

Pacific Northwest National Scenic Trail: 2019 Trail Monitoring Report



Katherine Coe¹
Elena Bigart¹
Douglas Dalenberg²
Jennifer Thomsen¹

March 2020

¹Department of Society and Conservation
W.A. Franke College of Forestry and Conservation

²Department of Economics
College of Humanities and Sciences

The University of Montana
Missoula, MT USA

Table of Contents

<i>Introduction</i>	3
<i>Methods</i>	5
<i>Comparison across sites</i>	8
<i>Trail Use by Site</i>	14
Whitefish Divide 2019	14
Blue Sky Creek 2019	18
Bluebird Lake 2019.....	22
Green Mountain 2019	26
Boulder Lake 2019.....	30
Gypsy Meadows 2019.....	34
Vinal Creek 2019	38
Midge Creek 2019	42
Garver Mountain 2019	46
Canuck Peak 2019	50
<i>Comparison of 2017, 2018, and 2019</i>	54
<i>Recommendations and Reflections</i>	59
Field Work.....	59
Specific Sites.....	59
Future Research.....	60
<i>Endnotes</i>	61
<i>Appendix</i>	62
Appendix A. Pacific Northwest Trail Association maps of trails in Section 1 and 2 of the PNNST.....	62

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 2019, the University of Montana (UM) conducted a visitor monitoring of the number and timing of trail visits using various sections of the PNNST. These sections are located in the Flathead National Forest (FNF) and Kootenai National Forest (KNF) in Montana. **Trail visits** included trail use by people on foot, as well as people on horses or bicycles, who may be:

- 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;
- day hikers or riders and overnight/multi-day hikers or riders 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);
- trail crew members and other government employees and volunteers using trails to perform administrative duties such as maintenance, monitoring, patrols, and other work.

Trail visits are estimates based on calibration of raw data as described in the methods section below. In the case of an “out-and-back” trip where a trail user 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 trail visits.

This report details findings related to trail use during 2019 at the following locations: Whitefish Divide, Blue Sky Creek, Bluebird Lake, Green Mountain, Gypsy Meadows, Boulder Lake, Vinal Creek¹, Midge Creek, Garver Mountain, and Canuck Peak. More information about these sites, including the corresponding trail name and number, appear in Appendix A.

¹ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Methods

This study replicated the methodology and site selection used in the University of Montana's initial monitoring project from the summer of 2017. However, calibration factors were calculated somewhat differently for 2019, than those for the 2017 and 2018 seasons. Calibration factors for 2019 accounted for all trail users (including overnight hikers, day hikers, horse riders, bike riders, and trail/administrative crew members). In contrast, 2018 data was calibrated only for day and overnight hikers (thus excluding trail/administrative crew members, horse riders, and bike riders). Additionally, because no calibration factors were available from 2017, the 2018 calibration factors were also applied to 2017 data. Therefore, while the percentage of trail users that were trail/administrative crew members, horse riders and bike riders is relatively small, comparisons between 2017, 2018, and 2019 are not entirely equivalent. Trail user estimates for 2017 and 2018 would likely be at least slightly higher than the reported hiking visit estimates.

Data collection took place from June 14, 2019 to October 10, 2019. During this time, the researchers made six trips into the field. Each trip lasted between two and four days. There were ten sites monitored, with nine in Kootenai National Forest and one in Flathead National Forest. Data was gathered using infrared trail counters and software from the company TRAFx. The trail counters were calibrated using infrared cameras trail cameras that took photographs when a motion was detected. 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 trail camera photos.

The trail cameras were shifted between the sites every two to three weeks. Most cameras spent eight weeks in total at each site throughout the monitoring period. The one exception was the camera at Vinal Creek², which was stolen mid-season; in this case, the camera was stationed at the Vinal Creek site for about three weeks. 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 throughout the entire season, footage did provide valuable information with which to adjust the infrared counts. For example, Canuck Peak and Gypsy Meadows are 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

² The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

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.

All available footage from cameras were used this year to determine calibration factors. While going through the camera data, the team noted whether it was an animal, a hiker, bike rider, a horse 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 trail visits. This use of the calibration factors allows us to remove estimated animal counts, bike rider counts, horse rider counts, trail crew, or phantom counts and double counts of individuals by applying the assumed constant calibration factor. It should be noted that infrared cameras that we used this year for calibration had 5-second minimum interval, which might be too long to capture fast-moving hikers, bike riders, horse riders, and animals. That might have resulted in some counts being missed on the camera data and reduced accuracy for calibration factors.

The calibration factors in this study ranged from 0.25 to 0.69 as shown in Table 1. The low traffic on the trails and the frequent wildlife on the trails could be factors contributing to lower calibration factors. Because the calibration factors are generated from a sample, we should formally refer to trail visits as estimated trail visits, but for brevity we will use the term trail visits in most places.

Table 1 Calibration Dates and Calculated Calibration Factors

Site	Calibration Dates	Calibration Factor
Bluebird Lake	7/18-8/9; 8/10-8/30	0.459283
Blue Sky	6/15-6/22	0.38843
Boulder Lake	6/14-6/24; 7/17-8/4	0.637363
Canuck Peak	7/17-8/6; 8/8-9/1	0.254902
Whitefish Divide	6/26-7/16;8/31-10/5	0.41791
Garver Mountain	6/26-7/15; 8/8-9/1	0.3084112
Green Mountain	7/19-8/7; 8/8-8/31	0.529703
Gypsy Meadows	7/1-7/14; 9/3-9/8	0.422222
Midge Creek	6/26-7/15; 8/7-9/1	0.688889
Vinal Creek ³	6/26-7/15	0.543478

³ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

It is important to note that the infrared counters are not distinguishing between thru-hikers, section hikers, day users, overnight/multi-day users, and trail crew/administrative 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 trail users. Rather, the infrared counters are providing counts for overall use on the trail sections that are being monitored. Therefore, a user on an out-and-back trip 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 composition (such as families with young children) suggestive of day-use versus overnight use.

This study does not address the number of parties or party size. Average and peak weekly trail 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 interested to explore 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 Libby. We used the station closest to the monitoring site to represent weather and air quality as noted in the graphs. The data in the 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 events, like snow levels, 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.

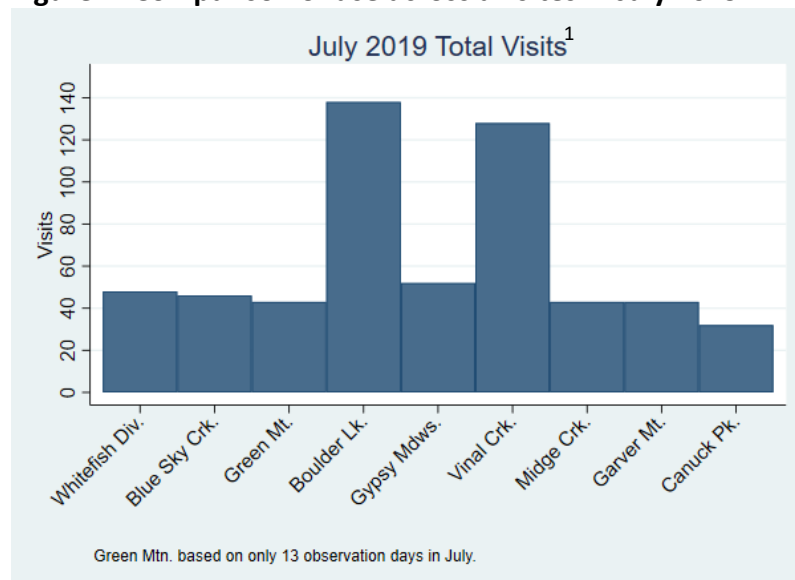
Comparison across sites

Locations monitored include, from east to west: Whitefish Divide, Blue Sky Creek, Bluebird Lake, Green Mountain, Boulder Lake, Gypsy Meadows, Vinal Creek⁴, Midge Creek, Garver Mountain, and Canuck Peak. More information about these sites, including the corresponding trail name and number, are in Appendix A.

Figures 1-3 display use across all sites in July, August, and September. Table 2 provides number of days monitored, monthly counts, daily averages, and min/max daily counts for each site for July-September. We excluded one day of data for Boulder Lake because it was much higher than the rest of the daily counts; the camera data from this day revealed that there were cattle traveling on the trail, which caused the much higher daily count. 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. The sites appear in the graphs running from east to west which is the typical direction thru-hikers travel this trail.

Figure 1 shows the number of trail visits throughout the month of July 2019 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 2019, Boulder Lake and Vinal Creek had the highest use of the trails monitored while Canuck Peak, Garver Mountain, Green Mountain, and Midge Creek experienced the lowest use.

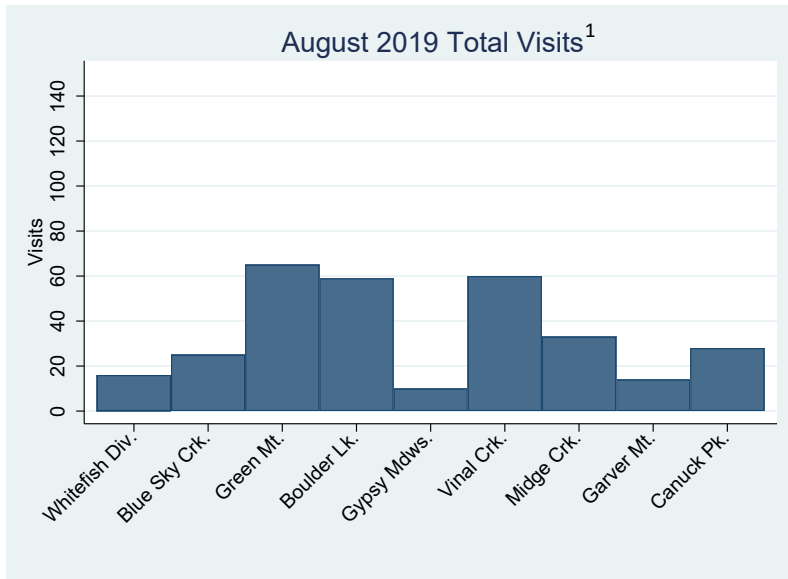
Figure 1: Comparison of use across all sites in July 2019



⁴ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 2 shows the number of trail visits throughout the month of August 2019 in the monitored sites (again, excluding Bluebird Lake). In August 2019, Green Mountain, Boulder Lake, and Vinal Creek⁵ had the highest use of the trails monitored while Gypsy Meadows, Whitefish Divide, and Garver Mountain experienced the lowest use.

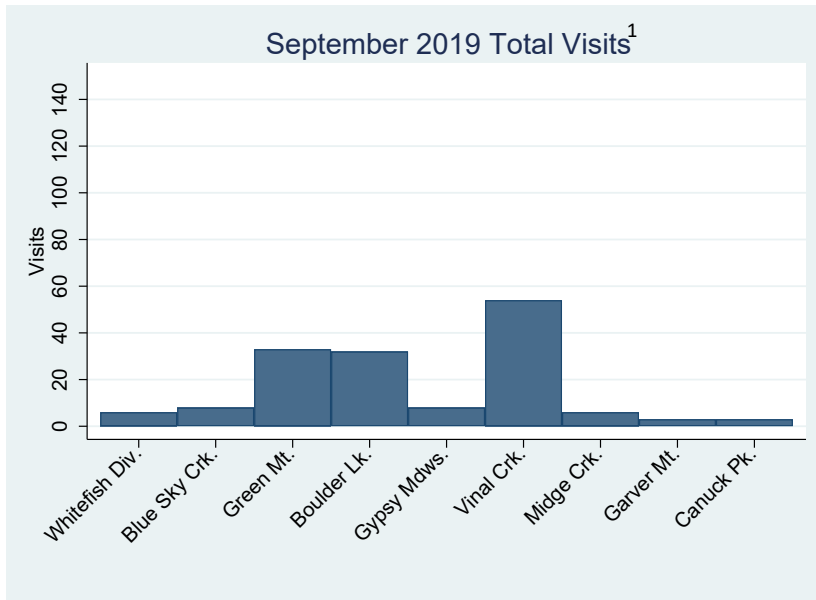
Figure 2: Comparison of use across all sites in August 2019



⁵ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 3 shows the number of trail visits throughout the month of September 2019 in the monitored sites (again, excluding Bluebird Lake). In September 2019, Vinal Creek⁶ had the highest use of the trails monitored while Canuck Peak and Garver Mountain experienced the lowest use.

Figure 3: Comparison of use across all sites in September 2019

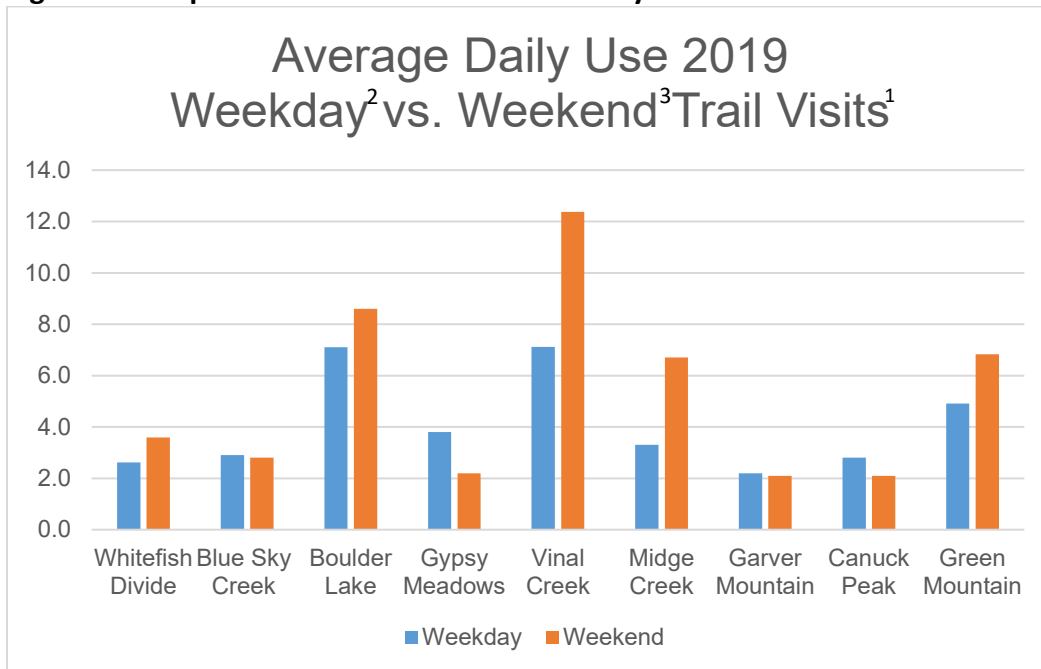


⁶ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 4 shows a comparison of weekday and weekend use across each site, excluding Bluebird Lake because visits to Bluebird Lake took place on a much larger scale than the rest of our sites. If we included Bluebird Lake in the same figure, it would be more difficult to see the differences between those sites. Figure 5 reveals the comparison of weekday and weekend use across Bluebird Lake. To stay consistent with the previous years' monitoring reports, Mondays, Tuesdays, Wednesdays, and Thursdays were counted as weekdays and Fridays, Saturdays and Sundays were considered weekend days.

Overall, Bluebird Lake and Vinal Creek⁷ show the greatest difference between weekday and weekend use. On weekends, Bluebird Lake displayed a 39% increase in use and there was a 75% increase in use at the Vinal Creek site from weekdays to weekends. This notable increase in use on weekends suggests that these sites were very popular for day hikers. Alternatively, there was a decrease in visitor use from weekend to weekday use in the Gypsy Meadows, Midge Creek, and Canuck Peak sites. These sites experienced a 19%, 27%, 32%, decrease respectively. There seemed to be almost no difference in use between weekend and weekdays within the Blue Sky Creek and Garver Mountain sites. This lack of variation among the daily weekend and weekday averages which suggests consistent use of the trails throughout the weeks may indicate primary thru-hiker presence or consistent day hiker use.

Figure 4: Comparison of Weekend and Weekday use across all sites in 2019



⁷ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 5: Comparison of Weekend and Weekday use in Bluebird Lake in 2019

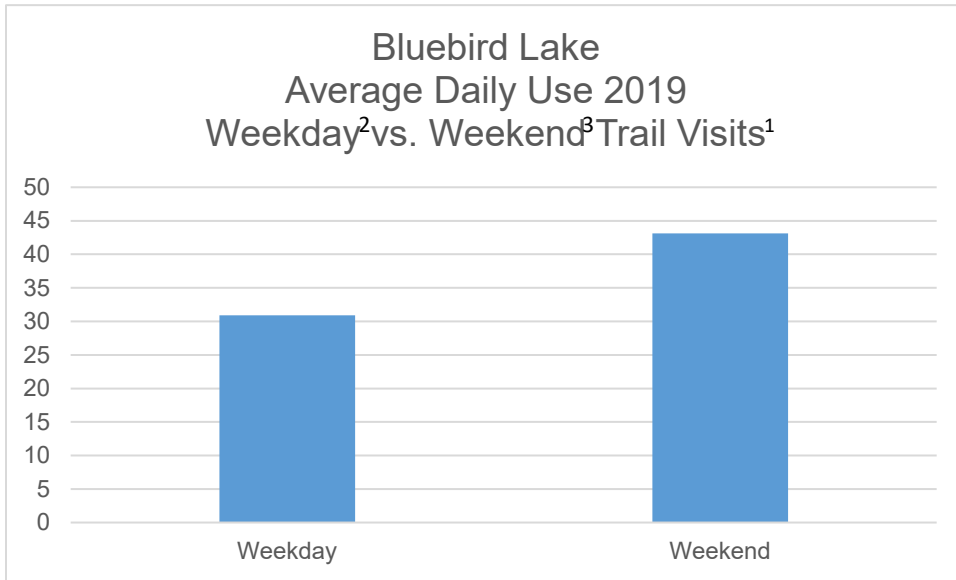


Table 2 Monitoring Data for July, August, and September 2019⁸

<i>Site¹</i>	<i>Days Monitored (Monthly)</i>	<i>Count⁴ (Monthly)</i>	<i>Daily Average</i>	<i>Min (Daily)</i>	<i>Max (Daily)</i>
<u>July</u>					
Blue Sky Trail	31	46	1	0	5
Bluebird Lake Trail	13	251	19	5	46
Boulder Lake Trail	30	134	4	0	22
Canuck Trail	31	32	1	0	4
Garver Mtn. Trail	31	43	1	0	6
Green Mtn. Trail	13	43	3	0	12
Gypsy Meadows Trail	31	52	2	0	12
Midge Creek Trail	31	43	1	0	10
Vinal Creek Trail	31	128	4	0	18
Whitefish Divide Trail	31	48	2	0	7
<u>August</u>					
Blue Sky Trail	31	25	1	0	4
Bluebird Lake Trail	31	472	15	2	37
Boulder Lake Trail	31	59	2	0	10
Canuck Trail	31	28	1	0	13
Garver Mtn. Trail	31	14	0	0	2
Green Mtn. Trail	31	65	2	0	10
Gypsy Meadows Trail	31	10	0	0	5
Midge Creek Trail	31	33	1	0	7
Vinal Creek Trail	31	60	2	0	11
Whitefish Divide Trail	31	16	1	0	6
<u>September</u>					
Blue Sky Trail	30	8	0	0	2
Bluebird Lake Trail	30	144	5	0	23
Boulder Lake Trail	30	32	1	0	7
Canuck Trail	30	3	0	0	1
Garver Mtn. Trail	30	3	0	0	1
Green Mtn. Trail	30	33	1	0	6
Gypsy Meadows Trail	30	8	0	0	3
Midge Creek Trail	30	6	0	0	2
Vinal Creek Trail	30	54	2	0	15
Whitefish Divide Trail	30	6	0	0	3

¹ Official Trail designations appear in Appendix A.

⁸ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Trail Use by Site

Whitefish Divide 2019

From June 23, 2019 through October 9, 2019, an estimated 104 trail visits were recorded on the trail. Figure 6 displays the weekly counts from the trail counter at the Whitefish Divide site. The week of June 24 to June 30 experienced the most use, with 28 trail visits. A weekly average of 6 trail visits were recorded at the Whitefish Divide site during the weeks monitored. Figure 7 includes the daily averages from the Whitefish Divide counter. The highest use days were Friday, Saturday, and Sunday, with an average of 1, 1.1, and 1.5 visitors per day respectively.

Based on camera data, this trail was frequented by day hikers, which could account for the higher weekend traffic. The trail was also frequented by horse riders. There appears to be a gradual increase in use beginning on June 24 and ending on July 14. 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 late June to mid-July appear to represent possible thru-hiker use.

Figure 8 shows counts relative to the maximum temperature in Eureka; Figure 9 shows counts as they correspond to precipitation levels in Eureka; Figure 10 shows counts relative to the air quality in Kalispell. This data suggests that there is not a strong relationship between temperature, precipitation, or air quality and visitor use of the Whitefish Divide trail.

Figure 6 Whitefish Divide Weekly Counts⁴

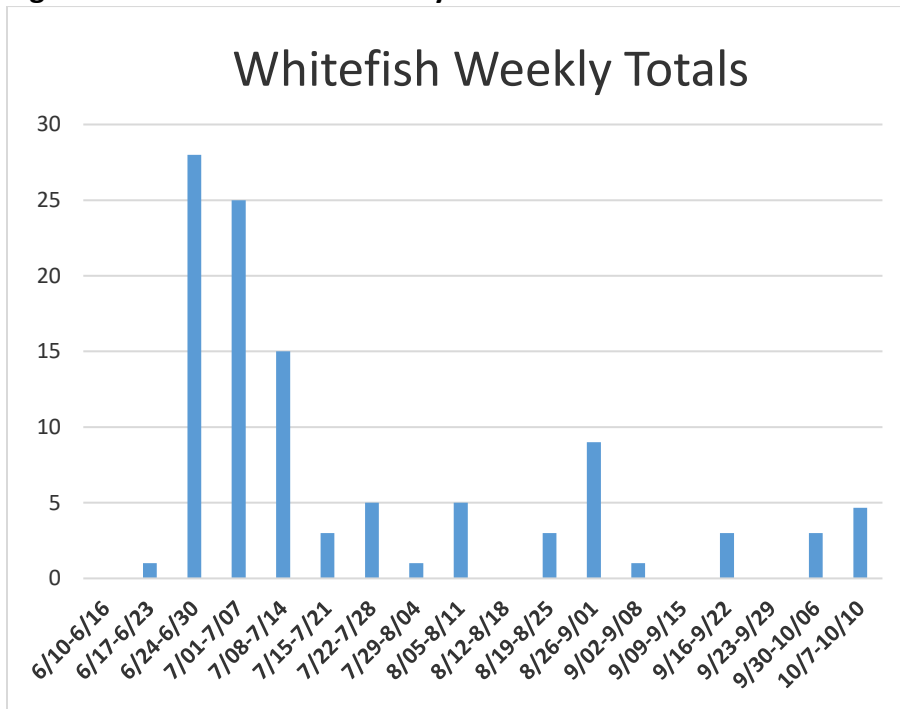


Figure 7 Whitefish Divide Daily Averages

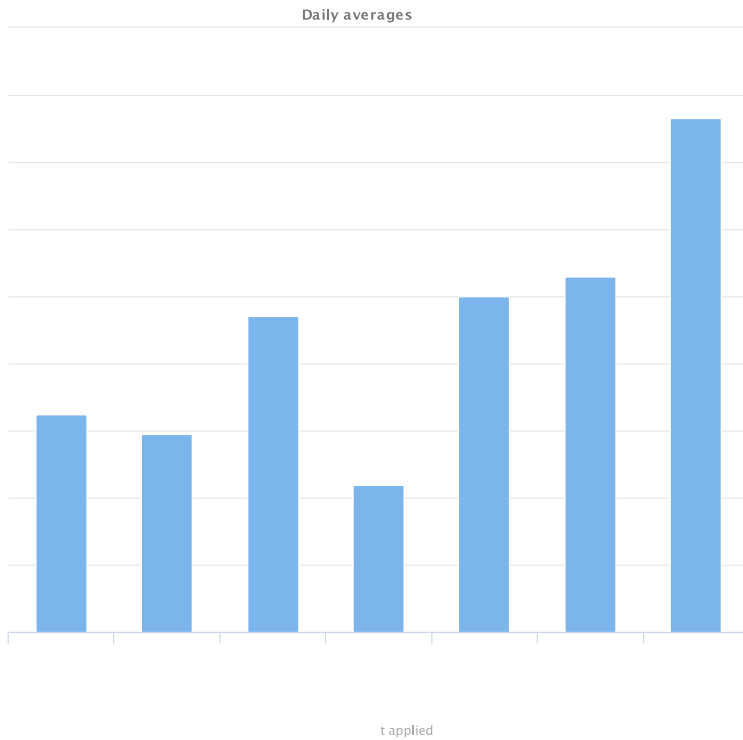


Figure 8 Whitefish Divide and Temperature

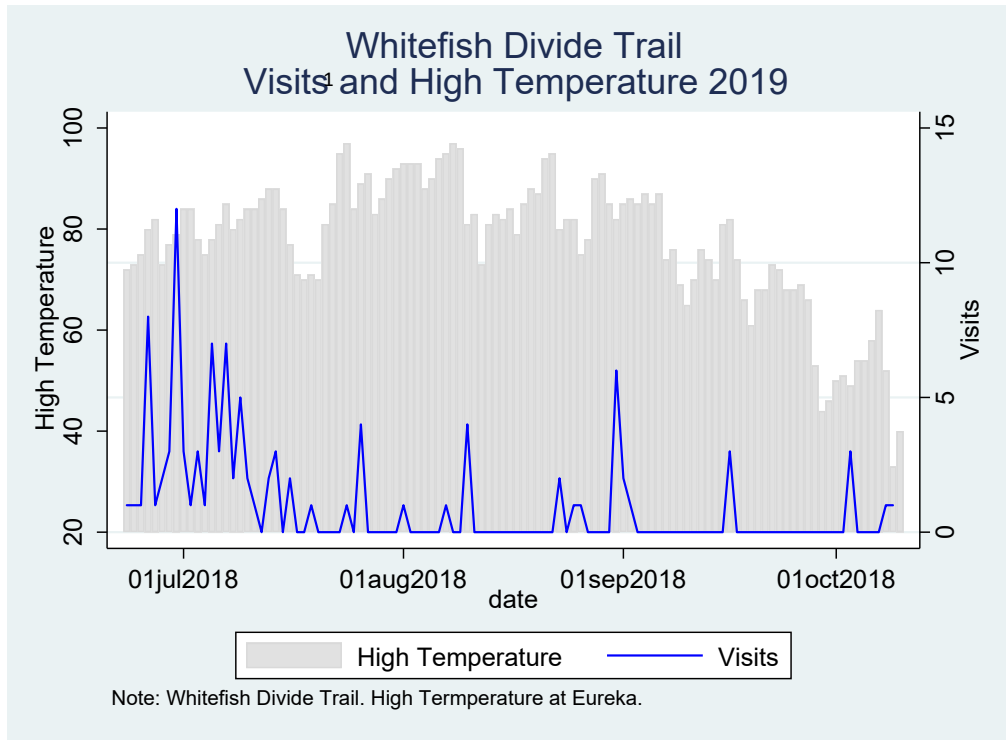


Figure 9 Whitefish Divide and Precipitation

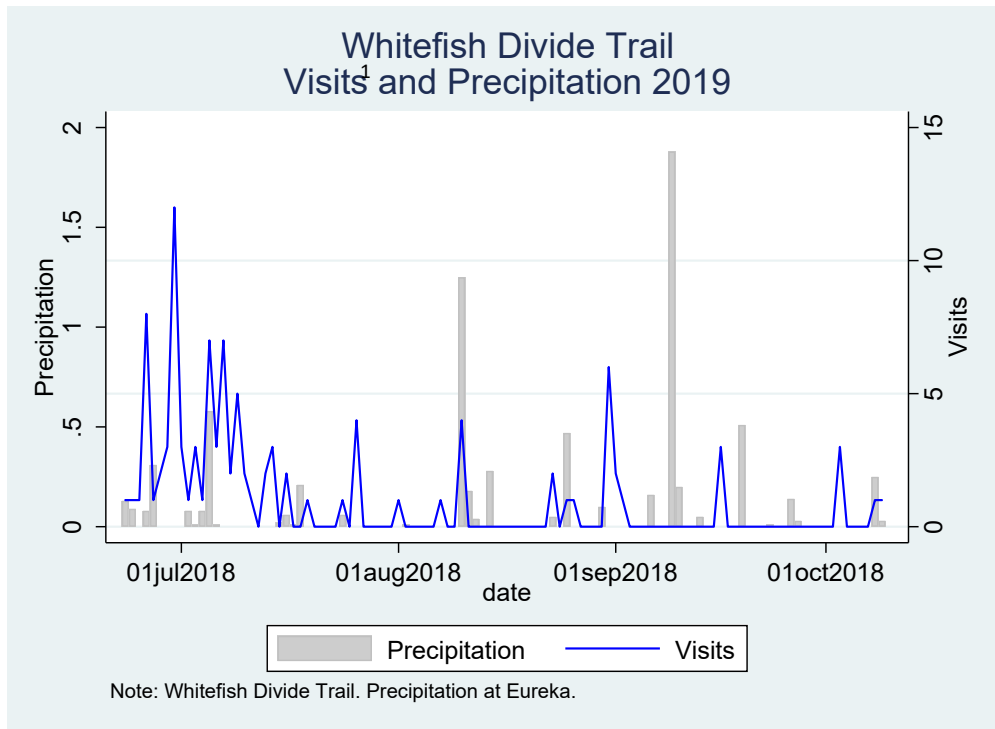
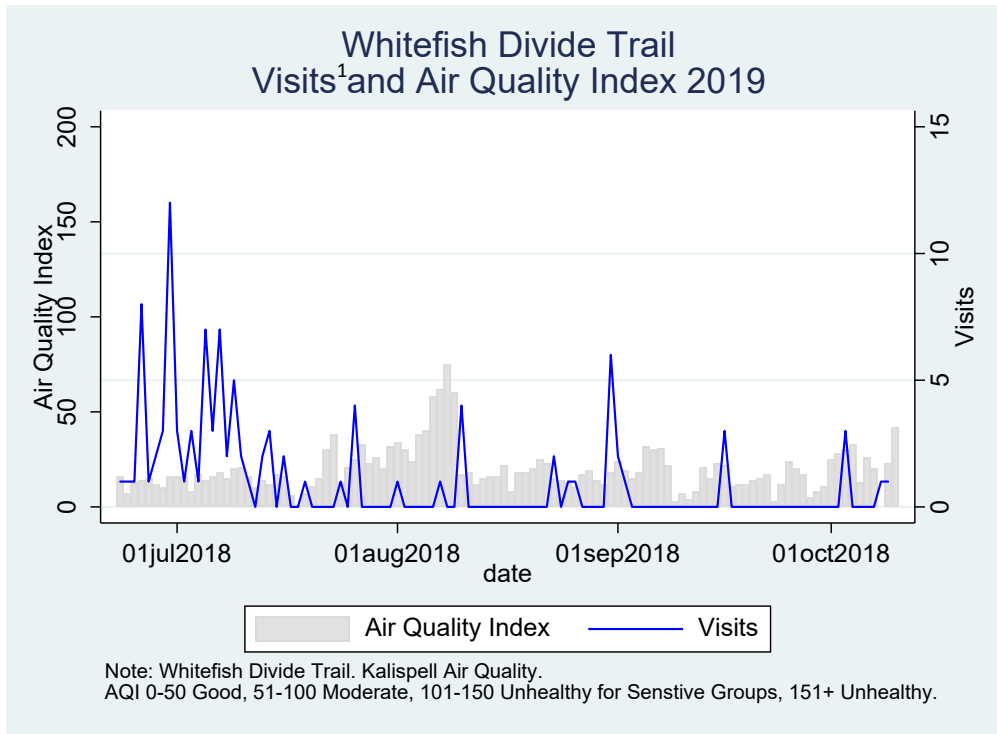


Figure 10 Whitefish Divide and Air Quality



Blue Sky Creek 2019

From June 23, 2019 through October 10, 2019, an estimated 90 trail visits were recorded on Blue Sky Creek Trail. Figure 11 displays the weekly counts from the trail counter at the Blue Sky Creek site. The week of July 8-July 14 experienced the most use, with 14 trail visits. A weekly average of 5.3 trail visits were recorded at the Blue Sky Creek site during the weeks monitored. Figure 12 includes the daily averages from the trail counter at the Blue Sky Creek site. The highest use days were Saturday and Sunday, with an average of 1.2 and 0.9 visitors per day respectively.

Based on camera data, this trail was frequented by day hikers on the weekends, which could account for the higher weekend traffic which is typical of day use patterns. The trail was also frequented by wildlife. Figure 13 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 14 shows counts relative to precipitation levels in Eureka. This data suggests that there is not a strong relationship between precipitation and visitor use of the Blue Sky Creek trail. Figure 15 shows the counts relative to the air quality in Kalispell. This data suggests that trail use does not appear associated with air quality.

Figure 11 Blue Sky Creek Weekly Counts⁴

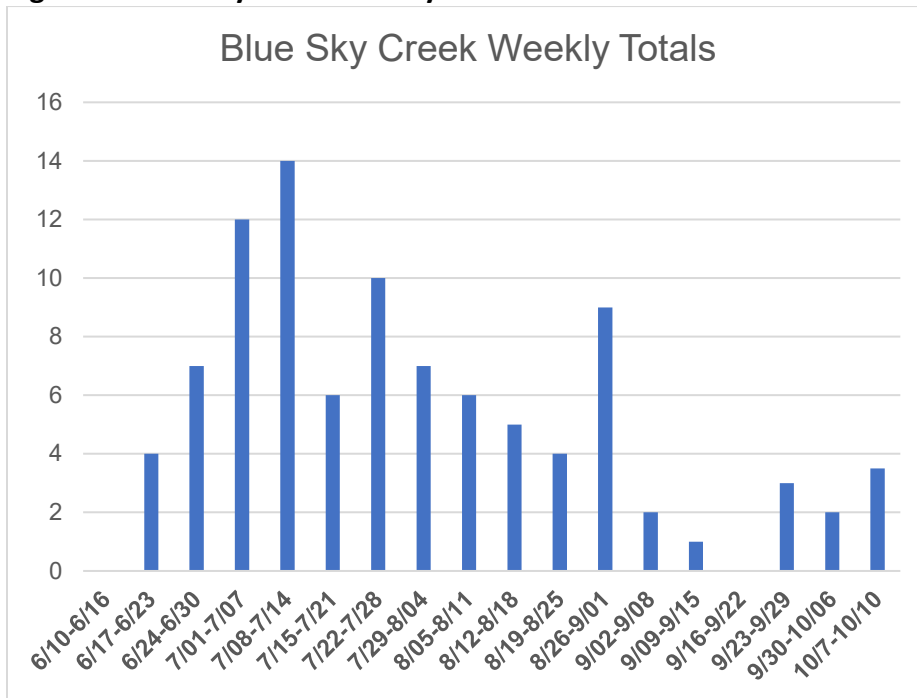
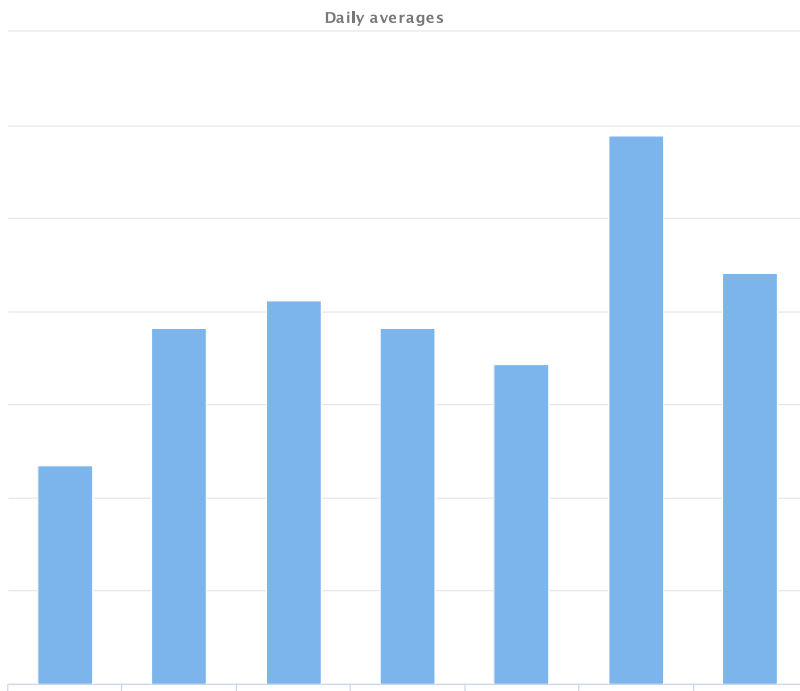


Figure 12 Blue Sky Creek Daily Averages



ed

Figure 13 Blue Sky Creek and Temperature

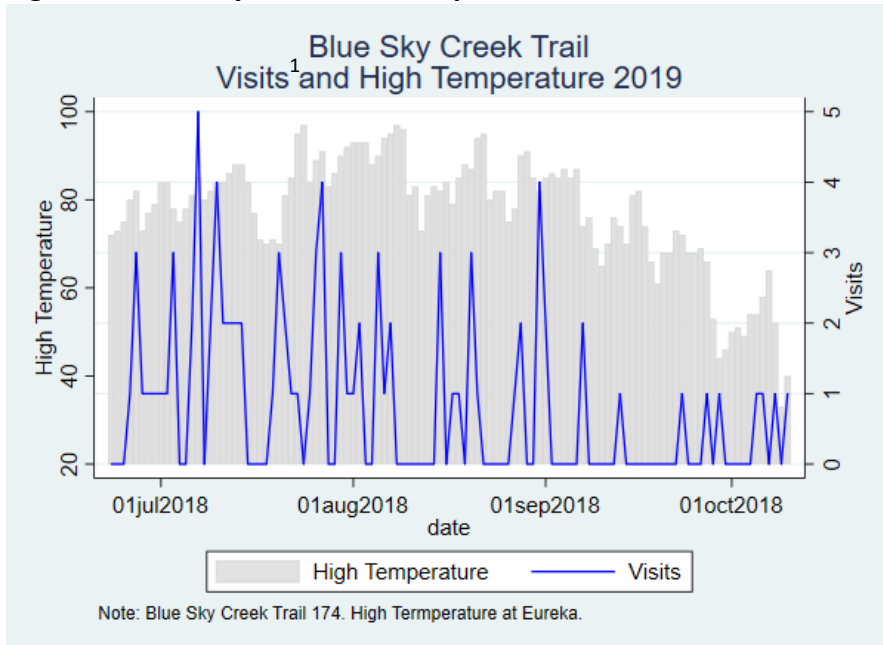


Figure 14 Blue Sky Creek and Precipitation

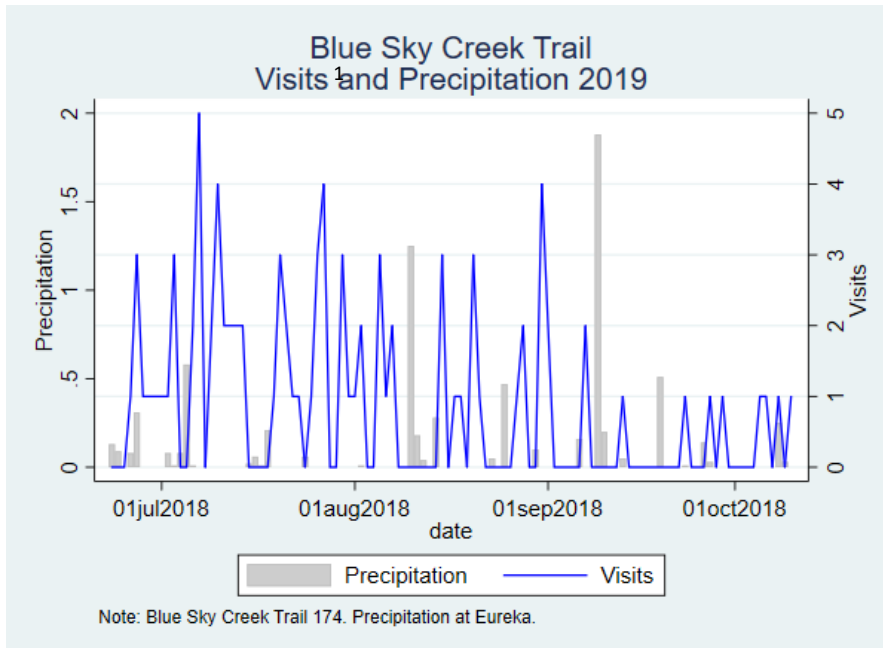
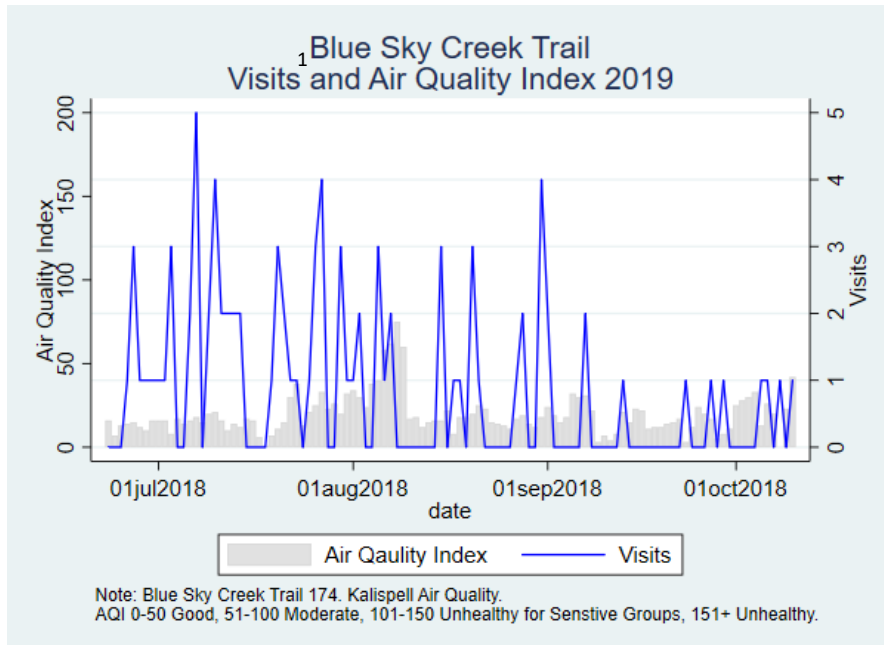


Figure 15 Blue Sky Creek and Air Quality



Bluebird Lake 2019

From July 19, 2019 through October 10, 2019, Bluebird Lake Trail saw 888 estimated hikers. Figure 17 displays the weekly counts from the trail counter at the Bluebird Lake site. The week of July 22 to July 28 experienced the most use, with 158 trail visits. A weekly average of 74.5 trail 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 21.4 and 13.4 trail visits per day 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 17. During the months that Bluebird Lake Trail was monitored, an estimated 1,280 trail visits were recorded on the trail. The day of highest use within the two months was Saturday, July 27th, with 46 trail 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. It is also located relatively close to Whitefish and Kalispell, which have larger populations, and is utilized by Canadian travelers fairly often. Moreover, Bluebird Lake is a scenic area at high elevation, which could make it a trail of high interest among users. Additionally, Bluebird Lake is near a campground that could account for increased trail visits. According to Kootenai National Forest recreation managers, Bluebird Lake was the only trail on Kootenai National Forest identified as “high use” in a 1978 trail inventory. In 2019, Bluebird Lake was the busiest trail monitored, while the trail with the next highest use was Vinal Creek⁹. Figure 18 shows Bluebird Lake counts compared to Vinal Creek.

Based on camera data, this trail was frequented by hikers with dogs, day hikers and users, bike riders and horse riders, which could account for the higher traffic in the month of July and August. However, the calibration factor adjusts for the anomalies of use on the trail.

Figure 19 shows counts as they correspond 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 20 shows counts for the trail counter relative to precipitation levels in Eureka, which does not reveal a strong relationship 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 trail use is not associated with air quality.

⁹ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 16 Bluebird Lake Daily Counts Vs. Vinal Creek¹⁰ Trail Daily Counts⁴

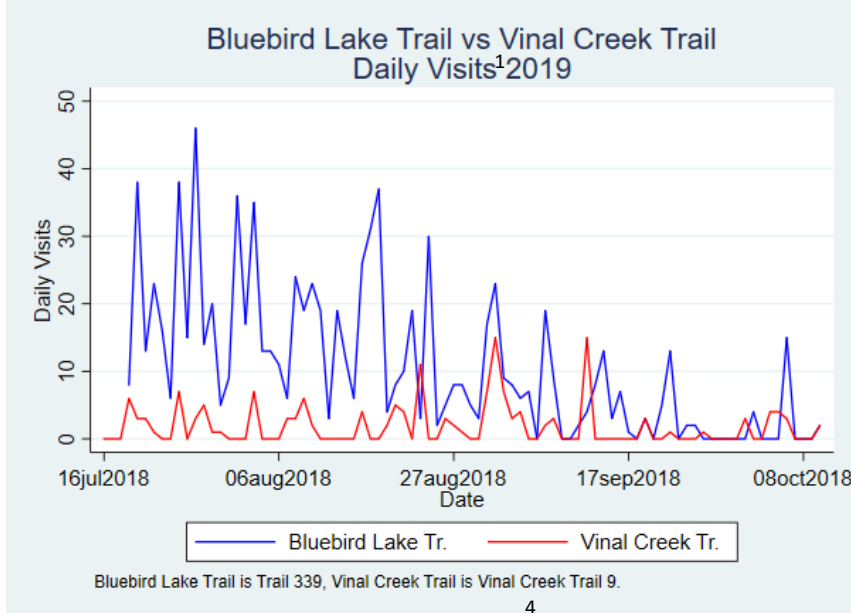
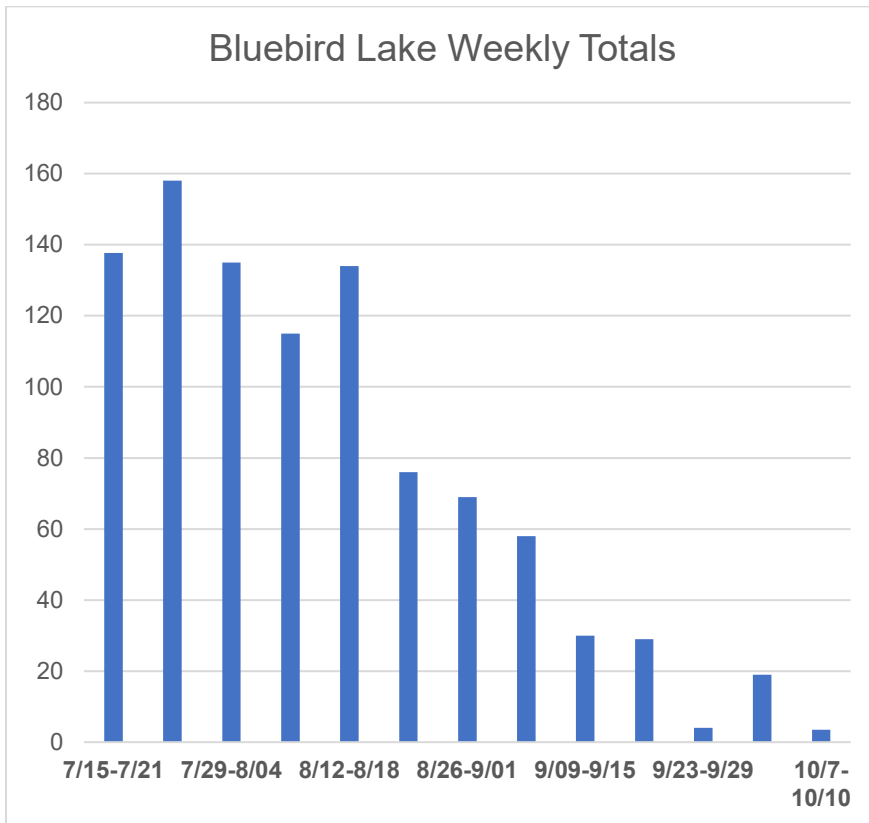


Figure 17 Bluebird Lake Weekly Counts



¹⁰ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 18 Bluebird Lake Daily Averages

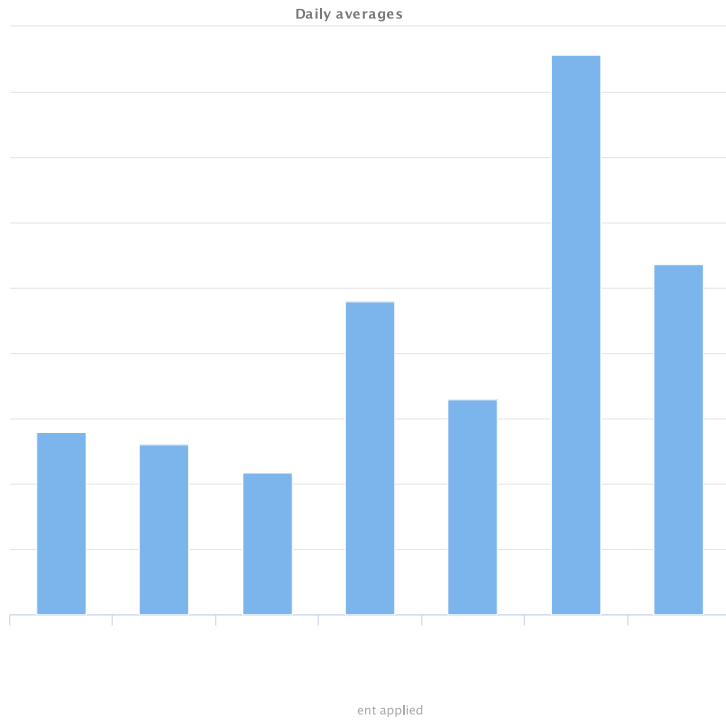


Figure 19 Bluebird Lake and Temperature

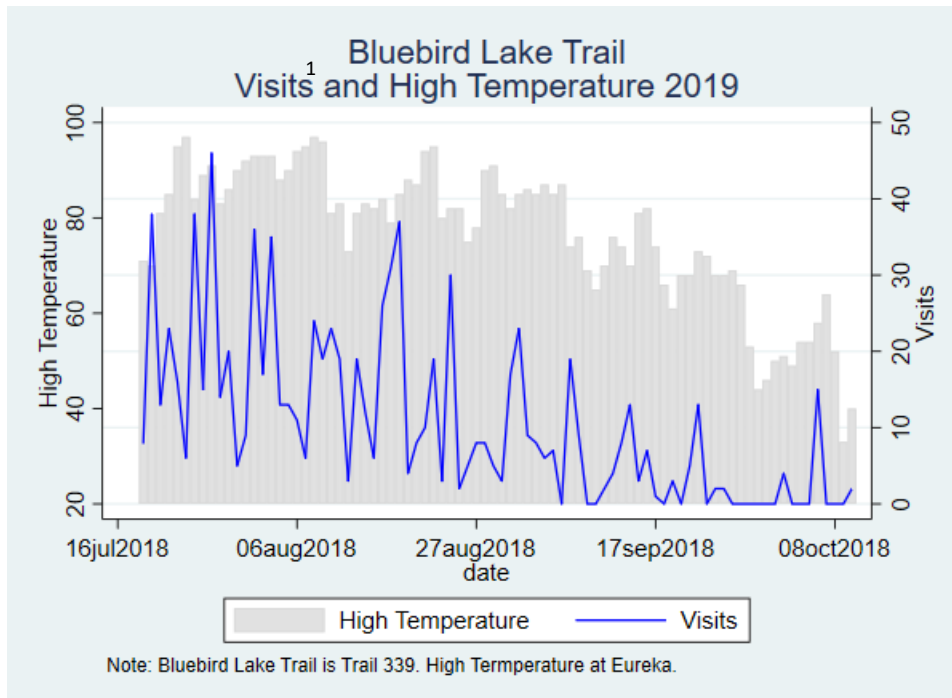


Figure 20 Bluebird Lake and Precipitation

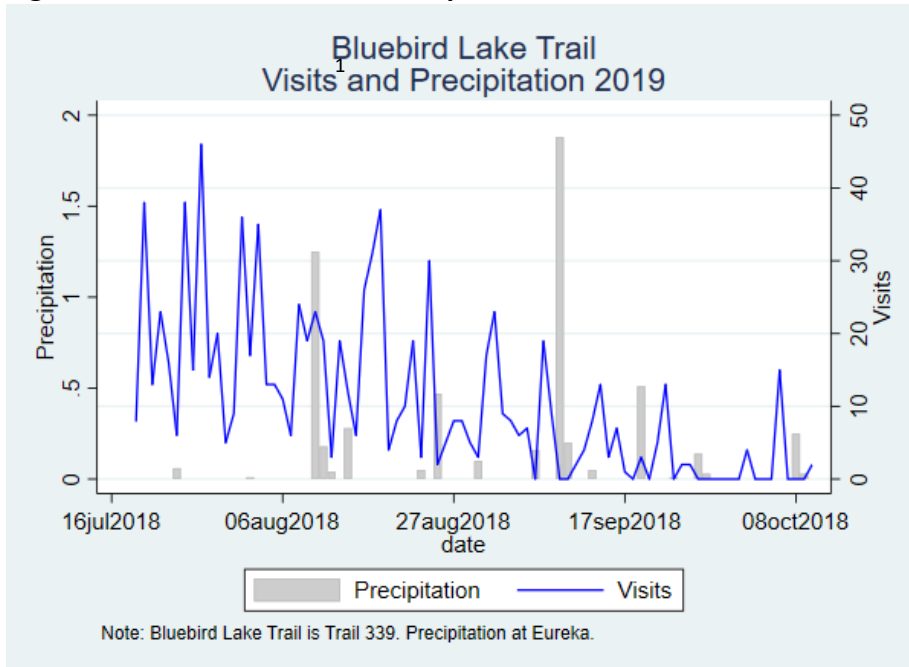
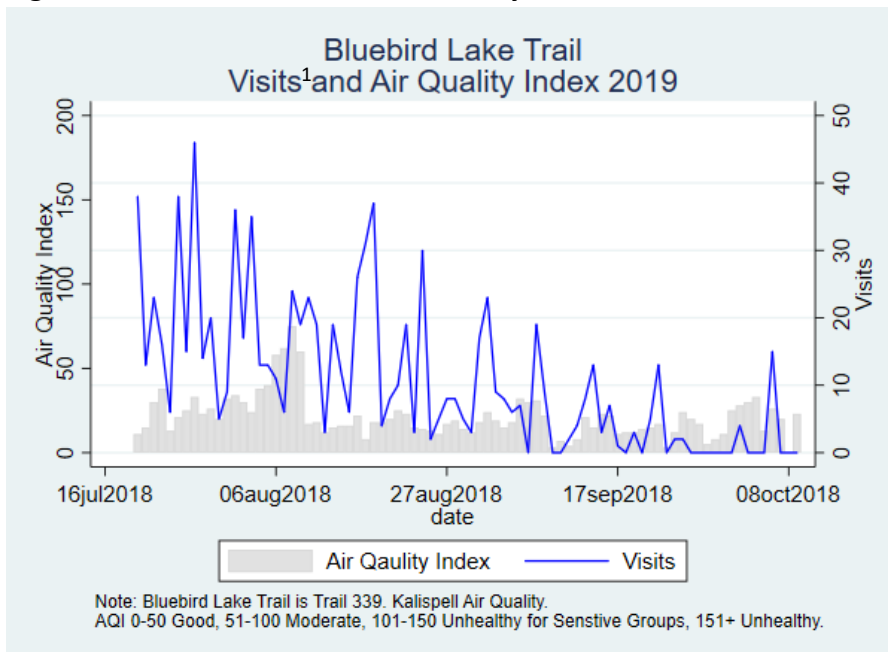


Figure 21 Bluebird Lake and Air Quality



Green Mountain 2019

From July 19, 2019 through October 10, 2019, an estimated 141 trail visits were recorded on the Green Mountain trail. Figure 22 displays the weekly counts from the trail counter on the trail at Green Mountain. The week of July 15 to July 21 experienced the most use, with 37 trail visits. A weekly average of 12.5 trail 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 Thursday and Saturday with an average of 1.5 and 4.3 visitors per day respectively. Based on camera data, this trail was frequented by day hikers, bike riders and horse riders, which could account for the higher weekend traffic. The calibration factor adjusts for these different uses when comparing camera and trail counter data.

Figure 24 shows counts relative to the maximum temperature in Eureka; Figure 25 shows counts as they correspond to precipitation levels in Eureka; Figure 26 shows counts relative to the air quality in Kalispell. This data suggests that there is not a strong relationship between temperature, precipitation, or air quality and visitor use of the Green Mountain trail.

Figure 22 Green Mountain Weekly Counts⁴

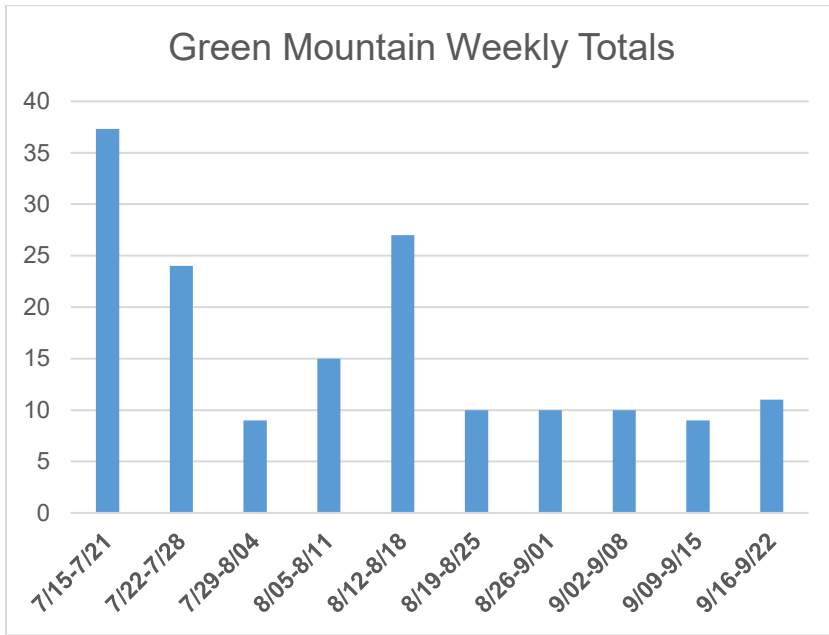


Figure 23 Green Mountain Daily Averages

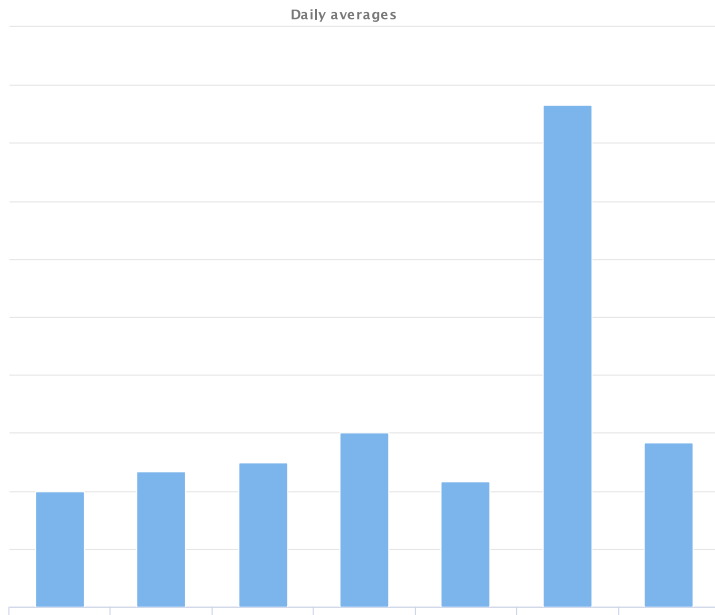


Figure 24 Green Mountain and Temperature

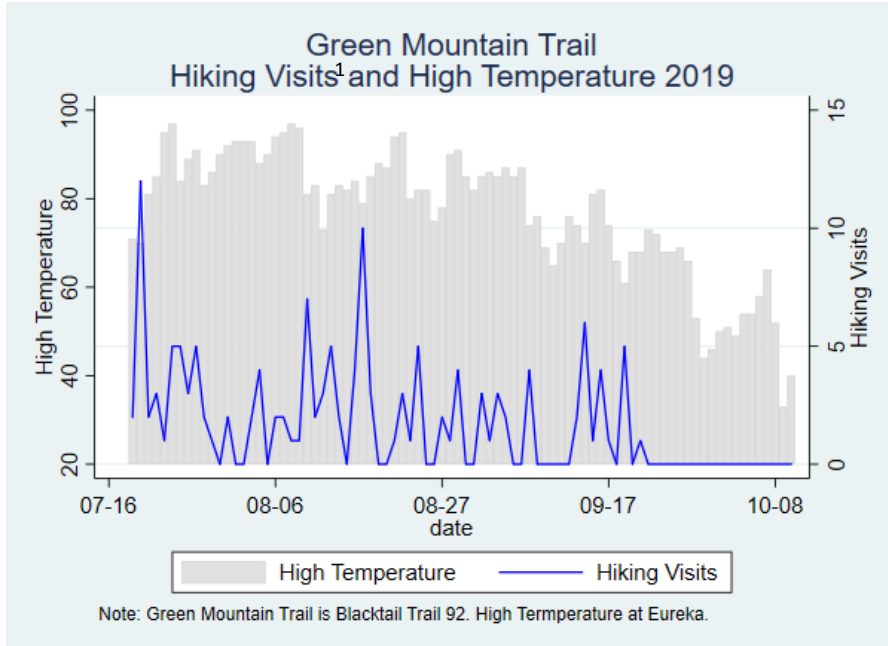


Figure 25 Green Mountain and Precipitation

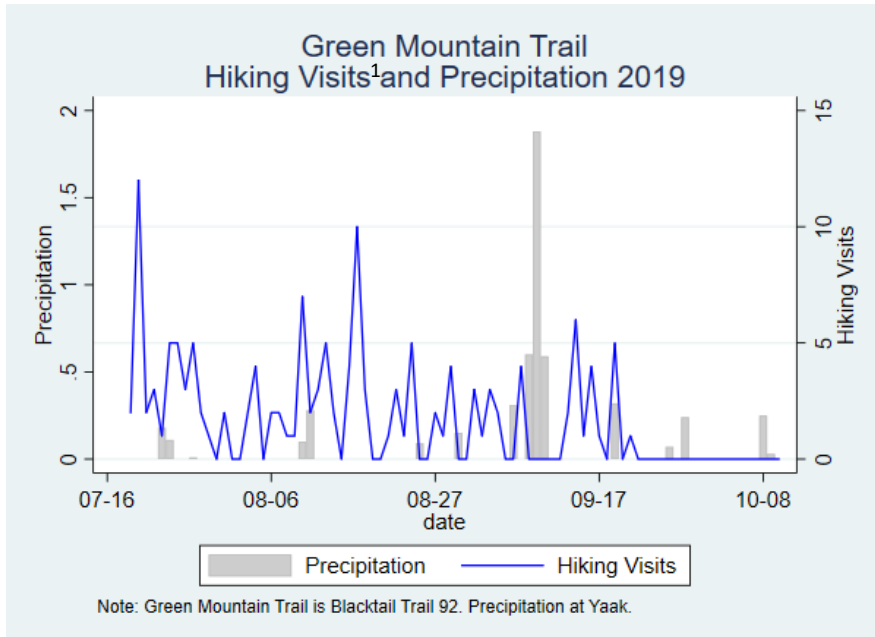
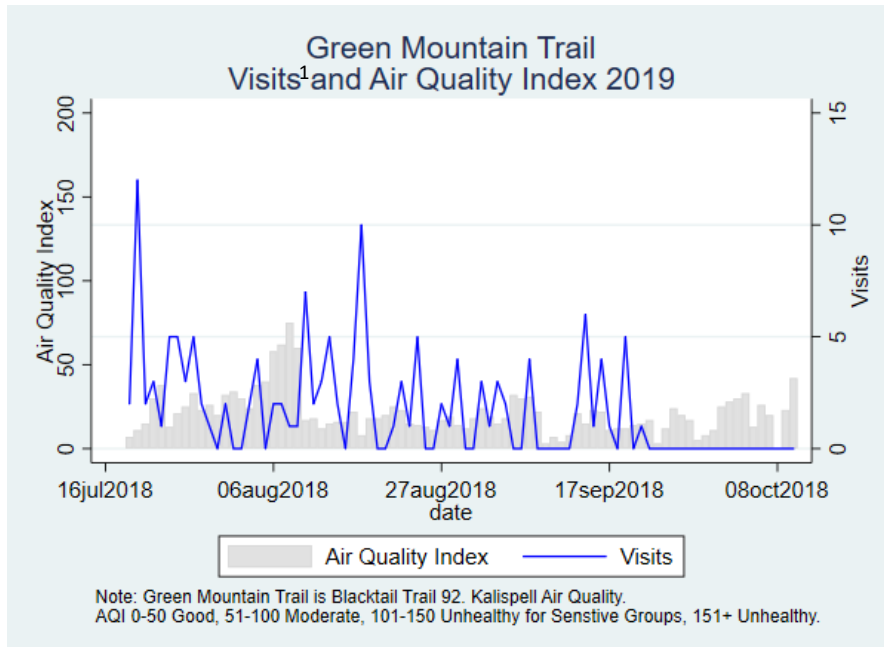


Figure 26 Green Mountain and Air Quality



Boulder Lake 2019

From June 23, 2019 through October 10, 2019 an estimated 241 trail visits were recorded on the Boulder Lake Trail. Figure 27 displays the weekly counts from the trail counter at the Boulder Lake site. The week of July 29 to August 4 experienced the most use, with 44 trail visits. A weekly average of 15 trail visits were recorded at the Boulder Lake site during the weeks monitored. Figure 28 includes the daily averages from the trail counter at the Blue Sky Creek site. The highest use days were Friday and Saturday, with an average of and 3.3 and 3.1 visitors per day respectively. Based on the camera data, the trail was frequented by day use hikers with dogs.

Figure 29 shows counts relative to the maximum temperature in Yaak. This data suggests that temperature is not associated with visitor use. The data Figure 30 shows counts as they correspond 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 31 shows counts relative to the air quality in Libby. This data suggests that there is not a strong relationship between air quality and visitor use of the Boulder Lake trail.

Figure 27 Boulder Lake Weekly Counts⁴

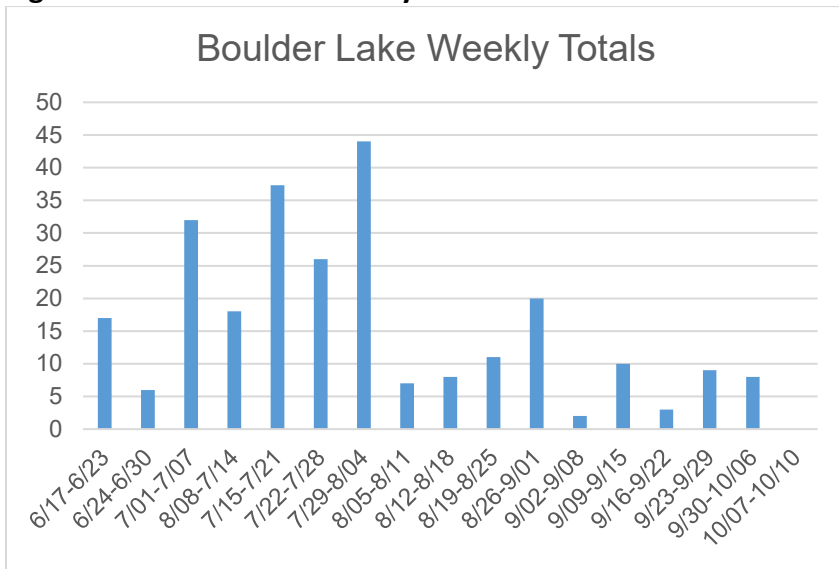


Figure 28 Boulder Lake Daily Averages

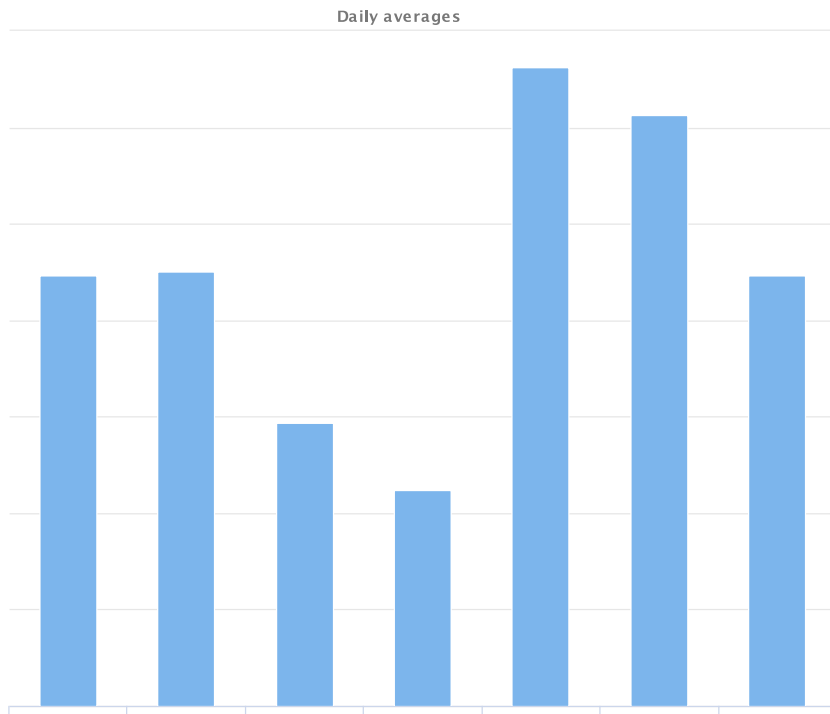


Figure 29 Boulder Lake and Temperature

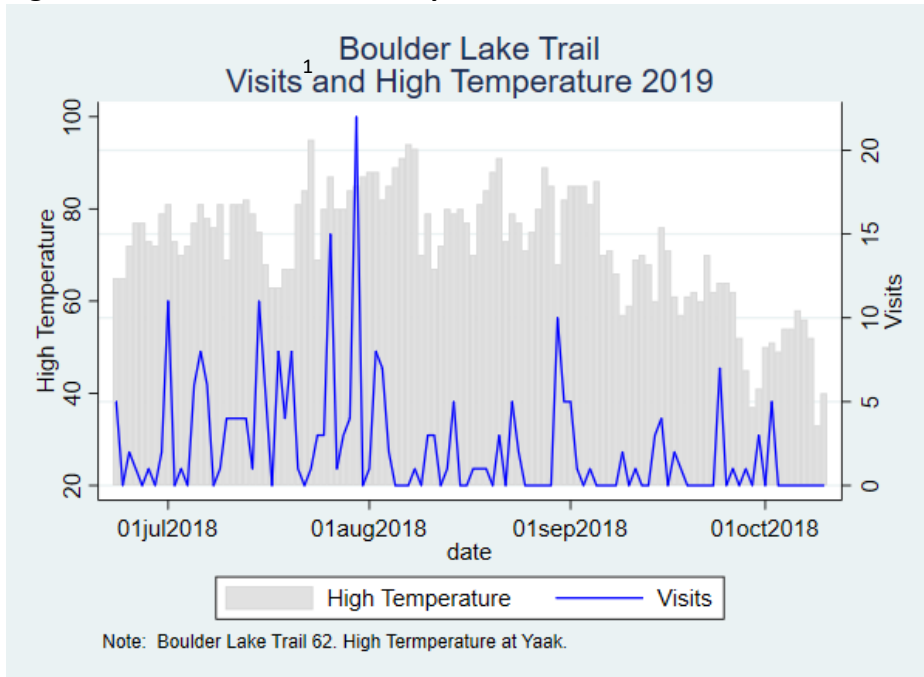


Figure 30 Boulder Lake and Precipitation

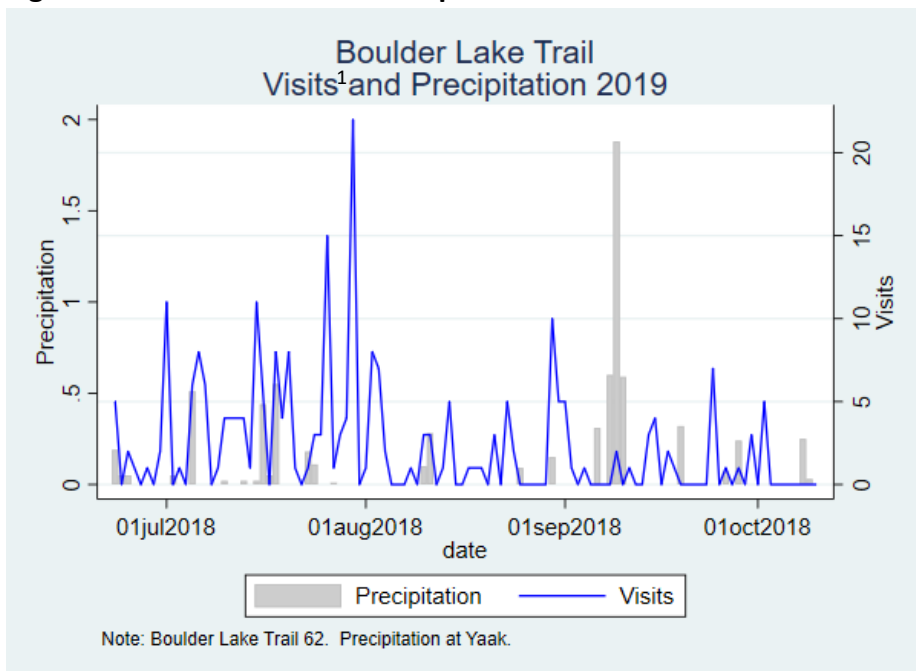
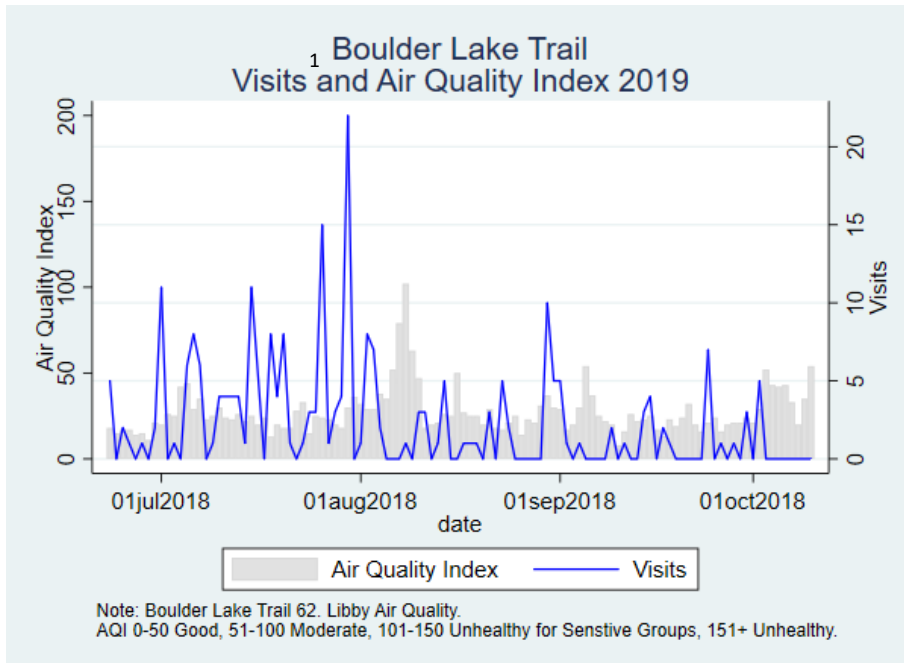


Figure 31 Boulder Lake and Air Quality



Gypsy Meadows 2019

From June 26, 2019 through October 10, 2019 an estimated 74 trail visits were recorded on the Gypsy Meadows Trail. Figure 32 contains the weekly counts from the trail counter at the Gypsy Meadows site. The week of July 15 to July 21 experienced the most use, with 19 trail visits. In a joint decision with USFS, the research team relocated the trail counter on July 15th to a location that was closer to the trailhead. A weekly average of 4.7 trail visits at the Gypsy Meadows site during the weeks monitored. Figure 33 includes the daily averages from the trail counter at Gypsy Meadows. The highest use days were Thursday and Friday, with an average of 1.5 and 1.1 visitors per day respectively. Based on the camera data, the trail was frequented by wildlife, especially in September and October.

Figure 34 shows counts relative to the maximum temperature in Yaak. This data suggests that temperature is not associated with visitor use. The data Figure 35 shows counts as they correspond 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 36 shows counts relative to the air quality in Libby. This data suggests that there is not a strong relationship between air quality and visitor use of the Gypsy Meadows trail.

Figure 32 Gypsy Meadows Weekly Counts⁴

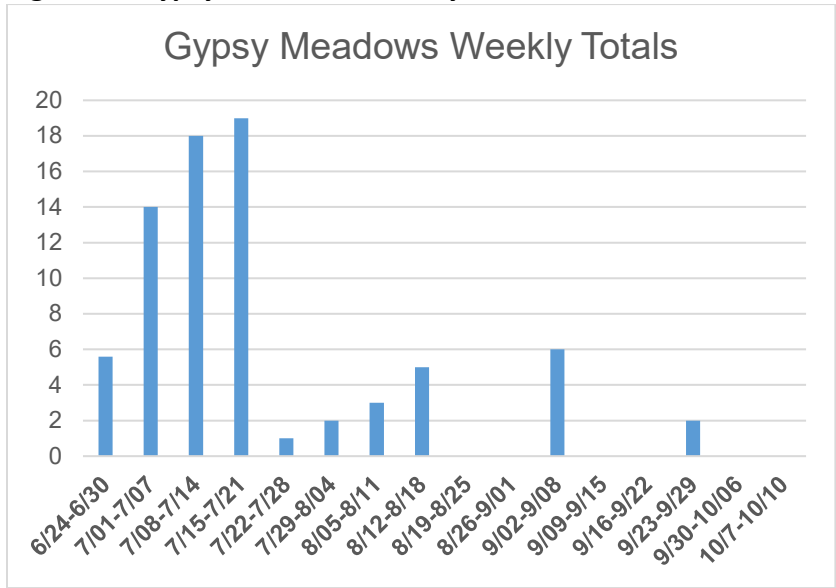


Figure 33 Gypsy Meadows Daily Averages

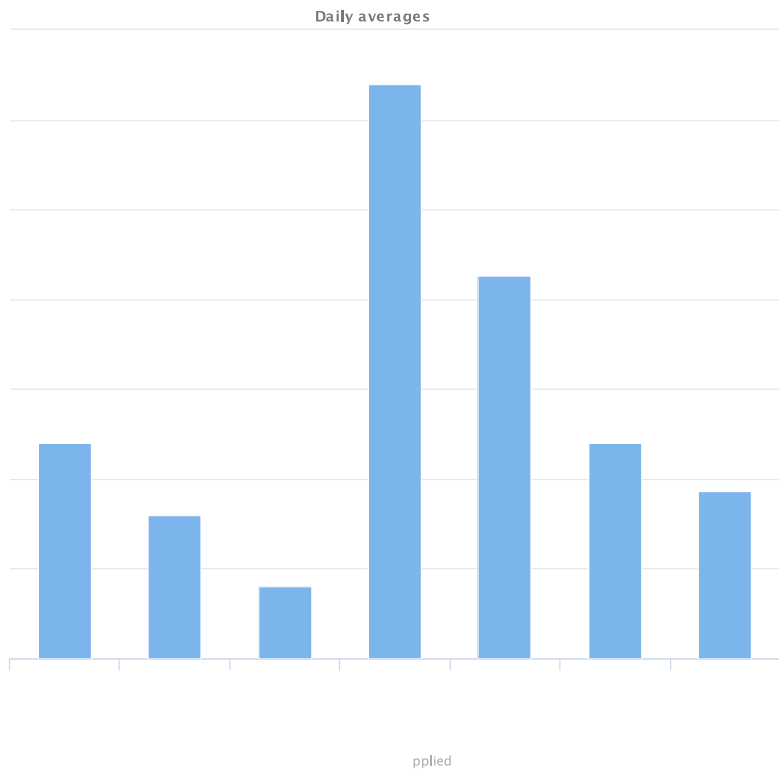


Figure 34 Gypsy Meadows and Temperature

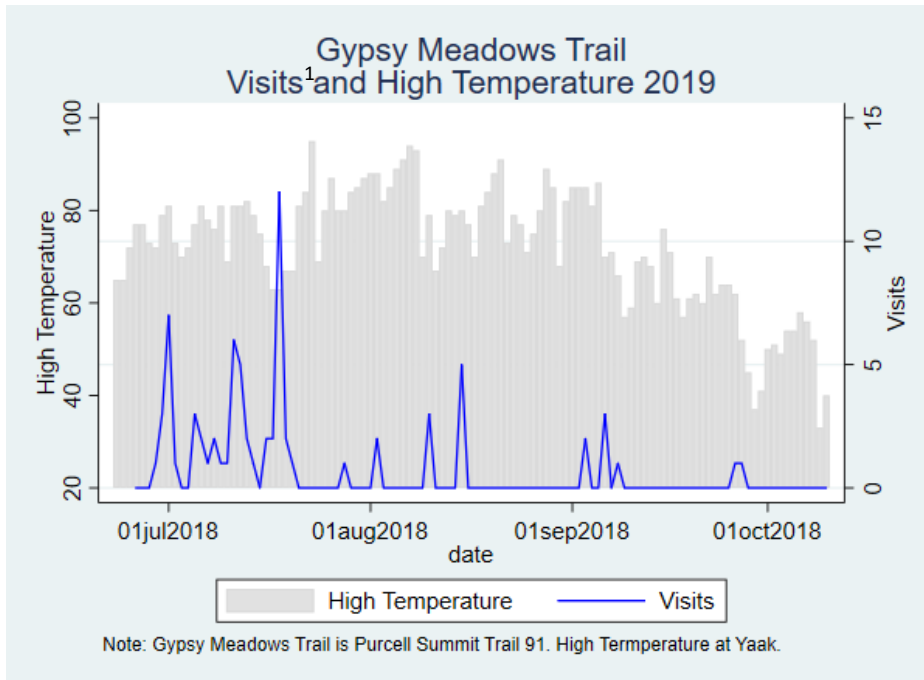


Figure 35 Gypsy Meadows and Precipitation

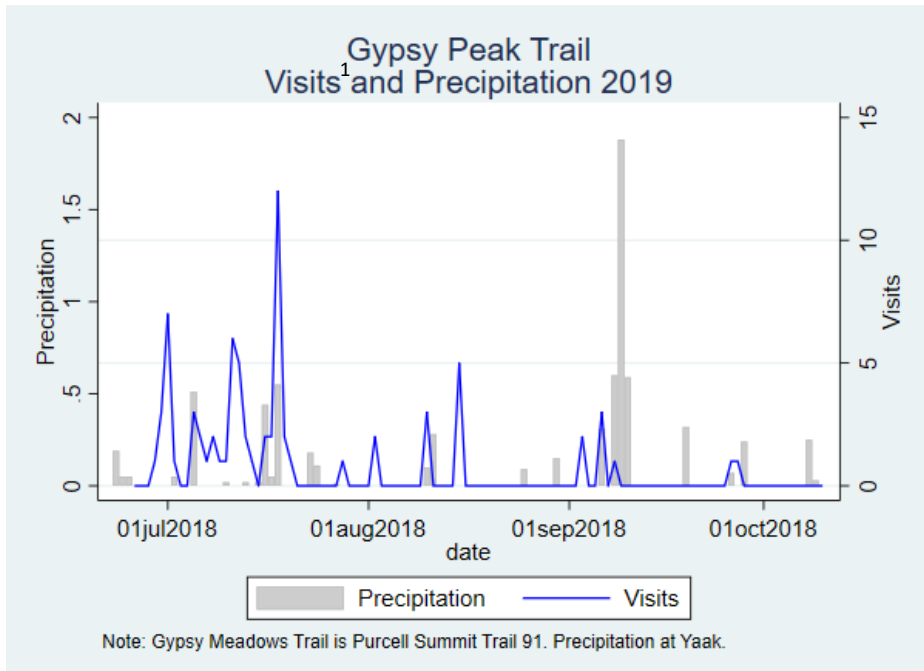
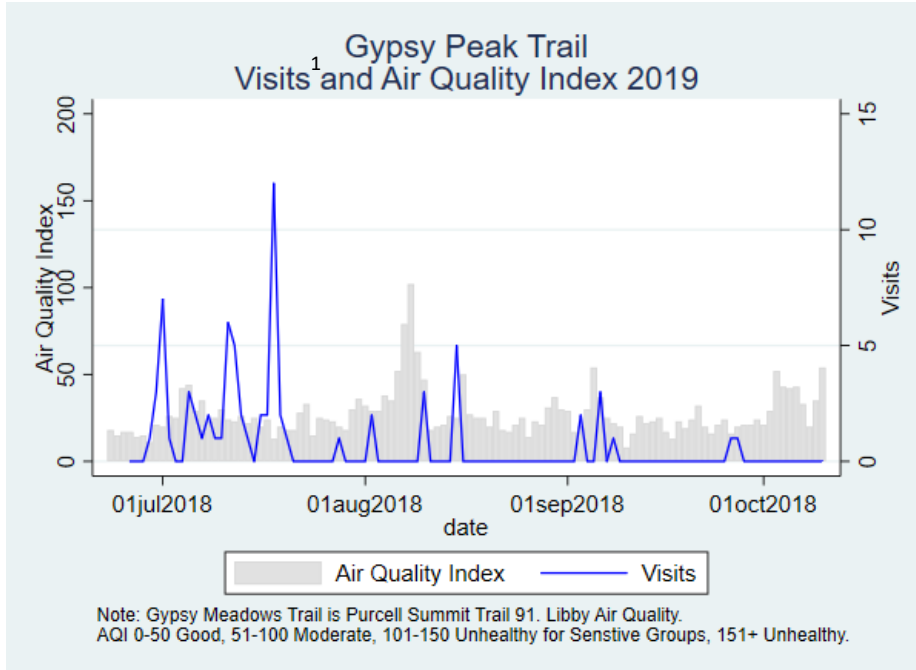


Figure 36 Gypsy Meadows and Air Quality



Vinal Creek 2019

The Vinal Creek monitoring site is not on the PNNST. This monitoring site is instead located on Vinal Creek Trail #9, to the west of where the PNNST is co-located on the 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, as this trail is a more direct route to the town. PNNST hikers may also use this trail to go around a section of the PNNST (Trail #41), in order to circumvent a section 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 project. 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.

From June 23, 2019 through October 10, 2019 an estimated 287 trail visits were recorded on the Vinal Creek Trail. Figure 37 displays the weekly counts from the trail counter at the Vinal Creek site. The week of July 1 to July 7 experienced the most use, with 55 trail visits. A weekly average of 18 trail visits were recorded at the Vinal Creek site during the weeks monitored. Figure 38 includes the daily averages from the trail counter at the Vinal Creek site. The highest use days were Friday, Saturday, and Sunday, with an average of 4.4, 4.9, and 3.1 visitors per day respectively, suggesting an increase in weekend use from day hikers. Based on camera data, this trail was frequented by day hikers and horse riders, which could account for the higher weekend traffic.

Figure 39 shows counts relative to the maximum temperature in Yaak. The pattern in this graph is not suggestive of a strong relationship 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 Libby, which is not associated with visitor use of the Vinal Creek site.

Figure 37 Vinal Creek Weekly Counts¹¹

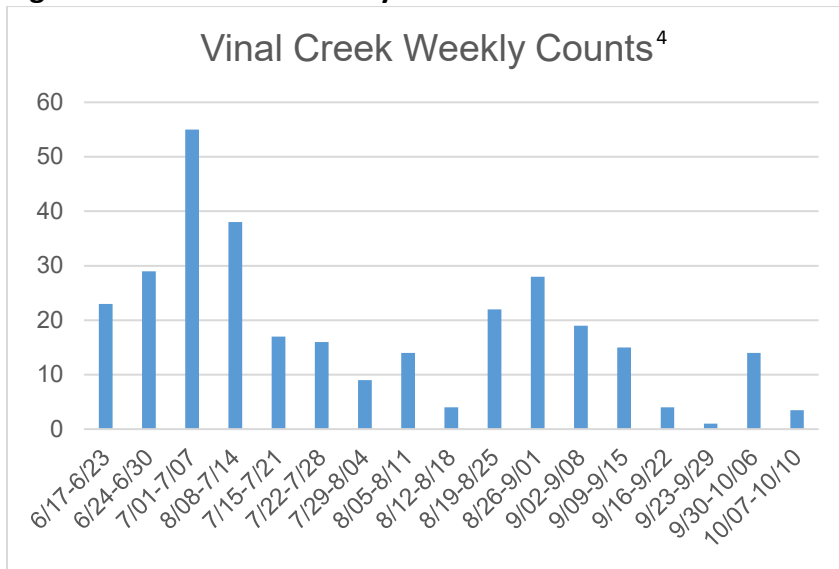
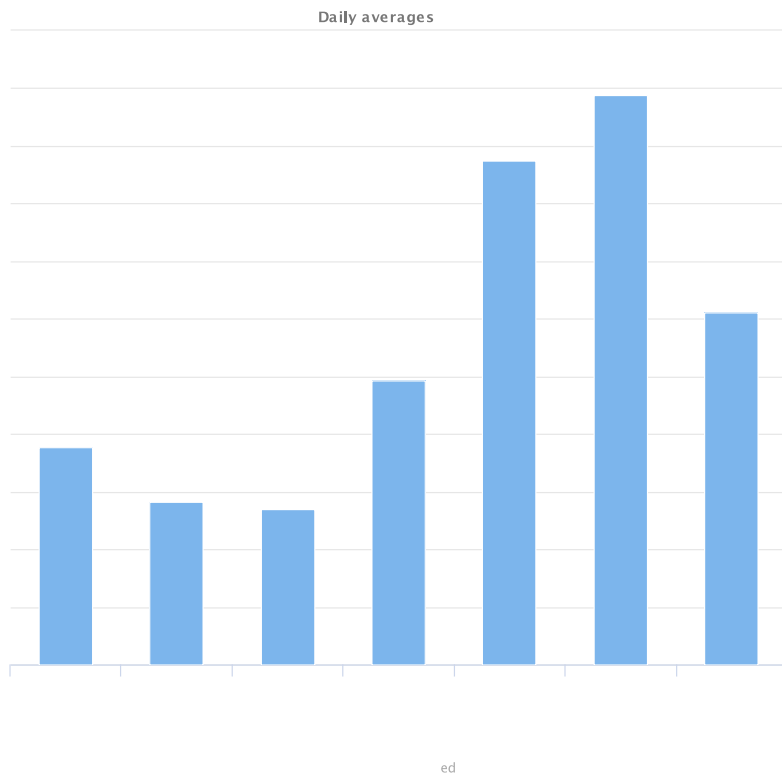


Figure 38 Vinal Creek Daily Averages



¹¹ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 39 Vinal Creek and Temperature¹²

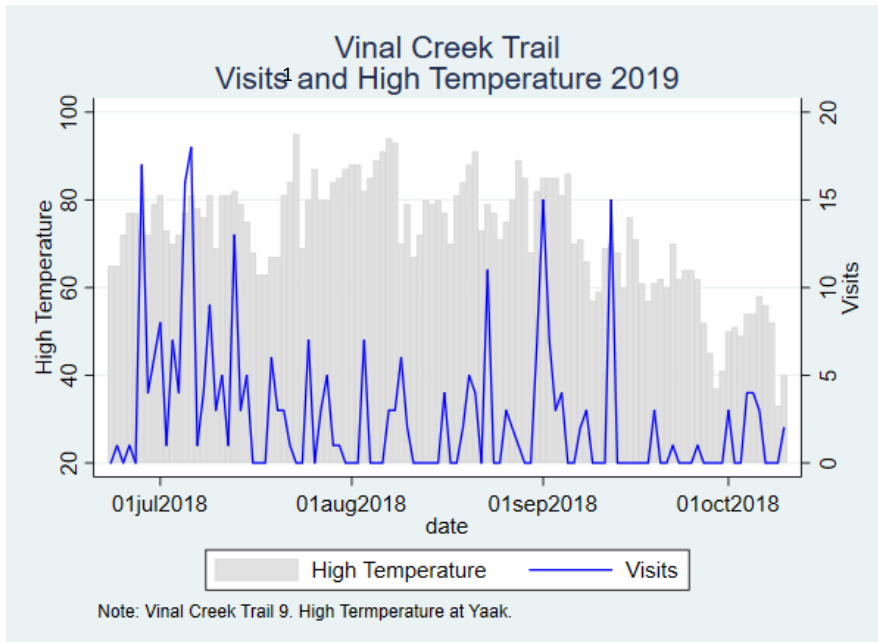
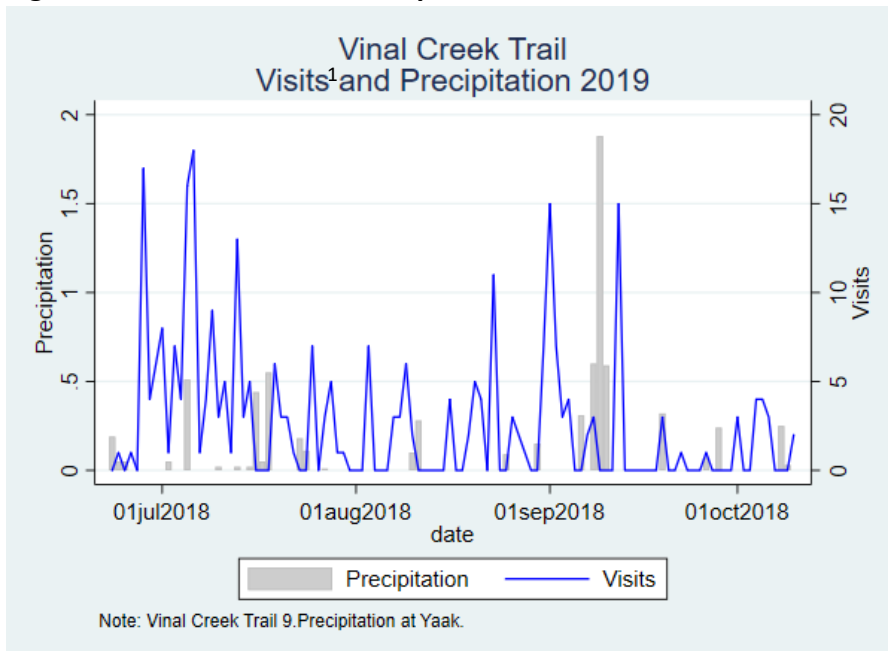
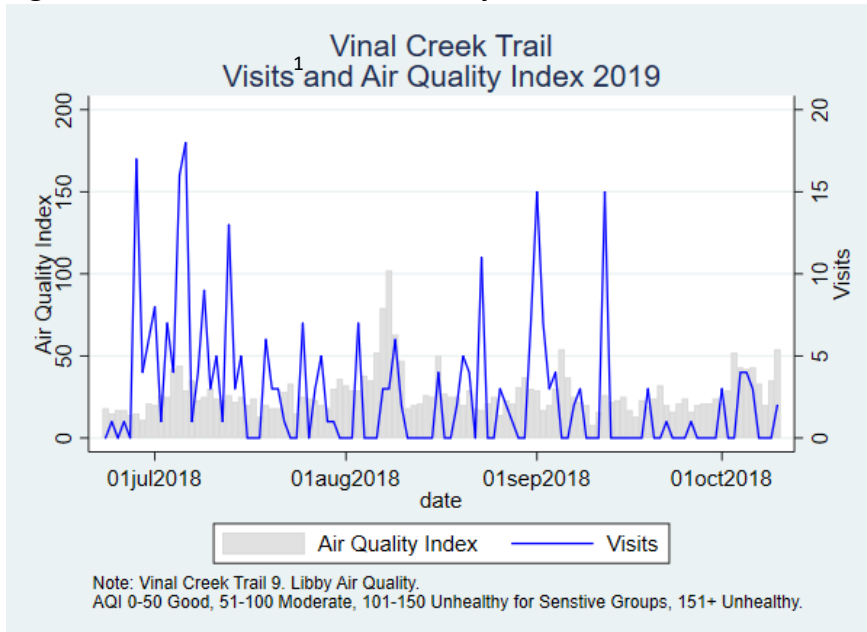


Figure 40 Vinal Creek and Precipitation



¹² The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 41 Vinal Creek and Air Quality¹³



¹³ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Midge Creek 2019

From June 25, 2019 through October 10, 2019 an estimated 103 trail visits were recorded on the Midge Creek Trail. Figure 42 displays the weekly counts from the trail counter at the Midge Creek site. The week of July 1 to July 7 experienced the most use, with 16 trail visits. A weekly average of 5.5 trail visits were recorded at the Midge Creek site during the weeks monitored. Figure 43 includes the daily averages from the trail counter at the Midge Creek site. The highest use days were Tuesday and Sunday, with an average of 1.4 and 1.0 visitors per day respectively. The camera recorded several trail crew members going up and down the trail.

Figure 44 shows counts relative to the maximum temperature in Yaak. The pattern in this graph is not suggestive of a relationship between visitor use and high temperature. Figure 45 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 46 shows the counts for this trail counter relative to the air quality in Libby. This data suggests that air quality could be associated with low use on this trail. The moderate spike in air quality to an unhealthy level does overlap with a time when lower counts were observed on the trail. It is unclear what the source of this poor air quality is; however, it is possible that hikers avoided this trail when air quality was unhealthy.

Figure 42 Midge Creek Weekly Counts⁴

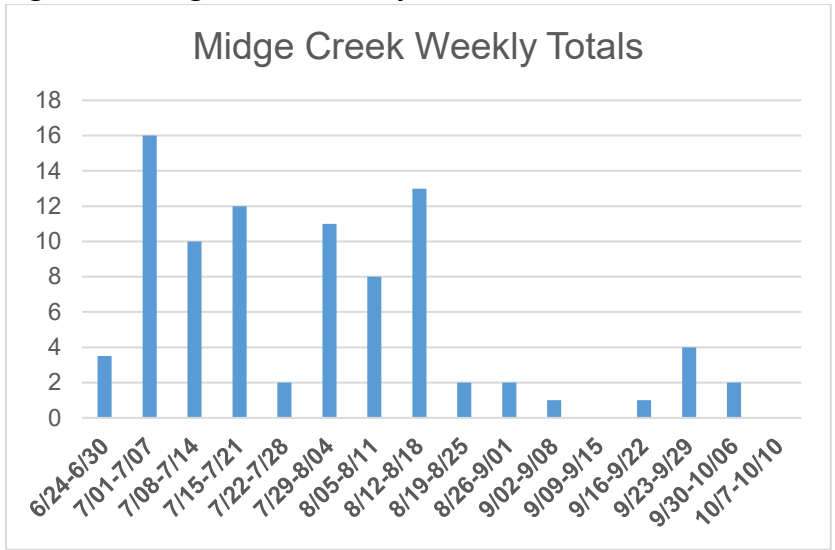


Figure 43 Midge Creek Daily Averages

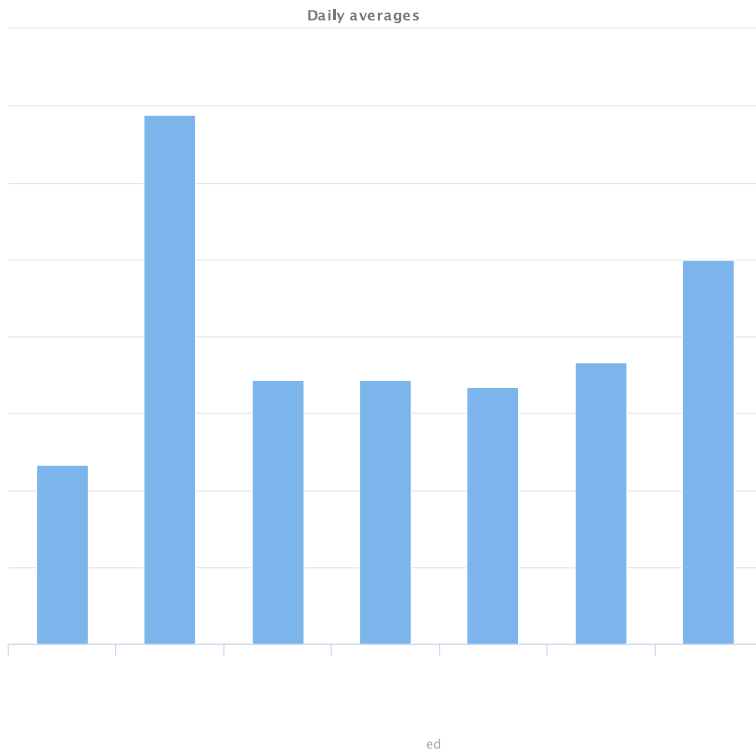


Figure 44 Midge Creek and Temperature

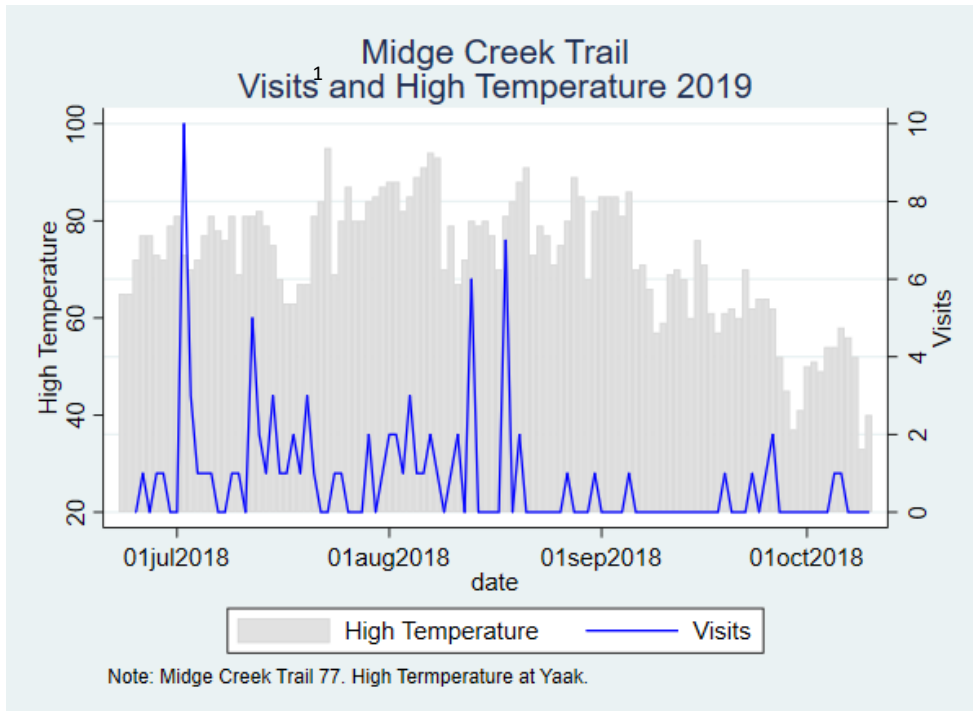


Figure 45 Midge Creek and Precipitation

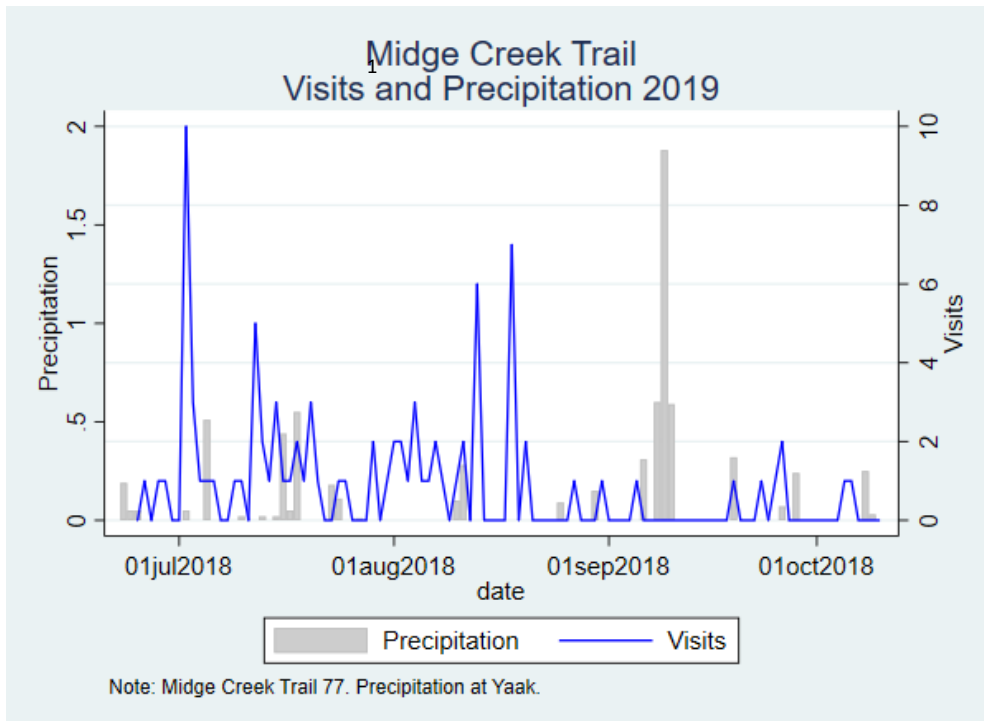
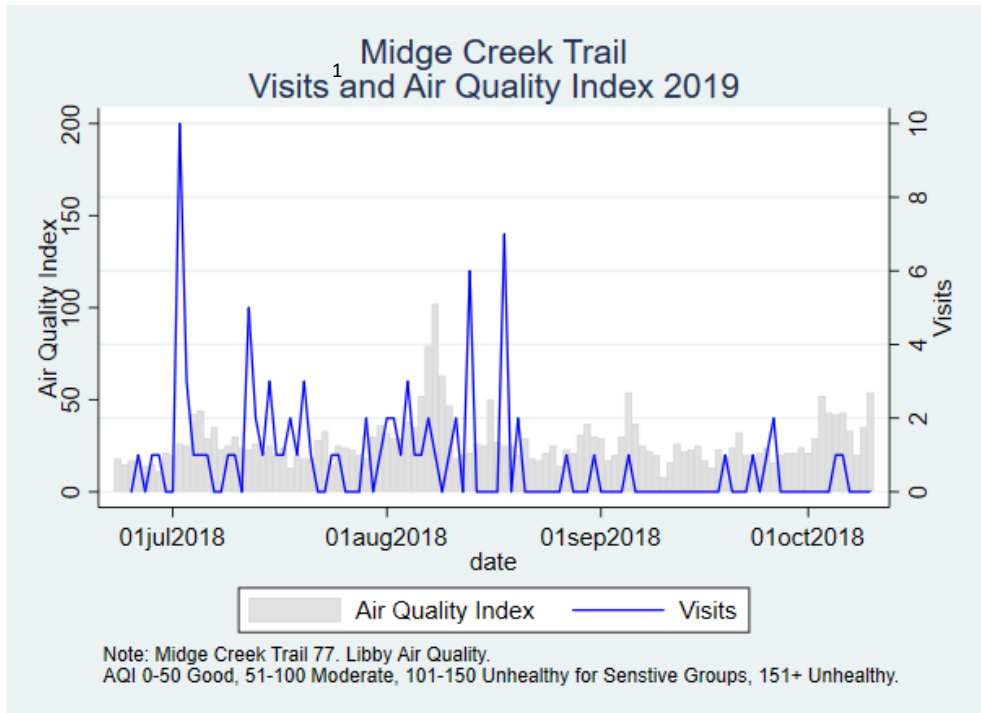


Figure 46 Midge Creek and Air Quality



Garver Mountain 2019

From June 25, 2019 through October 10, 2019 an estimated 67 trail visits were recorded on the trail. Figure 47 contains the weekly counts from the trail counter at the Garver Mountain site. The week of July 8 to July 14 experienced the most use, with 17 trail visits. A weekly average of 4.3 trail visits were recorded at the Garver Mountain site during the weeks monitored. Figure 48 includes the daily averages from the trail counter at the Garver Mountain site. The highest use days were Thursday and Sunday with an average of 1.3 and 1.1 visitors each day.

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. 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 51 shows the counts as they correspond to the air quality in Libby. This data suggests that air quality does not have a strong association with trail use.

Figure 47 Garver Mountain Weekly Counts⁴

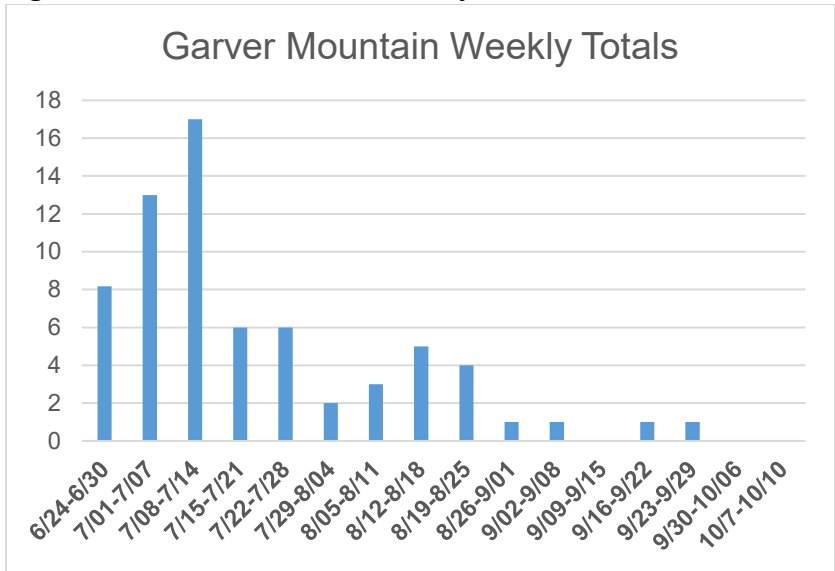


Figure 48 Garver Mountain Daily Averages

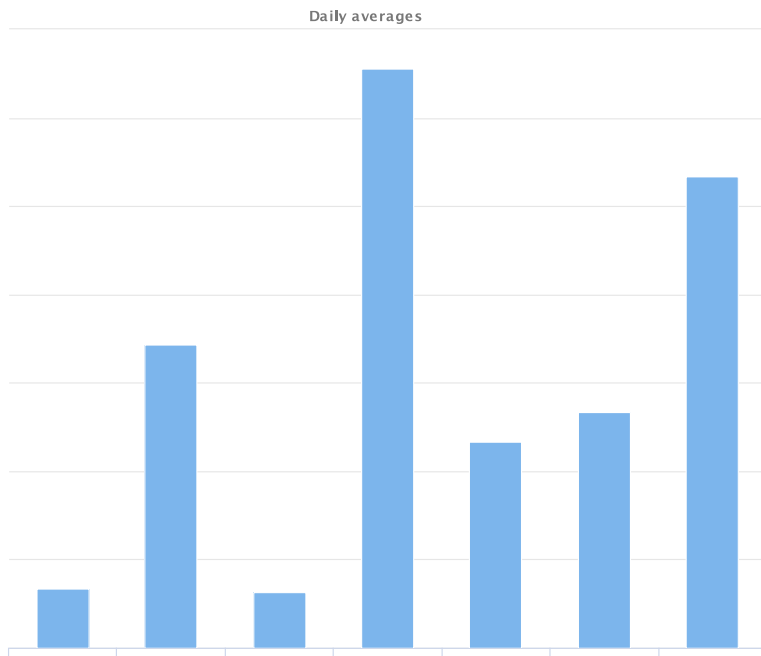


Figure 49 Garver Mountain and Temperature

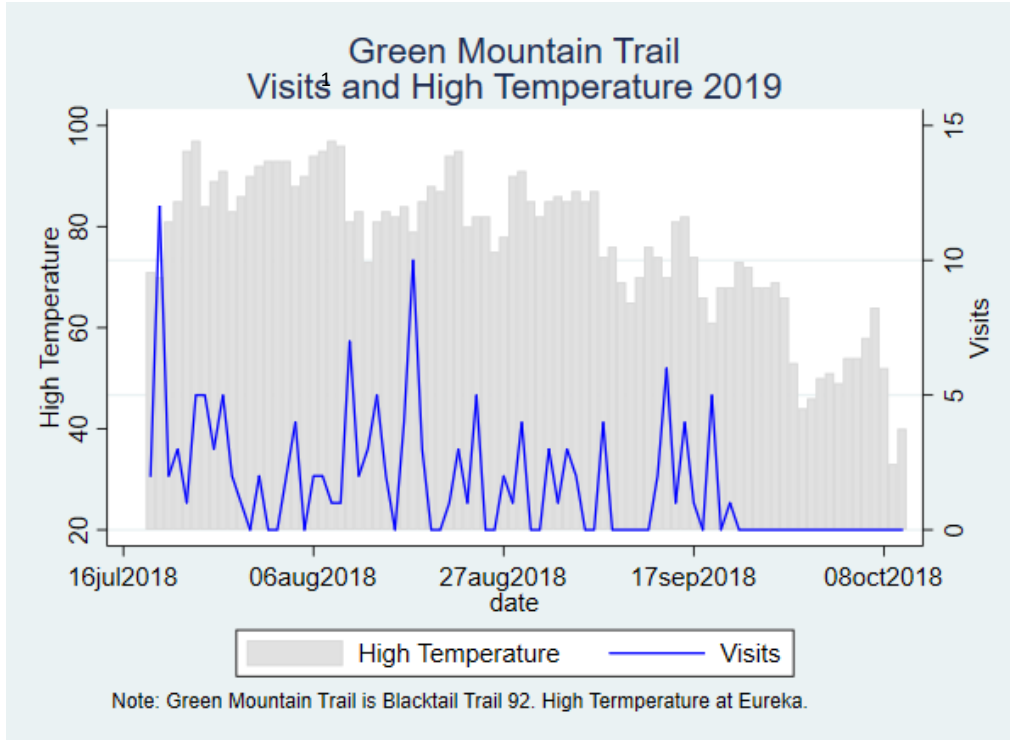


Figure 50 Garver Mountain and Precipitation

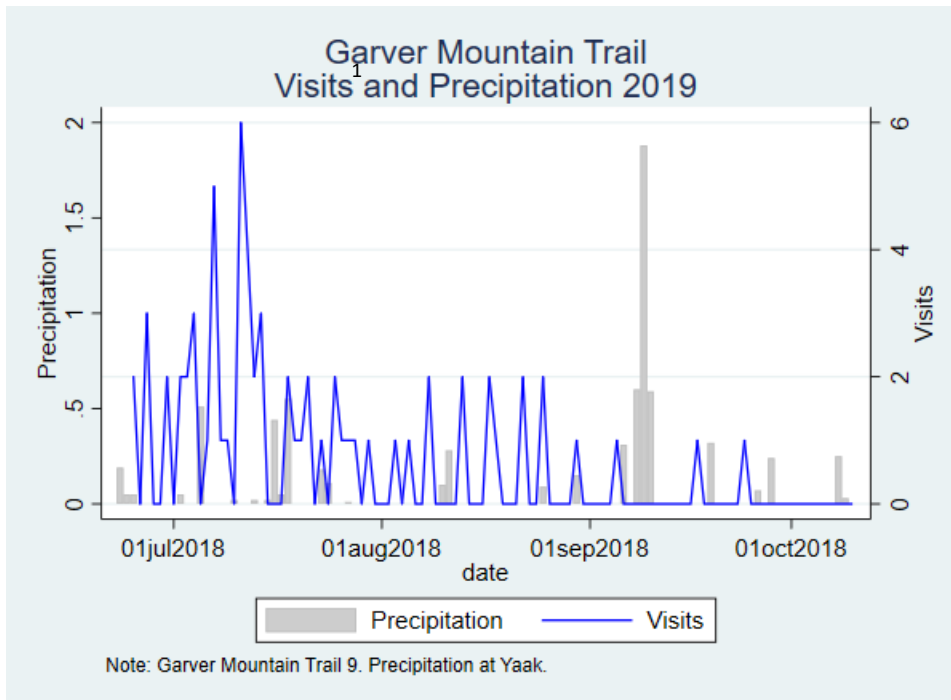
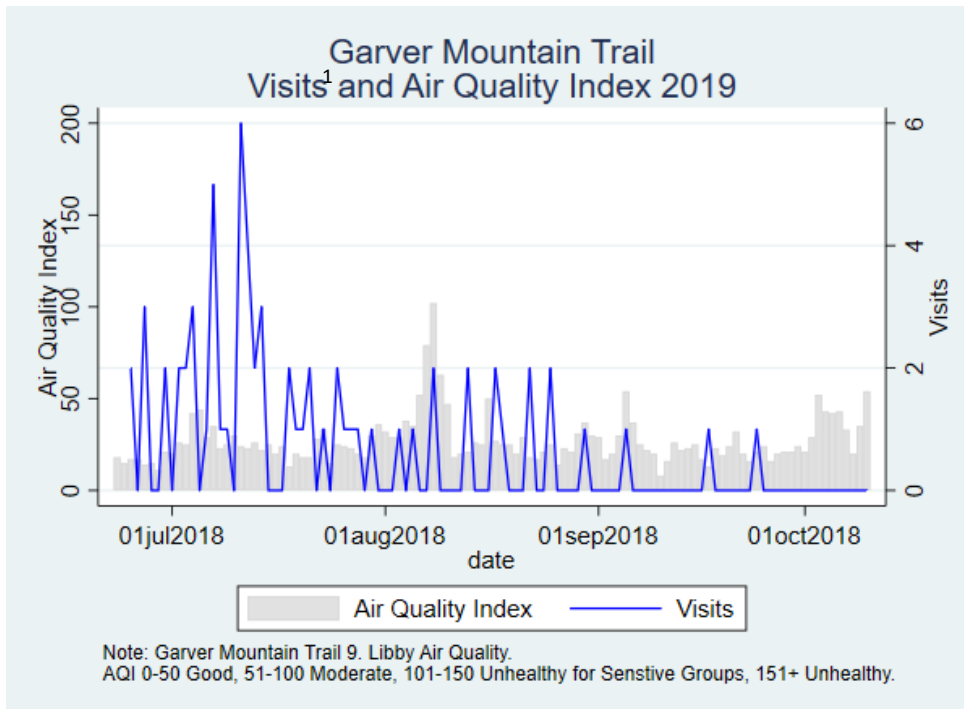


Figure 51 Garver Mountain and Air Quality



Canuck Peak 2019

From June 26, 2019 through October 10, 2019 an estimated 75 trail visits were recorded on the Canuck Peak Trail. Figure 52 displays the weekly counts from the trail counter at the Canuck Peak site. The week of August 5 to August 11 experienced the most use, with 15 trail visits. A weekly average of 4.9 trail 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 Wednesdays and Saturdays, with an average of 1.2 and 1.0 trail visits respectively. Based on the camera data, the trail was frequented by horse riders.

Figure 54 shows counts relative to the maximum temperature in Yaak. The pattern in this graph is not suggestive of a relationship between visitor use and high temperature. Figure 55 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 56 shows the counts as they correspond to the air quality in Libby. This data suggests that air quality does not have a strong association with trail use.

Figure 52 Canuck Peak Weekly Counts⁴

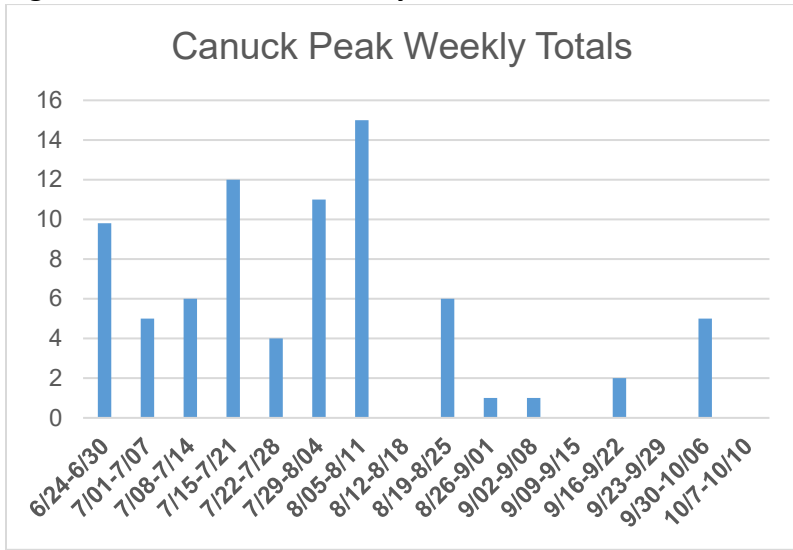


Figure 53 Canuck Peak Daily Averages

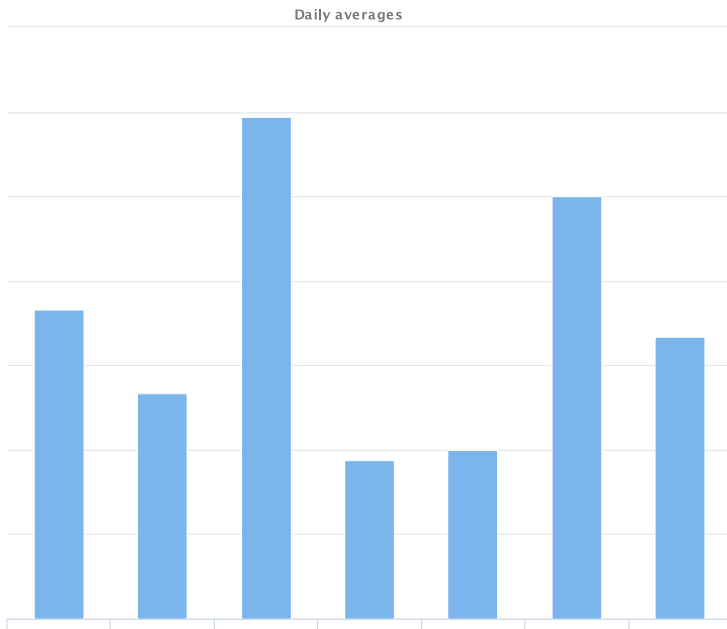


Figure 54 Canuck Peak and Temperature

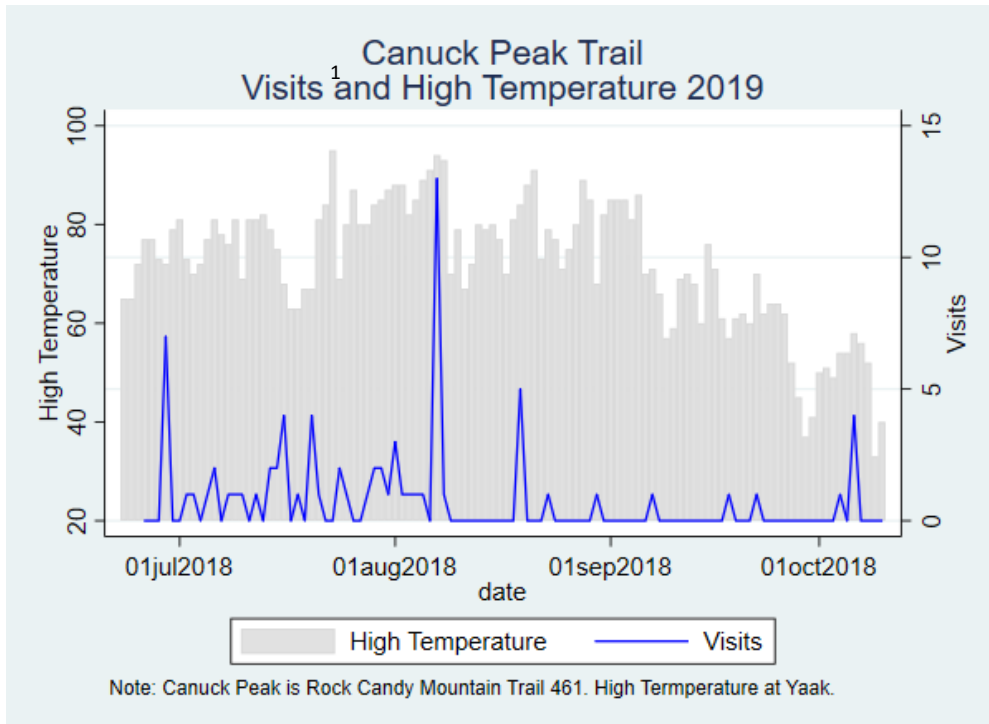


Figure 55 Canuck Peak and Precipitation

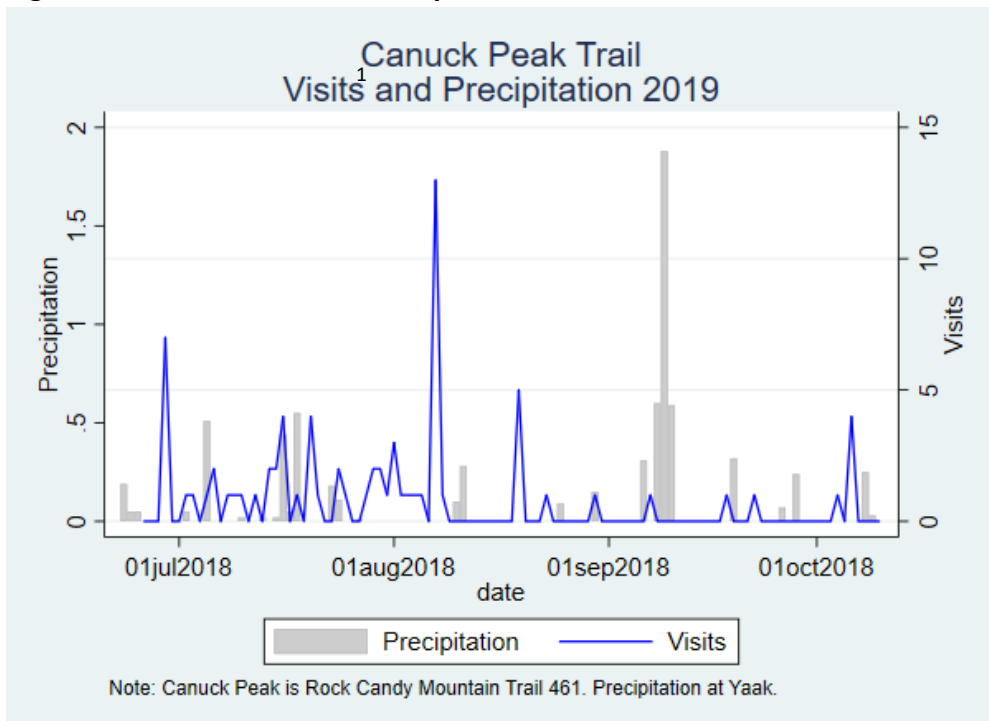
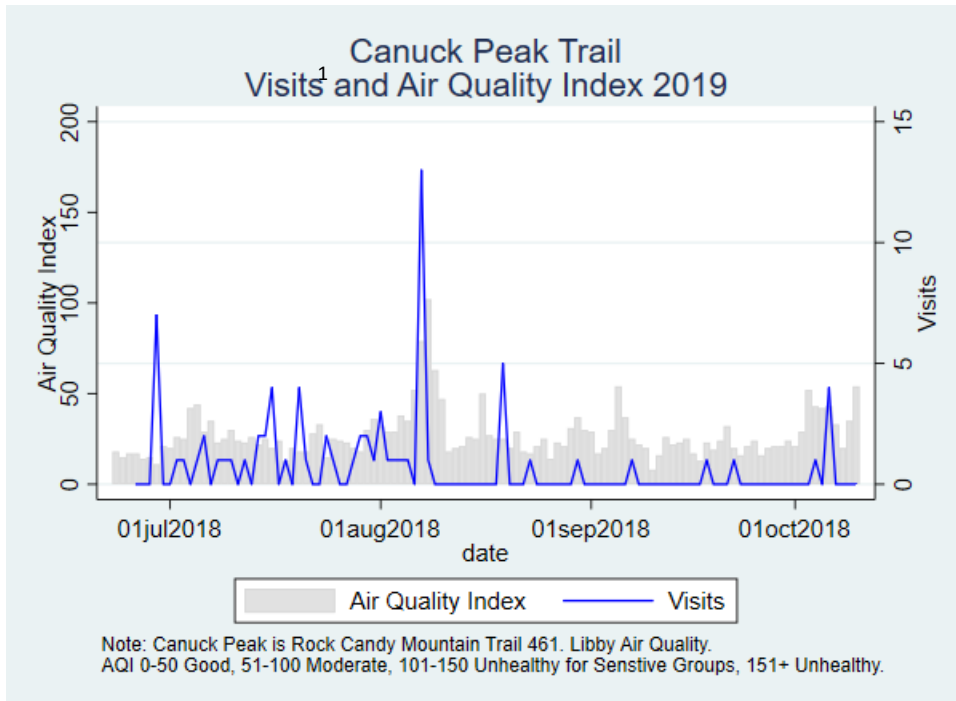


Figure 56 Canuck Peak and Air Quality



Comparison of 2017, 2018, and 2019

The following graphs compare use of trails between the past three 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 between the years.

Because no calibration factors were available from 2017, the 2018 calibration factors have been applied to the 2017 data in these graphs. We applied new calibration factors to the 2019 data. Comparison of the counts should be made with caution. It is important to note that calibration factors were calculated somewhat differently for 2019 than for the 2017 and 2018 seasons. Calibration factors for 2019 accounted for all trail users (including overnight hikers, day hikers, horse riders, bike riders, and trail/administrative crew members). In contrast, 2018 data was calibrated only for day and overnight hikers (thus excluding trail/administrative crew members, horse riders, and bike riders), and these factors were also applied to 2017. Therefore, while the percentage of trail users that were trail/administrative crew members, horse riders and bike riders is relatively small, comparisons between 2017, 2018, and 2019 are not entirely equivalent. Trail user estimates for 2017 and 2018 would likely be at least slightly higher than the reported hiking visit estimates.

Figures 57 and 58 compare counts within each trail for July during 2017, 2018, and 2019. 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. The 2019 counts in July differ between sites. There seems to be a decrease in use in the Blue Sky Creek, Canuck, and Garver sites and an increase in use in the Gypsy Meadows, Boulder Lake, Midge Creek, and Vinal Creek¹⁴ sites. However, the numbers remain small and the trend is not clear. It is also difficult to discern a trend because 2018 was a year with bad fire and smoke compared to 2019 that did not experience large amounts of fire and smoke.

If we compare use at the Canuck Peak and Blue Sky Creek sites over the past few years, these sites seem to be following a consistent trend in decreasing visitor use. There is also a slight decrease in visitor use at the Garver Mountain site during July from 2018 to 2019. The 2019 counts in July are generally larger at the majority of trails, including Gypsy Meadows, Boulder Lakes, Midge Creek, and Vinal Creek. The 2018 data from Whitefish Divide was not included; however, it appears to be experiencing an increase in visitor use over the past couple of hiking seasons.

¹⁴ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 57 Comparison of July Trail Visits Between Sites: 2017, 2018, and 2019¹⁵

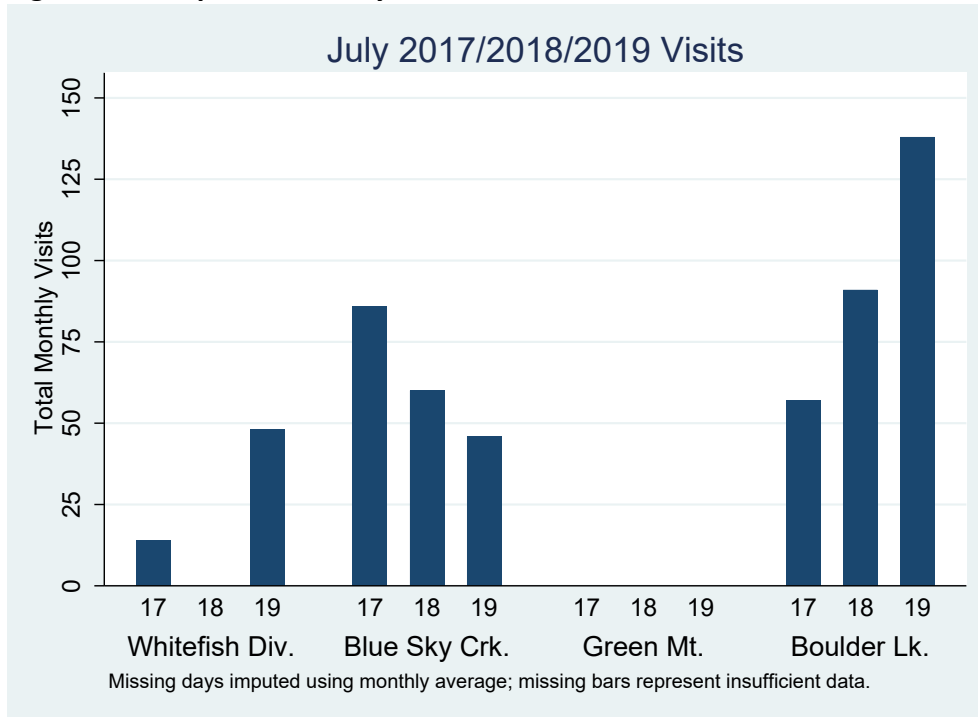
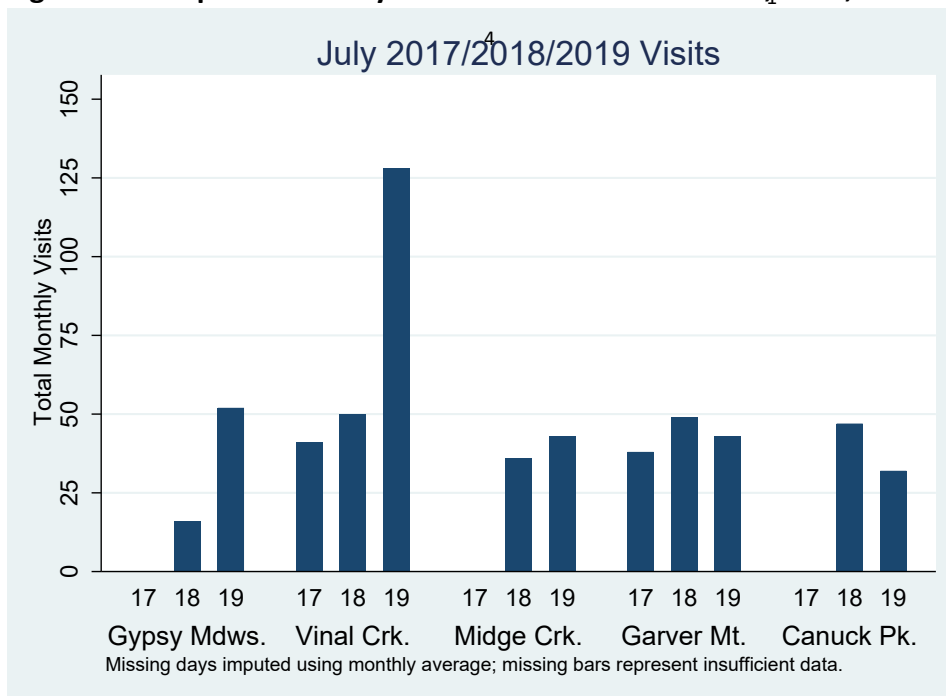


Figure 58 Comparison of July Counts Between Sites: 2017, 2018, and 2019¹⁶



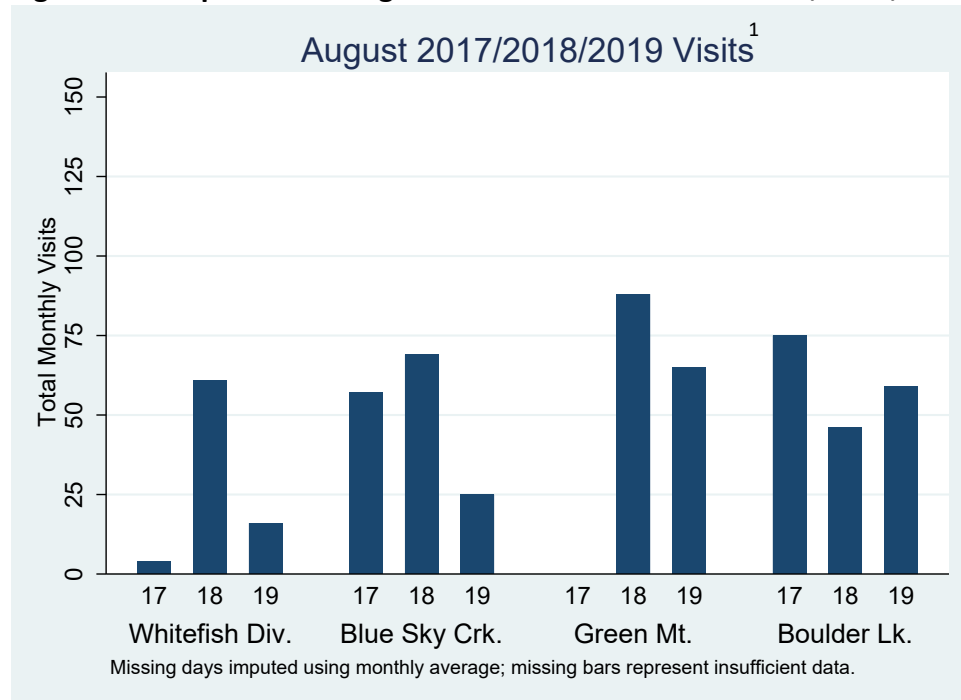
¹⁵ 2017 and 2018 calibration factors accounted for only hikers (including day and overnight), while 2019 calibration factors accounted for all trail users.

¹⁶ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 59 and 60 compare counts within each site for August during 2017, 2018, and 2019. 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.

4

Figure 59 Comparison of August Counts Between Sites: 2017, 2018, and 2019¹⁷



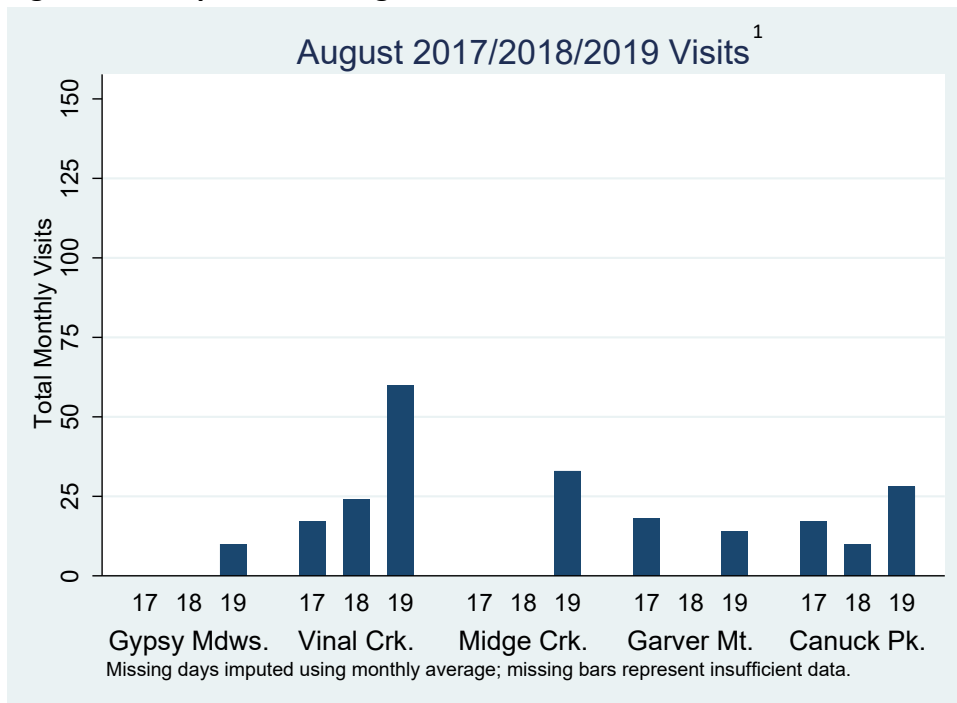
The 2018 August counts for Garver Mountain, Gypsy Meadows, and Midge Creek were not included in this graph due to the mismanagement of data and the Davis Fire, which required early removal of field equipment. Therefore, we cannot make inferences about how use at these sites compared between the past three years of the survey.

There was a split in patterns of use between 2018 and 2019 at each of the sites. Whitefish Divide, Green Mountain, and Blue Sky Creek experienced less visitor use in August of 2019 than August of 2018. The 2019 August counts for Vinal Creek¹⁸, Canuck Peak, and Boulder Lake are larger than August counts for 2018.

¹⁷ 2017 and 2018 calibration factors accounted for only hikers (including day and overnight), while 2019 calibration factors accounted for all trail users.

¹⁸ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 60 Comparison of August Counts⁴ Between Sites: 2017, 2018, and 2019¹⁹²⁰



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.

The total count for the months of July and August at Bluebird Lake was 1,071. The total count for the months of July and August at Bluebird Lake for 2018 was 1,161. Although there is a decrease in visitor use during the month of July and use during August has remained stable, overall visitor use of Bluebird Lake during the peak hiking season has stayed fairly consistent between 2018 and 2019 (Figure 61). Bluebird Lake also continues to be the most popular trail out of the sites monitored. For comparison, the trail with the next highest use in 2018, following Bluebird Lake, was Boulder Lake, with 137 counts in July and August, and the trail with the next highest use in 2019, following Bluebird Lake, was Vinal Creek, which had a total count of 292.

Figure 62 provides a more in-depth view of the use of Bluebird Lake throughout 2017 to 2019. There is a substantial increase in use from 2017 to 2018, which is most likely due to day use; there is a decrease in use from 2018 to 2019, but level of use still remains higher than in 2017. 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.

¹⁹ 2017 and 2018 calibration factors accounted for only hikers (including day and overnight), while 2019 calibration factors accounted for all trail users.

²⁰ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

Figure 61 Comparison of Use in Bluebird Lake: 2017, 2018, and 2019²¹

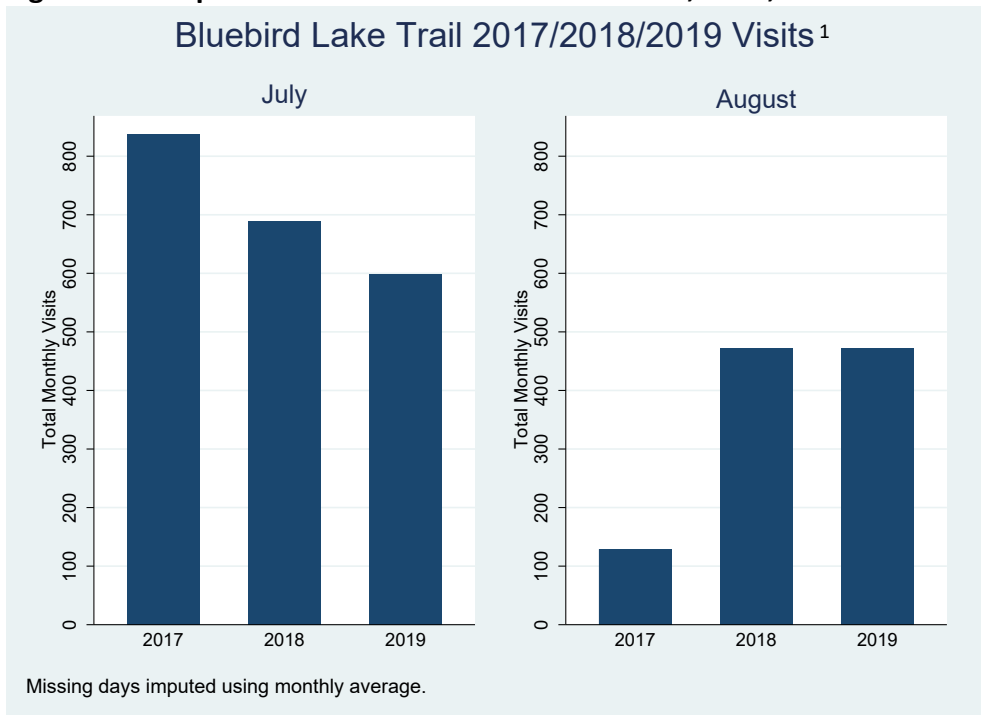
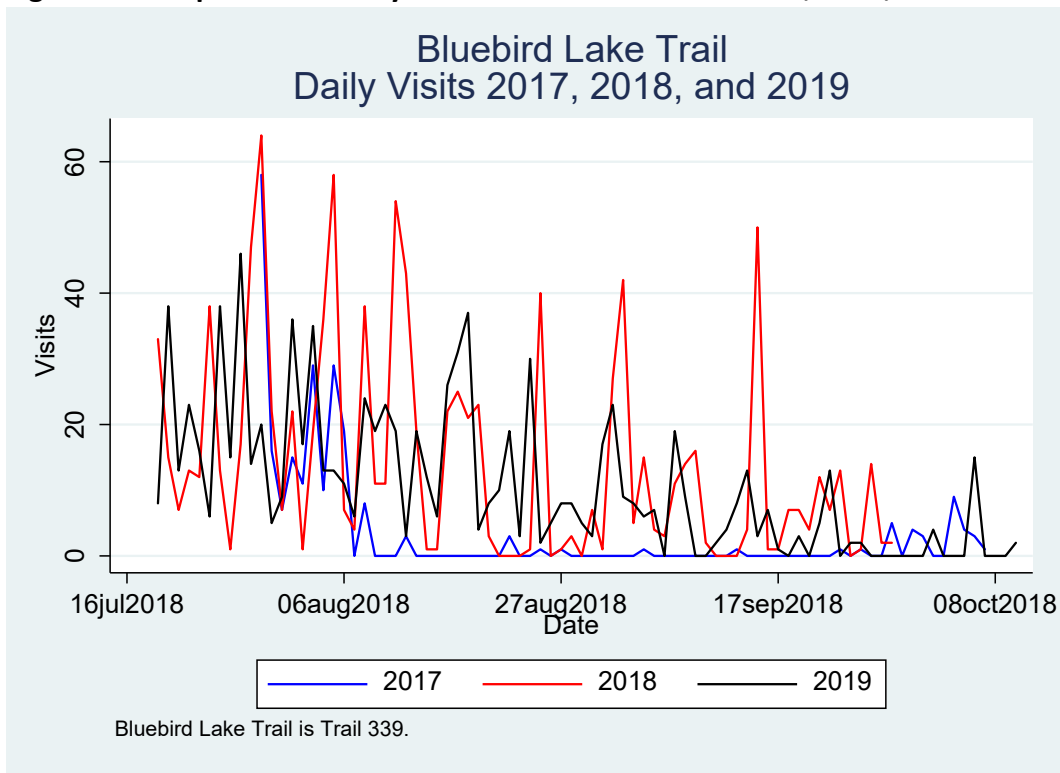


Figure 62 Comparison of Daily Counts in Bluebird Lake: 2017, 2018, and 2019



²¹ 2017 and 2018 calibration factors accounted for only hikers (including day and overnight), while 2019 calibration factors accounted for all trail users.

Recommendations and Reflections

Field Work

- The USFS supported last year's recommendations for game cameras with night-vision capabilities, an increase in cameras (up to 6), on-site training specific to the selection of an optimal camera/counter location, and on-site training specific to the installation of the equipment, which increased the ease and efficiency of data collection and analysis.
- We were able to improve on our data collection from the 2018 survey by starting the field season earlier in June and extending it into October.
- There were no errors in counter data this year, which provided us with complete representations of use at each site.
- As most of the trails were monitored from July to early October and there are no gaps in the data, there were many days of data to calibrate. However, like last year, there was still quite a big difference between the counter and camera data. The calibration factors for the majority of the counters look similar to the ones in 2018 (see Appendix B) and the research team would like to continue improving on the precision of the calibration methods.
- 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.

Specific Sites

- We were able to improve on our data collection from the 2018 survey due to an absence of wildfires in the area of our sites. The Davis Fire in 2018 prompted the removal of field equipment at the Garver Mountain and Midge Creek sites in early August, which prevented insight into possible peak season use. A field season with limited wildfires allowed us to include sites like Garver Mountain and Midge Creek in cumulative graphs representing comparisons of use in peak seasons across all sites in 2019 (see Figure 1 and Figure 2) and throughout all years.
- Despite it being hidden and locked, a camera was stolen from its location at the Vinal Creek²² site mid-season. The research team placed another camera in a different

²² The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

location on the trail that was more hidden from plain-view. The relocated camera was not stolen, but the research team is concerned about the efficacy of the safety lock system in protecting the cameras from potential theft. For sites that are more frequently used, manual calibration by a researcher may be a more appropriate option than a camera. If there are some sites that are particularly hard to hide a camera or appear more vulnerable to theft, the research team may have to forgo cameras at those sites or consider changing the sites for long-term monitoring.

Future Research

- Some possible explanations for the difference in counter and camera data could be that the infrared cameras take photos every five seconds (the minimum setting), which is too long to capture quick hikers and thus, the cameras do not take these hikers into account. It is recommended to acquire cameras that have a shorter interval (i.e. 3 seconds minimum interval), which will capture hikers that are moving quickly.
- In order to learn about the specific frequency of uses other than hiking at each site (e.g. horse riding, pack and saddle stock, biking):
 1. The number of cameras would need to match the number of monitored sites
 2. These cameras would need to be at each site for the entire data collection period (nearly two months at each site)
 3. There would need to be a larger research team to visit each site more regularly in order to “empty” the cameras’ SIM cards, transfer footage, and then watch and record the data or implement a sampling method.
- To gain a better understanding of types of users, their travel patterns, and their experience, it is recommended that a short questionnaire be administered by part of the research team at select locations throughout the field season in 2020. This could also be administered using a QSR code that is posted at select trailheads and ranger stations.
- It is recommended to expand the field sites into the Idaho portion of the PNNST trail in 2020 field season. This would allow for expansion of understanding trends in recreational use on the various portions of the PNNST and to work with additional managers beyond Montana.

Endnotes

¹ **Trail 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;
- day hikers or horse/bike riders and overnight/multi-day hikers or horse/bike riders 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); and
- trail crew members and other government employees and volunteers using trails to perform administrative duties such as maintenance, monitoring, patrols, and other work.

² Mondays, Tuesdays, Wednesdays, and Thursdays were counted as weekdays

³ Fridays, Saturdays and Sundays were considered weekend days. ⁴ Calibrated (excluding non-hikers).

Appendix

Appendix A. 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 74	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 ²³	Vinal Creek Trail #9 (the monitoring site is not located on the PNNST)	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

At the time of this report, the complete 2019 map set of the PNNST, including strip maps with greater details on individual trails, can be downloaded from <https://www.pnt.org/product/2020-pnta-mapset/>

²³ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.

These maps show 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.

The folder containing "Section 1 – Rocky Mountains" includes strip maps for Whitefish Divide, Blue Sky Creek, Bluebird Lake, and Green Mountain.

The folder containing "Section 2 – Purcell Mountains" includes strip maps for Boulder Lake, Gypsy Meadows, Vinal Creek²⁴, Midge Creek, Garver Mountain, and Canuck Peak.

The Pacific Northwest Trail maps available in future years may be updated, and are likely to be found under <https://www.pnt.org/pnta/maps/>

²⁴ The Vinal Creek monitoring site is not located on the PNNST and data is not PNNST use. See pp. 38-41.