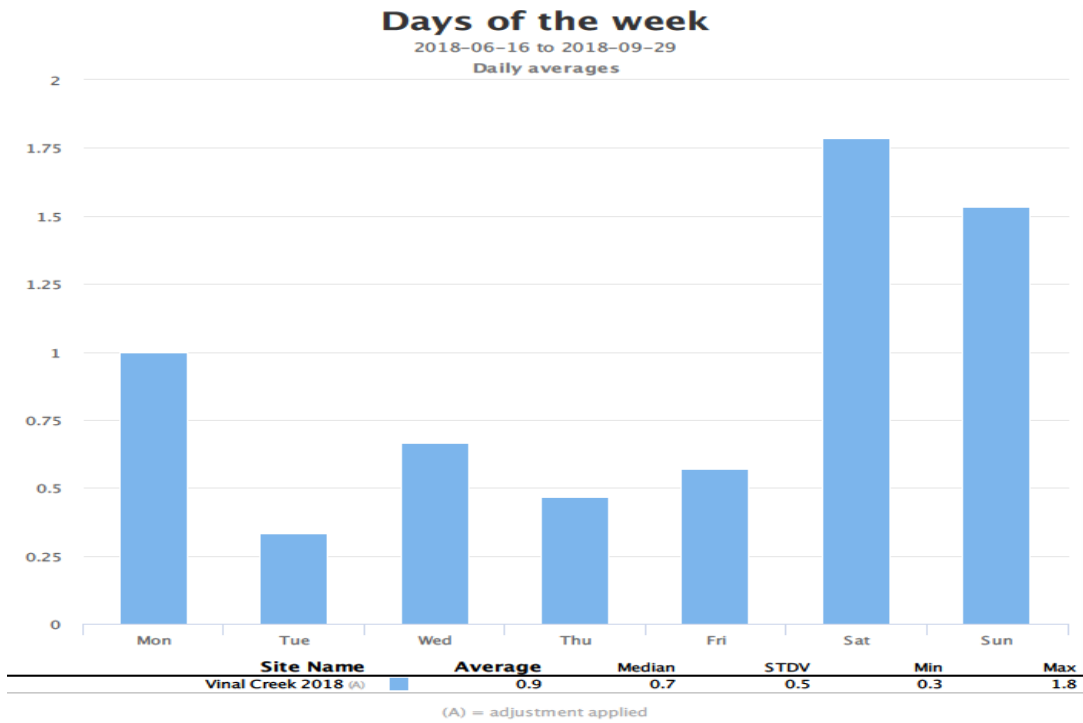


Figure 37. Vinal Creek Daily Averages



⁵ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.

Figure 38. Vinal Creek⁶ Highest Use Week

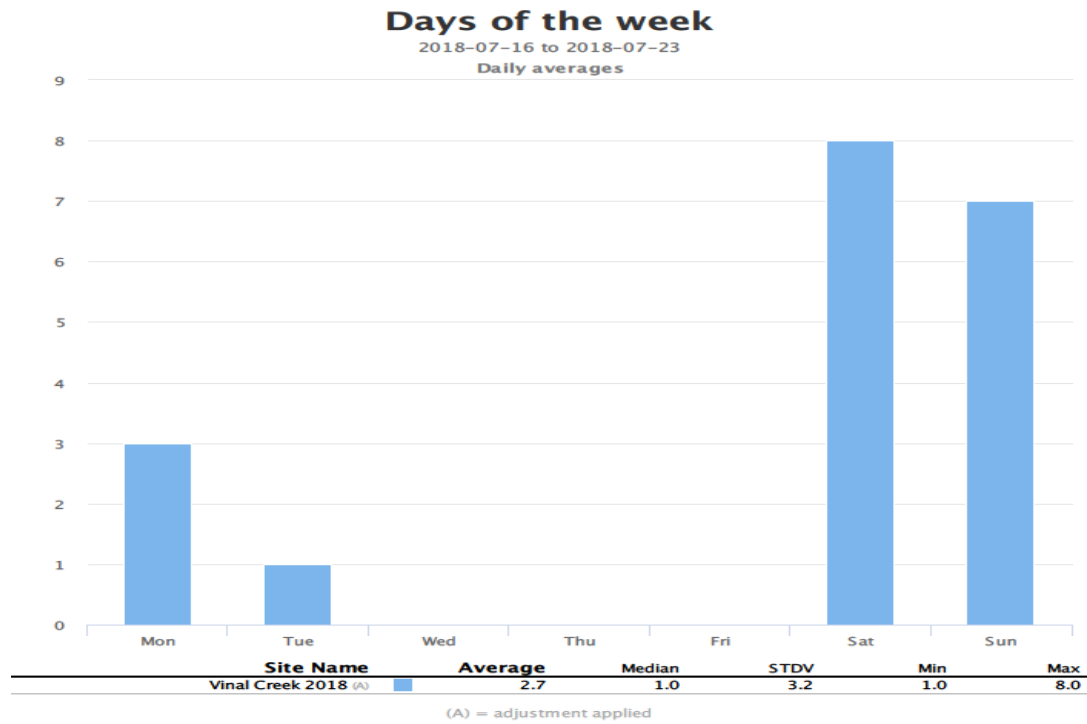
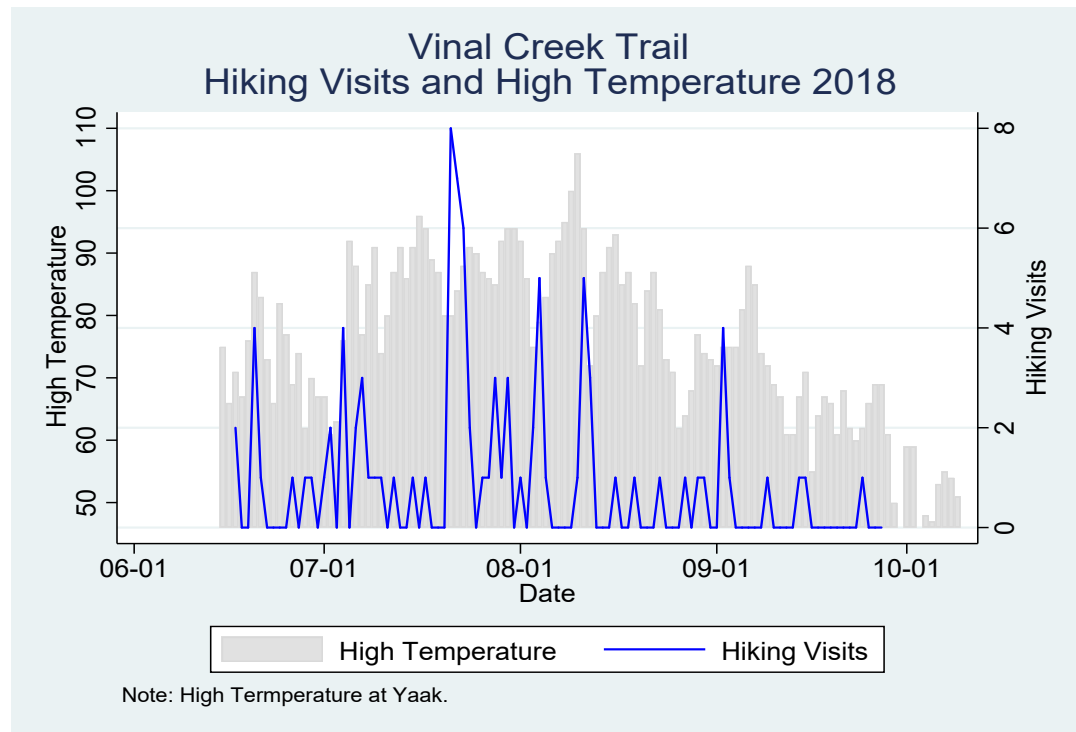


Figure 39. Vinal Creek and Temperature



⁶ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.

Figure 40. Vinal Creek⁷ and Precipitation

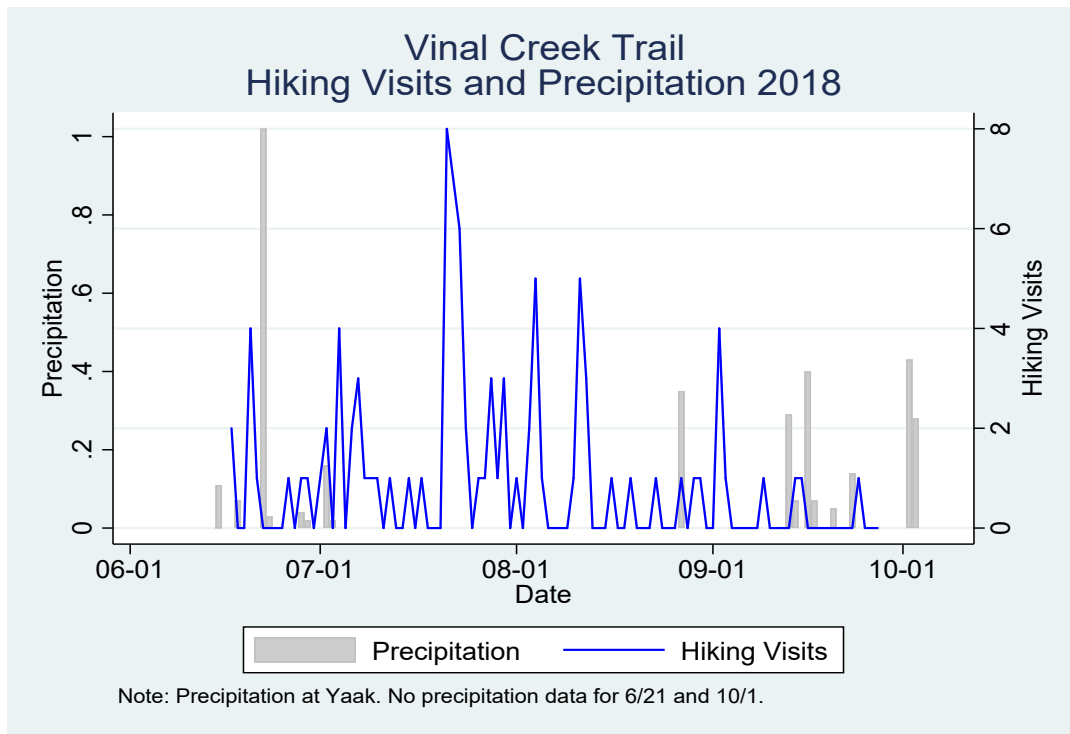
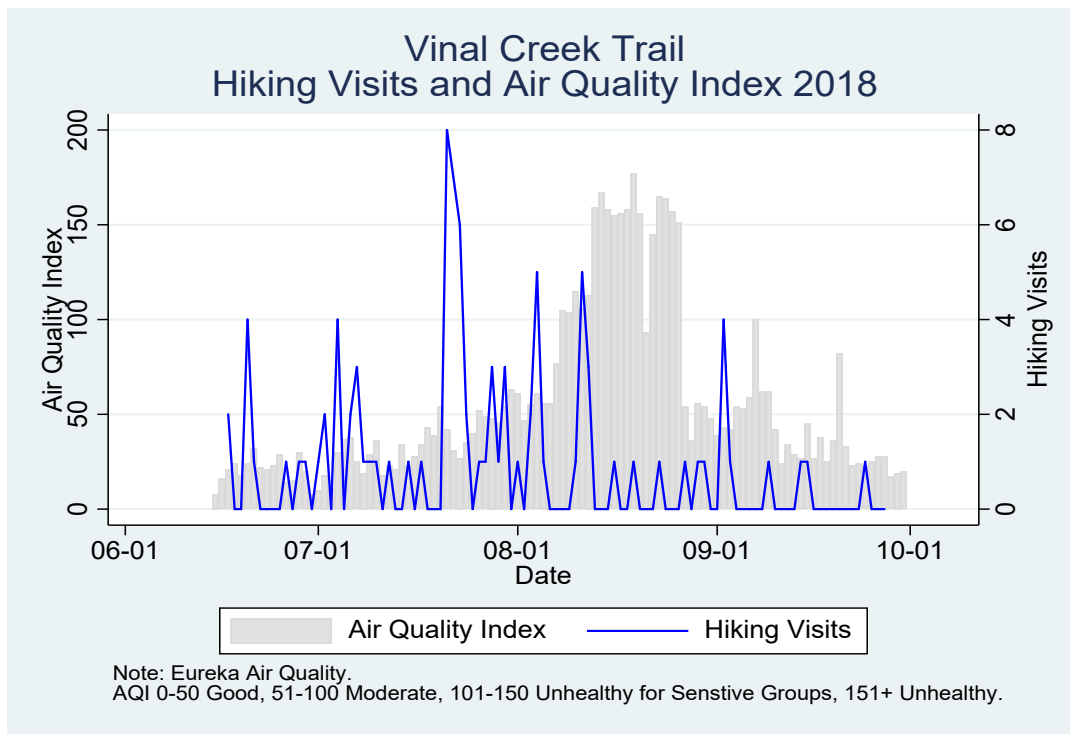


Figure 41. Vinal Creek and Air Quality



⁷ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.

Midge Creek 2018

Like the counter at the Garver Mountain site, the counter was not placed at Midge Creek until July 2 due to late spring snow. The counter was removed on August 1 also due to road closures from the Davis Fire. The roads remained closed until September 14, so the field team did not return to set the counters back up for the rest of the data collection season.

A weekly average of 7 hiking visits were recorded at the Midge Creek site during the weeks monitored. Figure 42 includes the daily averages from the trail counter at the Midge Creek site. The highest use days were Monday and Saturday, with an average of 2.6 and 1.5 visitors per day respectively. Figure 43 shows a breakdown of the highest use week of this trail: July 9 to July 15. Within this week, Monday and Saturday demonstrated the most counts with 4 and 5 counts respectively, suggesting an increase in weekend use from day hikers.

The camera data revealed that this trail was frequented by day hikers, which could account for the higher weekend traffic. Additionally, based on camera data and the testimonies from the research team, this trail was frequented by wildlife, especially bears.

Figure 44 shows counts relative to the maximum temperature in Yaak. The pattern in this graph is not suggestive of a correlation between visitor use and high temperature. Figure 45 shows counts relative to precipitation levels in Yaak, which also does not reveal a correlation between precipitation and visitor use at the Midge Creek site. Figure 46 shows the counts for this trail counter relative to the air quality in Eureka. This data suggests that air quality does not have a strong association with whether or not users are taking this trail.

During the months that the Midge Creek site was monitored, an estimated 35 hiking visits were recorded on the trail. We recommend continuing to monitor this trail because the data collection period from this season's work was stymied by the mid-summer Davis Fire, potentially limiting our scope on post-fire late season results when the trail re-opened in mid-September.

Figure 42. Midge Creek Daily Averages

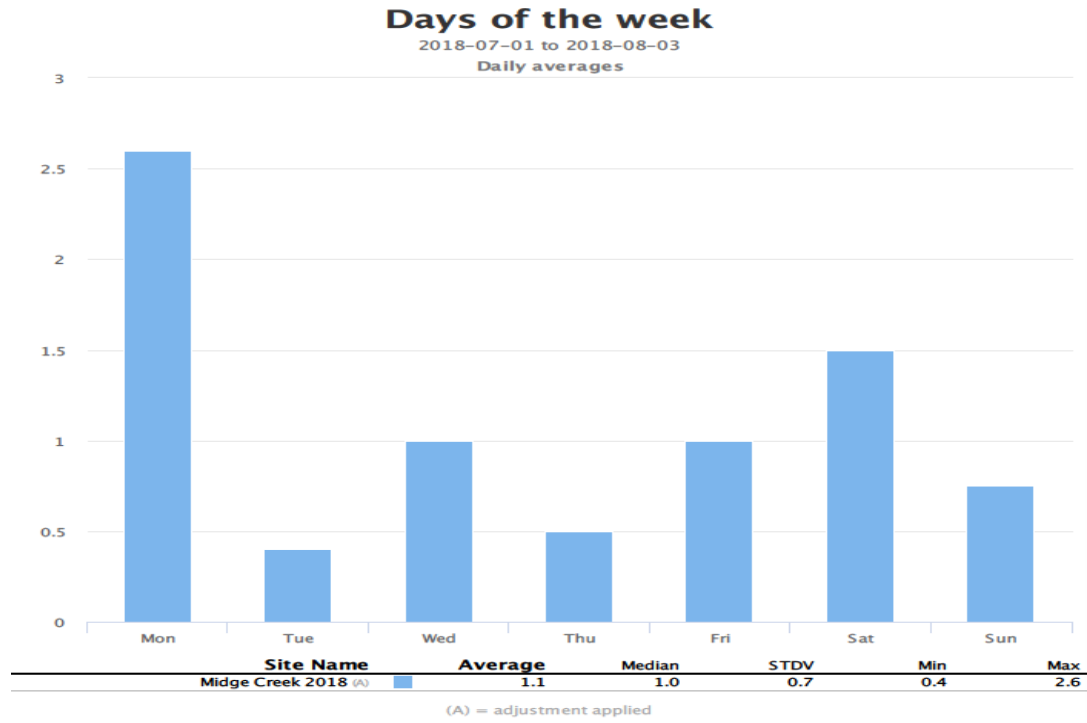


Figure 43. Midge Creek Highest Use Week

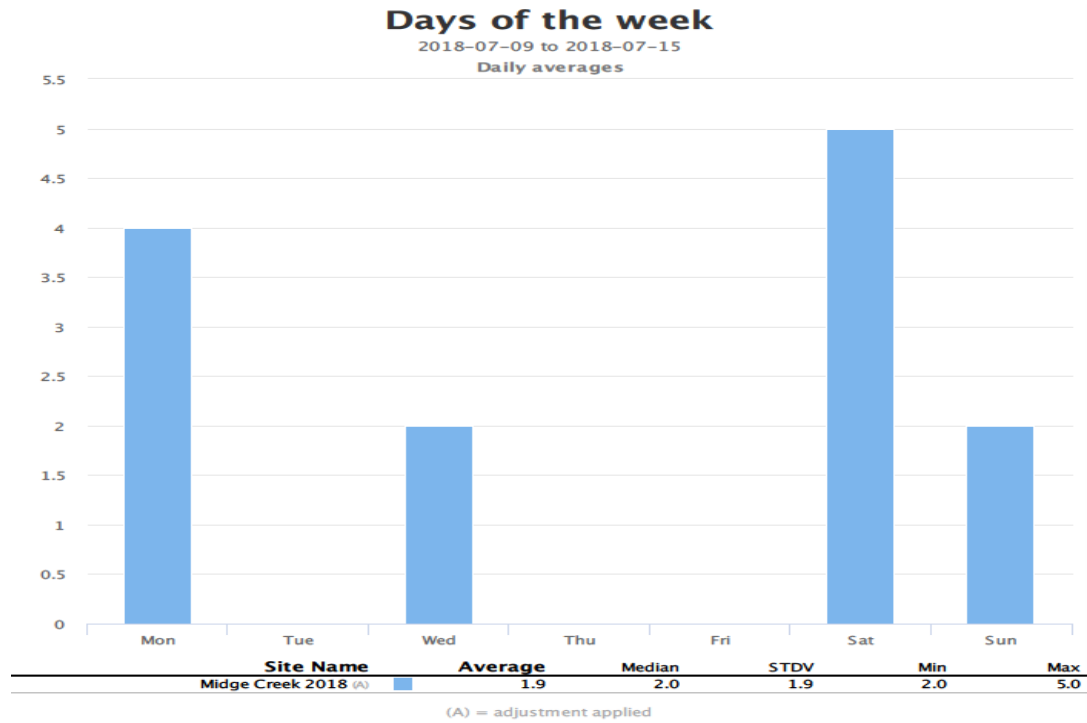


Figure 44. Midge Creek and Temperature

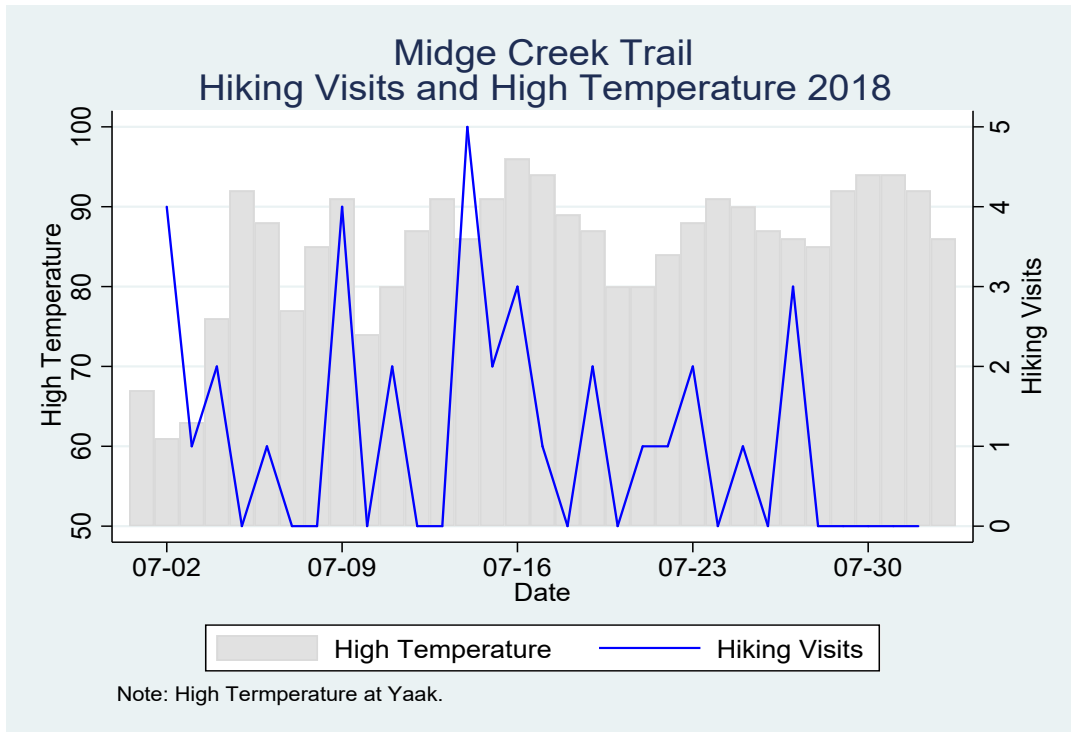


Figure 45. Midge Creek and Precipitation

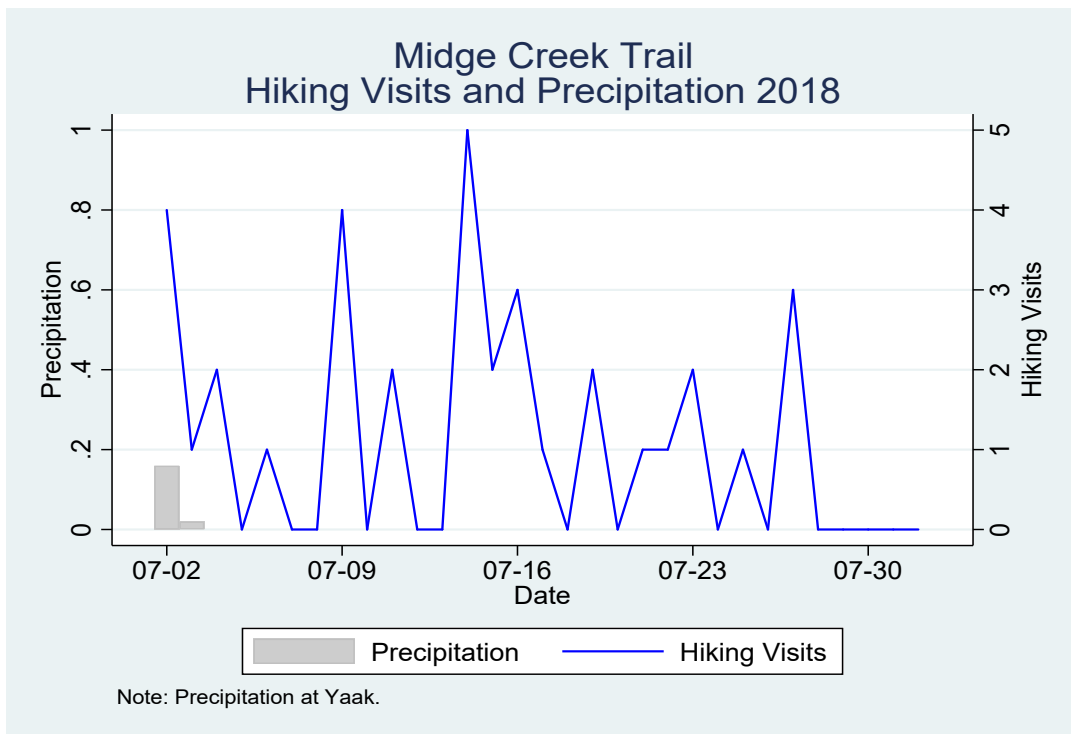
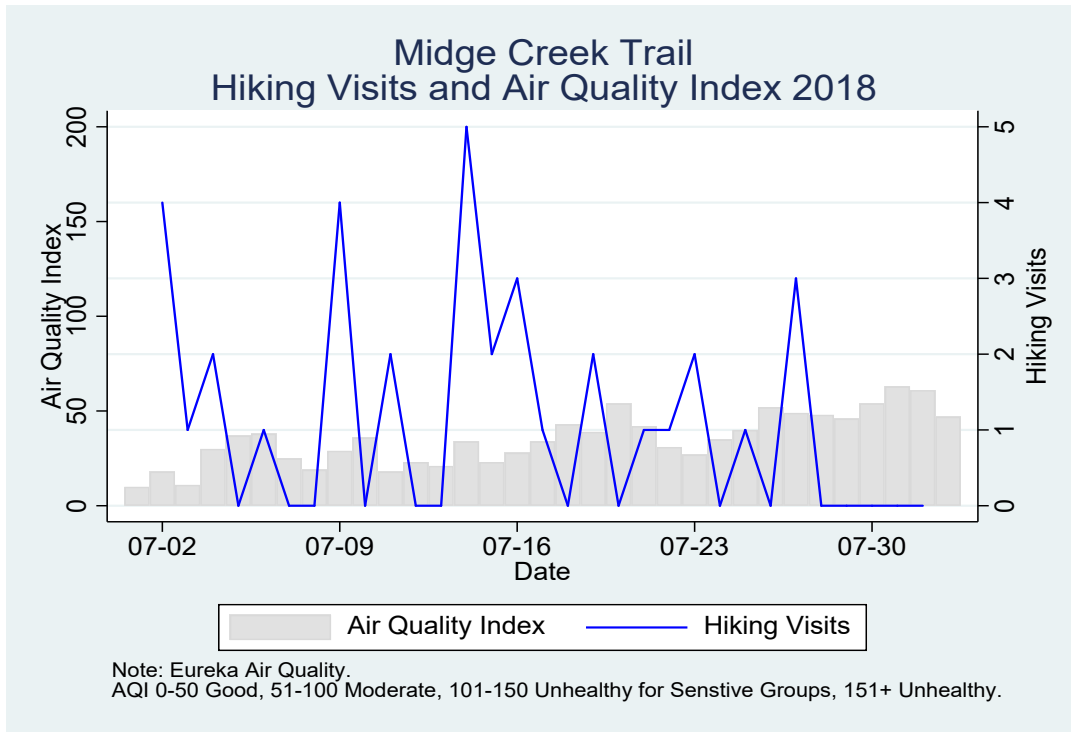


Figure 46. Midge Creek and Air Quality



Garver Mountain 2018

Due to late spring snows, the trail was not accessible until July 2 and the road accessing the trail was closed due to the Davis Fire on August 14; the counter was removed on August 1 due to the threat of the fire and the anticipated road closures. The closure was effective from August 14 to September 14.

A weekly average of 10 hiking visits were recorded at the Garver Mountain site during the weeks monitored. Figure 47 includes the daily averages from the trail counter at the Garver Mountain site. For the month that the counter was at the site, it registered the highest use days were Wednesday, Thursday, and Sunday, with an average of 1.8 visitors each day. Figure 48 shows the weeks of highest use during the month that the site was monitored. The weeks of July 9 to the 15 and July 16 to the 22 experienced the most use, with 13 hiking visits per week. Within these two weeks, Wednesday, Saturday, Sunday, and Monday were the most popular days to travel.

Based on camera data, this trail was frequented by day hikers. There is not much variation among the daily averages at this site, suggesting a consistent use of the trail throughout the week that may indicate primary thru-hiker presence or consistent day hiker use.

Figure 49 shows counts as they correspond to the maximum temperature in Yaak. The pattern in this graph suggests that more hikers were on the trail when it was cooler than when the temperatures were highest during the season. Figure 50 shows counts for this trail counter relative to precipitation levels in Yaak, which does not reveal a correlation between precipitation and visitor use at the Garver Mountain site. Figure 51 shows the counts as they correspond to the air quality in Eureka. This data suggests that air quality does not have a strong association with whether or not users are taking this trail.

During the month that the Garver Mountain site was monitored, an estimated 48 hiking visits recorded on the trail. Due to the closure from the Davis Fire, there is no data during this period so it's not possible to determine whether air quality, temperature, or precipitation would impact use of the trail. We recommend continuing to monitor this trail as it is distant enough from the lookout to not receive most day use traffic and because the data collection period from this season's work was stymied by the mid-summer Davis Fire, potentially limiting our scope on post-fire late season results when the trail re-opened in mid-September.

Figure 47. Garver Mountain Daily Averages

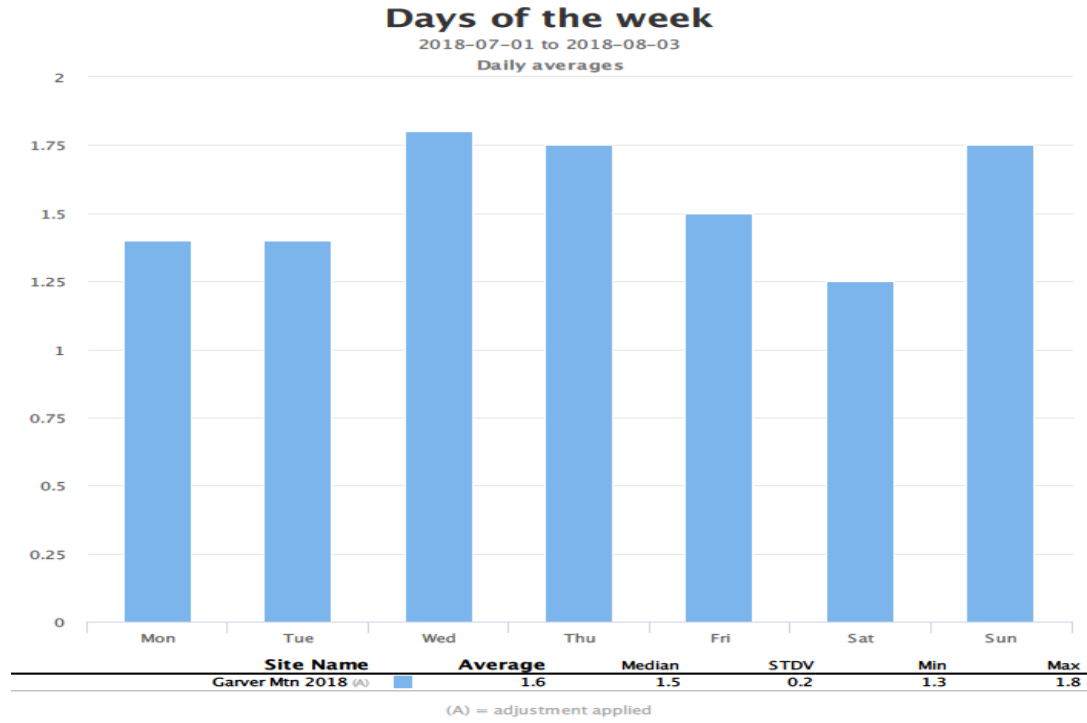


Figure 48. Garver Mountain Highest Use Week

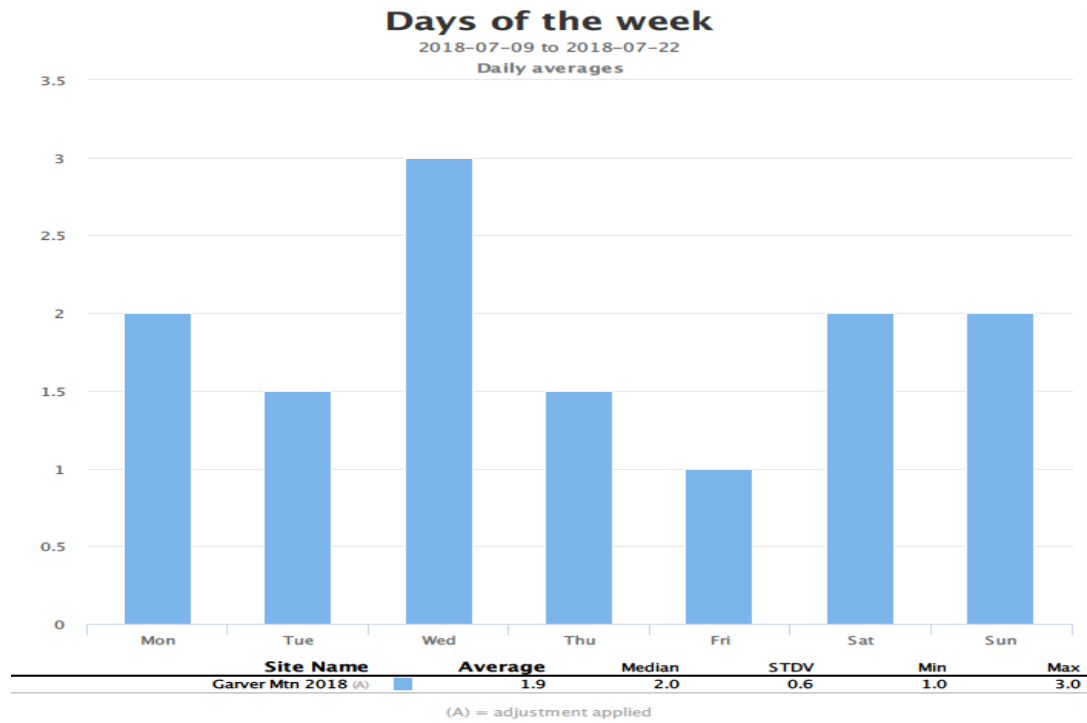


Figure 49. Garver Mountain and Temperature

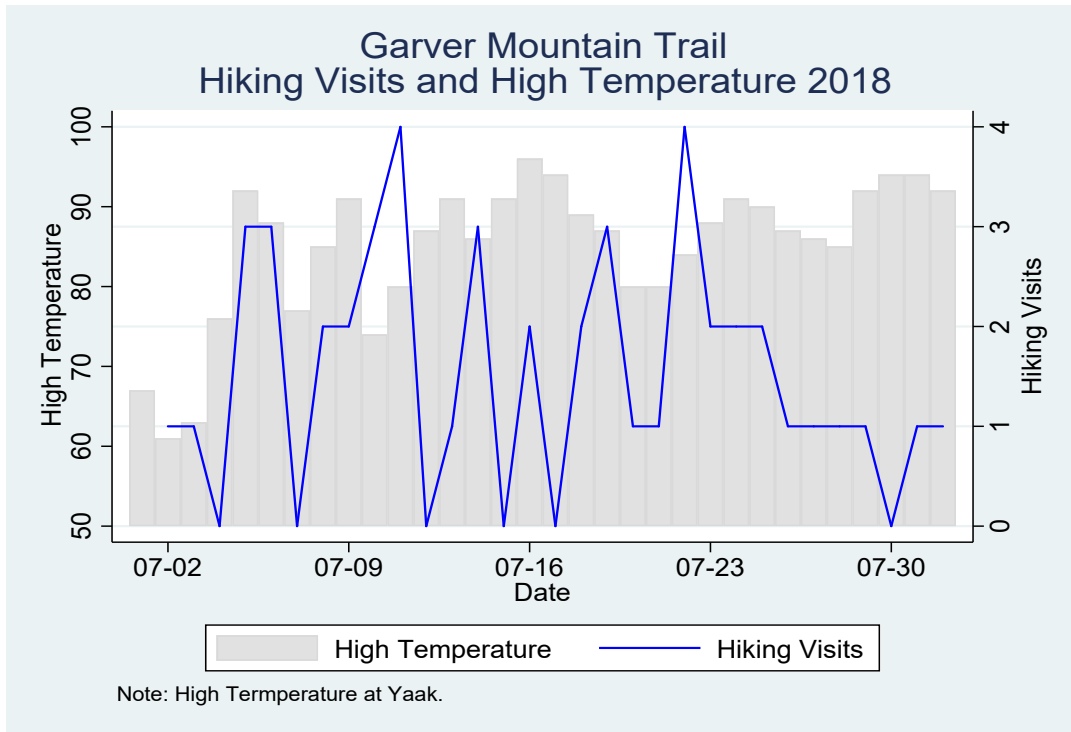


Figure 50. Garver Mountain and Precipitation

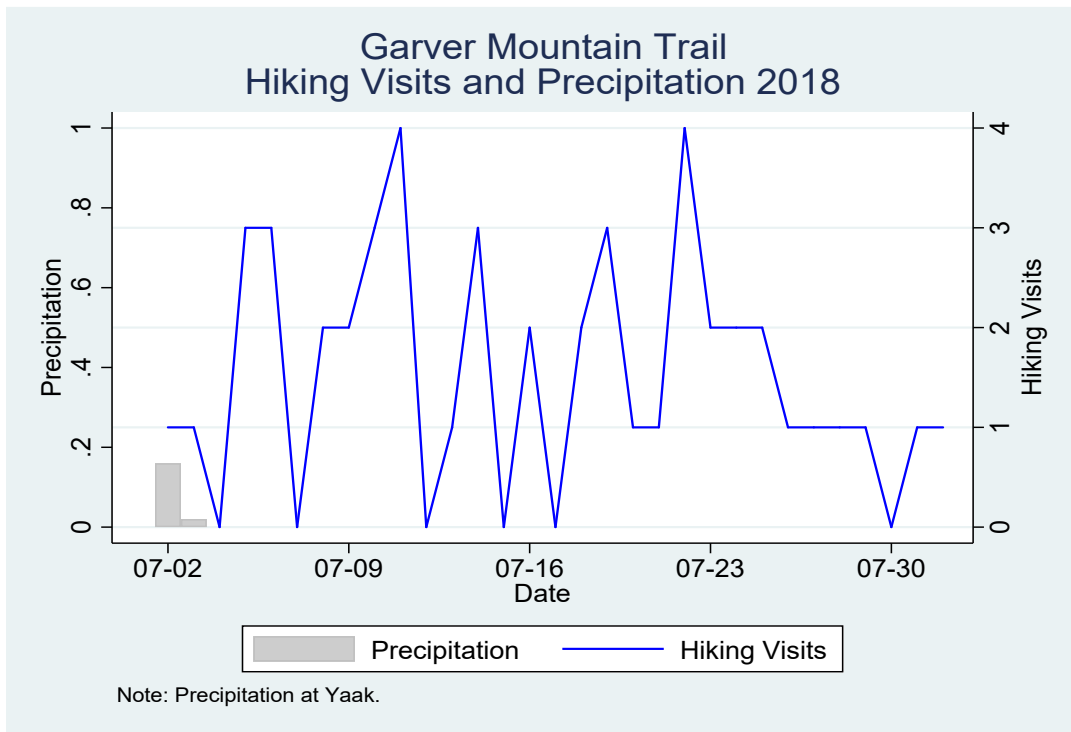
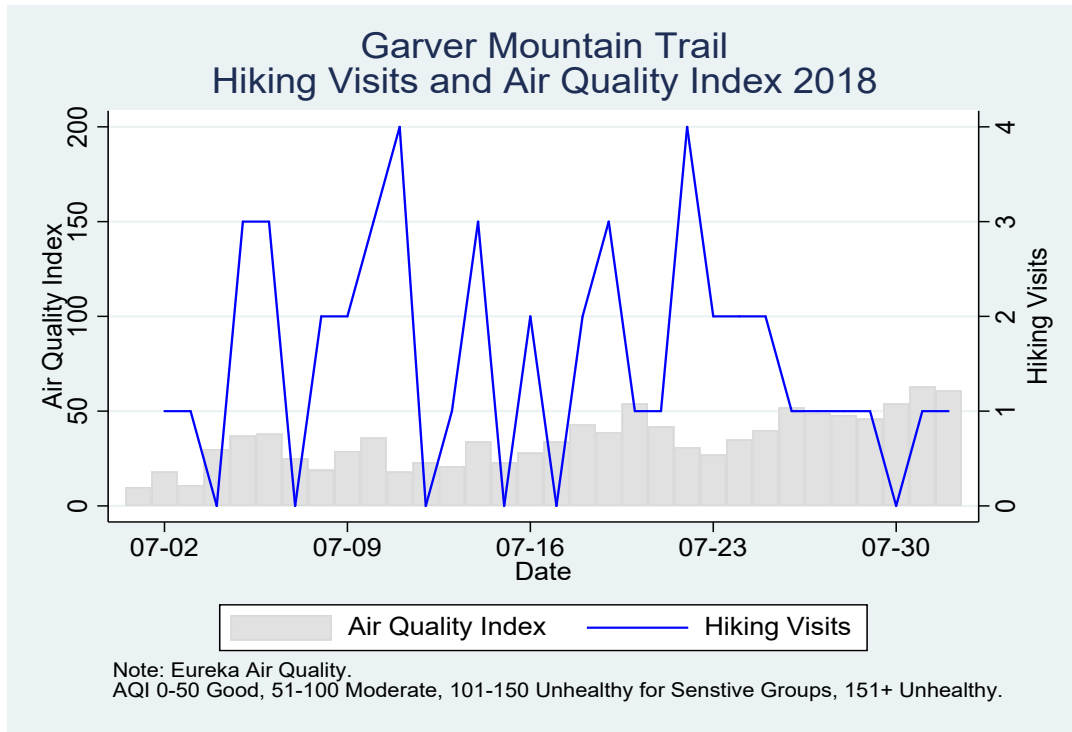


Figure 51. Garver Mountain and Air Quality



Canuck Peak 2018

Figure 52 contains the weekly counts from the trail counter at the Canuck Peak site. The week of July 9 to July 15 experienced the most use, with 18 hiking visits. There was a huge spike in weekly totals from July 9 to July 15. A weekly average of 4.7 hiking visits was recorded at the Canuck Peak site during the weeks monitored. Figure 53 includes the daily averages from the trail counter at the Canuck Peak site. The highest use days were Mondays and Wednesdays, with an average of 0.9 and 1 hiking visits respectively. Figure 54 shows a breakdown of the highest use week of this trail: July 9 to July 15. Within this week, Wednesday and Saturday demonstrated the most counts with 11 and 15 hiking visits respectively.

Based on camera data, this trail was frequented mostly by backpackers, which may be thru-hikers, section hikers, or “local” overnight or multi-day backpackers. The camera data also reveals that this trail was frequented by wildlife.

Figure 55 shows counts relative to the maximum temperature in Yaak. The pattern in this graph is not suggestive of a correlation between visitor use and high temperature. Figure 56 shows counts relative to precipitation levels in Yaak, which also does not reveal a correlation between precipitation and visitor use at the Canuck Peak site. Figure 57 shows the counts as they correspond to the air quality in Eureka. This data suggests that air quality does not have a strong association with whether or not users are taking this trail. During the months that the Canuck Peak site was monitored, an estimated 59 hiking visits were recorded on the trail. We recommend continuing to monitor this trail as it is used primarily by thru-hikers and the results could be compared to the nearby trail register.

Figure 52. Canuck Peak Weekly Hiking Visits

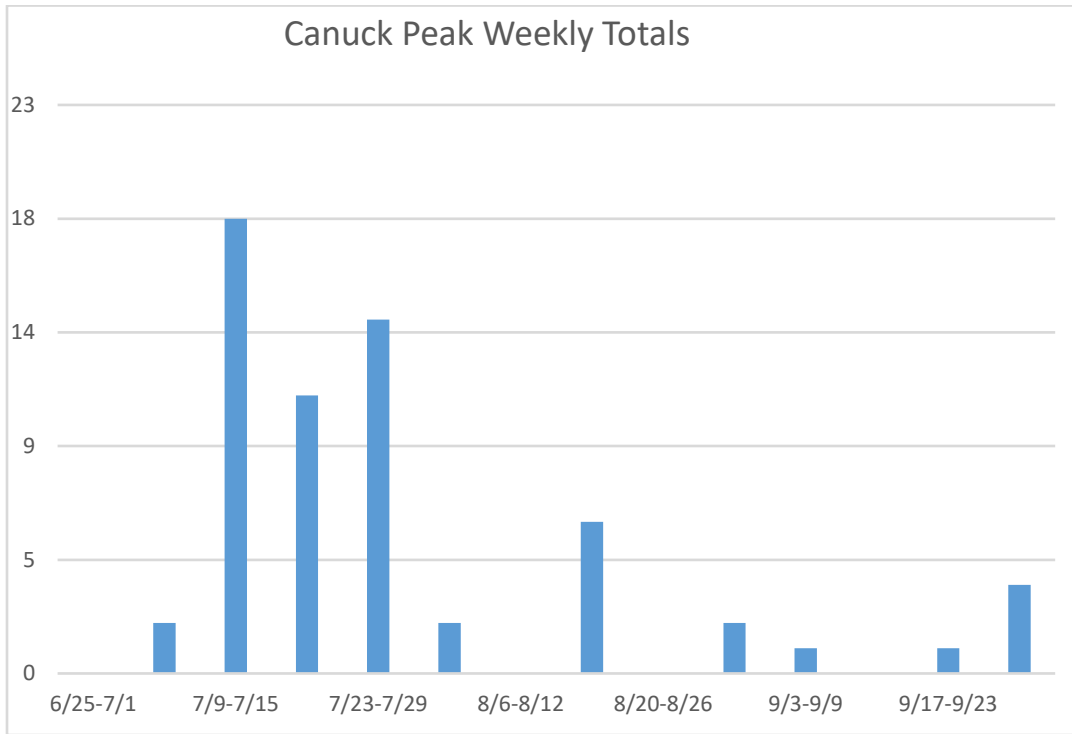


Figure 53. Canuck Peak Daily Averages

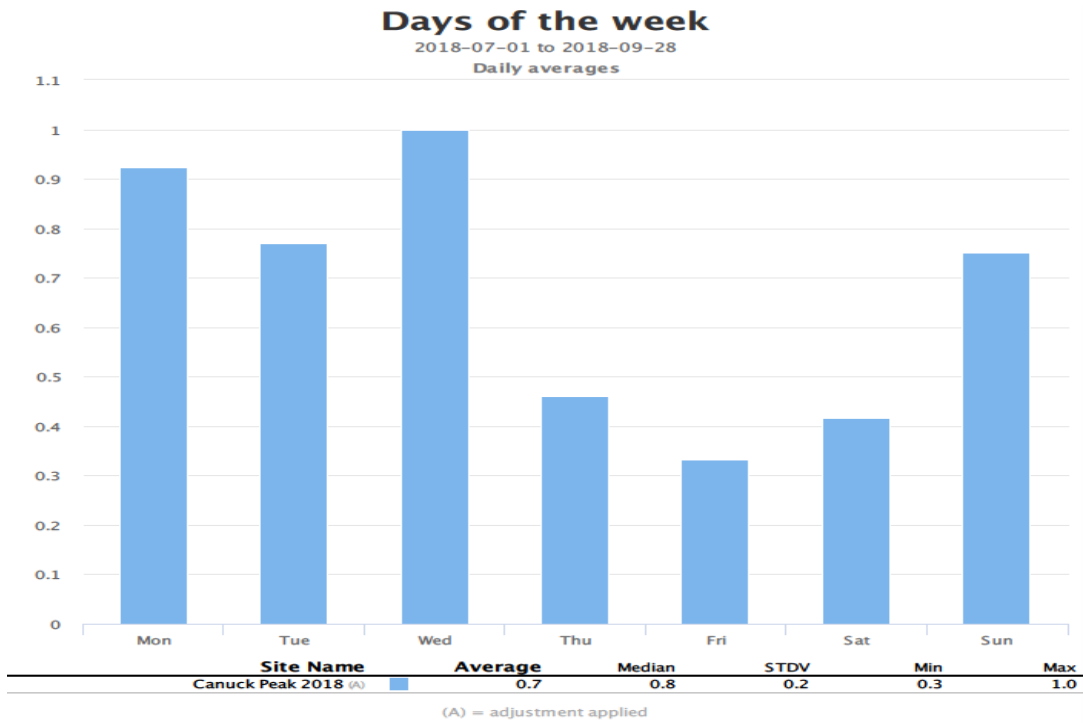


Figure 54. Canuck Peak Highest Use Week

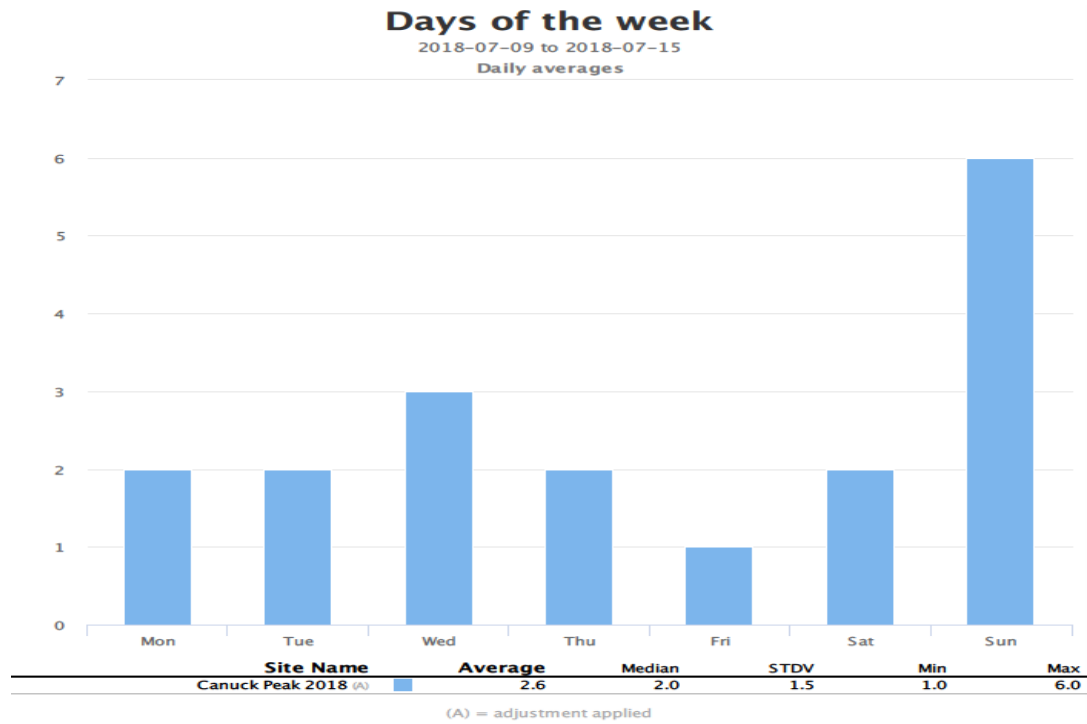


Figure 55. Canuck Peak and Temperature

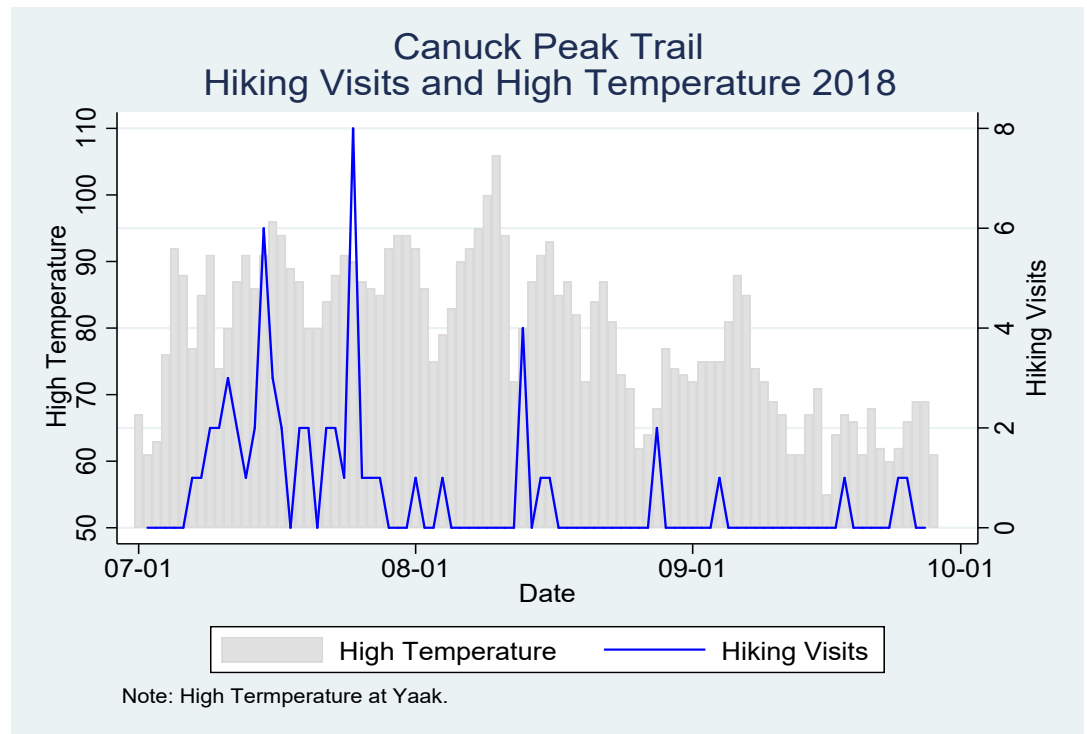


Figure 56. Canuck Peak and Precipitation

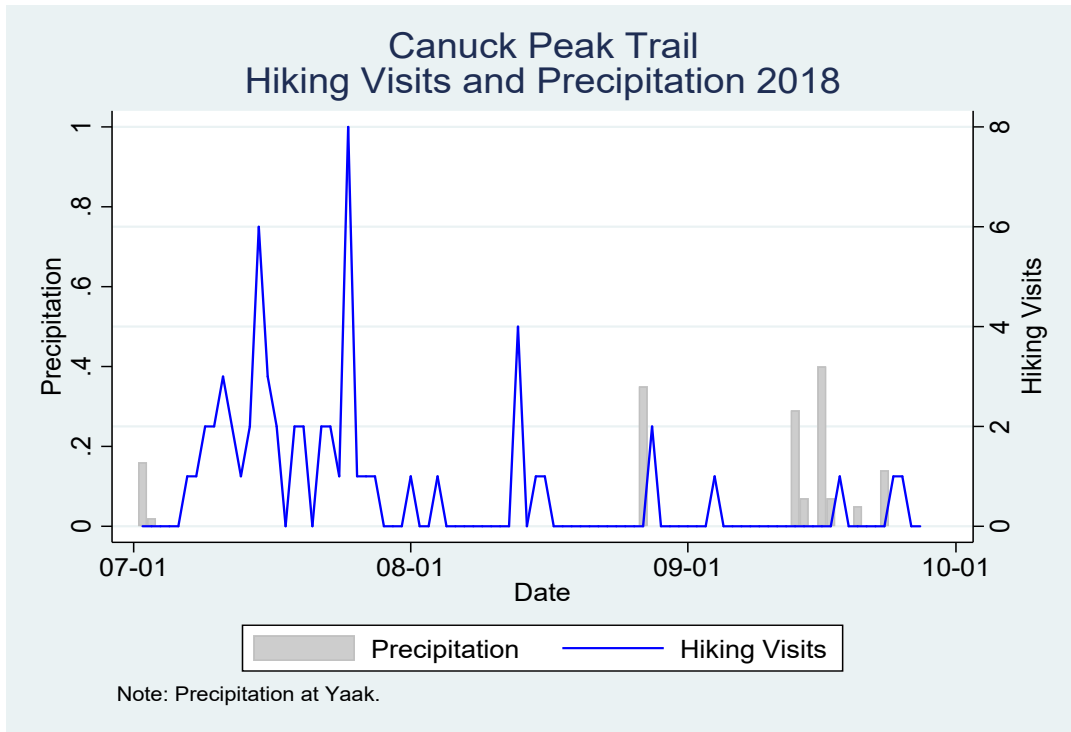
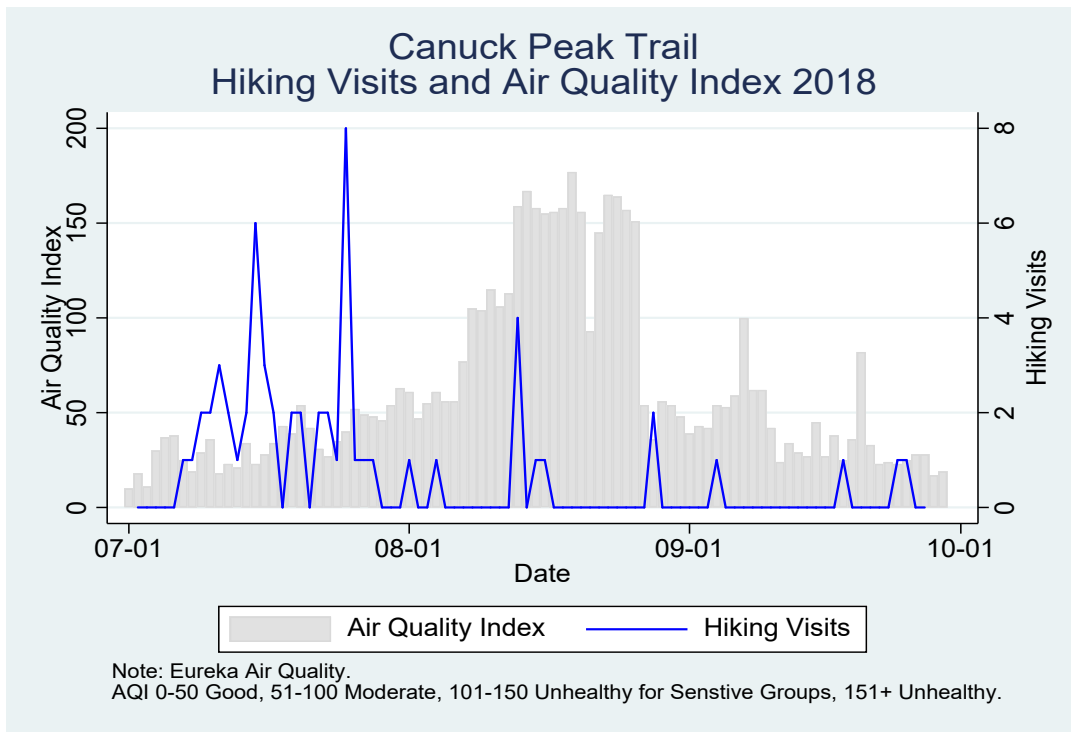


Figure 57. Canuck Peak and Air Quality



Comparison of 2017 versus 2018

The following graphs compare use of trails between the 2017 and 2018 monitoring seasons. The graphs that separately depict the July and August trail counts allow for a more in-depth examination of use at the site within the month, compared from 2017 to 2018. The graph that demonstrates the use during both July and August of both monitoring seasons allow for the exploration of possible trends in use according to month and year.

Gypsy Meadows, Green Mountain, and Bluebird Lake were excluded from the comparisons due to either insufficient data or the scale of use. (see “Figure 1: Comparison of use across all sites” for further explanation).

Because no calibration factors were available from 2017, the 2018 calibration factors have been applied to the 2017 data in these graphs. Comparison of the counts should be made with caution. .

Figure 58. Comparison of July Hiking Visits Between Sites: 2017 versus 2018

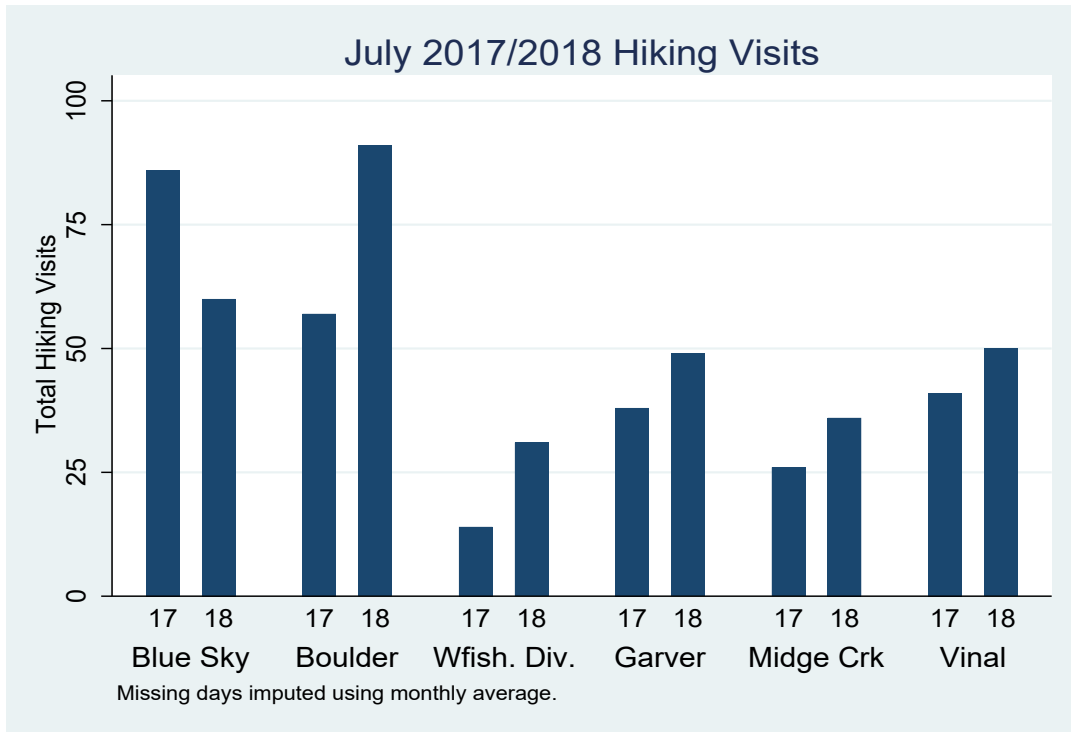


Figure 59. Comparison of August Counts Between Sites: 2017 versus 2018

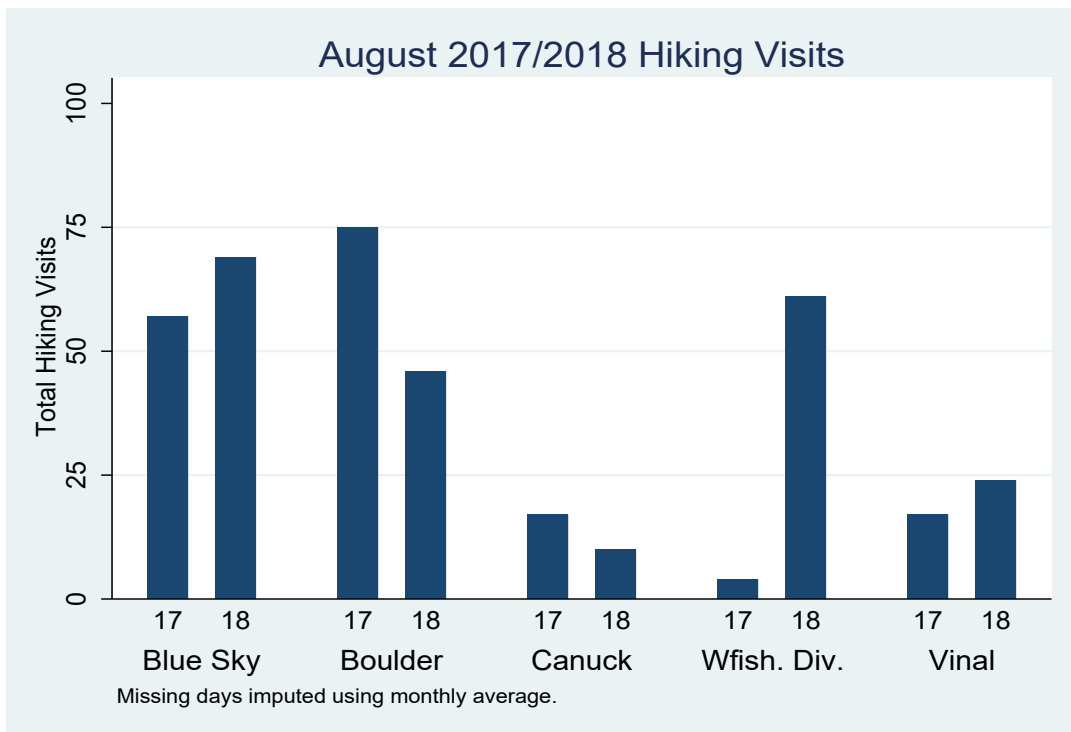


Figure 58 compares counts within each trail for July from 2017 and 2018. The 2018 counts in July are generally larger at each trail than in 2017, indicating an overall slight increase in use on these trails during July from 2017 to 2018. The Blue Sky Creek site does not follow this possible trend, demonstrating a slightly higher trail count in July 2017 than 2018. Figure 59 compares counts within each site for August 2017 and 2018. The 2018 counts in August are also generally larger at each site than in 2017, a difference in size that is suggestive of an overall increase in use on these trails during August from 2017 to 2018. The Boulder Lake site does not follow this possible trend because it exhibits a slightly higher trail count in August 2017 than 2018.

Figure 60. Comparison of July and August between Sites: 2017 versus 2018

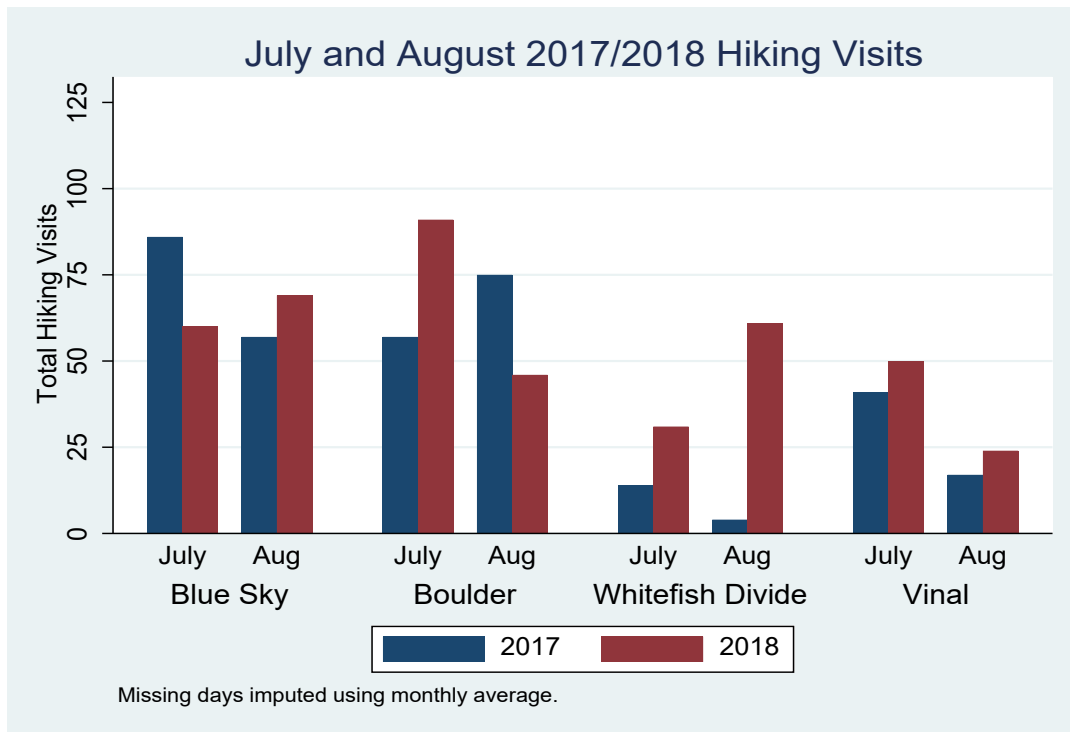
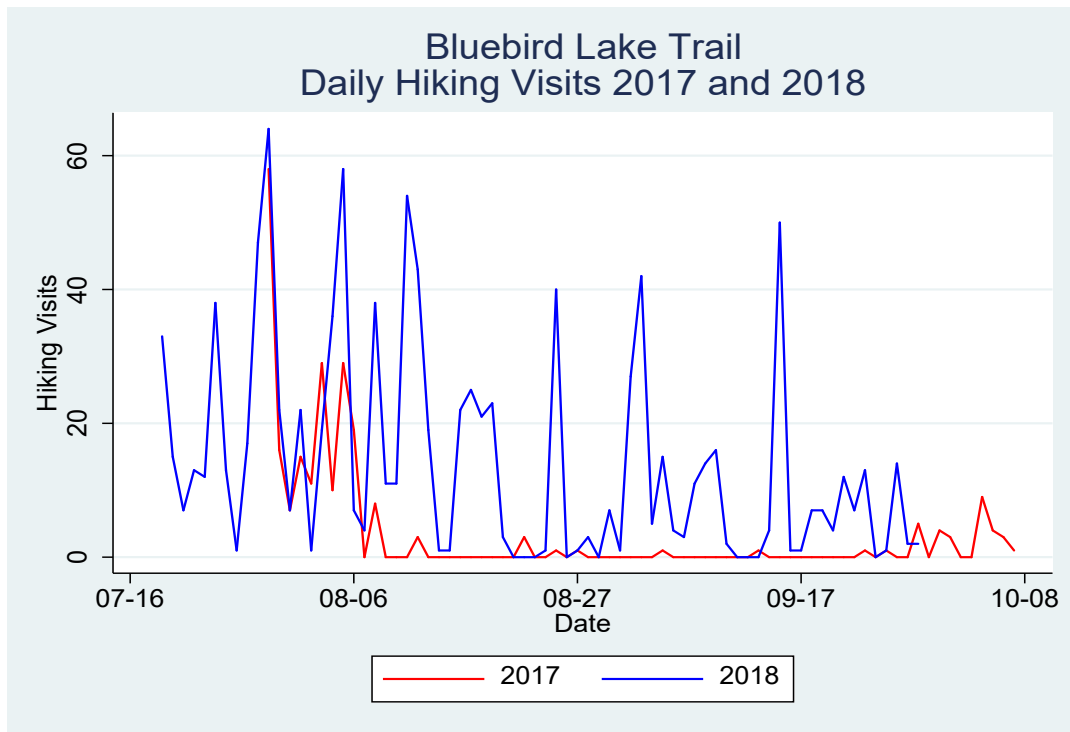


Figure 60 shows the difference in hiking visits within the months of July and August between the years of 2017 and 2018 at four different sites. These four sites had sufficient data to be represented in this way, but it's also important to recognize that extrapolating the data to suggest yearly trends regarding use of these trails is limited by the amount of data that was collected during these monitoring periods; more data than two years is needed in order to begin to really explain and predict possible trends in visitor use of these trails.

Figure 61. Comparison of Use in Bluebird Lakes: 2017 versus 2018



As mentioned earlier in the report. Bluebird Lake exhibits an average daily and monthly count that is much higher than the rest of the monitored sites (p. 17). The total count for the months of July and August at Bluebird Lake was 1,161. For comparison, the trail with the next highest use was Boulder Lake, which had a total count of 137. Figure 53 provides a more in-depth view of the use of Bluebird Lake in 2017 and 2018. There is a substantial increase in use from 2017 to 2018, which is most likely due to day use. The patterns of use in the earlier section of the monitoring season (mid-July to early August) do overlap between the years, suggesting that these times have remained popular times of the season to visit Bluebird Lake.

Recommendations for future PNNST work and Field Notes

The recommendations from last year's report on providing a SPOT device, four-wheel drive vehicle, GPS units, and for increasing the research team to two people, were implemented during this year's monitoring project. The team is thankful that the USFS followed through on these recommendations as they increased the ease and efficiency of the data collection and analysis processes.

We have come up with a few recommendations that might improve the calibration of the counters for next year's monitoring project. These recommendations include: game cameras with night-vision capabilities, on-site training specific to the selection of an optimal camera/counter location and on-site training specific to the installation of the equipment. Game cameras with night-vision capabilities could capture the hikers who were moving at night to avoid the summer heat and would ultimately allow for a more accurate evaluation of counter data. The team felt they could have been more proficient and selective when installing the research equipment at the sites, which could improve the capacity for the equipment to capture hikers on the trail as well as matching the footage from the camera to the counter data back in the lab. Lessons learned from miscounts and data loss (accidental deletions and data irregularity) are going to inform this year's crew training, ultimately reducing these occurrences.

Some sites (e.g. Bluebird Lake) include notes showing that the site was frequented by horse riders. The counts that we do have from these specific uses were gleaned from several hours of camera footage that was recorded during the data collection period. The cameras were rotated between the various sites throughout the monitoring period, so we cannot extrapolate trends regarding specific types of visitor use and their corresponding frequency. In order to learn more about the specific frequency of uses other than hiking at each site (e.g. horse riding, pack and saddle stock, biking), there would need to be a camera at each site for the entire data collection period (nearly two months at each site) and the research team would be required to visit each site more regularly in order to "empty" the cameras' SIM cards, and transfer footage and then watch and record the data. This would require a much larger team of researchers.

Online Presence

There is an increase in technological use and dependence on online resources by thru-hikers. Several Facebook groups that facilitate personal connection, communication, and information sharing. This group was especially helpful this season in communicating growing wildfires in the region and subsequent detours from the trail. The PNNST has three main groups on Facebook for hikers to connect: “PNT Hikers,” “PNT Class of 2018” and “Pacific Northwest Trail Thru-Hikers.” It seems like a lot of hikers use these groups for updates, questions, and as a way to stay in touch with others that are on the same journey as them.

Film and Outreach

“#YouthCrewHeroes”

The Pacific Northwest Trail Association created a campaign called #youthCrewHeroes to support programs that engage youth from gateway communities along the PNNST in trail stewardship. This campaign could generate funds to support the trail maintenance of the PNNST.

<https://www.classy.org/campaign/youth-crew-heroes/c213697>

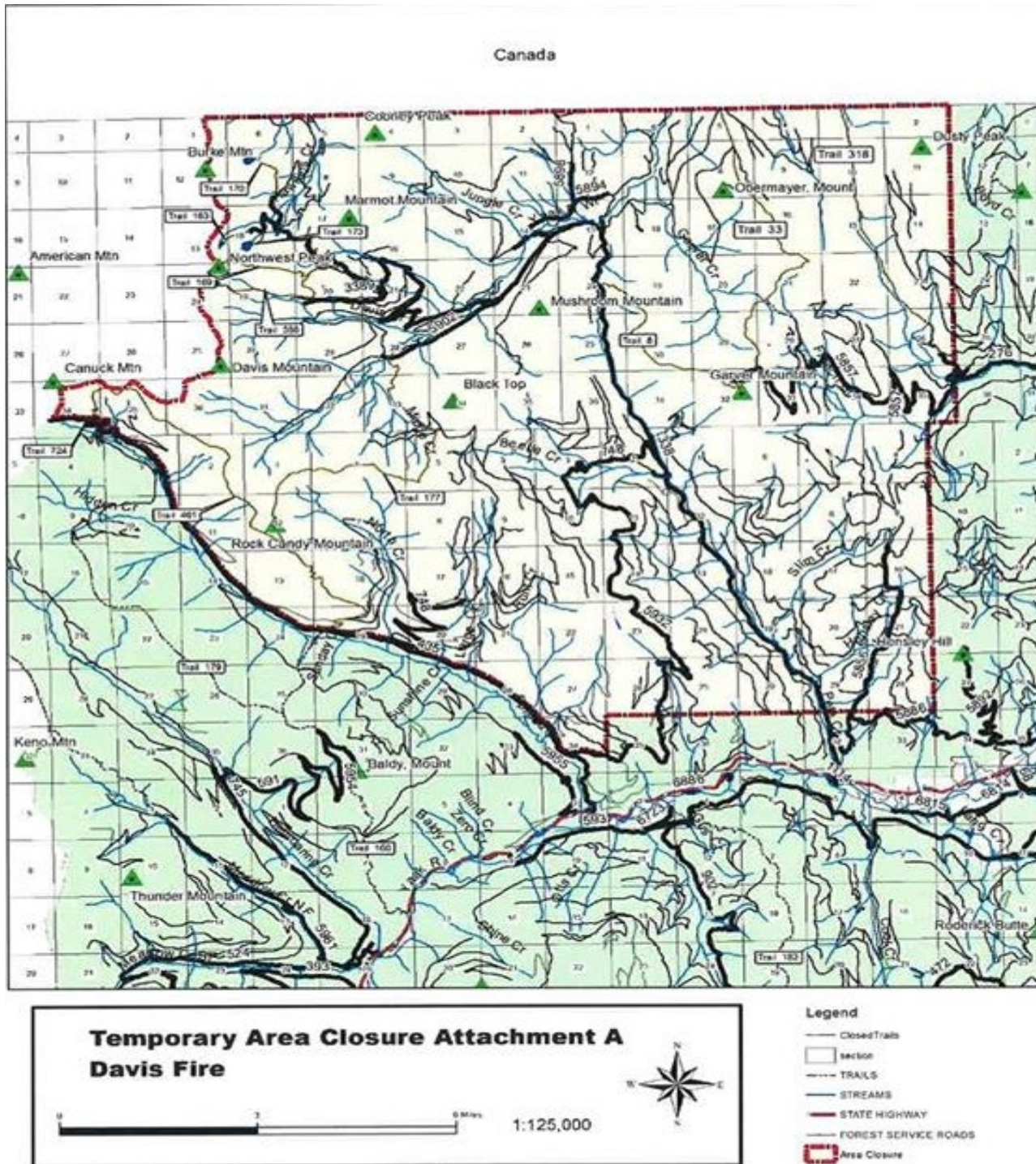
“THRU Film”

The mission of this film is to capture and share the journeys of four thru-hikers as they traverse the PNNST in an effort to connect those who didn’t experience the PNNST with the natural world. The first chapter of this film project was released on November 5, 2018.

https://www.youtube.com/watch?v=F3LqXIK9Cj0&fbclid=IwAR19_5yTPezMLV2jxhbgto0JZtMwBK0STycJkh-PQ-Wj62fvZk62gDciQBA

Appendix

A. Davis Fire Detour in effect from August 1 to September 14 2018.



B. Pacific Northwest Trail Association maps of trails in Section 1 and 2 of the PNNST.

Section 1, or “Rocky Mountains,” consists of 149 miles (240 km) of trail from Glacier National Park to Eureka, Montana. Section 2, or “Purcell Mountains,” consists of 97 miles (156 km) of trail from Eureka, Montana to Bonners Ferry, Idaho. The maps follow the trail from East to West and show the general location of trail counter/camera. The trails that included in this study are featured in pages 8-22 of the following sectional maps of the PNNST. The trail name, National Forest designation, and page number are included to orient the reader to the location of the study sites within the PNNST. Specific locations of trail counters/cameras are not included to avoid vandalism in future studies.

Counter/Camera Site	Trail	National Forest	Page Number in Map
Whitefish Divide	Whitefish Divide Trail	Flathead National Forest	8-9
Blue Sky Creek	Blue Sky Creek Trail 174	Kootenai National Forest	10-11
Bluebird Lake	Trail 339	Kootenai National Forest	12
Green Mountain	Blacktail Trail 92	Kootenai National Forest	12
Boulder Lake	Boulder Lake Trail 62	Kootenai National Forest	17
Gypsy Meadows	Purcell Summit Trail 91	Kootenai National Forest	17
Vinal Creek ⁸	Vinal Creek Trail 9	Kootenai National Forest	18
Midge Creek*	Midge Creek Trail 77	Kootenai National Forest	21
Garver Mountain*	Garver Mountain Trail 9	Kootenai National Forest	20
Canuck Peak*	Rock Candy Mountain Trail 461	Kootenai National Forest	22

* Road accessing site was closed from August 14-September 14, due to Davis Fire.

Please see the following links in order to view the locations of the counter/camera sites included in this report. The sites’ corresponding page number is located in the lower right-hand corner of the sections of the map.

Section 1 of PNNST “Rocky Mountains” sites: https://167711ccl8c1h52gskq8wcd6-wpengine.netdna-ssl.com/wp-content/uploads/2018/05/PNT_Section1_V2.pdf

Section 2 of PNNST “Purcell Mountains” sites: https://167711ccl8c1h52gskq8wcd6-wpengine.netdna-ssl.com/wp-content/uploads/2018/05/PNT_Section2_V2.pdf

⁸ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 33-36.