VISITOR USE IN THE MANAGEMENT ZONES OF MOUNT RAINIER NATIONAL PARK

MARK E. VANDE KAMP

Technical Report NPS/PWR/UW/NRTR-2009—04
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1. INTRODUCTION

The University of Washington Protected Area Social Research Unit administered this project. It was proposed and funded by Mount Rainier National Park (MORA). The general purpose of the project was to collect information about the number of visitors using specific areas of Mount Rainier National Park, as well as their distribution in space and time. This information is critical for effective planning of visitor management. More specifically, the information will be used in the Visitor Experience and Resource Protection (VERP) planning framework.

1.1 The Visitor Experience and Resource Protection (VERP) Framework

The VERP framework is a tool developed by the National Park Service to address user capacities and thus protect both park resources and visitor experience from impacts associated with visitor use. VERP was used in developing the Mount Rainier National Park General Management Plan, and the park has made a commitment to implement VERP throughout MORA. The VERP framework is an ongoing, iterative process of determining desired conditions (including desired cultural resource conditions, desired natural resource conditions, and desired visitor experiences), selecting and monitoring indicators and standards that reflect these desired conditions, and taking management action when the desired conditions are not being realized. VERP is a decision-making framework, but does not diminish management's role in decision-making.

Information about visitor use is essential because VERP is, at its core, a means of managing the impacts associated with visitor use. It is difficult to imagine how decisions intended to limit the impact of visitation could be made in the absence of information describing current levels and patterns of visitor use.

1.1.1 Management Zones in the VERP Framework and in This Document

MORA is a large park with diverse environments and recreation opportunities. Within the VERP framework, managers deal with such diversity by designating a variety of management zones for a given park. At MORA, the General Management Plan describes 10 recreation zones. In order to make the information reported in this document as useful as possible within the VERP framework, the collected information is organized around the management zones proposed in the General Management Plan. Within each zone, information for specific sites will be presented separately.

1.2 Simulation Models Based on Descriptions of Visitor Use

Information describing visitor use can be analyzed in ways that range from simple to very sophisticated. VERP planning can benefit greatly from relatively simple summary statistics that describe visitation in terms of the number of visitors or parties and the distribution of their activities. Information about visitation can also be used to develop sophisticated computer simulation models of visitor distribution. Much of the information reported in this document will be used in developing such simulations.

Computer simulation models provide a range of information that can be of great use to managers. For example, a computer simulation can provide estimates of potential indicators that are difficult and/or expensive to measure directly. A simulation of day-hiker movement on the

Comet Falls Trail can be used to estimate not only the number of encounters between hikers, but the longest times between encounters and the trail segments in which those periods of solitude are most likely to occur. Similarly, a simulation of hikers in Paradise Meadow can be used to project the times and trail segments in which visitor density currently impedes hikers' freedom of movement. Such estimates can help managers select indicators and set standards that will protect both visitor experiences and physical resources.

The types of simulations used at MORA (see Vande Kamp 2009a and Vande Kamp 2009b) require a form of information about visitor use that we call itinerary data. Itinerary data describe in some detail the movement of individual visitors or parties. If all we were interested in was information about the absolute number of visitors using specific sites, then simple visitor counts would be sufficient to provide most descriptive information. However, because simulation of visitor use requires complete itineraries, additional methods are required to gather information describing visitation.

1.3 Two Primary Methods Were Used to Collect Information about Visitation

Each of the studies described in this document generally use one of two methods to collect information. The first method is the simplest, and involves the use of electronic trail counters to collect counts of hikers, as well as information about the times when they passed the counter. The second method, called the waypoint survey, was developed specifically to collect itinerary information. Waypoint surveys provide detailed information about the movement of hiking parties on trails, as well as information about the amount of time they spend in specific areas. This information is needed for the development of computer simulation models, but is also extremely informative in summary form. More detailed descriptions of the two methods of data collection are provided in the next two sections of this document.

2. GENERAL METHOD OF TRAIL COUNTER DATA COLLECTION

The simplest type of visitor use information is a count of the number of visitors passing a specific point. Such information can be collected by observers, or by automated means. The count information described in this document was collected using modern electronic trail counters that record a tally of the number of passing hikers, and also record the time of each passage. Such time-stamped information is particularly useful in assessing social conditions because solitude is determined not by the total number of visitors, but by the number of visitors present at any one time.

2.1 Instruments

All the trail counters used for the studies reported in this document were Trailmaster Model 1550 active infrared trail monitors (www.trailmaster.com). These monitors are a two-piece system in which a small unit emits an infrared beam that is sensed by the larger, receiving unit. The beam is emitted in pulses, and the receiving unit only records an "event" when a specified number of pulses are blocked. This system cuts down on the number of spurious events recorded by the counter compared to passive systems in which any break in a constant beam is recorded. Figure 1 represents the trail counter with an abstract depiction of the infrared pulses passing between the two pieces.

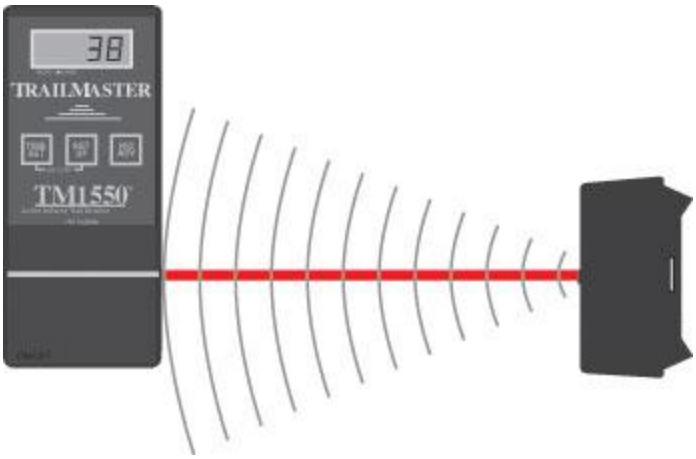


Figure 1. Trailmaster infrared trail counter.

In addition to the counters, a data collector and cable were used to transfer the count and timestamp data from the field units to a desktop computer where they could be analyzed or emailed. A laptop computer could have been used instead of the data collector, but the data collector is a weather-proof unit that is much more durable and convenient to use than a laptop.

2.2 Installation

The primary factors to consider when installing the counters are the concealment of the equipment, the characteristics of the trail at the point where the beam crosses it, and the lack of interference with the beam

All the trail counters used for this report were installed by strapping the emitter and receiver to trees located on opposite sides of a trail. Concealing the counters was relatively easy in areas where there were many trees of various sizes. It was useful to remember that the emitter and receiver could be a considerable distance apart. Considering locations outside the immediate vicinity of the trail opened up many possible locations for installation. The visibility of the counters was also decreased by covering most of each piece with camouflage duct tape. The straps were also covered in tape. The irregular pattern of the tape broke up the visual image of the boxy pieces and the straight straps, greatly decreasing the degree to which the counters attracted attention.

The ideal trail location for the counters were: a) narrow, so that hikers are single file when passing the counter; b) rocky or rooted so that hikers are moving relatively slowly and have their attention focused on their footing; and c) not on a steep side hill where the beam must cross the trail at an angle diverging significantly from horizontal. On some trails it was necessary to use locations that did not meet all these criteria.

Conditions that could interfere with the beam included: a) movement of the trees on which the emitter or receiver are installed; b) twigs or limbs that could grow or move during the course of the season or day to obstruct the beam; c) un-shaded installation locations where direct sunlight shines on the emitter or receiver; and d) angled installations in which the emitter and receiver are lined up horizontally but not optimally situated vertically. In all such cases, obstruction or inconsistent transmission of the beam could produce spurious readings.

2.3 Maintenance

When deploying the trail counters, survey workers generally downloaded data and checked the beam for alignment and obstruction on at least a weekly basis. Workers were trained to follow the procedure for downloading data that was described in detail in the Trailmaster instruction manual. Limited amounts of data were lost because the download procedure was not understood or completed correctly. Workers were taught to double check and confirm that new data files had been downloaded into the collector before clearing data from the counter.

When downloading the data, workers also routinely checked on the proper alignment of the infrared beam. One advantage of frequent maintenance was that small changes in the position of the equipment were more likely to be noticed. A visual inspection of the emitter and receiver positions was usually supplemented by setting the counter into setup mode and confirming that the beam was being received strongly. Adjusting the beam is more difficult with one person than with two, but even with one person, it was worth the extra time to readjust the emitter and receiver in order to confirm that the strongest, center portion of the beam was hitting the receiver. The receiver will give an "OK" signal even when the beam is considerably off center, but spurious readings appeared to be more likely under those conditions.

Data were generally examined several times during the season. It was not necessary to check every download, but it was critical to check at least one of the first few downloads to determine if the initial setup was producing reasonable data (and to determine whether personnel were downloading the data correctly). One standard analysis to check data was to assess the number of hits per hour across the days in the observed time period. The distributions usually showed one or two gentle daily peaks (depending on whether the trail was used as a through or out-and-back trail) and show very few hits at night. Implausibly heavy traffic, wildly variable peaks in use, spiky distributions, or late-night hits were all cause for concern.

2.4 Validation

Trail counters do not produce perfect counts of visitors. The most common source of error in our studies arose when visitors walked in close proximity and passed the counter at the same time so that multiple visitors resulted in a single break of the infrared beam. Thus, in the absence of spurious events, counters generally underestimated the number of passing hikers. Validation of trail counter operation was valuable in producing the most accurate possible estimates of visitor use.

In general terms, the validation procedure consisted of having an observer sit at a location where the counter readout was visible (sometimes using binoculars), watching groups of visitors walk past the counter, then recording both the number of visitors in the group and the number of "hits" recorded by the counter. Workers also recorded the times and dates when validation data were collected. The specific procedure and total amount of time spent recording these counts varied widely for the different locations where trail counters were installed. This variability was primarily due to the fact that collection of the trail counter data was not the primary focus of the research projects funding their collection. Accordingly, research workers were assigned to collect validation data on an "as available" basis.

This document reports the specific procedures and results of trail counter validation conducted at each site. Whenever possible, validation results were used to adjust the use estimates reported in charts and tables.

3. GENERAL METHOD OF WAYPOINT STUDY DATA COLLECTION

Itinerary information of the type necessary to develop simulation models has most often been collected by contacting visitors after their hikes and recording the route and time information that they recall. This method can yield accurate itinerary data for backpackers in remote and complex trail systems because such hikers usually pay close attention to navigation. It can also suffice for simple trail systems because hikers don't have complex itineraries to recall. An alternate method of collecting itineraries in which visitors to remote and extensive systems are given map-diaries before their hikes and asked to record their movement has also been used to obtain accurate itinerary data.

It is more difficult to collect accurate itinerary data in many areas of Mount Rainier because the trail system is both complex and readily accessible. Many visitors to areas such as Paradise Meadow and Sunrise do not have a clear destination when beginning their hikes and they meander through the trail system without maintaining their geographic orientation. Visitors with specific destinations such as Alta Vista or Myrtle Falls often depend on directional signs for guidance and do not know which of several possible routes they followed. As a result, recall of hiking itineraries in post-hoc interviews is often vague and inaccurate. Providing a map-diary and asking visitors to keep detailed record of their movement is also problematic. Hikers who keep such itinerary records are required to pay considerable attention to both the map and the environment. Such attention is likely to alter their hiking itineraries and thus produce biased results.

A method of collecting itinerary information was needed that a) could provide detailed route and time information, and b) posed a small burden on hikers that was unlikely to alter hiking behavior. The waypoint survey method of collecting itinerary information proved particularly well suited for use in complex and readily accessible trail systems like Paradise Meadow. The waypoint survey method combined waypoint signs with recording of the time when visitors pass strategic locations to create a method of collecting itinerary data that was simple for visitors to complete but did not require large numbers of survey workers.

3.1 Sampling and Visitor Contact

The goal of sampling was to contact a random sample of visitor parties entering a trail or trail system. Survey workers were stationed at trailheads or entry points and instructed to approach parties and ask them to participate in a short survey. Depending on the location and sampling scheme, workers approached every party or every third party who passed.

When approaching a hiking party, survey workers introduced themselves, stated that they were conducting a study of visitor movement for Mount Rainier, and asked one member of the party to participate in the study. A laminated copy of the OMB disclosure statement was handed to those visitors who agreed to participate. Then the survey worker asked for the visitor's home zip code, the size of their party, the number of party members who were less than 18 years old, and asked for the party's hiking destination. The survey worker then instructed the respondent how to complete the remainder of the survey by explaining:

> "There are waypoint signs like this one (pointing to the entry waypoint) placed along trails throughout the meadow. Every time you pass one of these signs, please write the letter of the sign and the time on your card. I'll fill out this first one for you (writing down the time and entry waypoint letter on the card). If you pass the same sign more than once,

please write down the time each time you pass. There are pencils and clocks on each sign. When you are done hiking, please leave your card with the survey worker where you leave the meadow, or place the card in the survey box like this one (point to exit sign and box) if no one is there."

3.2 Instruments

Figure 2 shows the front and back of the waypoint cards on which data were written. The cards were printed on waterproof card stock so that respondents could easily write on them.

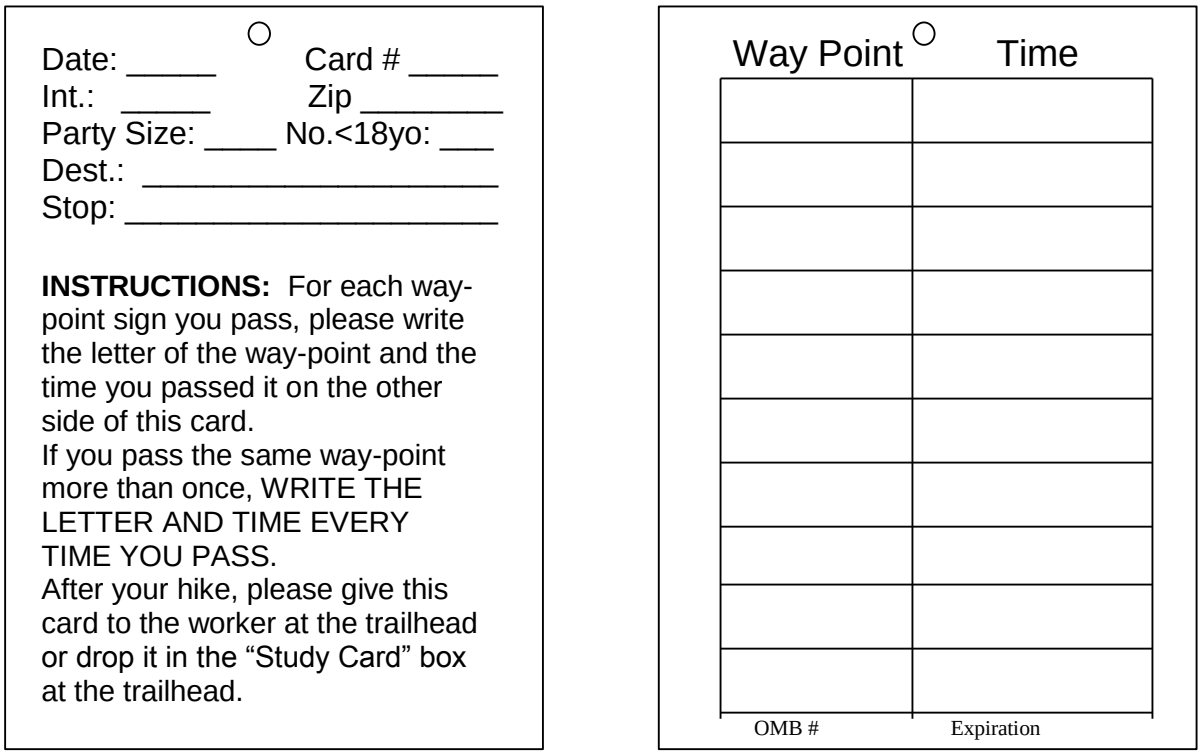


Figure 2. Waypoint card used in surveys.

Figure 3 shows the front of a waypoint sign. Each sign was printed on 8.5" x 11" card stock, attached to a metal stake, and covered with a clear plastic bag to protect it from rain or fog. A small LCD clock was attached to the center of the sign. The clocks on all signs were synchronized. The back of each sign was identical to the front, with the exception that the clock area included text explaining that a clock could be found on the other side.

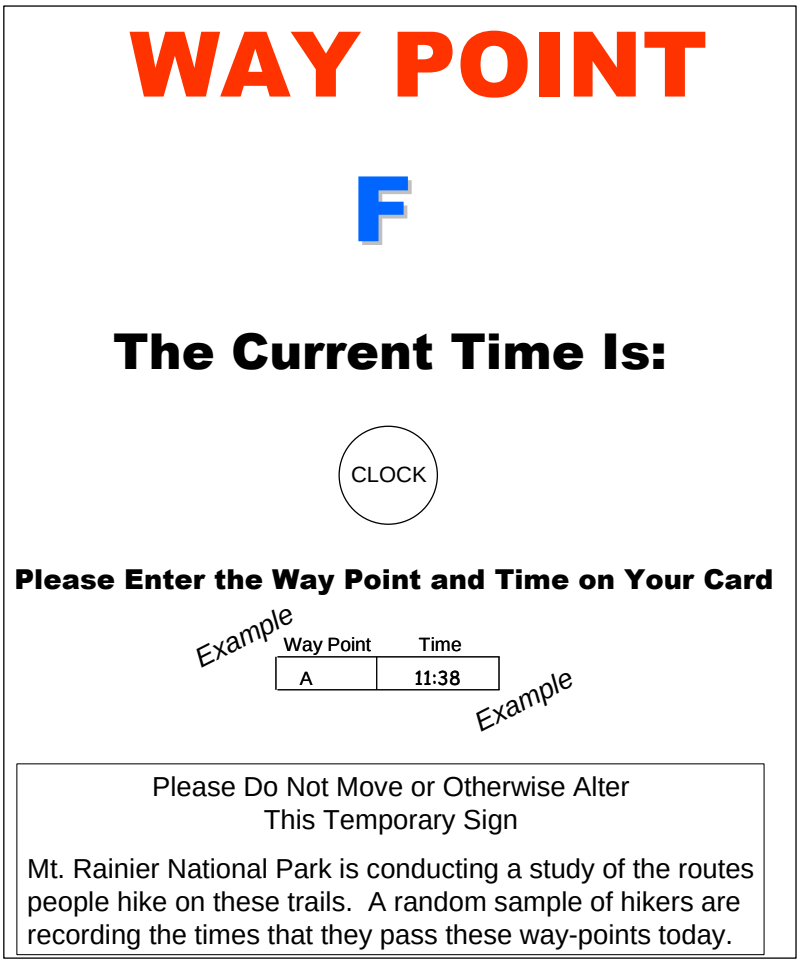


Figure 3. Waypoint sign used in study. Note that a digital LCD clock was attached to the middle of each sign.

Waypoint signs were placed at locations along the trail or trails that were selected to define common hiking itineraries. The number of signs necessary to provide precise information about hiking routes varied considerably in the studies reported below.

Exit signs (see Figure 4) also measured 8.5" x 11" and were attached to metal stakes that were placed at the entry/exit points. Plastic boxes were attached to the base of each staked exit sign where respondents could deposit cards if the survey worker was not present when they finished hiking.

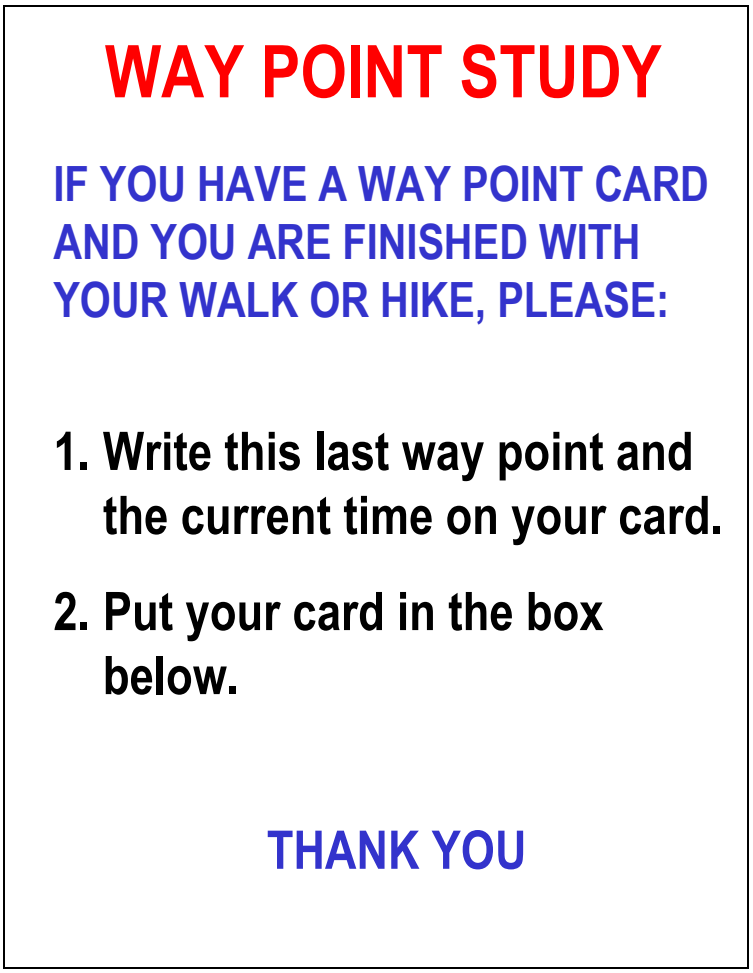


Figure 4. Exit sign used in waypoint study.

4. WILDERNESS HIGH USE CLIMBING ZONE

Descriptive information for use in the climbing zones is generally and routinely collected through the camping and climbing permit systems. Little day-use occurs in the climbing zones. One exception is the Muir Snowfield, where some day-hikers venture into the high use climbing zone.

4.1 Waypoint Results for Muir Snowfield

A waypoint study was conducted to assess the number and hiking patterns of day-hikers who passed Pebble Creek and entered the High Use Climbing Zone. In conjunction with this study, a pad-sensor trail counter was also installed in the tread of the way-trail above Pebble Creek. Unfortunately, this trail counter malfunctioned shortly after its installation and did not provide useable counts of hikers and climbers entering and leaving the area.

4.1.1 Location

Waypoint cards were handed out to day-hikers passing a point just north of Pebble Creek on the way trail leading to the Muir Snowfield. Figure 5 below shows the approximate locations

of the waypoint signs used in this study. Survey workers contacted visitors at sign A.

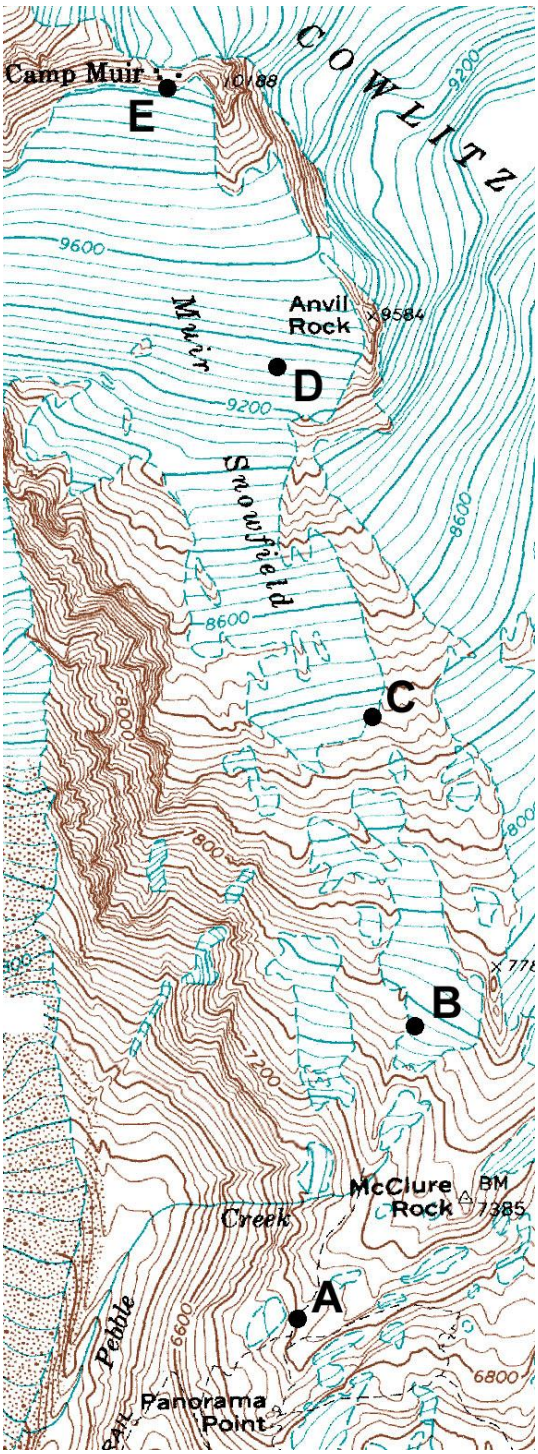


Figure 5. Locations of waypoint signs for Muir Snowfield Survey.

4.1.2 Sample

Data were collected on 6 days (5 weekdays and 1 weekend day) between July 19 and July

24, 2004. On sampled days, all day-hiking parties passing sign A were asked to participate in the study. If it was unclear whether a party was day-hiking or planned to climb to the summit, workers asked for hikers' destinations.

A total of 142 parties were asked to participate in the study. Of those parties, 123 returned their cards (86.7%), 14 failed to return cards (9.9%), and 5 refused to participate or could not participate due to foreign language issues (3.5%).

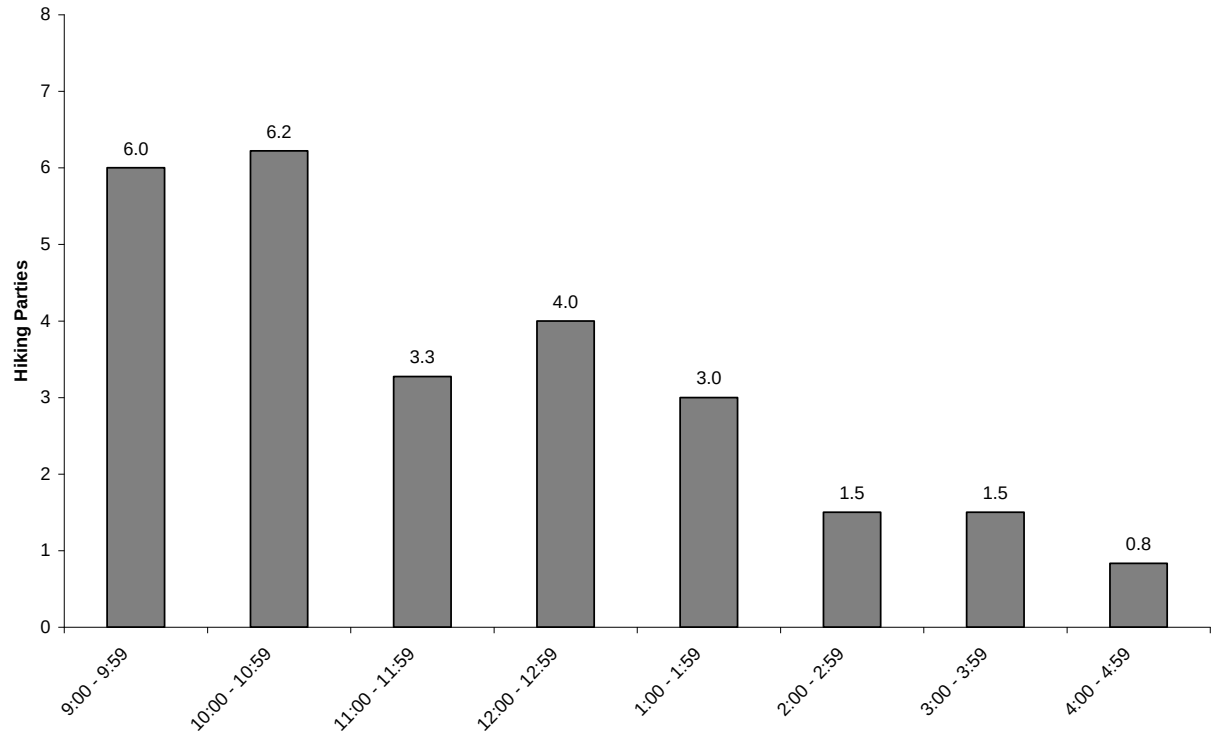
4.1.3 Results

Party size. The average party size was 2.06. Throughout this section, data are presented in terms of parties, but those numbers can be used to estimate the number of visitors by multiplying them by the average party size of 2.06 persons.

Party counts and distribution. On weekdays, an average of 19.8 day-hiking parties passed the first waypoint to hike up the mountain in the direction of the Muir Snowfield and Camp Muir. Only one weekend day was sampled, but on that day, 43 parties passed the waypoint.

Figure 6 below shows the hourly distribution of hiking entries during the observed hours on the six days that were sampled.

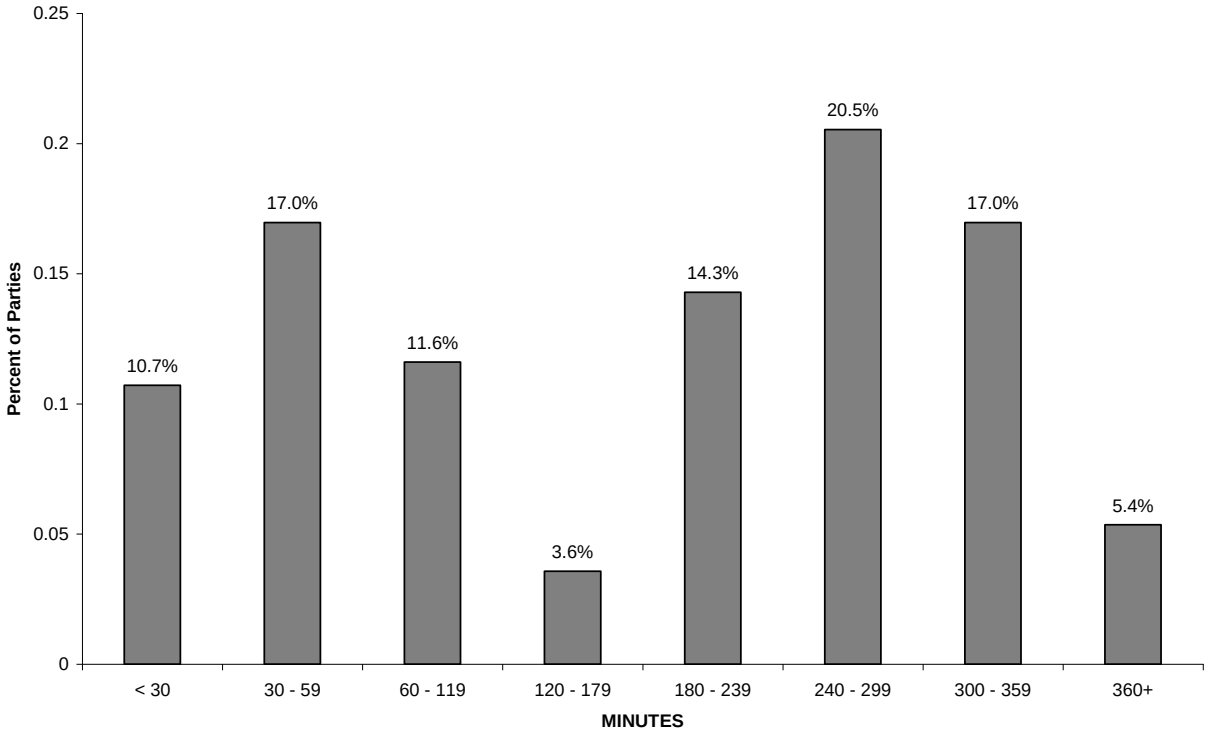
Figure 6: Hiking Parties Entering High Use Climbing Zone During Observed Hours



Hiking durations. The average duration of hikes above Pebble Creek was 185.6 minutes, but Figure 7 shows that the distribution of durations was bi-modal. About 40 percent of day-hikers spent less than two hours above the contact point, while the average duration of the other

parties' hikes was approximately 4.5 hours. This pattern of data correlated strongly with whether the party reached Camp Muir during their hike. All parties that reported reaching Camp Muir had hiking durations greater than 206 minutes. Presumably, many of the hikers who stayed for brief periods spent little or no time on the snowfield itself. In particular, 44 parties returned to the contact point without recording any waypoint signs beyond sign A. Nonetheless, the average duration of stay for such parties was 78 minutes.

Figure 7: Duration of Day-Hikes Above Pebble Creek in the High Use Climbing Zone



Hiking patterns. Analyses of the recorded waypoints showed that 27.6 percent of hiking parties reported that they reached Camp Muir (i.e., they passed waypoint E). Table 1 shows the percentage of hiking parties that passed each waypoint. It should be noted that many parties turned in cards that clearly indicated that they had missed some waypoint signs when hiking up or down. In some cases, this was unavoidable. Wind, snow, and sun damaged or destroyed one or more signs during a number of data collection periods. Because of limited staff and the difficult hike to Camp Muir, signs could not reasonably be checked on a daily basis to be sure they were present and functioning. Moreover, the route of travel can change from day to day, so some visitors traveling to Camp Muir simply did not pass by signs that were in place. Table 1 is not based on the actual signs recorded by hikers, but on the highest sign they reported passing. For example, if a party reported passing waypoint sign A at 10:45, waypoint sign D at 12:06, and finished at waypoint sign A at 13:45, it was assumed that they had also passed waypoint signs B and C.

Waypoint	Percent of Parties Passing
A	100.0
B	62.6
C	52.0
D	41.5
E	27.6

Table 1. Parties passing waypoints in Muir waypoint study.

4.1.4 Statistical Limitations and Estimation of Use Levels

The waypoint survey data describing the number and hiking patterns of day-hikers who passed Pebble Creek and entered the High Use Climbing Zone were collected on a very small sample of days (5 weekdays and 1 weekend day). Such a small sampling period limits our confidence that the sample is generally representative of day hiking use in that area. One piece of information that can help managers make best use of the information is to place it in the context of the level of general park visitation that occurred on the days when the Muir Snowfield waypoint data were collected.

The average number of vehicles entering MORA at the Nisqually entrance in July and August of 2004 was 1027 on weekdays, and 1655 on weekends. The number of vehicles entering the park on the days of the Muir waypoint survey averaged 1151 on weekdays, and was 2247 on the one weekend day. The relationship between the number of vehicles entering the Nisqually entrance and the number of day hikers passing the survey point was strong, with an R^2 of .713. Based on that relationship, it can be estimated that 16 parties day-hike above Pebble Creek on average weekdays, and 32 parties hike on average weekends. The small number of days observed severely limits the statistical confidence in those estimates. Ninety-five percent confidence intervals are +/- 17 parties. Because there is no a-priori reason to suspect that the estimates are biased the estimates could be used as "best-available" descriptions of Muir Snowfield day-hiking. However, serious discussions of policy regarding these visitors should be supported by additional data collection.

5. WILDERNESS TRANSITION TRAIL ZONE

This section reports data collected at six sites in the Transition Trail zone. At three of the sites data were collected using trail counters and at three other sites data were collected using both trail counters and waypoint surveys. The table below lists the section heading and name for each site, and the type of data collected at that site. Readers should note that additional information regarding several trails in the Transition Trail zone is provided in section *7.2 Waypoint Results for Sunrise Trails*.

Heading(s)	Trail	Trail Counter(s)	Waypoint Survey
5.1	Ipsut Pass	1	No
5.2	Shadow Lake	1	No
5.3	Snow Lake	1	No
5.4 & 5.5	Comet Falls	1	Yes
5.6 & 5.7	Spray Park	2	Yes
5.8 & 5.9	Wonderland Trail to Summerland	2	Yes

Table 2. Reference guide to trail counter and waypoint results describing the Transition Trail Zone.

5.1 Trail Counter Results for Ipsut Pass Trail from Mowich Lake

The Ipsut Pass Trail from Mowich Lake is a popular day-hiking trail in the northwest corner of MORA. It drops downhill from its start at Mowich Lake before climbing to Ipsut Pass where a trail junction forces hikers to choose between hiking uphill to Eunice Lake and, eventually, Tolmie Peak, or downhill toward Ipsut Falls and the Ipsut Creek trailhead. As part of the Wonderland Trail, the Ipsut Pass trail is also used by backpackers who wish to hike all or part of the Wonderland Trail loop. Day-hikers access the trail from a number of social trails leading from the old road (now blocked to vehicular traffic before the Mowich Lake watershed) to the trail along the southwest shore of Mowich Lake. Parking capacity is limited primarily by the willingness of visitors to hike from their vehicles to the lake because parking along the road shoulder commonly extends for a considerable distance prior to the road terminus.

In order to better describe use of the trail, an electronic trail counter was installed on the Ipsut Pass Trail along the shore of Mowich Lake in 2004 (see Figure 8). Due to its location, this trail counter recorded a wide variety of hikers including Wonderland Trail backpackers, day hikers traveling to Ipsut Pass or Tolmie Peak, and visitors to Mowich Lake and/or Mowich Lake Campground who were taking short walks to explore the lakeshore.

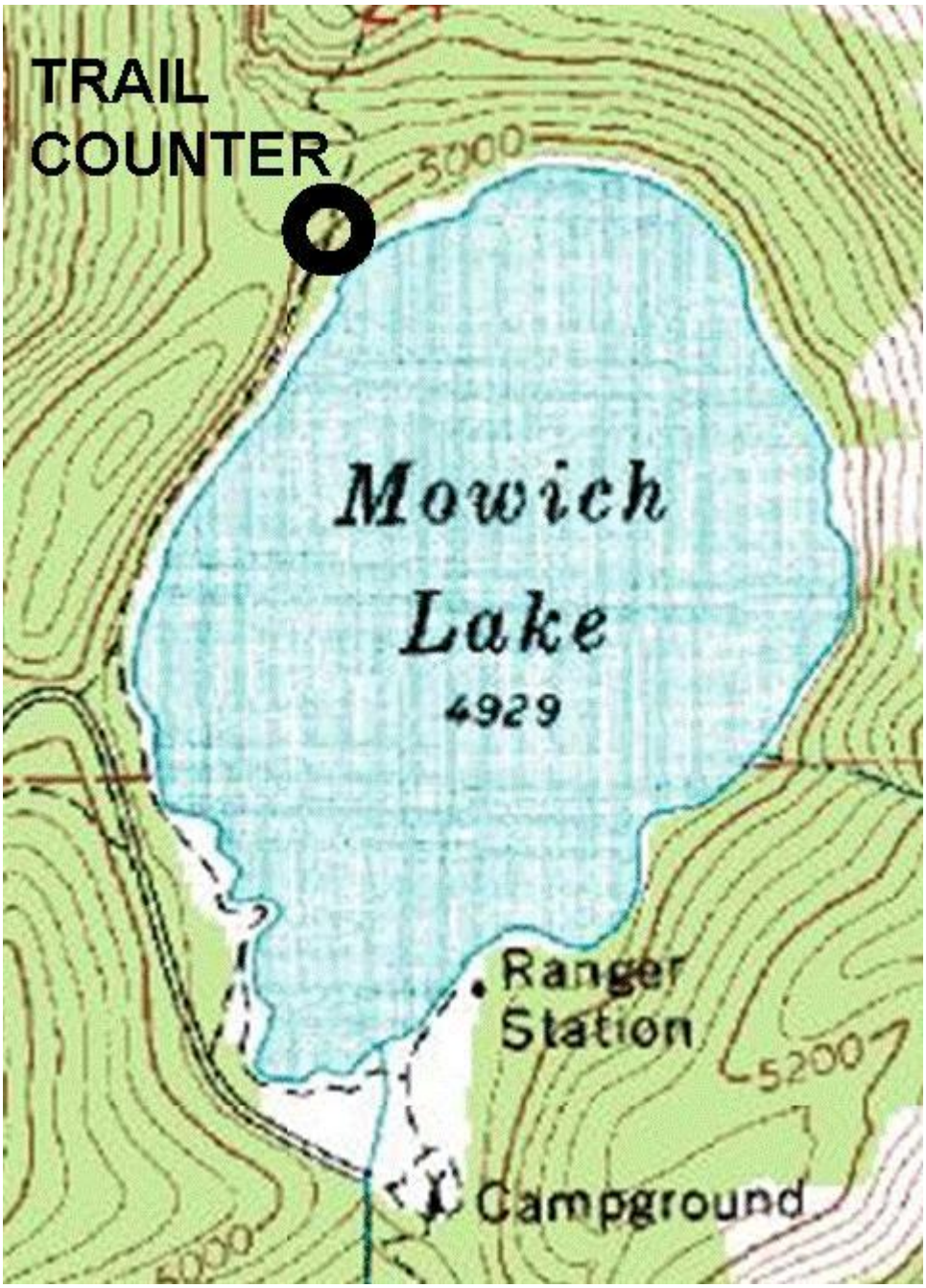


Figure 8. Approximate location of Ipsut Pass Trail electronic counter.

5.1.1 Validation Results: Ipsut Pass Trail

Due to its relatively remote location and demands on limited survey worker time, the counter installed on the Ipsut Pass Trail was not observed to collect validation data concerning the accuracy of its counts. Although inspection of the recorded counts showed no evidence of counter malfunction, it is uncertain whether the counter consistently recorded all visitor passages. The validation results for other counters suggest that most counters were either accurate, or undercounted the number of passing hikers. Thus, the counts from the Ipsut Pass Trail counter

can be considered a reasonable minimum estimate of the number of hikers using the trail along Mowich Lake.

5.1.2 Data Cleaning and Limitations of Data: Ipsut Pass Trail

The trail counter functioned from July 12 to August 9, and from August 24 to September 1. The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were considered to be outliers and examined to determine if they were consistent with other counts registered on that day.[1] These analyses showed enough consistency that none of the hourly counts were replaced.

5.1.3 Descriptive Data: Ipsut Pass Trail

The following charts show the estimated daily counts of hikers based on the readings of the trail counter. It should be noted that these counts include day-hikers, backpackers, and visitors to Mowich Lake and/or Mowich Lake Campground who used the trail along the southeast shore of Mowich Lake. The relative proportion of these different users can not be determined from the trail counter data, but in the future, more detailed studies of visitor behavior at Mowich Lake might be used to estimate that proportion.

The counts show a strong weekend/weekday effect. Such a result is consistent with the idea that use of the Ipsut Pass Trail is strongly correlated with total use of MORA. Indeed, the correlation between counts from the trail counter and counts of the total number of vehicles passing the Nisqually and White River entrances was 0.895 (N = 35).

Peak use of the Ipsut Pass Trail (467 hiker passages) was recorded on July 8. Use was not exceptionally high on Independence Day. The 95th percentile day was 413 hiker passages.

The average count was 82 on weekdays, with a standard deviation of 47. On weekends, the average count was 324, with a standard deviation of 104. Median counts were 78 and 348 for weekdays and weekends, respectively.

[1] In most cases, outlier counts were compared to gate counts of vehicles to determine if it was plausible that visitation was particularly high at that time and date.

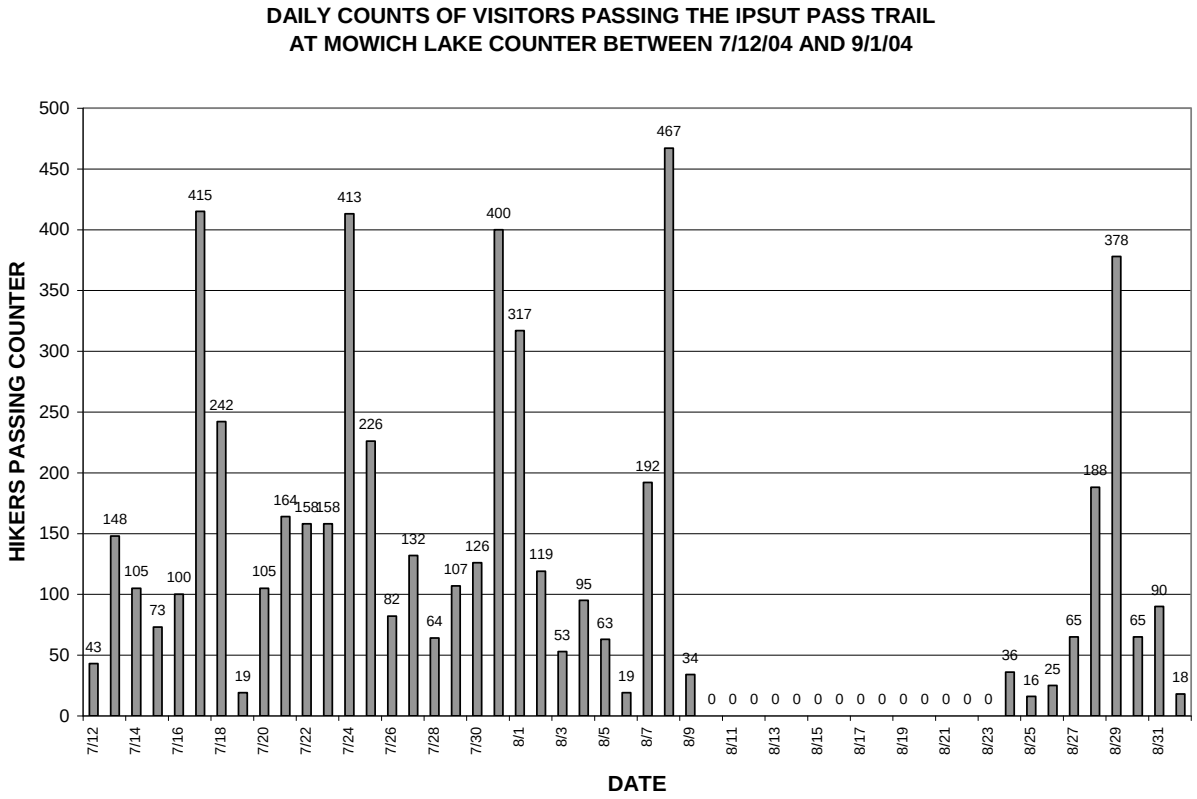


Figure 9. Daily counts of visitors passing Ipsut Pass Trail counter. Note that counts of "0" indicate periods when the counter was not functioning.

The hourly distributions of hikers passing the counter on the Ipsut Pass Trail along Mowich Lake shows a relatively flat distribution showing relatively even levels of use from 10:00 in the morning to 18:00 in the afternoon. Both the weekend and weekday distributions show similar shapes, with a slight dip in counts from 12:00 to 13:00 that is consistent with decreased visitor movement during the lunch hour.

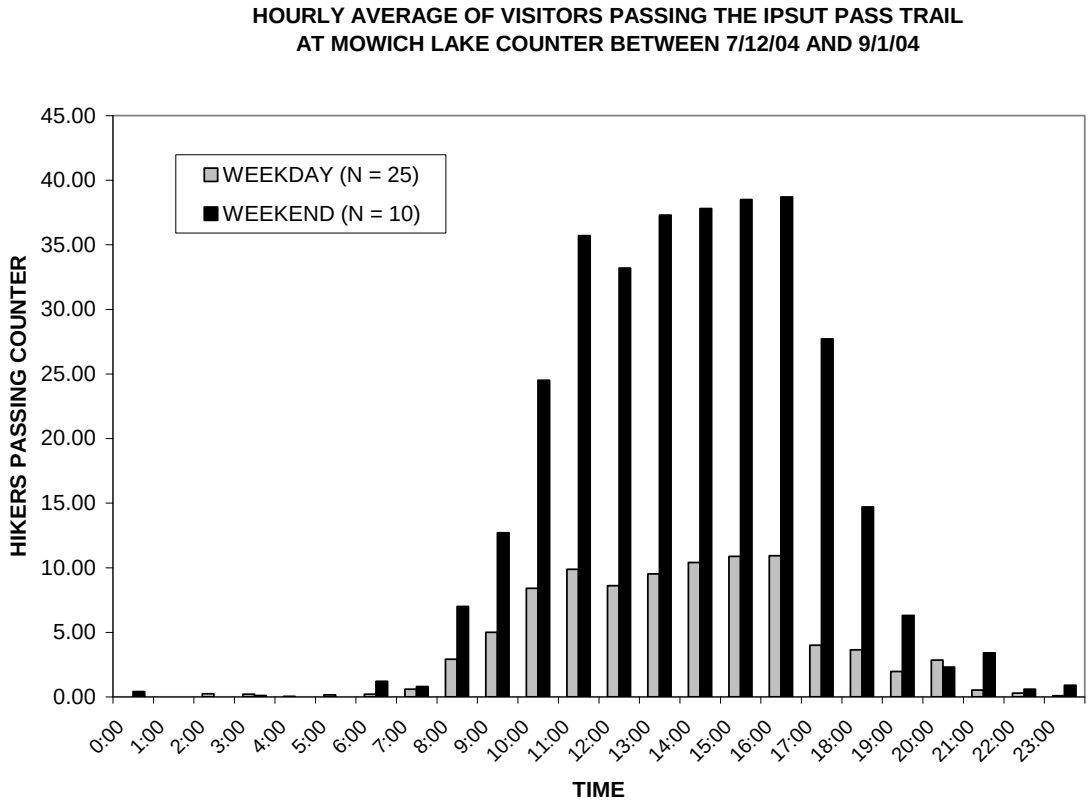


Figure 10. Hourly distributions of visitors passing Ipsut Pass Trail counter.

5.2 Trail Counter Results for Shadow Lake Trail

The Shadow Lake Trail is a very popular day-hiking trail in the Sunrise area of MORA. It is relatively flat and offers views of the White River Valley and Mount Rainier. As part of the web of trails near Sunrise, it is primarily used by day-hikers doing loops or out-and-back hikes after parking at Sunrise. However, it is also part of the Wonderland Trail and is used by backpackers who wish to hike all or part of the Wonderland Trail loop. Day hikers access the trail from a trailhead at the southwest corner of the Sunrise parking lot. The formal parking capacity of the Sunrise parking lot is 260 vehicles, but when gravel and overflow parking areas are included, capacity is approximately 600 vehicles (BRW 1994).

In order to better describe use of the trail, an electronic trail counter was installed on the trail southeast of Shadow Lake in 2004 (see Figure 11). The counter was concealed in trees and visitors were very unlikely to detect the emitter or receiver because they were out of their field of view from the trail tread, and the trail was narrow and rough at the counter site. This counter also provided information useful in creating and validating simulation models of visitor use. For this purpose it was used in combination with waypoint survey data describing hiking patterns in the Sunrise area in general (see section 7.2).

Figure 11. Approximate location of Shadow Lake Trail electronic counter.

5.2.1 Validation Results: Shadow Lake Trail

The counter installed on the Shadow Lake Trail was observed for a total of 14 hours and 30 minutes. Hikers passing during the observed times were counted in 29 30-minute "bins". Both the number of hikers passing and the number of hikers tallied by the trail counter were recorded. Based on the data from the 30 minute bins, linear regression analysis was used to describe the relationship between the electronic and observed counts. The regression coefficient derived from this analysis can be thought of as a correction factor – the true count can be estimated by multiplying the electronic count by the coefficient. The coefficient for the counter was 1.12 – the counter tallied approximately 10 percent fewer visitors than were counted by the observer.

5.2.2 Data Cleaning and Limitations of Data: Shadow Lake Trail

The trail counter functioned from June 29 to July 13, and July 17 to September 14. The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were examined to determine if they were consistent with other counts registered on that day (gate counts of vehicles were used in some comparisons). These analyses showed enough consistency that none of the hourly counts were replaced.

5.2.3 Descriptive Data: Shadow Lake Trail

The following chart shows the estimated daily counts of hikers based on the readings of the trail counter (adjusted based on the validation procedure described in section 5.2.1). It should be noted that these counts include both day-hikers and backpackers. The relative proportion of these different users can not be determined from the trail counter data, but other sources of information might be used to estimate that proportion.

The counts show a strong weekend/weekday effect. Such a result is consistent with the idea that use of the Shadow Lake Trail is strongly correlated with use of the White River area of MORA. Indeed, the correlation between counts from the trail counter and counts of the total

number of vehicles passing White River entrance was 0.705 (N = 76).

Peak use of the Shadow Lake Trail (482 hiker passages) was recorded on July 1. Use was not exceptionally high on Independence Day but was very high on Labor Day. The 95th percentile day was 382 hiker passages.

The average count was 112 on weekdays, with a standard deviation of 72. On weekends, the average count was 235, with a standard deviation of 118. Median counts were 106 and 258 for weekdays and weekends, respectively.

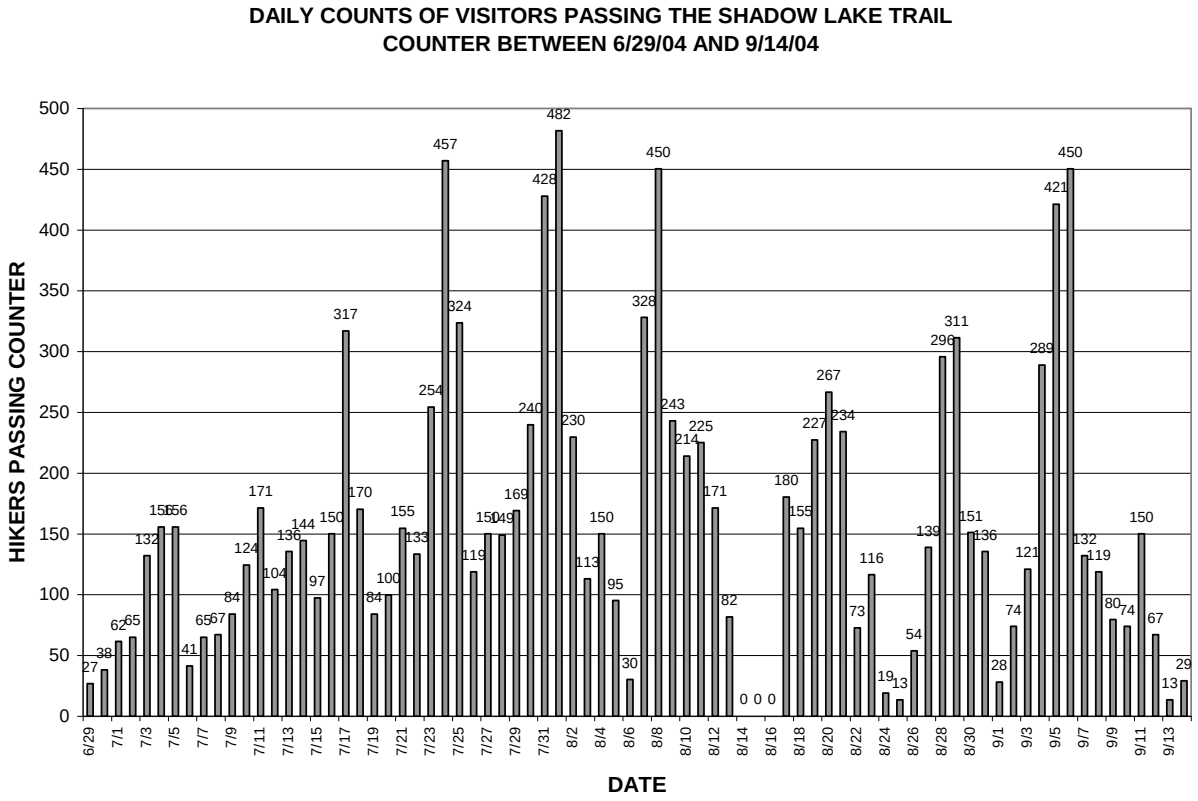


Figure 12. Daily counts of visitors passing Shadow Lake Trail counter. Note that counts of "0" indicate periods when the counter was not functioning and that counts were adjusted using the correction factor estimated from the validation results.

The hourly distributions of hikers passing the counter on the Shadow Lake Trail show a peaked distribution with highest levels of use from 14:00 to 16:00 in the afternoon (Figure 13). Both the weekend and weekday distributions show similar shapes, with weekday use dropping off slightly more quickly after the peak use hour.

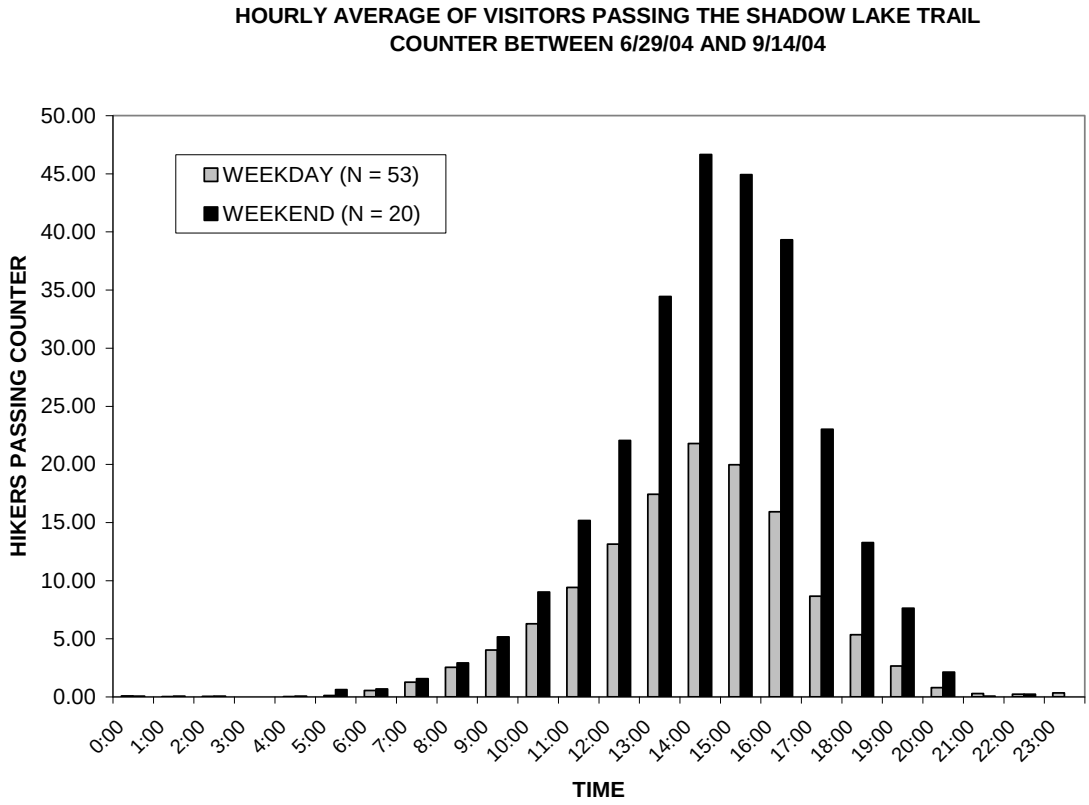


Figure 13. Hourly distributions of visitors passing Shadow Lake Trail counter. Note that counts were adjusted using the correction factor estimated from the validation results.

5.3 Trail Counter Results for Snow Lake Trail

The Snow Lake Trail is a popular day-hiking trail not far from Paradise in the southern part of MORA. The trail is a succession of shallow ups and downs as it crosses a series of low ridges and reaches Bench Lake after .75 miles. The trail then continues another .5 miles to Snow Lake, located in a cirque in the Tatoosh range. The Snow Lake Trail is not part of the Wonderland Trail loop, but there is a backcountry camp accessed via the trail. Day hikers access the trail from a trailhead on the Stevens Canyon Road. The formal parking capacity at the trailhead is 20 vehicles (BRW 1994).

In order to better describe use of the trail, an electronic trail counter was installed on the trail in 2004 (see Figure 14). The counter was concealed in trees about .5 miles from the trailhead, so it did not register hits from hikers who only made short exploratory hikes just beyond the trailhead.

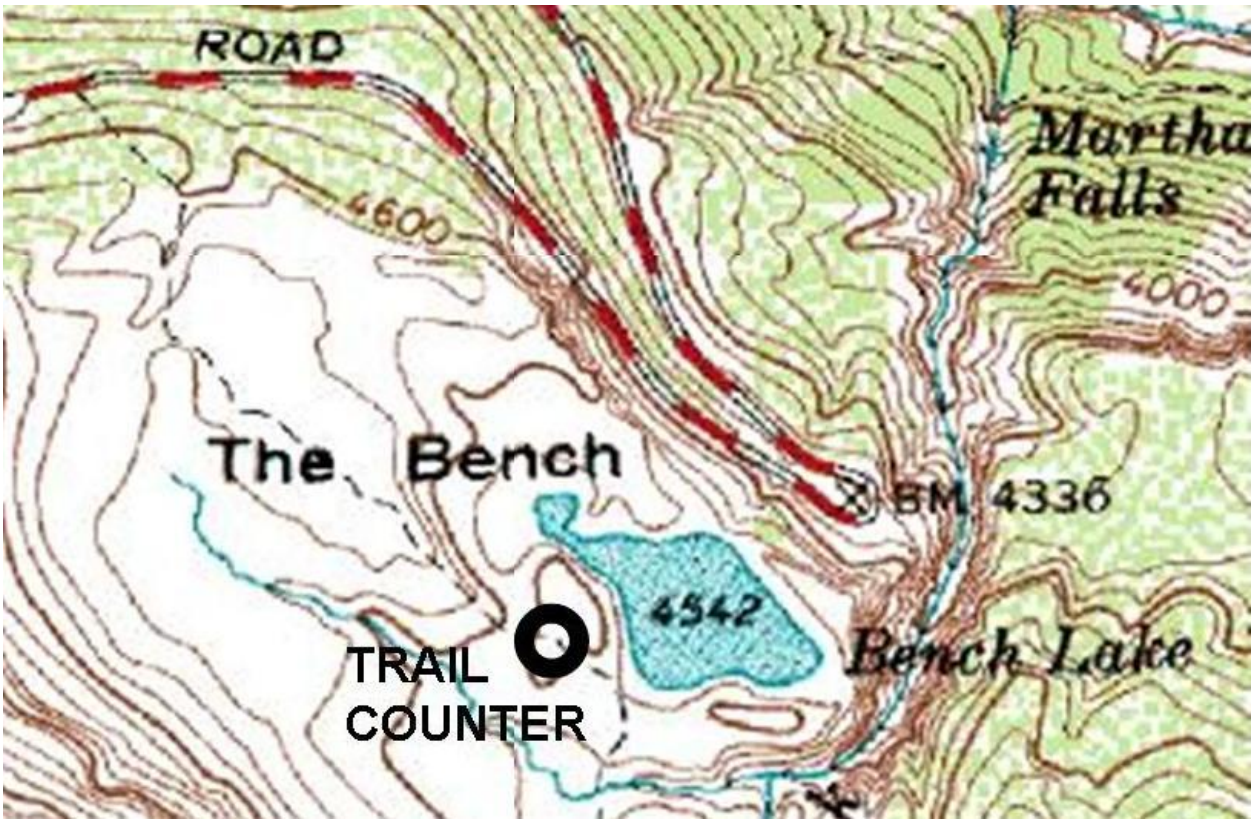


Figure 14. Approximate location of Snow Lake Trail electronic counter.

5.3.1 Validation Results: Snow Lake Trail

The counter installed on the Snow Lake Trail was observed for a total of 8 hours and 10 minutes. Hikers passing during the observed times were counted in 15 30-minute "bins". Both the number of hikers passing and the number of hikers tallied by the trail counter were recorded. Based on the data from the 30 minute bins, linear regression analysis was used to describe the relationship between the electronic and observed counts. The regression coefficient derived from this analysis can be thought of as a correction factor – the true count can be estimated by multiplying the electronic count by the coefficient. The coefficient for the counter was 1.03 – the counter tallied almost the same number of visitors that were counted by the observer.

5.3.2 Data Cleaning and Limitations of Data: Snow Lake Trail

The trail counter functioned from July 11 to September 14. The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Inspection of the data suggested that the trail counter started to dramatically over-count on September 5. Prior to that date, the maximum daily count was 317, but after that date, the average daily count was 954. Further evidence of malfunction was found in the correlation between vehicle counts at the Nisqually entrance and the daily trail counts. For the dates prior to September 5, the correlation between vehicle and trail counts was 0.831 (N = 56). However, if the daily counts from September 5 to 14 are included, the correlation drops to 0.133

(N = 66). Based on these analyses, the trail counts collected after September 4 were dropped from the data set.

5.3.3 Descriptive Data: Snow Lake Trail

The following chart shows the estimated daily counts of hikers based on the readings of the trail counter (adjusted based on the validation procedure described in section 5.3.1). It should be noted that these counts include both day-hikers and backpackers. The relative proportion of these different users can not be determined from the trail counter data, but in the future, other sources of information might be used to estimate that proportion.

The counts show a strong weekend/weekday effect. Such a result is consistent with the idea that use of the Snow Lake Trail is strongly correlated with use of the Nisqually/Stevens Canyon corridor in MORA. Indeed, the correlation between counts from the trail counter and counts of the total number of vehicles passing Nisqually entrance was 0.831 (N = 53).

Peak use of the Snow Lake Trail (327 hiker passages) was recorded on July 31. The 95th percentile day was 226 hiker passages.

The average count was 84 on weekdays, with a standard deviation of 36. On weekends, the average count was 180, with a standard deviation of 63. Median counts were 87 and 181 for weekdays and weekends, respectively.

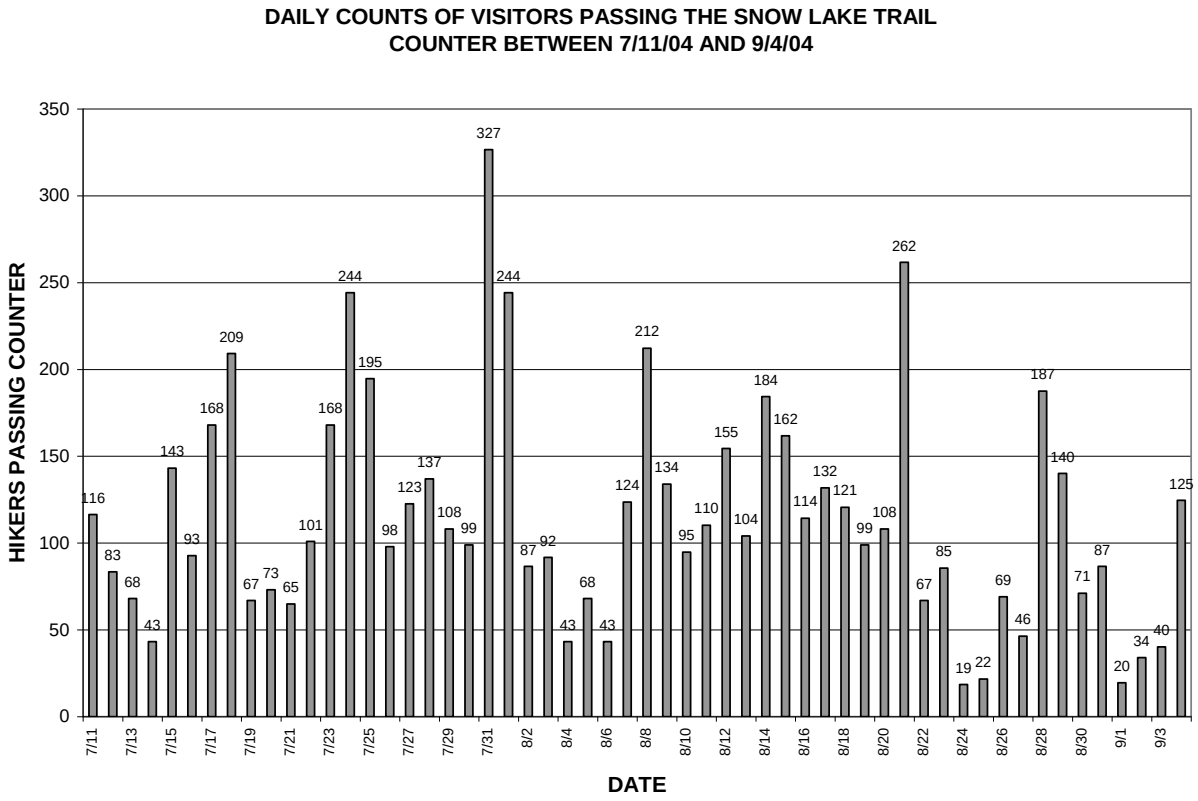


Figure 15. Daily counts of visitors passing Snow Lake Trail counter. Note that counts were adjusted using the correction factor estimated from validation results.

The hourly distributions of hikers passing the counter on the Snow Lake Trail show a peaked distribution with highest levels of use from 13:00 to 16:00 in the afternoon. Both the

weekend and weekday distributions show similar shapes, with weekday use showing a flatter distribution with peak use more evenly spread from 11:00 to 16:00.

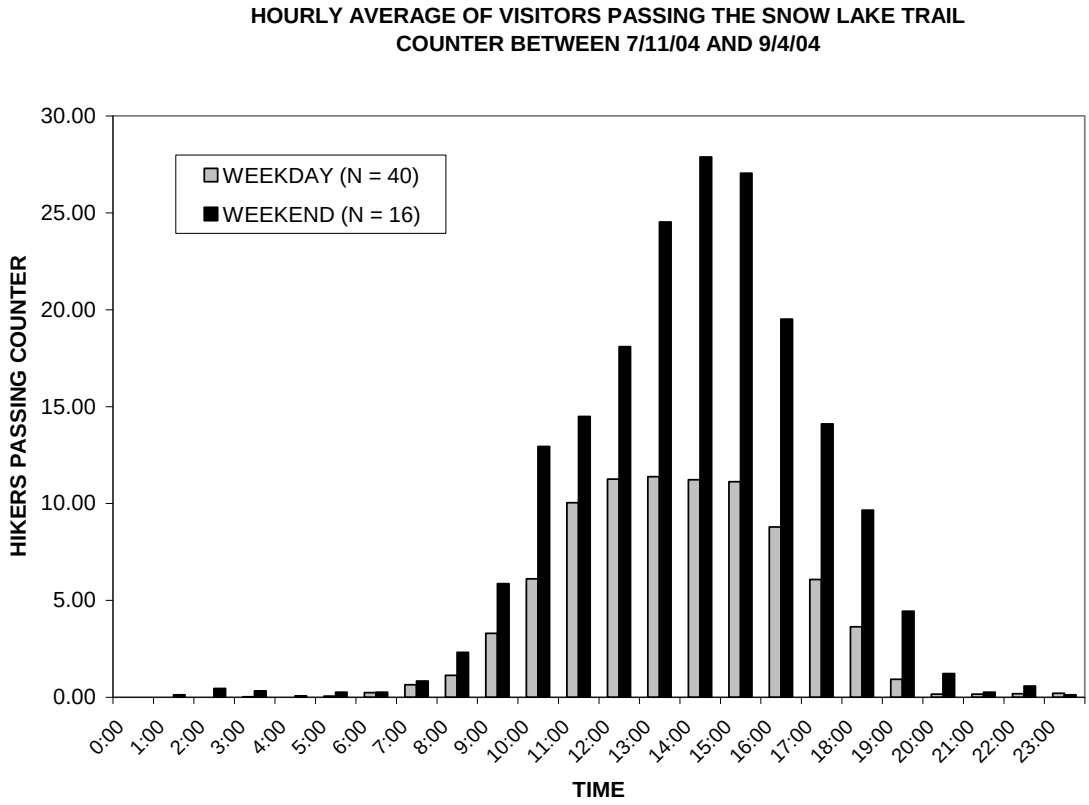


Figure 16. Hourly distributions of visitors passing Snow Lake Trail counter. Note that counts were adjusted using the correction factor estimated from the validation results.

5.4 Trail Counter Results for Comet Falls Trail

The Comet Falls Trail is a relatively short hike located in the southwestern area of MORA. The park website states, "320 ft. Comet Falls is a popular destination for many hikers." The trail is not part of the Wonderland Trail, and is used primarily by day-hikers who wish to view the falls or continue upward to Van Trump Park. Day hikers access the trail from a trailhead near Christine Falls on the Longmire-Paradise Road. Parking capacity at the trailhead is 26 vehicles but can overflow along access drives and roadway shoulders (BRW 1994).

The trail climbs steadily through mature forest along Van Trump Creek until it reaches the base of Comet Falls at 1.9 miles. From there, the trail switchbacks .6 miles uphill to the junction with the Rampart Ridge Trail. Van Trump Park is to the right, where the trail winds through the meadows before ending in .5 miles.

In order to better describe day-hiking use of the trail, and to provide a means of creating simulation models of visitor use, a trail counter was installed on the Comet Falls Trail (see Figure 17). The trail counter was installed and maintained in 2004. Located not far from the trailhead, the counter was marginally concealed in trees beyond a footbridge over Comet Creek. Each unit was about twenty feet from the trail tread, and plainly visible on tree trunks. However,

visitors were unlikely to detect the counters because the trail was narrow and rough at the counter site.

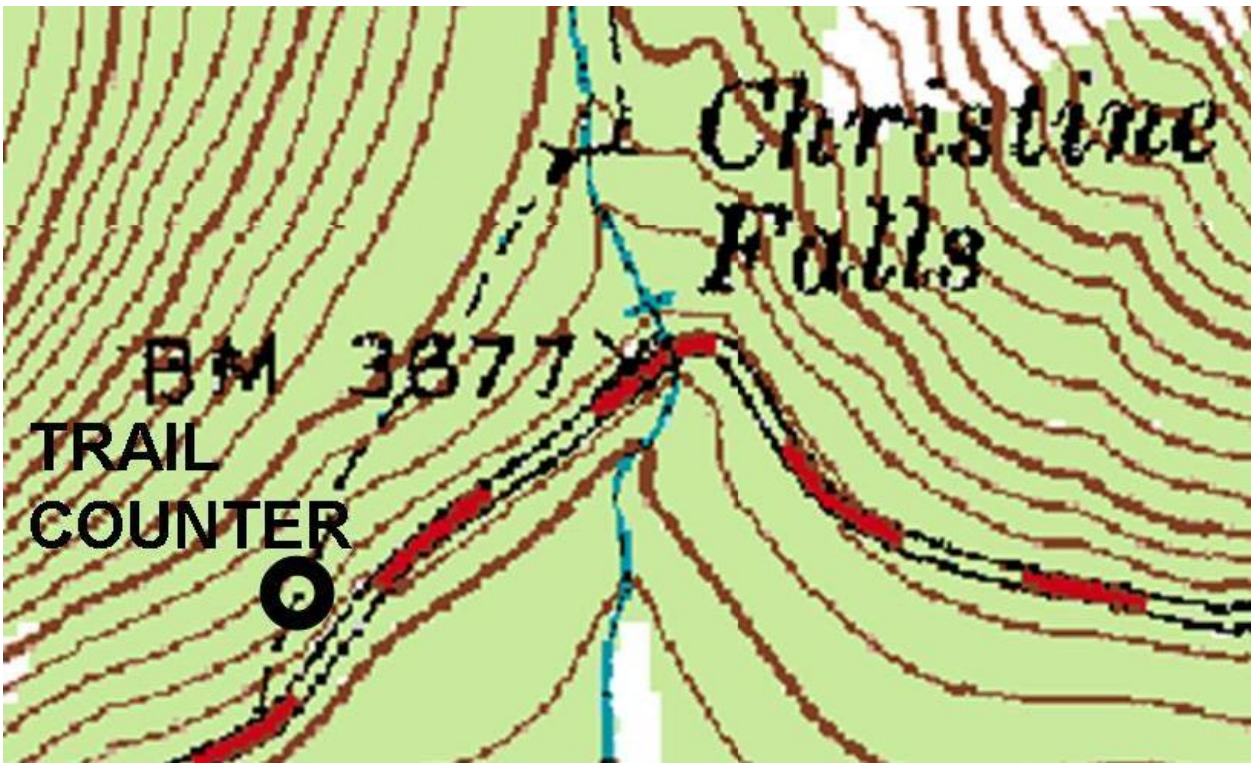


Figure 17. Approximate location of Comet Falls Trail electronic counter.

5.4.1 Validation Results: Comet Falls Trail

The counter installed on the Comet Falls Trail was observed for a total of 5 hours and 40 minutes. Hikers passing during the observed times were counted in twelve 30 minute "bins". Both the number of hikers passing and the number of hikers tallied by the trail counter were recorded. Based on the data from the 30 minute bins, linear regression analysis was used to describe the relationship between the electronic and observed counts. The regression coefficient derived from this analysis can be thought of as a correction factor – the true count can be estimated by multiplying the electronic count by the coefficient. The coefficient for the upper counter was 1.05 – the counter tallied nearly the same number of visitors counted by the observer.

5.4.2 Data Cleaning and Limitations of Data: Comet Falls Trail

In 2004, the Comet Falls trail counter functioned from June 29 to September 14. The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were examined to determine if the times when counts were recorded showed patterns more consistent with malfunction than the passage of large groups. This examination showed no

reason to replace any of the hourly counts.

5.4.3 Descriptive Data: Comet Falls Trail

The following charts show the estimated daily counts of hikers based on the trail counter readings (the correction factor of 1.05 has been applied to the counts). It should be noted that these counts include both day-hikers and backpackers using the trail. The relative proportion of these different users can not be determined from the trail counter data, but other sources of information might be used to estimate that proportion.

The counts show a strong weekend/weekday effect. Such a result is consistent with the idea that use of the Comet Falls Trail is strongly correlated with total use of the Nisqually/Stevens Canyon area. Indeed, the correlation between counts from the lower trail counter and counts of the number of vehicles passing the Nisqually entrance was 0.838 (N=???).

Peak use of the Comet Falls Trail (344 hiker passages) was recorded on August 8, but this day was also notable because a very large group apparently walked a short distance up the trail between 11:18 and 11:54. Use was also quite high on the Labor Day holiday (262 hiker passages on September 4 and 286 hiker passages on September 5). The 95th percentile day was 284 hiker passages.

The average count was 94 on weekdays, with a standard deviation of 36. On weekends, the average count was 206, with a standard deviation of 66. Median counts were 95 and 207 for weekdays and weekends, respectively.[2]

[2] Because the large group of short-term visitors noted on August 8 was considered a legitimate portion of the visitor population, they were included in the data used to calculate averages, standard deviations, and medians for use levels. That single day had little effect on these aggregate measures.

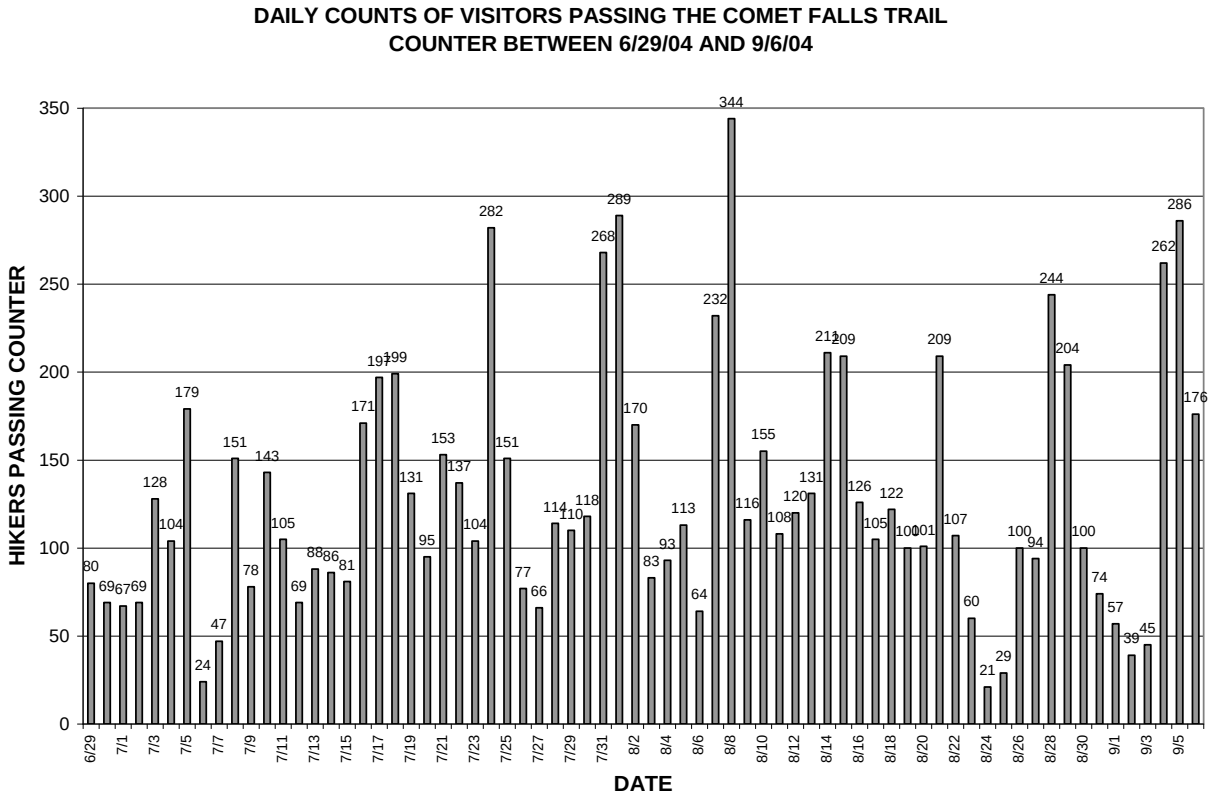


Figure 18. Daily counts of visitors passing Comet Falls Trail counter. Note that counts were adjusted using the correction factor estimated from the validation results.

The hourly distributions of hikers passing the Comet Falls trail counter show a single peak shape on both weekdays and weekends. There is some suggestion of a peak in hiker entries at mid-day, but the number of hikers spending longer times hiking the trail is not large enough to produce bimodal distributions like those seen on longer day-hiking trails.

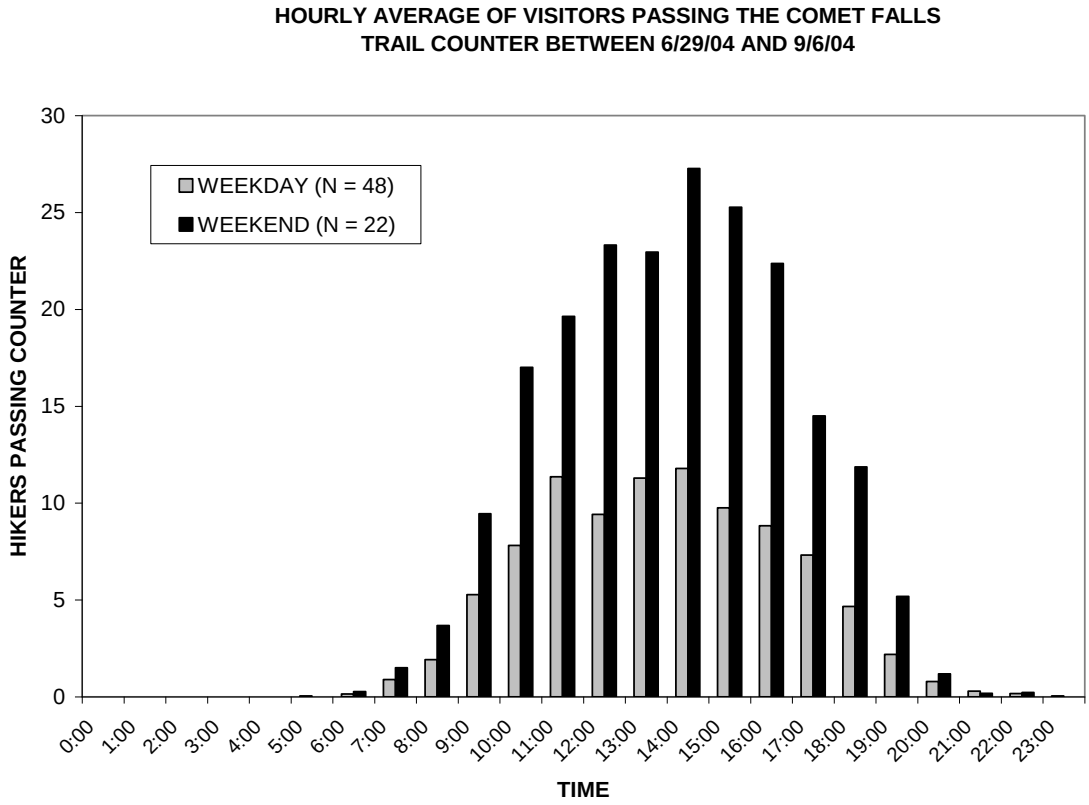


Figure 19. Hourly distributions of visitors passing Comet Falls Trail counter. Note that counts were adjusted using the correction factor estimated from the validation results.

5.5 Waypoint Results for Comet Falls Trail

A waypoint study was conducted in 2004 to assess the hiking patterns of day-hikers using the Comet Falls Trail.

5.5.1 Location

The waypoint survey was conducted by a field worker stationed at sign A, located at the Comet Falls trailhead very near the parking area. Figure 20 below shows the approximate locations of all the waypoint signs used in the study.

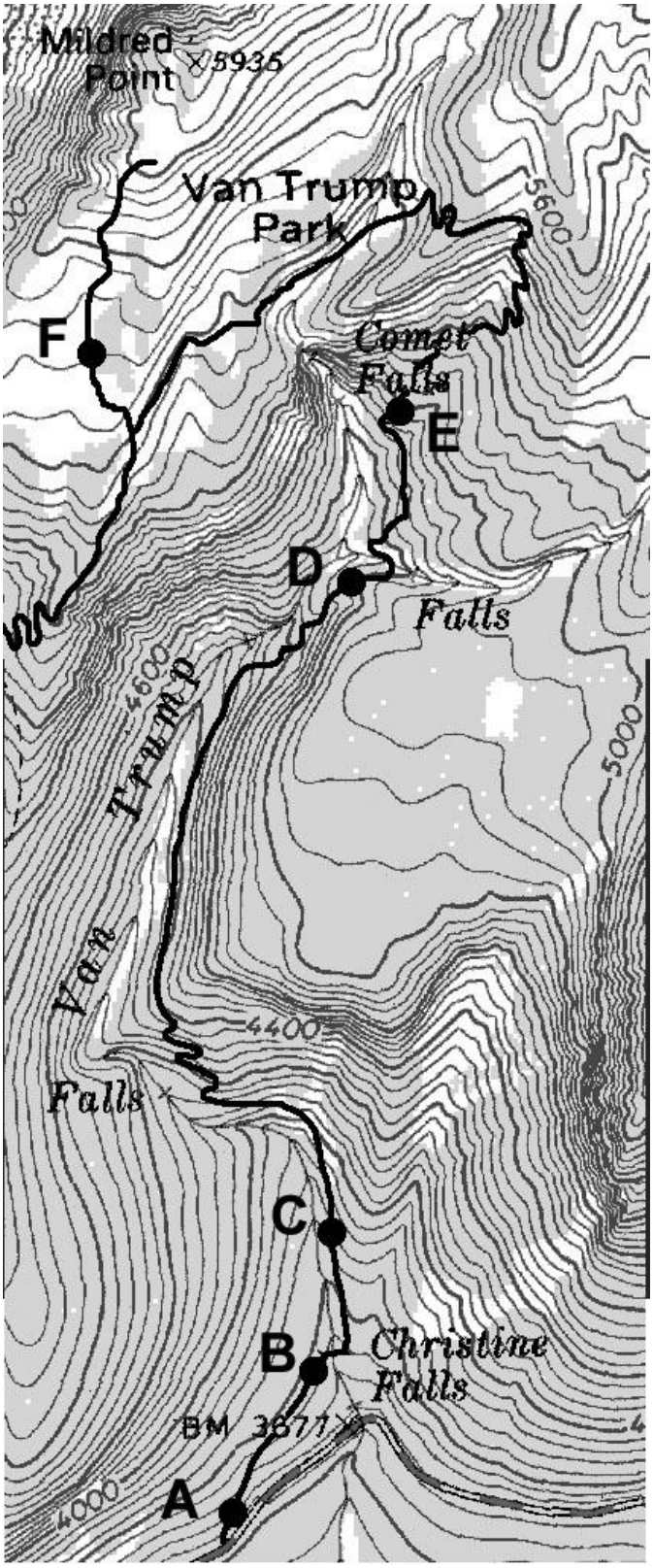


Figure 20. Locations of waypoint signs for Comet Falls Waypoint Survey.

5.5.2 Instruments

The waypoint cards handed out to day-hikers were of the standard design described in section 3.2 above.

5.5.3 Sample

Data were collected on 17 days (11 weekdays and 6 weekend days) between July 6 and September 6, 2004. On sampled days, all day-hiking parties passing sign A were asked to participate in the study. If it was unclear whether a party was day-hiking or consisted of overnight backpackers, workers asked for hikers' destinations.

A total of 270 parties were asked to participate in the study. Of those parties, 240 returned their cards (88.9%), 18 failed to return cards (6.7%), and 12 refused to participate or could not participate due to foreign language issues (4.4%).

5.5.4 Results

Party size. The average party size was 3.24 (SD = 2.67)

Hiking patterns. Analyses of the recorded waypoints showed that only 56.7 percent of hiking parties reported that they reached Comet Falls (i.e., they passed waypoint E), and 30.0 percent of hiking parties hiked toward Van Trump Park (passed waypoint F). Table 3 below shows the percentage of hiking parties that passed each waypoint.

Waypoint	Percent of Parties Passing
A	100.0
B	99.6
C	82.9
D	72.9
E	56.7
F	30.0

Table 3. Percent of parties passing Comet Falls waypoints.

Hiking durations. The average duration of day-hikes on the Comet Falls Trail was 139 minutes (SD = 88). Hike durations were 201 minutes (SD = 64) for parties that reported reaching Comet Falls (including parties that went on toward Van Trump Park), and 239 minutes (SD = 59) for only those parties that went on toward Van Trump Park. The figure below shows a bimodal distribution of hiking durations for all hikers, with one peak for durations of less than one hour, and another peak for 2-3 hour durations. Most hikes for hikers who reached Comet Falls (and/or hiked further) were between 2 and 4 hours in duration. The distribution of hiking durations for only those hikers who hiked toward Van Trump Park was also tightly clustered, with most hikes taking between 3 and 5 hours.

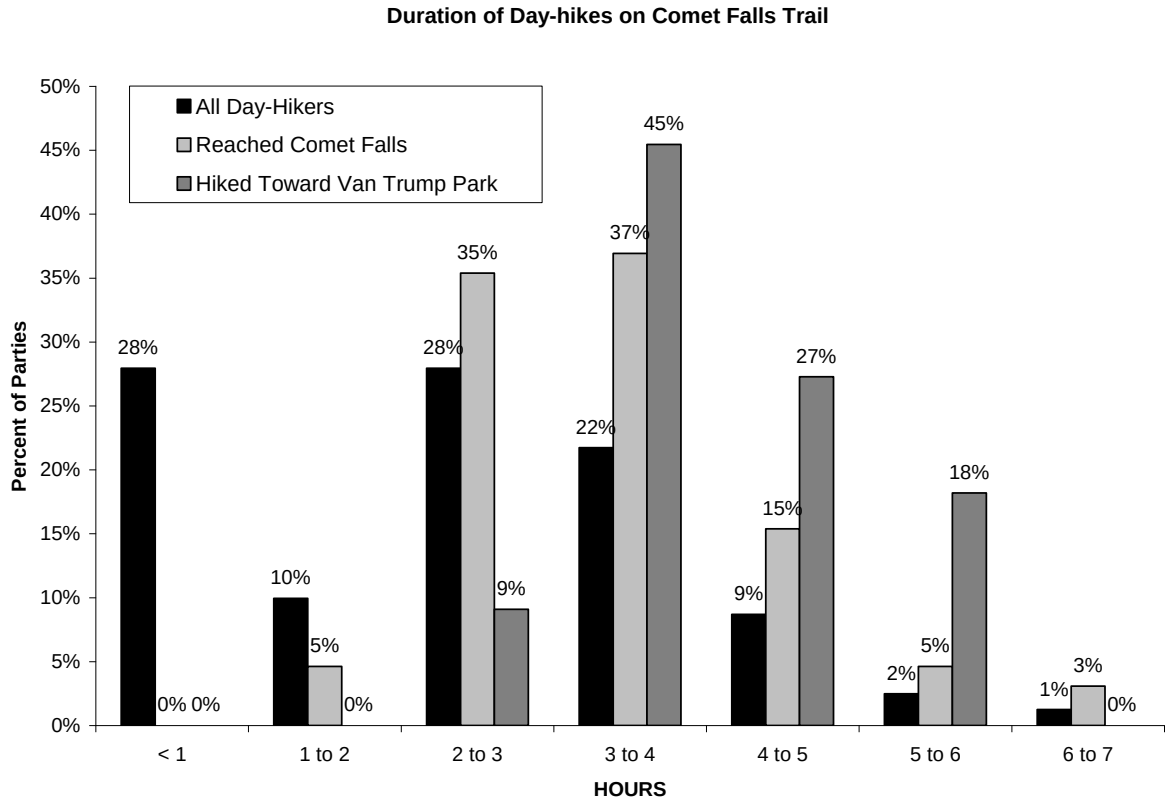


Figure 21. Durations of day-hikes on Comet Falls Trail.

Informal observation of visitors hiking the Comet Falls Trail suggests that some parties hike to the small falls between waypoints B and C, then, either because they mistake them for Comet Falls, or because they have limited time for their hike, return to the trailhead. The relatively low proportion of hikers who reach Comet Falls (56.7%) is consistent with the 1995 Wilderness Trail Survey (Vande Kamp, Swanson, and Johnson 2000) which found that, "Compared to Summerland (the only other contact point not accessed from a front country facility), Comet Falls is visited by many more people with front country destinations. It is the least "single destination" site of all the contact points." Many hikers at Comet Falls have additional destinations elsewhere -- their hike durations may be limited by a desire to reach those other destinations.

Further observation suggests that parties hike fairly steadily up the trail, taking short breaks to rest, but rarely taking long breaks before reaching Comet Falls and/or Van Trump Park. The times recorded in the waypoint survey are consistent with such observations. For all hiking parties that reached Comet Falls, the average hiking speed between point A and E was 1.86 kph, with a relatively small standard deviation of .50 kph.

5.6 Trail Counter Results for Spray Park Trail

The Spray Park Trail is a popular day-hiking destination in the northwest corner of MORA. Although it is not officially designated as part of the Wonderland Trail, it intersects the Wonderland Trail at each end and can be used by backpackers who wish to hike all or part of the

Wonderland Trail loop. Day hikers access the trail from a trailhead near Mowich Lake at the terminus of the Mowich Lake Road. Parking capacity is limited primarily by the willingness of visitors to hike from their vehicles to the trailhead because parking along the road shoulder commonly extends for a considerable distance prior to the road terminus.

The Spray Park Trail is used to access Spray Falls and the sub-alpine meadows of Spray Park. From the trailhead, the trail descends .25 mile to a junction with the Wonderland Trail. The Spray Park Trail then continues east for two miles, up and down forested terrain, across Lee Creek and eventually to the junction with a spur trail to view Spray Falls. The next half mile to the first meadows of Spray Park is a steep climb up a series of switchbacks. More extensive meadows are found in another half mile.

In order to better describe day-hiking use of the trail, and to provide a means of creating simulation models of visitor use, two trail counters were installed on the Spray Park Trail in 2004. The first, located not far from the trailhead, was intended to count all hikers, the second, located several miles away from the trailhead, near the point where the trail leaves the forest and enters the sub-alpine meadows of Spray Park, was intended to indicate the proportion of hikers who reach the meadow area where visitors' behavior and their impact on the environment commonly change.

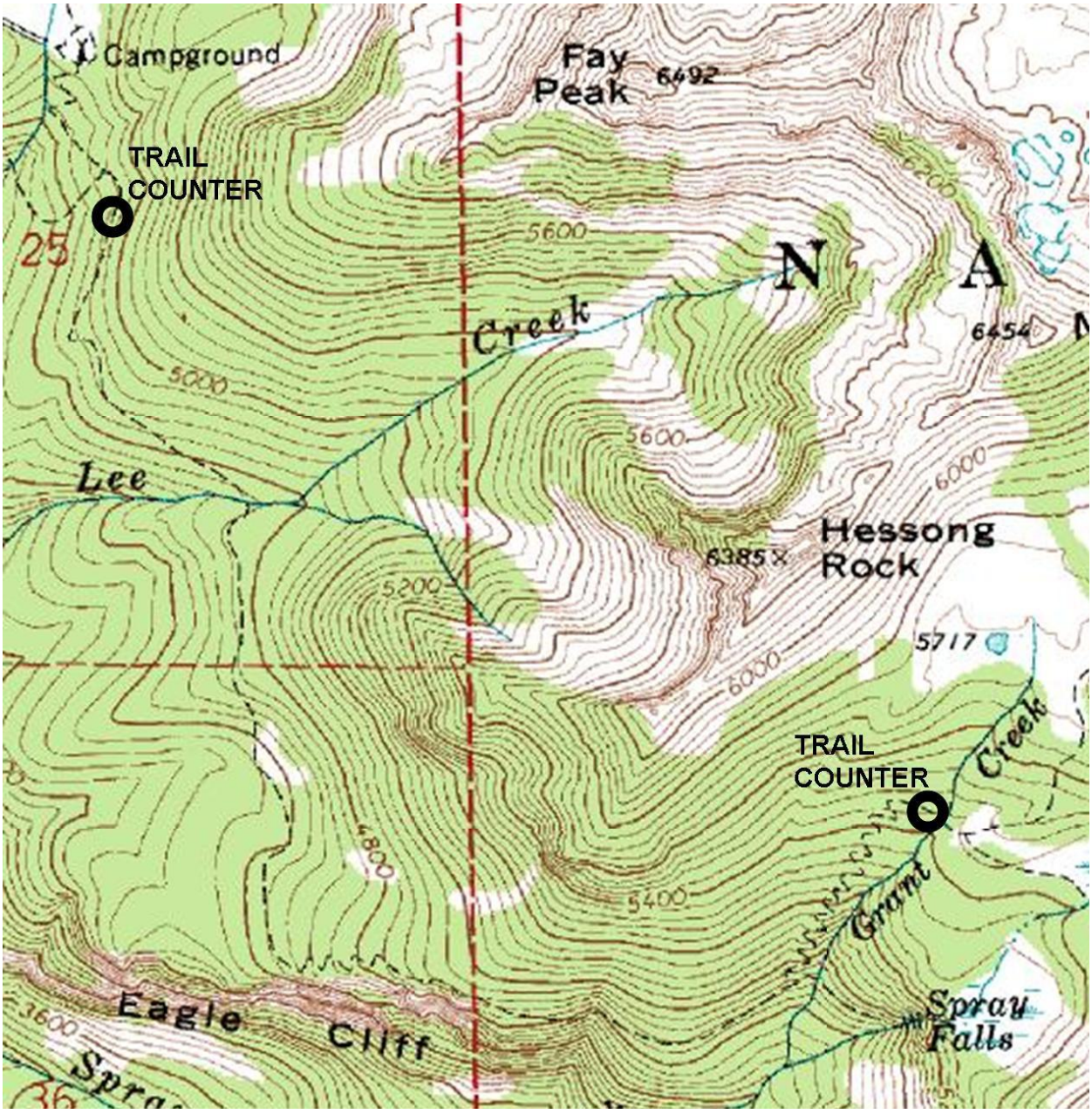


Figure 22. Approximate locations of Spray Park Trail electronic counters.

5.6.1 Validation Results: Spray Park Trail

Due to their relatively remote location and demands on limited survey worker time, the counters installed on the Spray Park Trail were not observed to collect validation data concerning the accuracy of their counts. Future research to validate Spray Park Trail counts is recommended. In the meantime, a comparison of the counts made during the waypoint study and the counts recorded by the lower trail counter can serve as a similar, but less precise form of validation.

There were six days during which the trail counter was functioning and waypoint studies were being conducted. On each of those days the time period between the first and last waypoint

survey contact could be used to compare the number of hikers counted by the trail counter to the number that would be expected based on the waypoint survey. For example, on July 13, 8 parties with a total of 17 hikers were sampled for the waypoint survey between 11:35 and 15:24. During that same time period, one party of two hikers completed their hike and turned in their waypoint card. Accordingly, one would expect that the counter should record 19 passages during the same time period. The table below shows the expected counts and mechanical counter counts.

Date	Expected Count (Based on Waypoint Survey)	Mechanical Counter Count
July 13	19	23
July 14	18	31
July 19	9	12
July 20	24	23
July 31	147	182
August 1	152	205

Table 4. Spray Park Trail counter validation: Expected and mechanical counter counts.

The expected counts were only 77.5 percent of the mechanical counter counts. There are at least four potential sources for this discrepancy. First, some hiking parties who started their hikes before the waypoint survey began may have returned during the specified time periods. Thus, they would not be included in the expected count but would be recorded by the trail counter. Second, an unknown number of backpackers who were not eligible for the waypoint survey may have hiked past the trail counter. Third, group sizes were not recorded for seven parties in the waypoint study and the expected count was thus short by approximately 18 hikers. Fourth, and finally, the trail counter may have been set up improperly, so that it sometimes registered more than one passage for some hikers. Because the first three sources were certain to create at least some discrepancy between the expected and actual counts, the question at hand is whether the total discrepancy was such that counter malfunction should be assumed. Of the 107 unexpected hiker passages recorded by the trail counter, we can assume that 18 were created by hikers in the groups whose sizes were not recorded in the waypoint study (the third source described above). To account for the remaining 89 unexpected passages would require only an average of 4.2 backpackers or early-starting day-hikers per hour during the 21 observed hours. Such traffic levels (particularly given the proximity of the Eagle's Roost campground) are sufficiently likely that we will assume no malfunction of the lower trail counter and will use the unadjusted counts to estimate use of the Spray Park Trail.

A similar comparison of the counts recorded by the upper trail counter and the expected counts based on the waypoint study was attempted. However, the sign for waypoint "C" was erected almost exactly at the same point as the trail counter and the data suggested that many parties were counted multiple times while they recorded that waypoint on their cards. Thus, the validity of the upper counts is poor during the waypoint studies and unknown for other time periods. Because of this questionable validity, information from the upper trail counter is not discussed further in this report. Estimates of the proportion of all hikers reaching Spray Park can be more accurately based on the Spray Park waypoint study (see section 5.7 below).

5.6.2 Data Cleaning and Limitations of Data: Spray Park Trail

In 2004, the lower Spray Park Trail counter functioned from July 12 to August 7. During

that interval, data were lost or failed to be recorded for approximately three hours on July 30. The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were examined to determine if they were consistent with other counts registered on that day (counts from both the lower trail counter and upper trail counter were examined). These analyses showed enough consistency that none of the hourly counts were replaced.

5.6.3 Descriptive Data: Spray Park Trail

The following charts show the estimated daily counts of hikers based on the readings of the lower trail counter. It should be noted that these counts include both day-hikers and backpackers using the trail. The relative proportion of these different users can not be determined from the trail counter data, but other sources of information might be used to estimate that proportion.

The counts show a strong weekend/weekday effect. Such a result is consistent with the idea that use of the Spray Park Trail is strongly correlated with total use of MORA. Indeed, the correlation between counts from the lower trail counter and counts of the number of the total number of vehicles passing the Nisqually and White River entrances was 0.906.

Peak use of the Spray Park Trail (532 hiker passages) during the period when the counter was installed was recorded on July 31. The 95th percentile day was 424 hiker passages. Because of the relatively short observation period, a regression equation predicting total daily hiker passages based on vehicle entries was used to estimate hiker passages for all days from July 1 to September 6, a time period better representing the period of peak visitor use. The 95th percentile day based on the estimated data was 413 hiker passages.

The average count was 97 on weekdays, with a standard deviation of 36. On weekends, the average count was 411, with a standard deviation of 70. Using the regression-based counts, weekday hiker passages were estimated to average 98 (SD = 76) and weekends averaged 300 (SD = 96).

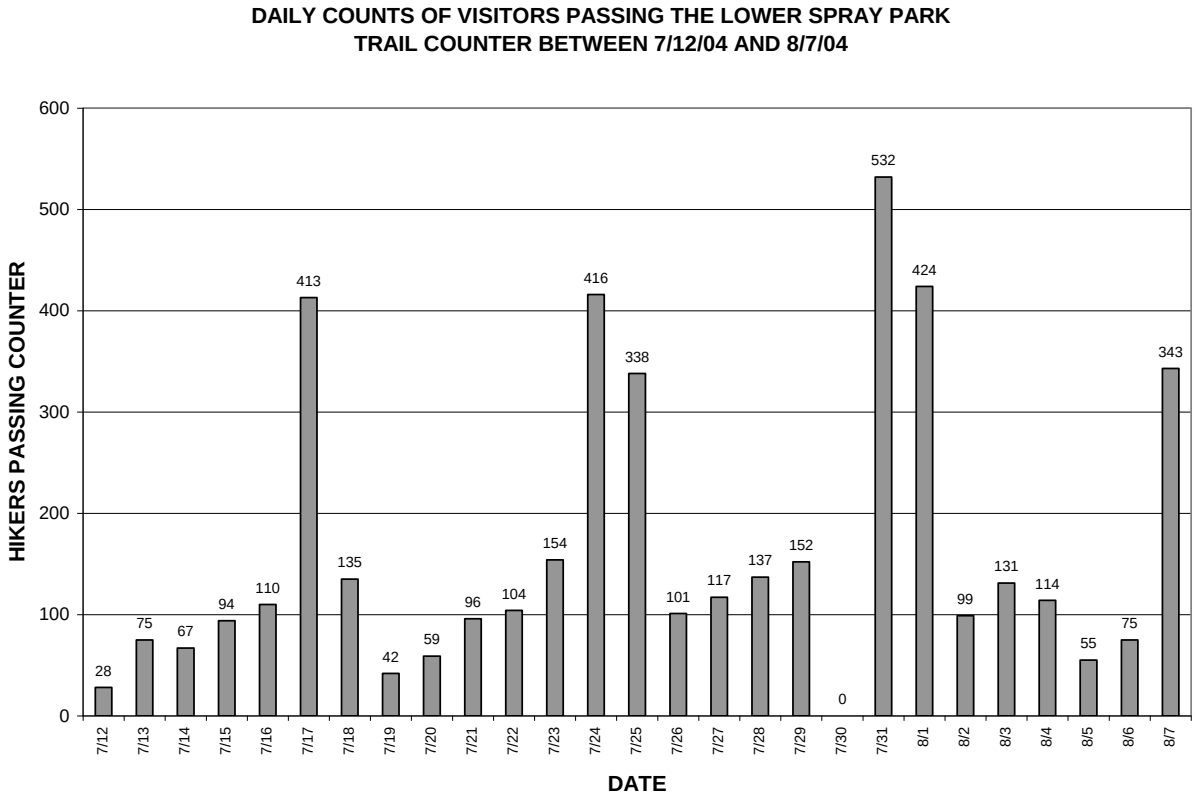


Figure 23. Daily counts of visitors passing Spray Park Trail counter. Note that counts of "0" indicate periods when the counter was not functioning.

The hourly distributions of hikers passing the lower Spray Park Trail counter show a bimodal distribution that reflects the predominant use of the trail by day-hikers. Most hikers begin hiking between the hours of 9:00 and 12:00, and leave between 14:00 and 18:00 in the afternoon. Both the weekend and weekday distributions show similar bimodal shapes, with a more jagged distribution on weekends due to the larger number of hikers.

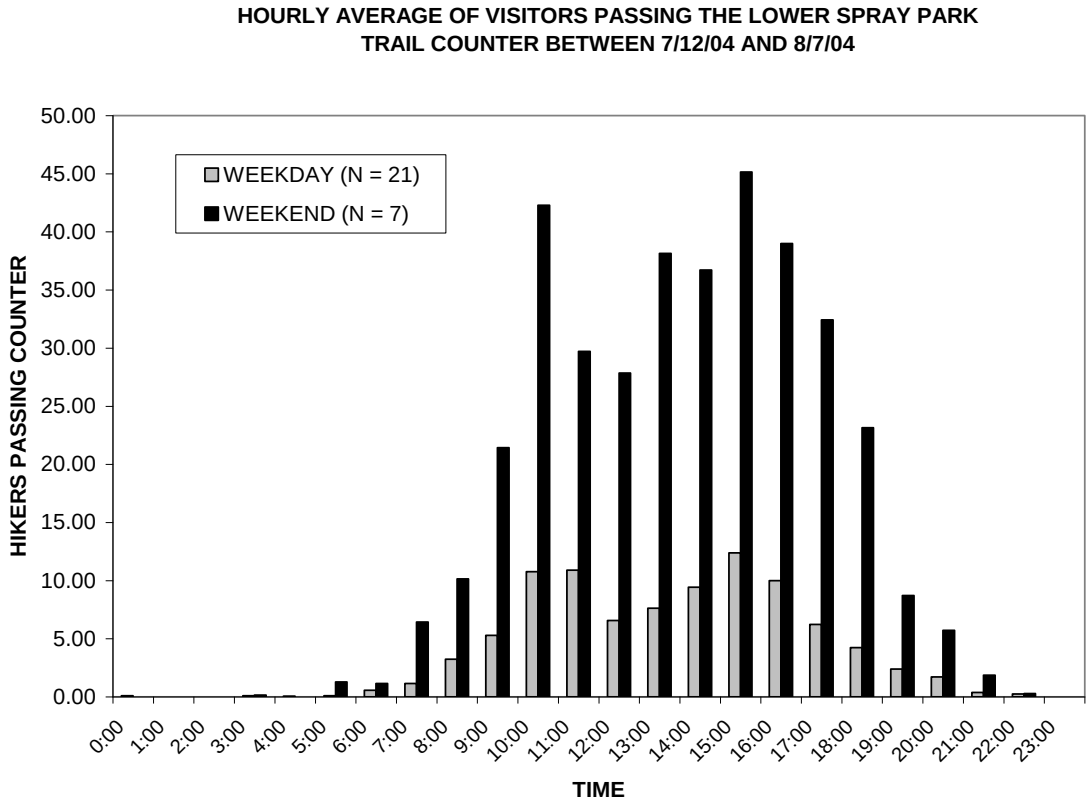


Figure 24. Hourly distributions of visitors passing Spray Park Trail counter.

5.7 Waypoint Results for Spray Park Trail

A waypoint study was conducted in 2004 to assess the hiking patterns of day-hikers using the Spray Park Trail.

5.7.1 Location

Waypoint surveys were conducted by a field worker stationed at sign A, shortly after the Spray Park Trailhead. Figure 25 below shows the approximate locations of all the waypoint signs used in the study. Note that waypoint FF near the ranger station was intended to record any hikers who returned to Mowich Lake via Knapsack Pass. In this study, none of the participating hikers recorded passing waypoint FF.

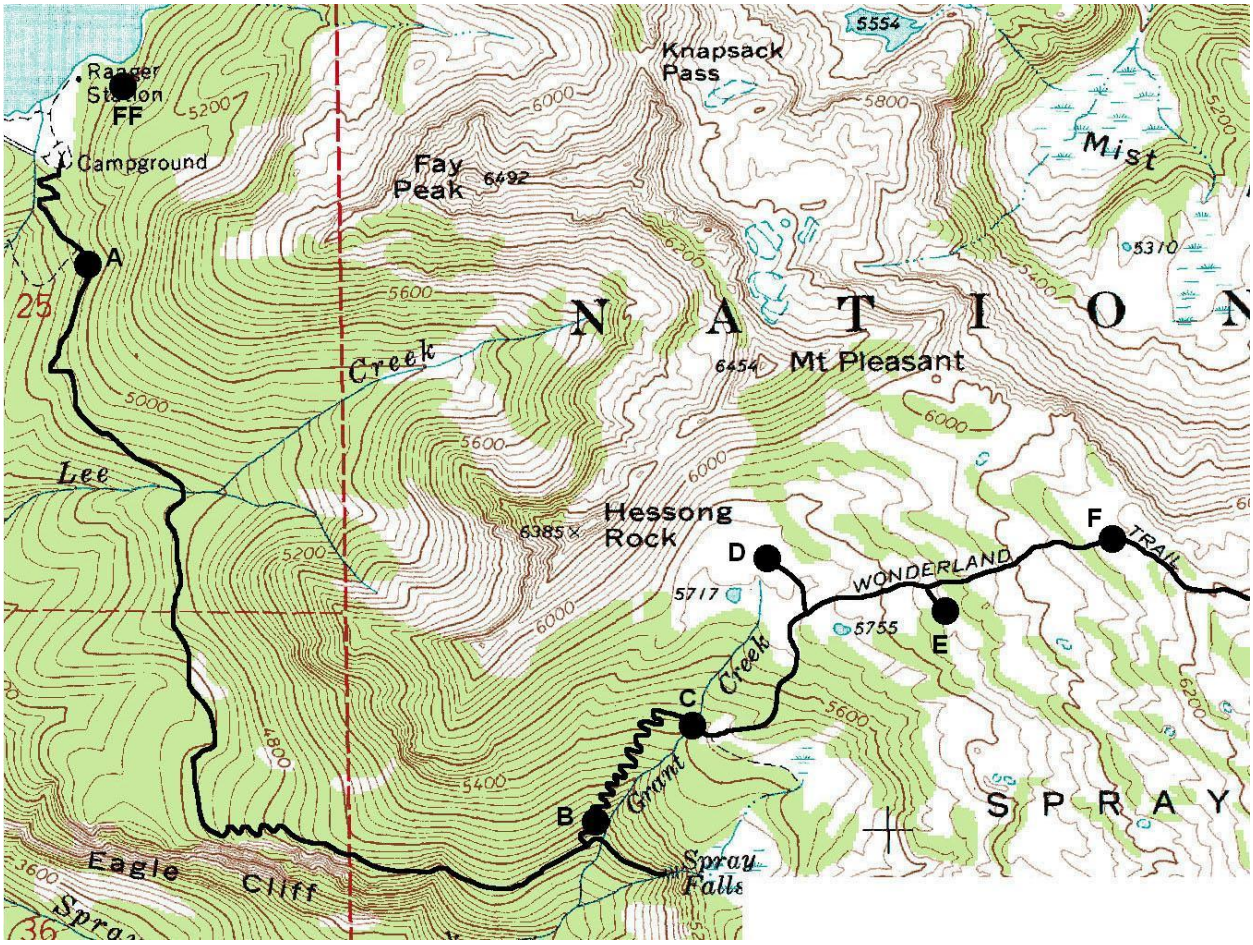


Figure 25. Locations of waypoint signs for Spray Park Waypoint Survey.

5.7.2 Instruments

The waypoint cards handed out to day-hikers were of the standard design described in section 3.2 above.

5.7.3 Sample

Data were collected on 11 days (7 weekdays and 4 weekend days) between July 13 and August 17, 2004. On sampled days, all day-hiking parties passing sign A were asked to participate in the study. If it was unclear whether a party was day-hiking or consisted of overnight backpackers, workers asked for hikers' destinations.

A total of 252 parties were asked to participate in the study. Of those parties, 235 returned their cards (93.3%), 12 failed to return cards (4.8%), and 5 refused to participate or could not participate due to foreign language issues (2.0%).

5.7.4 Results

Party size. The average party size was 2.59 (SD = 1.33)

Hiking patterns. Analyses of the recorded waypoints showed that 95.7 percent of hiking parties reported that they reached the spur trail to Spray Falls, 78.7 percent of hiking parties reported that they reached the first meadows of Spray Park (i.e., they passed waypoint C), and

35.7 percent of hiking parties hiked in the upper, more alpine areas of Spray Park (passed waypoint F). Table 5 shows the percentage of hiking parties that passed each waypoint on the official trail.

Waypoint	**Percent of Parties Passing**
A	100.0
B	95.7
C	78.7
F	35.7

Table 5. Percent of parties passing Spray Park waypoints.

Waypoint B was located at the intersection of the Spray Park Trail and the spur trail to Spray Falls. If hiking parties correctly followed the survey instructions, they would be expected to pass waypoint B twice, three times, or not at all. Passing B three times showed that a party visited Spray Falls in the course of a hike to points higher on the trail (such as Spray Park). For the 22 parties (9.4%) who passed B three times, the duration of the presumed visits to Spray Falls was 26 minutes (SD = 12). Passing B twice without passing any of the higher waypoints suggested that parties visited Spray Falls and then returned to the trailhead. It is also possible that parties stayed on the main trail and turned back before reaching waypoint C, but the lack of specific attractions on that trail segment suggests that such hiking patterns were unlikely. For the 25 parties (10.6%) who showed this pattern, the duration of the presumed visits to Spray Falls was 45 minutes (SD = 19).

Several well-established way-trails branch off from the official Spray Park trail. Waypoint D and E were placed on two of the most prominent of these way-trails to determine the extent to which those trails are used by hikers. Analyses showed that only eight hiking parties (3.4% of all parties, 4.3% of parties that reached Spray Park) reported passing waypoint D, and 19 hiking parties (8.1% of all parties, 10.3% of parties that reached Spray Park) reported passing waypoint E. In combination with survey findings that two-thirds of Spray Park visitors leave the official trail during their visits (Vande Kamp, Johnson, and Swanson 1998), these findings suggest that off-trail hiking is widely dispersed in Spray Park and not concentrated on the two most prominent way-trails.

Hiking durations. The average duration of day-hikes on the Spray Park Trail was 274 minutes (SD = 97). Hike durations were 303 minutes (SD = 80) for parties that reported reaching Spray Park (including parties that hiked to the upper areas of Spray Park), and 337 minutes (SD = 70) for only those parties that hiked to the upper areas of Spray Park. The figure below shows a single peak distribution of hiking durations for all hikers, with a strong peak for durations between 4 and 5 hours. Most hike durations for parties who reached Spray Park (and/or hiked further) were between 4 and 6 hours. The distribution of hiking durations for hikers who hiked to the upper areas of Spray Park was relatively flat, with most hikes taking between 4 and 7 hours.

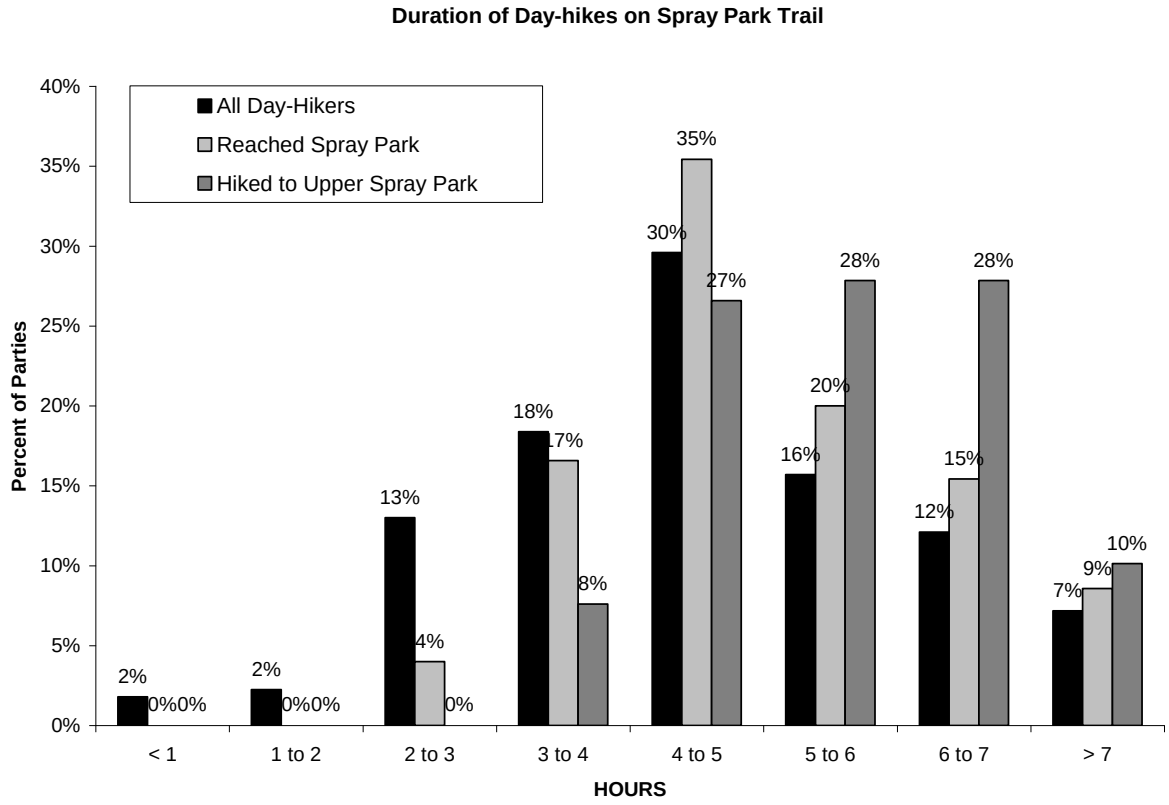


Figure 26. Durations of day-hikes on Spray Park Trail.

The pattern of waypoint results suggests that most hiking parties (78.7%) on the Spray Park Trail reach at least the first meadows of Spray Park. Most of the remaining parties reach Spray Falls. Other survey and observational data suggest that hiking off the official trail is more common at Spray Park than at Summerland (see Vande Kamp, Johnson, and Swanson 1998, and section 5.9 below), and is widely dispersed on both well-established way-trails and other areas in Spray Park. Hike durations were slightly shorter at Spray Park than at Summerland because hike durations were more tightly clustered in the 4 to 5 hour range.

5.8 Trail Counter Results for Wonderland Trail to Summerland

The Wonderland Trail to Summerland is a popular day-hiking destination in the White River/Sunrise area of MORA. As part of the Wonderland Trail, it is also used by backpackers who wish to hike all or part of the Wonderland Trail loop. Day hikers access the trail from a trailhead near the bridge over Fryingpan Creek on the Sunrise Road. Parking capacity at the trailhead is 27 vehicles but can overflow along roadway shoulders (BRW 1994).

In order to better describe day-hiking use of the trail, and to provide a means of validating simulation models of visitor use, two trail counters were installed on the trail to Summerland (see Figure 27). The first, located not far from the trailhead, was intended to count all hikers, the second, located several miles away from the trailhead, near the point where the trail leaves the forest and enters the sub-alpine meadows of Summerland, was intended to indicate the proportion of hikers who reach the meadow area where visitors' behavior and impact to the

environment commonly changes.

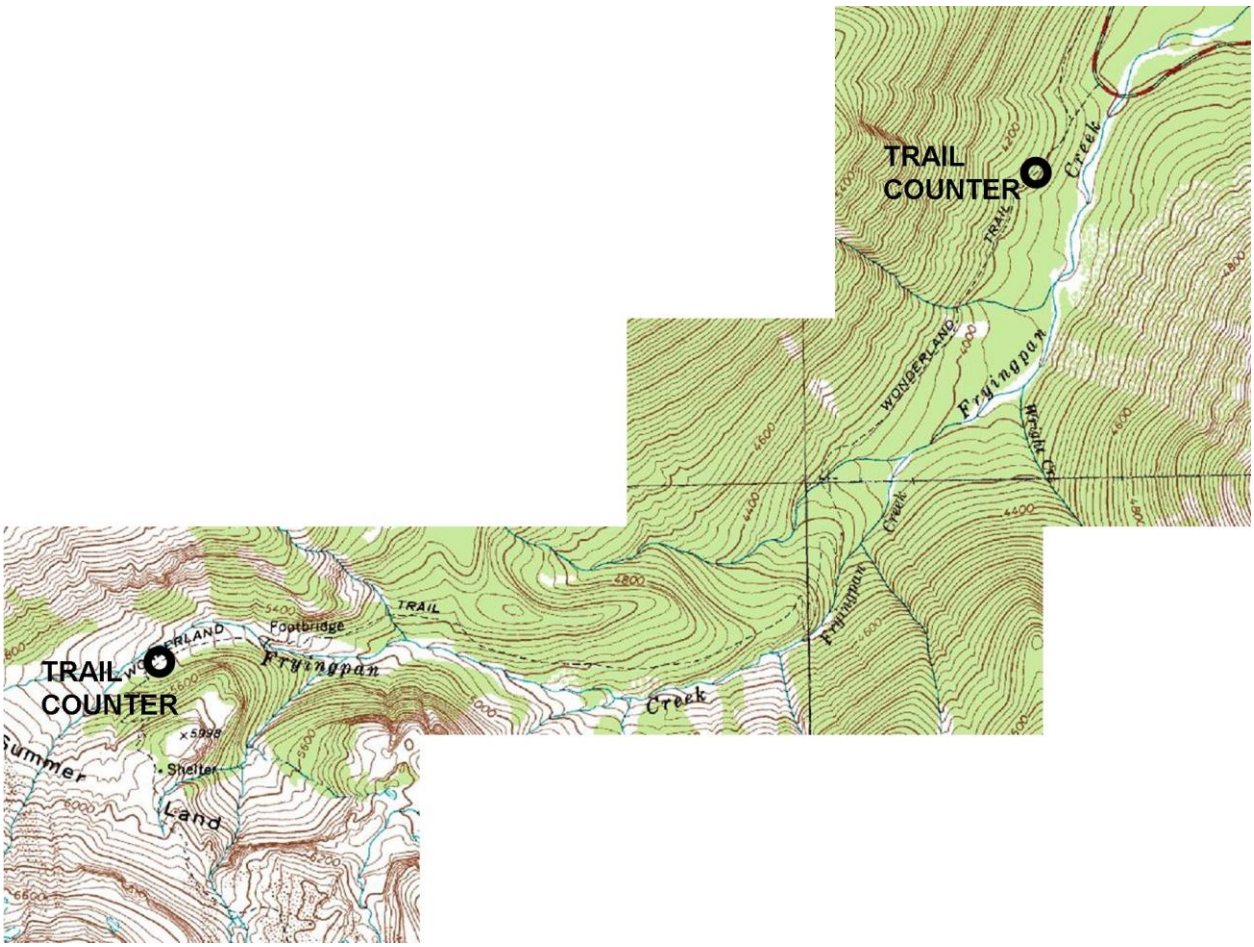


Figure 27. Approximate location of Summerland Trail electronic counters.

Trail counters were installed in 2004 and 2005 on the Summerland trail. Data gathered during both years are reported separately below. Analyses compared the data for consistency.

5.8.1 Validation Results: Wonderland Trail to Summerland

In 2004, the upper counter installed on the trail to Summerland was observed for a total of 6 hours. The lower counter was observed for a total of 13 hours and 30 minutes. Hikers passing during those times were counted in 30 minute "bins" (12 and 27 bins, respectively). Both the number of hikers passing and the number of hikers tallied by the trail counters were recorded. Based on the data from the 30 minute bins, linear regression analysis was used to describe the relationship between the electronic and observed counts for each counter. The regression coefficients derived from these analyses can be thought of as correction factors – the true count can be estimated by multiplying the electronic count by the coefficient. In 2004, the coefficient for the upper counter was 1.0 – the counter tallied the same number of visitors counted by the observer. In contrast, the coefficient for the lower counter was 1.51 – about 3 hikers were counted passing the counter for every two hikers tallied by the counter. The difference most

likely arose because the trail was wide where the lower counter was located and many parties hiked side-by-side, or in close proximity, thus overlapping when they broke the counter's infrared beam. The nature of the trail dictated the placement. There were no better alternative locations for the trail counter.

In 2005, the upper counter was observed for a total of 12 hours. During that time, a total of 98 hikers were counted, and the counter tallied 109 hikers. However, the observer's field notes indicated that a relatively large group of hikers may have paused at the point where the counter was positioned. When the observation for that time period is dropped, the actual hiker count was 81, and the counter tallied 77 hikers. Thus, it appears that the counter was nearly as accurate in 2005 (with a correction factor of 1.05) as it had been in 2004 (when it required no correction). The lower counter was observed for a total of 8 hours. A total of 59 hikers passed the counter during that time, and the counter tallied 37 hikers. Thus, the correction factor in 2005 was 1.59, quite close to the 1.51 observed in 2004.

5.8.2 Data Cleaning and Limitations of Data: Wonderland Trail to Summerland

In 2004, the upper trail counter functioned from June 30 to September 1. During that interval, data were lost or failed to be recorded for 16 days during two time periods: 1) from July 6 through July 12, and 2) from August 5 through August 13. The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were examined to determine if they were consistent with other counts registered on that day (counts from both the lower trail counter and upper trail counter were examined). These analyses showed enough consistency that none of the hourly counts were replaced.

In 2004, the lower trail counter functioned from June 30 to September 14. During that interval, data were lost or failed to be recorded for 13 days during two time periods: 1) from July 6 through July 12, and 2) from August 8 through August 13. The count data were examined for outlier values that may have resulted from trail counter malfunction and produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were examined to determine if they were consistent with other counts registered on that day (counts from both the lower trail counter and upper trail counter were examined). These analyses showed such consistency that none of the hourly counts were replaced.

In 2005, both the upper and lower trail counter functioned from July 25 to September 13. During that interval, no data were lost or failed to be recorded. The count data were examined for outlier values that may have resulted from trail counter malfunction and produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were examined to determine if they were consistent with other counts registered on that day (counts from both the lower trail counter and upper trail counter were examined). These analyses showed enough consistency that none of the hourly counts were replaced.

5.8.3 Descriptive Data: Wonderland Trail to Summerland

The following charts show the estimated daily counts of hikers based on the readings of

the lower trail counter (note that a correction factor of 1.51 has been applied to the counts from 2004 and a correction factor of 1.59 [see *Validation Results* above] has been applied to the 2005 counts). It should be noted that these counts include both day-hikers and backpackers using the trail. The relative proportion of these different users can not be determined from the trail counter data, but other sources of information might be used to estimate that proportion.

The counts show a strong weekend/weekday effect. Such a result is consistent with the idea that use of the Wonderland Trail to Summerland is strongly correlated with total use of the White River/Sunrise area. Indeed, the correlation between counts from the lower trail counter and counts of the number of vehicles passing the White River entrance was 0.648 in 2004 (N = 64) and 0.698 in 2005 (N = 22).

Peak use of the Wonderland Trail to Summerland (297 hiker passages) was recorded on July 31 in 2004, and on August 6 (301 hiker passages) in 2005. Use was not exceptionally high on Independence Day, but was moderately high on the Labor Day holiday. The 95th percentile day was 256 hiker passages in 2004, and 285 hiker passages in 2005.

In 2004, the average count was 80 on weekdays, with a standard deviation of 39. On weekends, the average count was 181, with a standard deviation of 68. Median counts were 77 and 180 for weekdays and weekends, respectively.

In 2005, the average count was 102 on weekdays, with a standard deviation of 43. On weekends, the average count was 196, with a standard deviation of 88. Median counts were 104 and 204 for weekdays and weekends, respectively.

Counts were higher in 2005 than in 2004, apparently as a result of generally higher levels of visitation in the White River/Sunrise area. The ratio of hiker passages to vehicle entries in 2004 (.0969) was very similar to that observed in 2005 (.0996).

DAILY COUNTS OF VISITORS PASSING THE LOWER WONDERLAND TRAIL TO SUMMERLAND COUNTER BETWEEN 6/30/04 AND 9/14/04

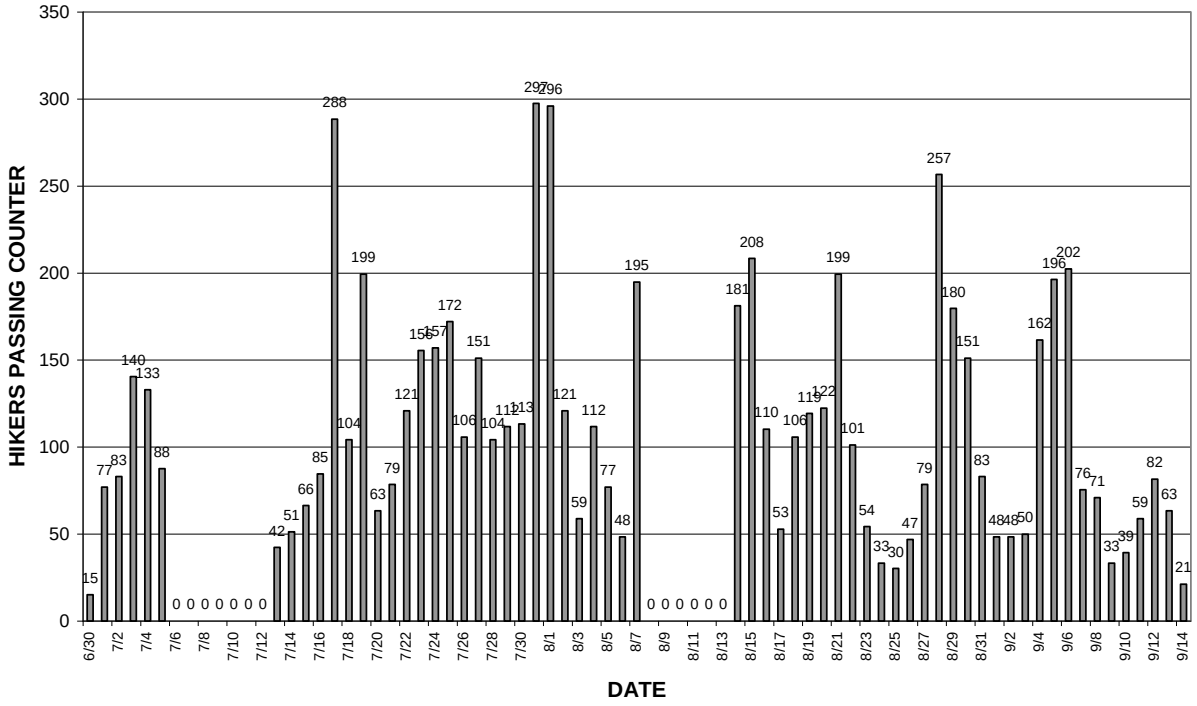


Figure 28. Daily counts of visitors passing lower Summerland Trail counter in 2004. Note that counts of "0" indicate periods when the counter was not functioning and that counts were adjusted using the correction factor estimated from the validation results.

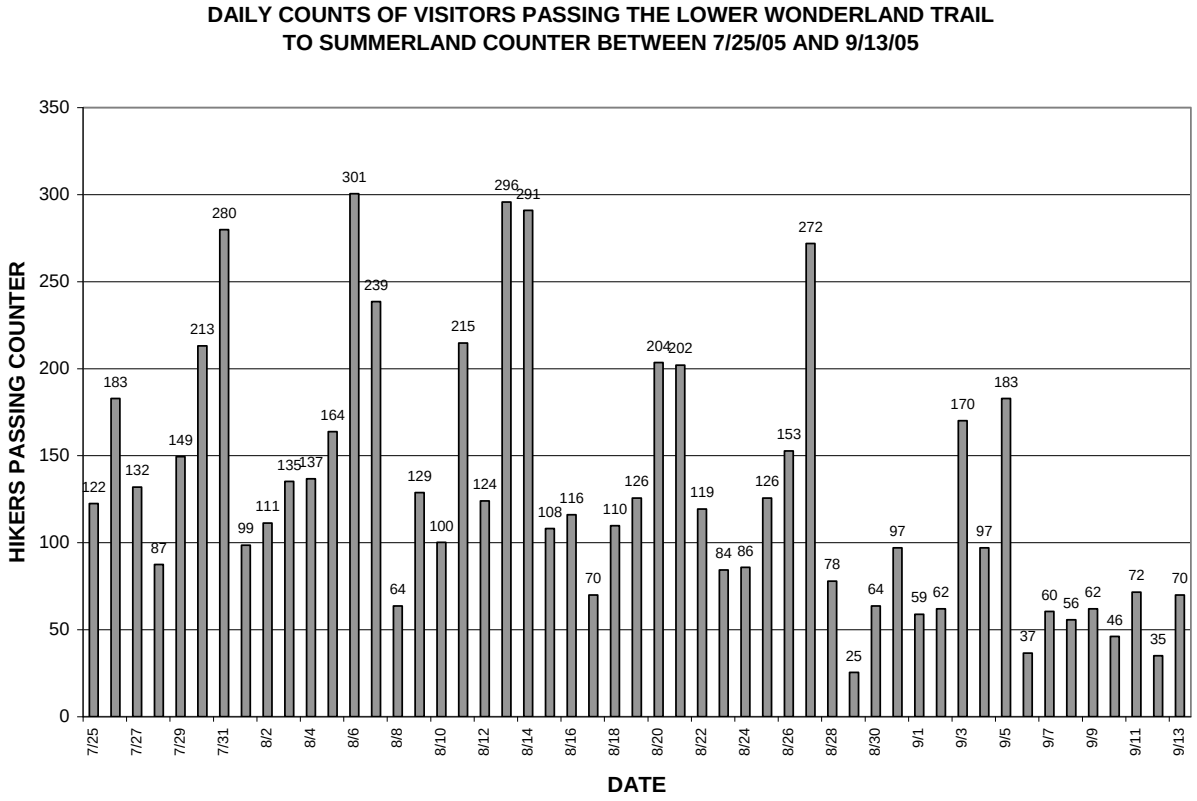


Figure 29. Daily counts of visitors passing lower Summerland Trail counter in 2005. Note that counts were adjusted using the correction factor estimated from the validation results.

The hourly distributions of hikers passing the lower counter on the Wonderland Trail to Summerland in 2004 and 2005 show similar bimodal distributions that reflect the predominant use of the trail by day-hikers. Most hikers begin hiking between the hours of 9:00 and 12:00, and leave between 14:00 and 18:00 in the afternoon. Both the weekend and weekday distributions show similar bimodal shapes.

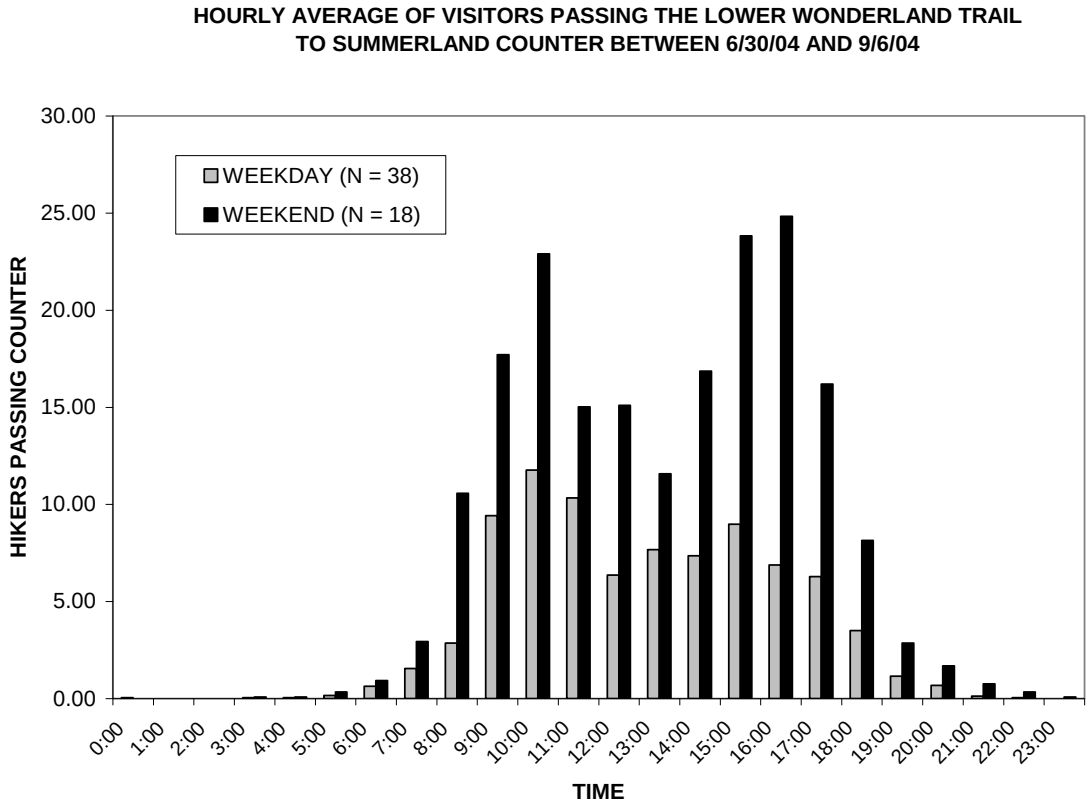


Figure 30. Hourly distributions of visitors passing lower Summerland Trail counter in 2004. Note that counts were adjusted using the correction factor estimated from the validation results.

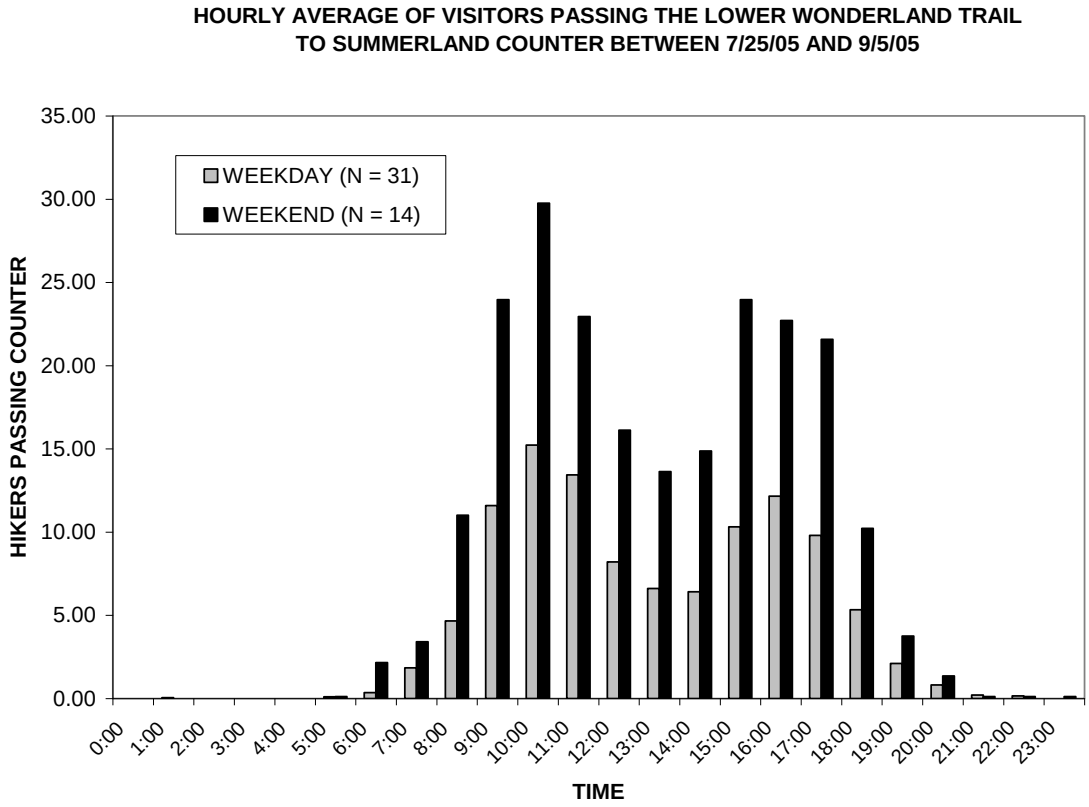


Figure 31. Hourly distributions of visitors passing lower Summerland Trail counter in 2005. Note that counts were adjusted using the correction factor estimated from the validation results.

The following charts show the estimated daily counts of hikers based on the readings of the upper trail counter (note that a correction factor of 1.05 has been applied to the counts from 2005 [see *Validation Results* above]). It should be noted that these counts include both day-hikers and backpackers using the trail. The relative proportion of these different users can not be determined from the trail counter data, but other sources of information might be used to estimate that proportion.

As might be expected, the counts show a strong relationship with the readings of the lower trail counter. Indeed, the correlation between daily counts from the lower and upper trail counter was 0.953 in 2004 (N = 48) and 0.975 in 2005 (N = 51). Counts were also consistent with the results of the waypoint study that found 82.3 percent of hikers reached the Summerland Shelter (see section 5.2.4 below) – counts at the upper counter were 80.1 percent of those at the lower counter in 2004 and 80.7 percent in 2005.

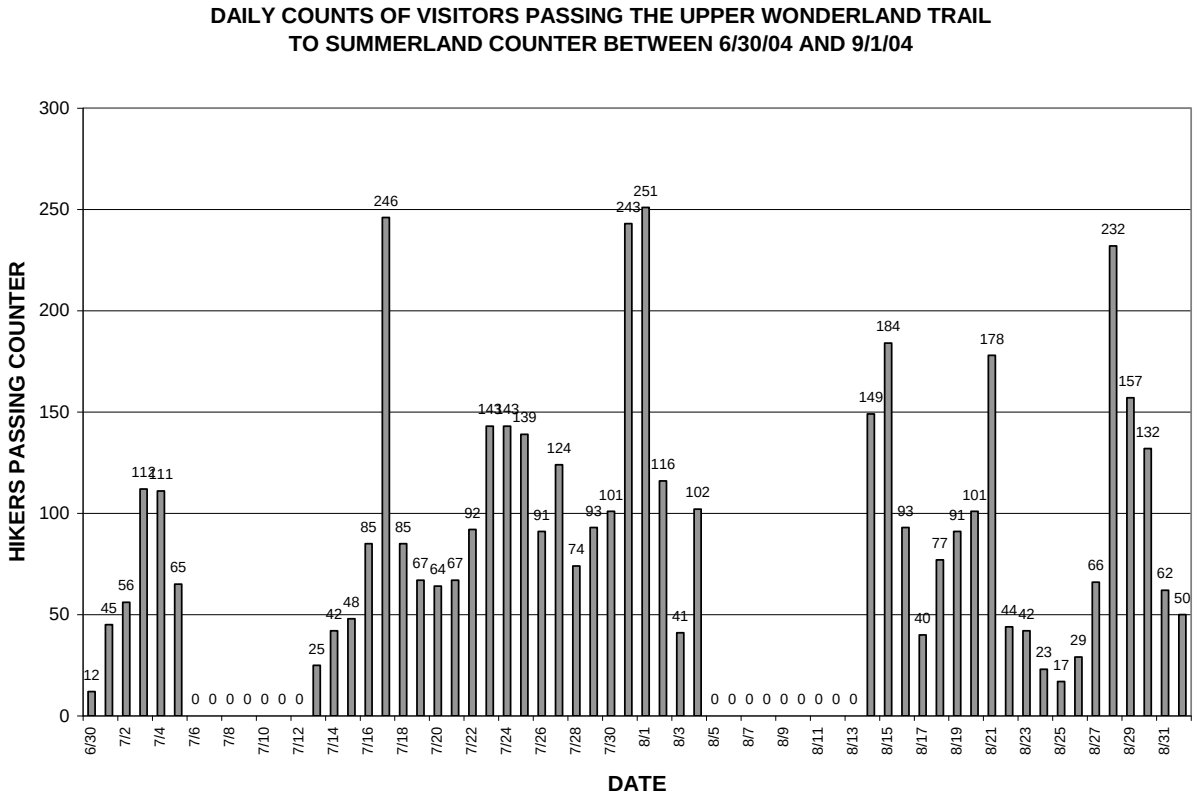


Figure 32. Daily counts of visitors passing upper Summerland Trail counter in 2004. Note that counts of "0" indicate periods when the counter was not functioning.

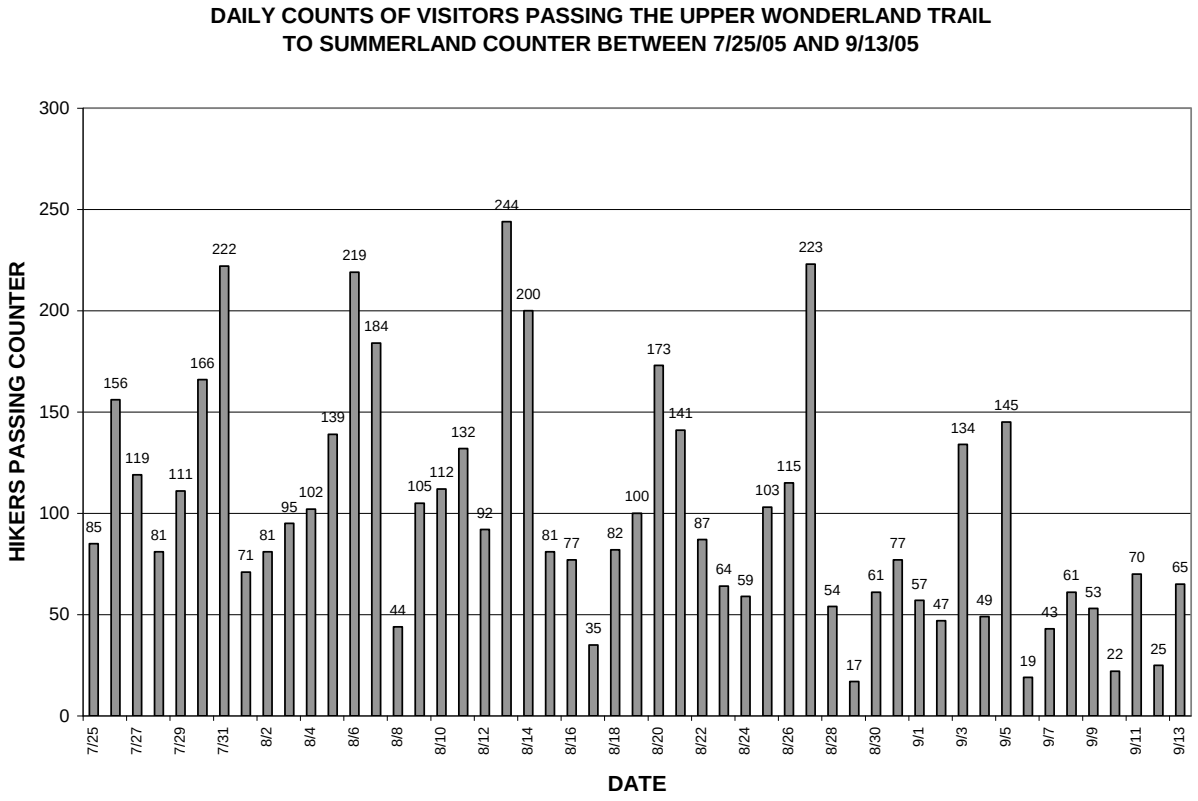


Figure 33. Daily counts of visitors passing upper Summerland Trail counter in 2005. Note that counts were adjusted using the correction factor estimated from the validation results.

The hourly distributions of hikers passing the upper counter on the Wonderland Trail to Summerland in 2004 and 2005 show similar distributions that are consistent with the lower counter. Peak passages occur in the middle of the day between the hours of 11:00 and 16:00, with weekends primarily showing higher use in the middle of the day.

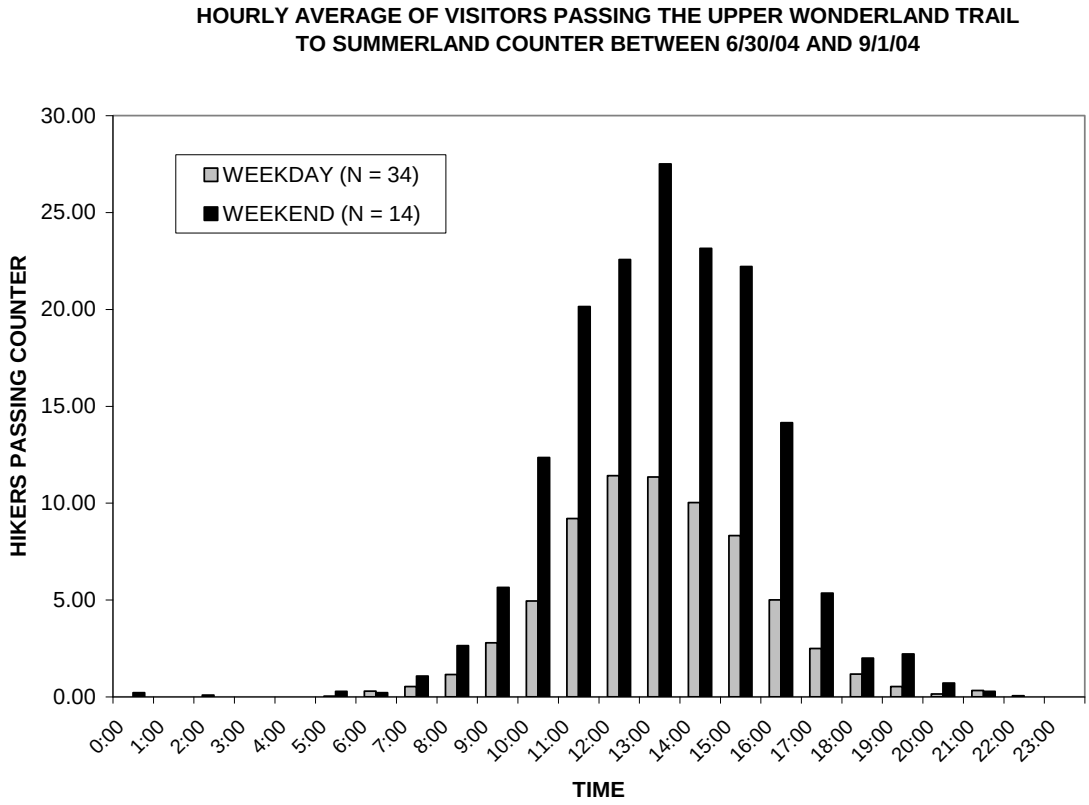


Figure 34. Hourly distributions of visitors passing upper Summerland Trail counter in 2004.

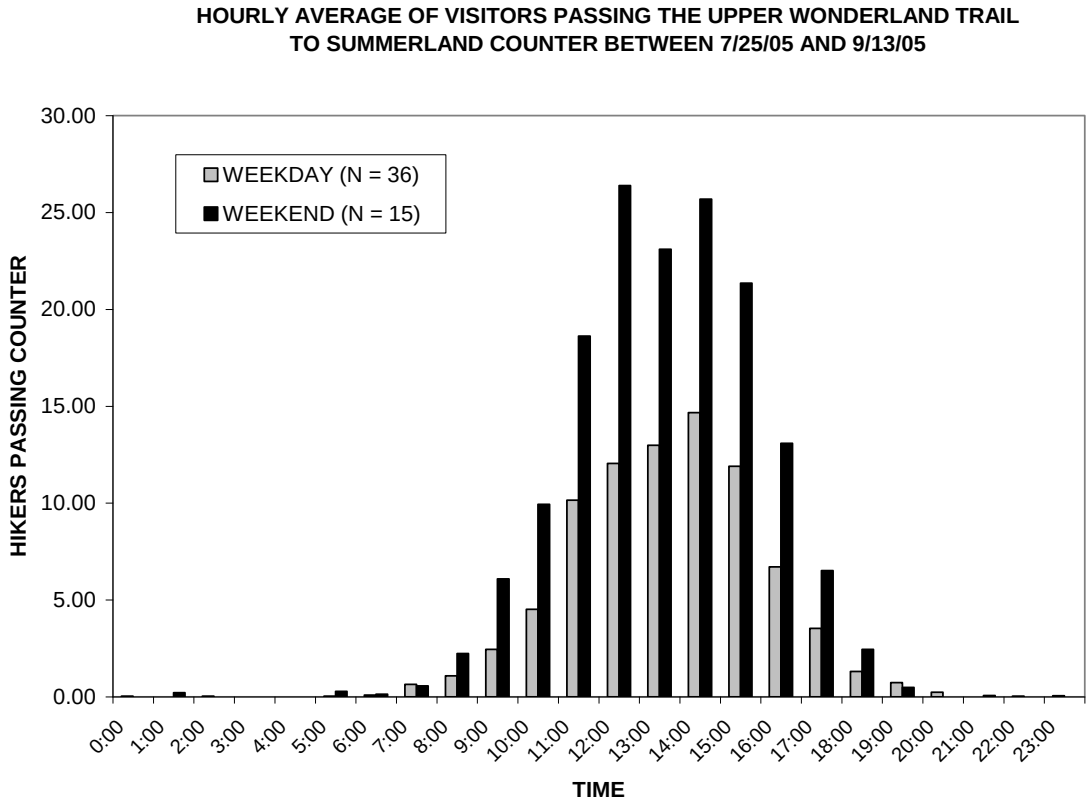


Figure 35. Hourly distributions of visitors passing upper Summerland Trail counter in 2005. Note that counts were adjusted using the correction factor estimated from the validation results.

5.9 Waypoint Results for Wonderland Trail to Summerland

Waypoint studies were conducted in 2004 and 2005 to assess the hiking patterns of day-hikers using the Wonderland Trail to Summerland.

5.9.1 Location

Waypoint surveys were conducted by a field worker stationed at sign A, southwest of the Fryingpan Creek trailhead and just past the intersection of the Wonderland Trail and the spur trail to the trailhead. Figure 36 below shows the approximate locations of all the waypoint signs used in the studies.

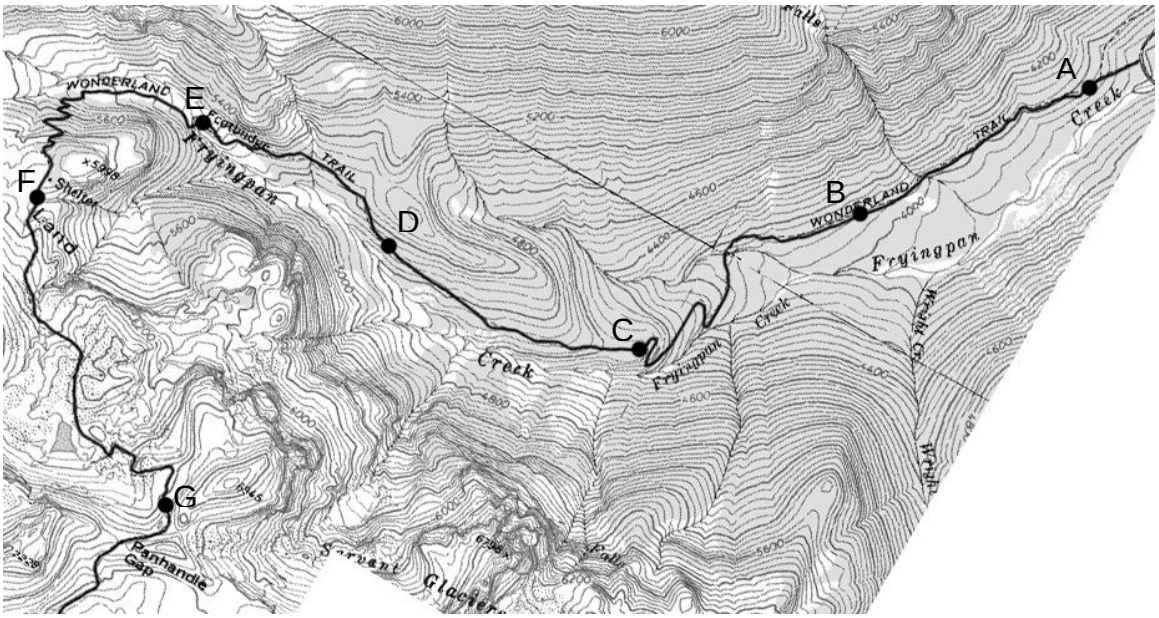


Figure 36. Locations of waypoint signs for Summerland Waypoint Survey.

5.9.2 Instruments

In 2004, the waypoint cards handed out to day-hikers were of the standard design described in section 3.2 above. However, managers were interested in whether, and where, day-hikers left the Wonderland trail during their visits. Thus, in 2005, the waypoint card was modified to include a map on which visitors were asked to indicate places where they left the trail. Figure 37 below shows the waypoint map used in 2005.

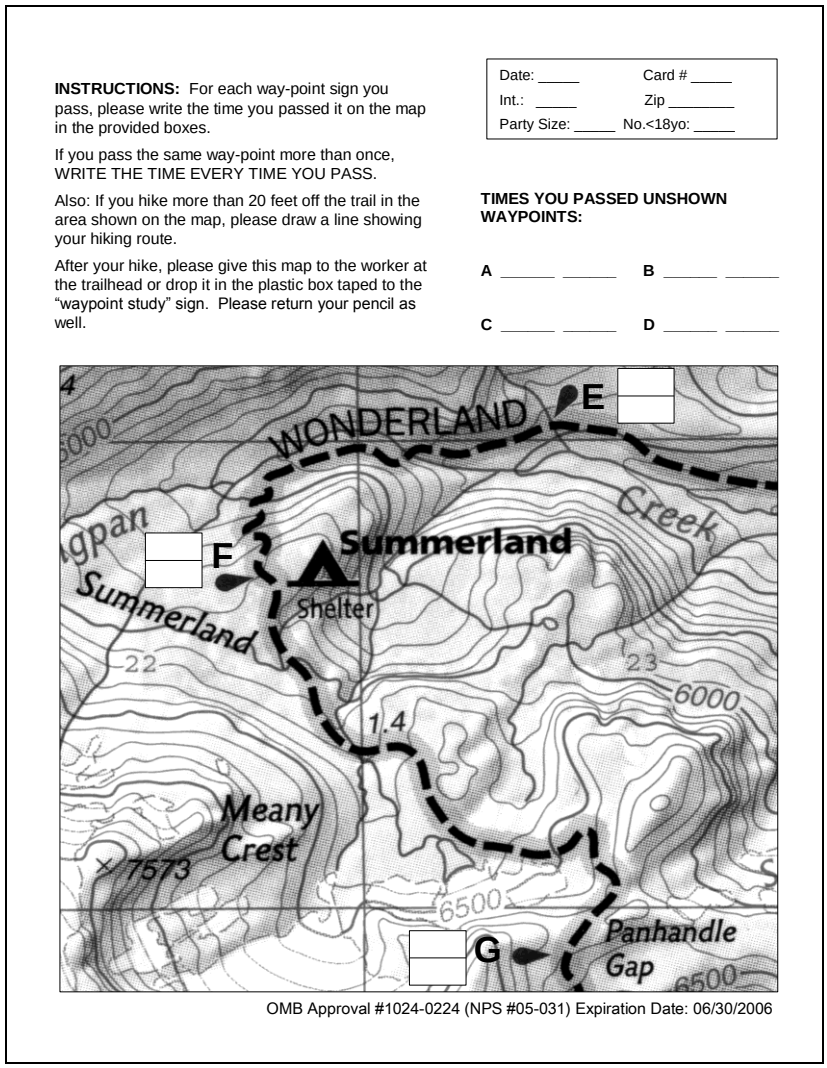


Figure 37. Waypoint card/map used in 2005 study of Summerland Trail hiking..

5.9.3 Samples

2004 sample. Data were collected on 13 days (10 weekdays and 3 weekend days) between July 1 and September 3, 2004. On sampled days, all day-hiking parties passing sign A were asked to participate in the study. If it was unclear whether a party was day-hiking or consisted of overnight backpackers, workers asked for hikers' destinations.

A total of 152 parties were asked to participate in the study. Of those parties, 130 returned their cards (85.5%), 14 failed to return cards (9.2%), and 8 refused to participate or could not participate due to foreign language issues (5.3%).

2005 sample. Data were collected on 18 days (10 weekdays and 8 weekend days) between July 2 and September 8, 2005. On sampled days, all day-hiking parties passing sign A were asked to participate in the study. If it was unclear whether a party was day-hiking or consisted of overnight backpackers, workers asked for hikers' destinations.

A total of 242 parties were asked to participate in the study. Of those parties, 220 returned their cards (90.9%), 14 failed to return cards (5.8%), and 10 refused to participate or could not

participate due to foreign language issues (4.1%).

5.9.4 Results

Party size. The average party size was 2.38 (SD = 1.34) in 2004 and 2.73 (SD = 1.91) in 2005. Variability in party size was greater in 2005, as was the average party size; t(356.7) = 2.057, p = .04. It is not clear why party sizes differed for the two years.

Hiking patterns. Analyses of the recorded waypoints for the combined 2004 and 2005 data showed that 82.3 percent of hiking parties reported that they reached Summerland (i.e., they passed waypoint F), and 26.9 percent of hiking parties reached Panhandle Gap (waypoint G). Table 6 shows the percentage of hiking parties that passed each waypoint.

Waypoint	Percent of Parties Passing
A	100.0
B	92.7
C	90.8
D	88.6
E	87.8
F	82.3
G	26.9

Table 6. Percent of parties passing Summerland waypoints.

The survey instrument used in 2005 included a map on which visitors were asked to indicate places where they left the trail. Of the 220 returned forms, only 23 (10.5 percent) included responses showing that the party hiked off the official trail. It is not entirely clear whether this rate of off-trail hiking is accurate because there was at least one factor that may have discouraged hikers from reporting off-trail hiking. Specifically, there were small signs along the trail in the Summerland area telling hikers to stay on the official trail. Such signs may have led hikers to believe that off-trail hiking was against park regulations and deterred them from reporting such behavior even if they engaged in it. Because so few parties reported that they left the trail, there was no attempt to map the locations of off-trail hiking.

Hiking durations. The average duration of day-hikes on the Wonderland Trail to Summerland was 312 minutes (SD = 108) in 2004 and 339 minutes (SD = 102) in 2005. Durations were longer in 2005; t(331) = -2.272, p = .024. It is not clear why hiking durations differed for the two years. Based on all 2004 and 2005 data, hike durations were 352 minutes (SD = 81) for parties that reported reaching Summerland (including parties that went on to Panhandle Gap), and 395 minutes (SD = 65) for only those parties that reported reaching Panhandle Gap. The figure below shows a distribution of hiking durations with a relatively flat peak in which most hikes were between 4 and 7 hours in duration. The distribution of hiking durations for hikers who reached Panhandle Gap was more tightly clustered, with most hikes taking between 6 and 8 hours.

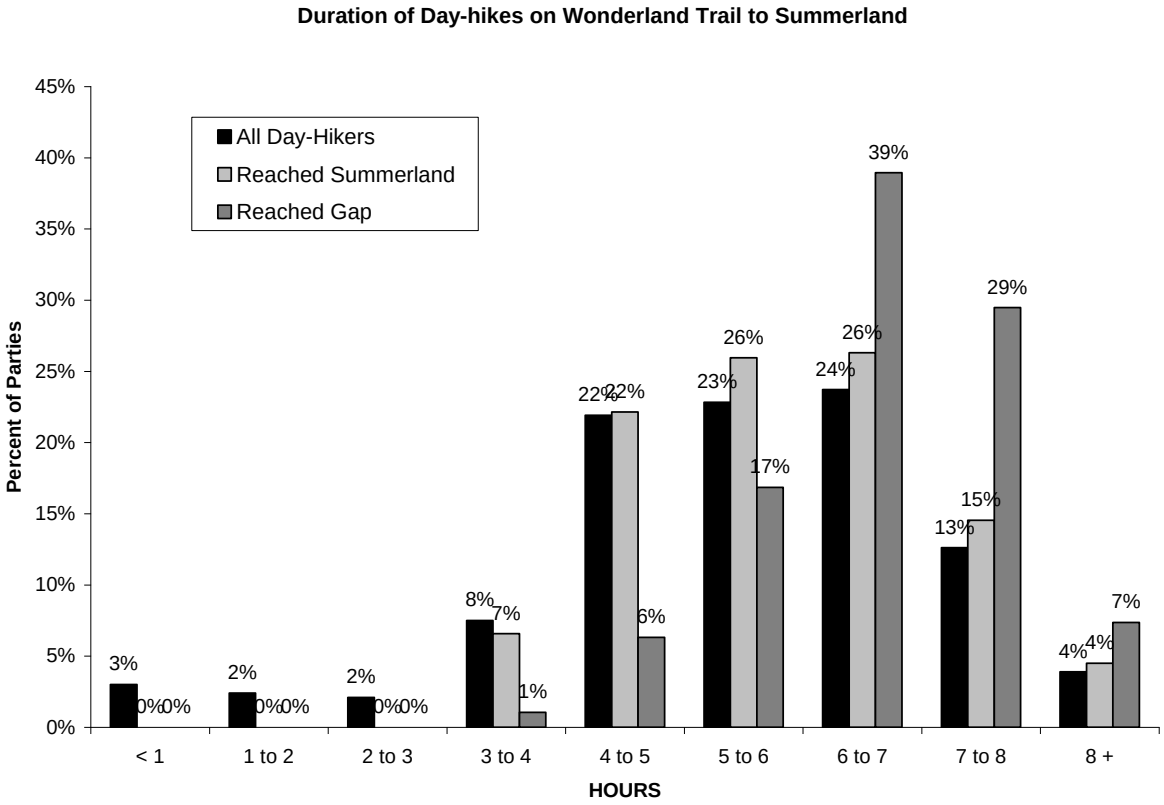


Figure 38. Durations of day-hikes on Wonderland Trail to Summerland.

Informal observation of visitors hiking to Summerland suggests that most parties hike fairly steadily up the trail, taking short breaks to rest, but generally reaching Summerland before taking longer breaks to eat lunch and enjoy the scenery. The times recorded in the waypoint survey are consistent with such observations. For all hiking parties that reached Summerland, the average time spent beyond point F was 108 minutes (SD = 73). For parties that did not reach Panhandle Gap, the average time in Summerland was 77 minutes (SD = 58). For parties that reached Panhandle Gap, the average time spent beyond point F was 176 minutes (SD = 52), with an average of 129 minutes (SD = 34) spent in Summerland (i.e., between point F and G) and 51 minutes (SD = 47) spent beyond Panhandle Gap.[3]

6. WILDERNESS SEMI-PRIMITIVE TRAIL ZONE

This section reports data collected at one site in the Semi-primitive Trail zone. Readers should note that some additional information regarding use of semi-primitive trails can be found in the waypoint studies of the Comet Falls, Spray Park, and Wonderland Trail to Summerland Trails (see sections 5.5, 5.7, and 5.9 above). In all cases, those studies can be used to estimate numbers of day-hikers using trails that are zoned Semi-primitive, but are directly connected to the trails in the Transition Trail zone that were the focus of the studies.

[3] The total time spent above point F does not equal the sum of the time spent in Summerland and the time spent above the Gap for parties that reached Panhandle Gap because of missing data that dropped some parties from one or the other summary statistic.

6.1 Trail Counter Results for Crystal Lakes Trail

The Crystal Lakes Trail is one of the trails in the Semi-primitive Trail zone that is most heavily used by day-hikers. It is located in the northeast corner of MORA. The trail switchbacks uphill from the trailhead on SR 410, offering good views of Mount Rainier for the first 1.5 miles. After another mile it reaches Lower Crystal Lake, and the open basin containing Upper Crystal Lake lies .5 miles further along the trail. The Crystal Lakes Trail is not part of the Wonderland Trail loop, but there are two backcountry camps accessed via the trail. Day hikers access the trail from the trailhead on SR 410.

In order to better describe use of the trail, an electronic trail counter was installed in the summer of 2004 (see Figure 39). The counter was concealed in trees about 100 meters from the trailhead.

Figure 39. Approximate location of Crystal Lakes electronic counter.

6.1.1 Validation Results: Crystal Lakes Trail

The counter installed on the Crystal Lakes Trail was observed for a total of 8 hours and 15 minutes. Hikers passing during the observed times were counted in 15 30-minute "bins". Both the number of hikers passing and the number of hikers tallied by the trail counter were recorded. Based on the data from the 30 minute bins, linear regression analysis was used to describe the relationship between the electronic and observed counts. The regression coefficient derived from this analysis can be thought of as a correction factor – the true count can be estimated by multiplying the electronic count by the coefficient. The coefficient for the counter was 1.04 – the counter tallied almost the same number of visitors that were counted by the observer.

6.1.2 Data Cleaning and Limitations of Data: Crystal Lakes Trail

The trail counter functioned from June 29 to September 14. Data were lost or failed to be recorded from about 15:00 on August 31 until about 11:00 on September 2, and about 16:00 on September 8 until about 9:00 on September 10. The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Hourly counts that exceeded the median count by more than three times the inter-quartile range (calculated separately for weekends and weekdays) were examined to determine if they were consistent with other counts registered on that day (gate counts of vehicles were used in some comparisons). These analyses found three hours with observations that were suspect. Two observations (a count of 14 at 1:00 A.M. and a count of 25 at 5:00 A.M. were replaced by counts of 0. The third observation, a count of 43 at 9:00 A.M. was replaced by the mean of the remaining 9:00 counts, which was 5.

6.1.3 Descriptive Data: Crystal Lakes Trail

The following charts show the estimated daily counts of hikers based on the readings of the trail counter. It should be noted that these counts include both day-hikers and backpackers using the trail. The relative proportion of these different users can not be determined from the trail counter data, but other sources of information might be used to estimate that proportion.

The counts show a strong weekend/weekday effect. Such a result is consistent with the idea that use of the Crystal Lakes Trail is strongly correlated with total use of MORA. Indeed, the correlation between counts from the trail counter and counts of the total number of vehicles passing the Nisqually and White River entrances was 0.781.

Peak use of the Crystal Lakes Trail (124 hiker passages) was recorded on July 31. The 95^{th} percentile day was 97 hiker passages.

The average count was 20 on weekdays, with a standard deviation of 13. On weekends, the average count was 72, with a standard deviation of 29.

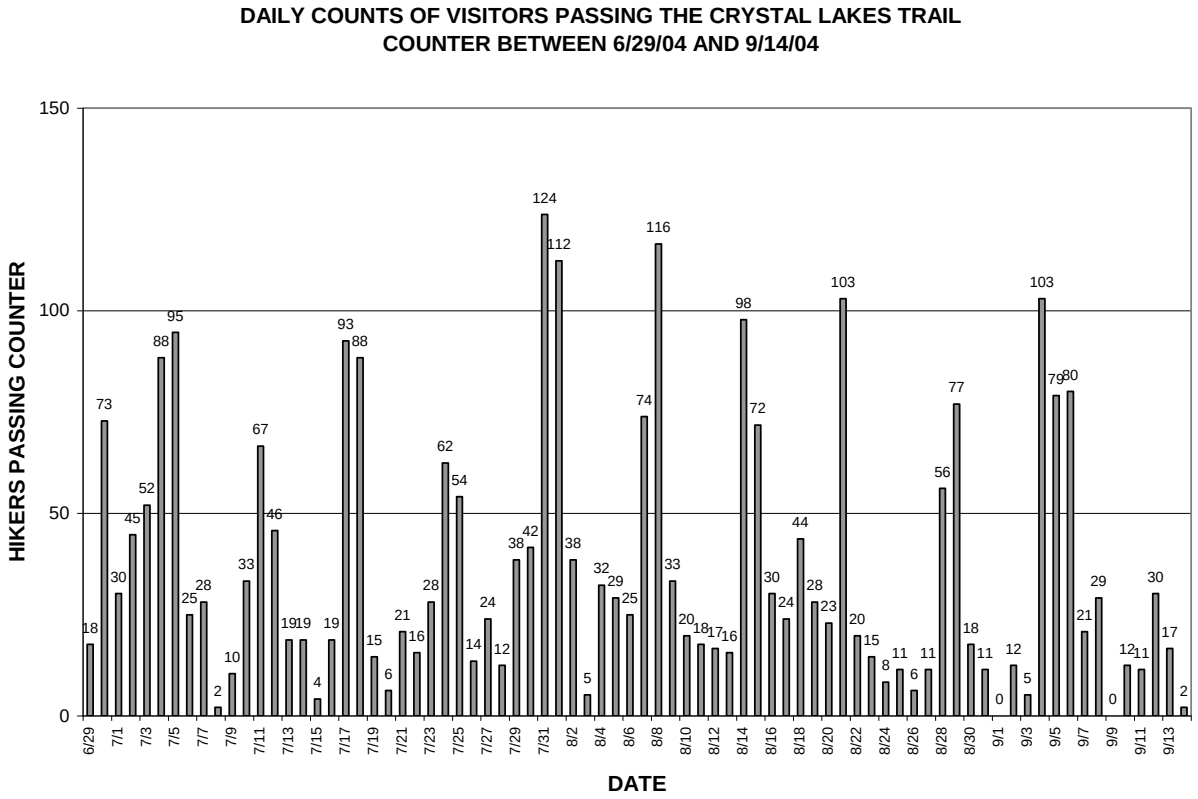


Figure 40. Daily counts of visitors passing Crystal Lake Trail counter. Note that counts of "0" indicate periods when the counter was not functioning and that counts were adjusted using the correction factor estimated from the validation results.

The hourly distributions of hikers passing the Crystal Lakes Trail counter show a slightly bimodal distribution that reflects the predominant use of the trail by day-hikers. Most hikers begin hiking between the hours of 9:00 and 12:00, and leave between 14:00 and 18:00 in the afternoon. Both the weekend and weekday distributions show similar bimodal shapes, with a slightly later arrival peak on weekends.

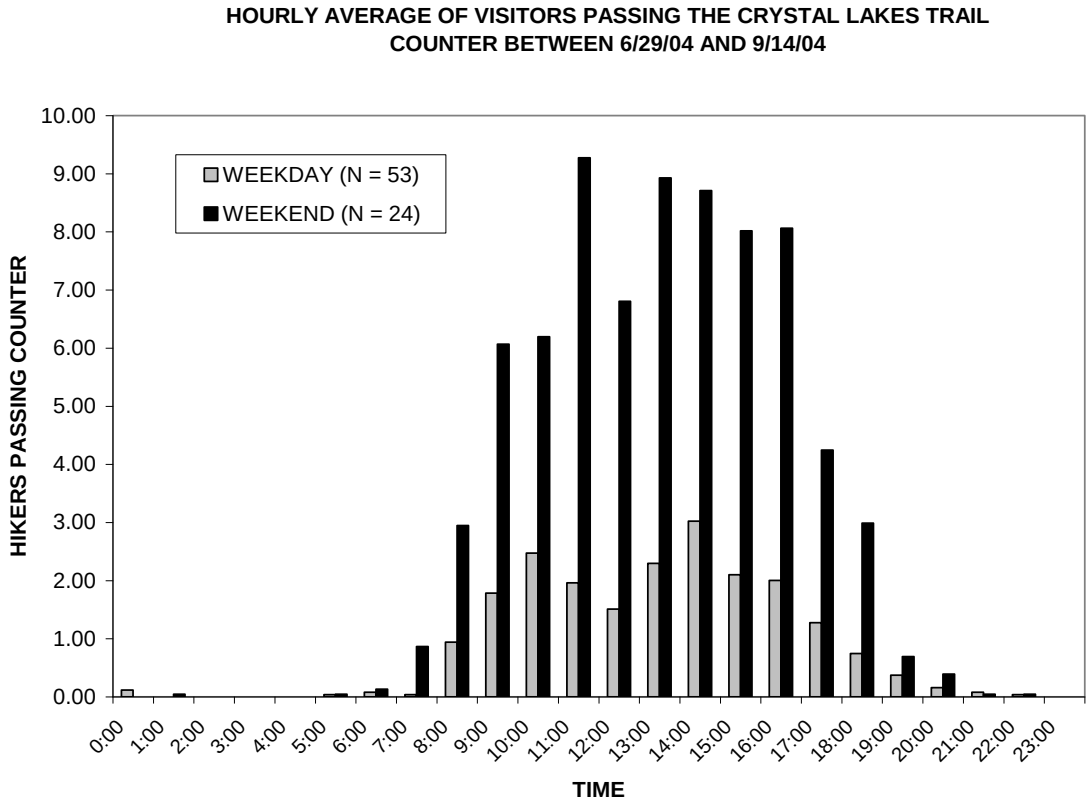


Figure 41. Hourly distributions of visitors passing Crystal Lakes Trail counter. Note that counts were adjusted using the correction factor estimated from the validation results.

7. SENSITIVE RESOURCE ZONE

This section reports data that were collected at Paradise, Sunrise, and Tipsoo Lake, the three largest areas included in the Sensitive Resource zone. Readers should note that some additional information regarding use of the Sensitive Resource zone can be found in the report describing altered visitor use in 2006 due to construction activity (Vande Kamp 2008) and the report describing simulation modeling of trails in the sensitive resource zone (Vande Kamp 2009b).

Readers should also note that information reported in this section can be used in estimating visitor use of a variety of trails in the Transition Trail and Semi-primitive Trail zones that are directly connected to the trails in the Sensitive Resource zone that were the focus of these studies.

7.1 Trail Counter Results for Skyline Trail (past Alta Vista Junction)

The Skyline Trail may be the most heavily-used trail in MORA. A majority of MORA visitors stop at Paradise, and most of them take walks or hikes on the paved and gravel trails that pass through the sub-alpine meadows. The Skyline Trail is the most direct route to the upper meadow and is used by day-hikers and by climbers. Paradise is the start location for most climbers seeking to reach the summit of Mount Rainier and heavily-laden groups of climbers are

commonly seen ascending or descending the Skyline Trail. The trail is accessed from a trailhead at the north end of the main parking lot at Paradise. The formal parking capacity of all the parking areas that feed the Paradise Meadow trails (i.e., the Visitor Center parking lot, the Picnic Area parking lot, and the main parking lot) was 756 vehicles in 2004 (BRW 1994).

In order to better describe day-hiking use of Paradise Meadow, and to provide a means of validating simulation models of visitor use, a trail counter was installed on the Skyline Trail in 2004 (see Figure 42). It was located north of the junction of the Skyline and Alta Vista trails. The emitter was strapped to a tree about 20 meters east of the paved trail and the receiver was concealed in a small group of trees on the west side of the trail.

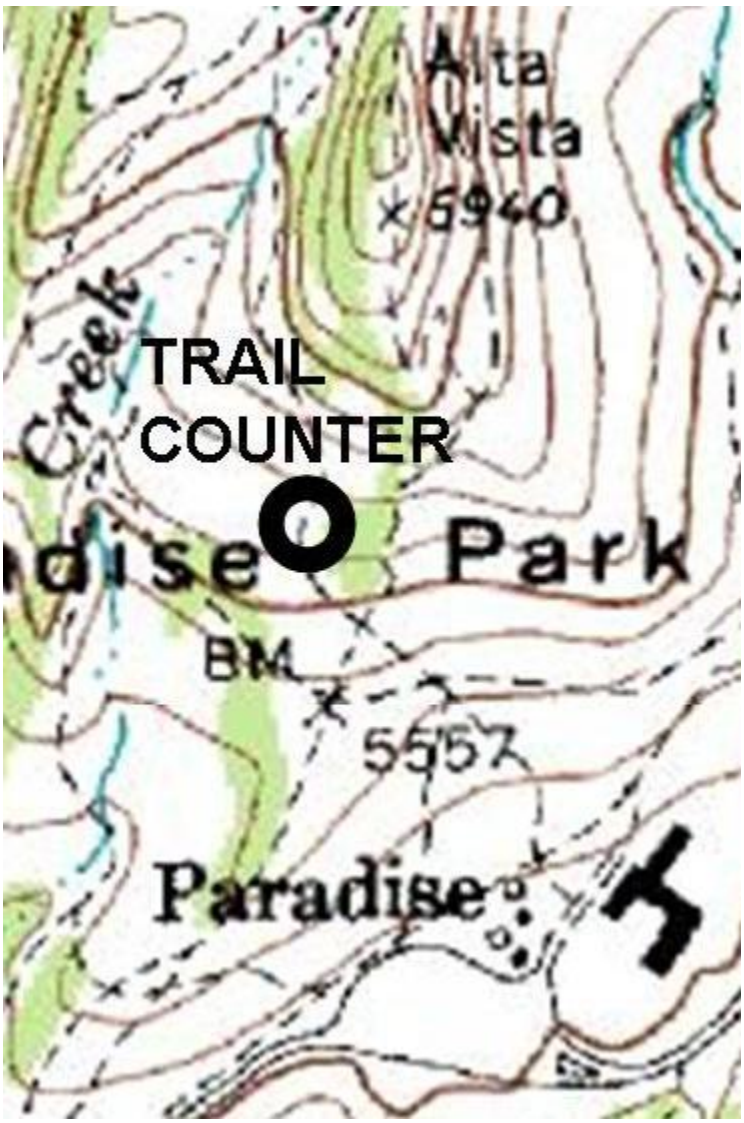


Figure 42. Approximate location of Skyline Trail electronic counter.

7.1.1 Validation Results: Skyline Trail

The counter installed on the Skyline Trail was observed for a total of 8 hours and 15

minutes. Hikers passing during the observed times were counted in 16 30-minute "bins". Both the number of hikers passing and the number of hikers tallied by the trail counter were recorded. Based on the data from the 30 minute bins, linear regression analysis was used to describe the relationship between the electronic and observed counts. The regression coefficient derived from this analysis can be thought of as a correction factor – the true count can be estimated by multiplying the electronic count by the coefficient. The coefficient for the counter was 1.37. This was one of the higher correction factors recorded in 2004, almost certainly because the trail is quite wide where the counter was located and many parties hiked side-by-side, or in close proximity, thus overlapping when they broke the counter's infrared beam. It is worth noting that when a trail counter was installed at this location again in 2006, its performance was very similar. In 2006, validation determined that the appropriate "correction factor" was 1.32 (Vande Kamp 2008).

7.1.2 Data Cleaning and Limitations of Data: Skyline Trail

The trail counter functioned for relatively brief periods between July 11 and September 11. The counter had limited memory capacity and would stop recording after approximately 1,900 passages. Due to this limited capacity, as well as some other problems, data were recorded only for the intervals shown in the table below.

Observed Periods	
Begin	**End**
July 11, 16:00	July 11, 17:00
July 20, 16:00	July 21, 16:00
July 28, 13:00	July 30, 11:00
August 3, 18:00	August 7, 19:00
August 19, 18:00	August 26, 16:00
September 4, 11:00	September 5, 17:00
September 7, 13:00	September 11, 14:00

Table 7. Time intervals during which visitor counts were collected by the Skyline Trail counter.

The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Initial inspection suggested that the trail counter commonly registered spurious counts, and that those counts most commonly occurred for the 16:00 to 18:00 time period. A regression analysis was used to predict each hourly count based on the prior hourly count. Then, the difference between the predicted and actual counts was used to identify hours with counts that were likely to be spurious. Based on this analysis, 13 of the 286 hourly counts were selected for replacement. That replacement was made on the basis of the same regression equation – spurious counts were replaced by the counts predicted by the regression equation utilizing the count from the prior hour (i.e., New Count = Prior Hour * .635 + 21.8).

7.1.3 Descriptive Data: Skyline Trail

Because the Skyline Trail counter recorded only 14 complete days between July 11 and September 11, a chart showing those data would form only a weak basis for estimating the

pattern of use for the entire season. Regression analyses of those 14 days, however, showed that the daily counts were strongly related to the total number of vehicles entering the Nisqually entrance of MORA (r = .721). Thus, the vehicle counts were used to estimate the number of visitors passing the Skyline Trail counter (i.e., Skyline Count = ((Vehicle Count * .736) – 199) * 1.37). The following chart shows those estimated daily counts of hikers. The counts show a strong weekend/weekday effect, with peak use on August 8 (2217 hiker passages) and moderate to high use on the Labor Day holiday. The 95th percentile day was 1770 hiker passages. The average count was 714 on weekdays, with a standard deviation of 246. On weekends, the average count was 1422, with a standard deviation of 448. Median counts were 747 and 1577 for weekdays and weekends, respectively.

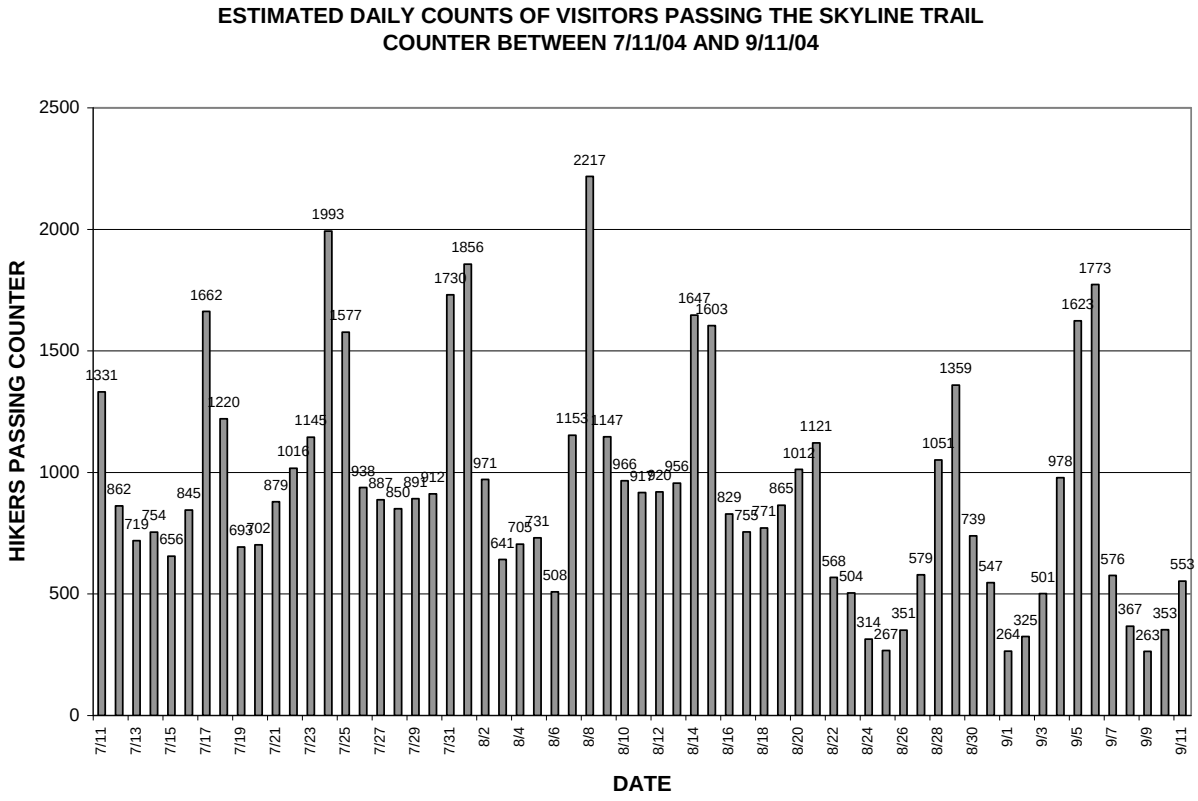


Figure 43. Estimated daily counts of visitors passing Skyline Trail counter.

The hourly distribution of hikers passing the Skyline Trail counter shows a bell-shaped distribution with the exception of a dip between 11:00 and 12:00. Peak use occurred between 15:00 and 17:00.

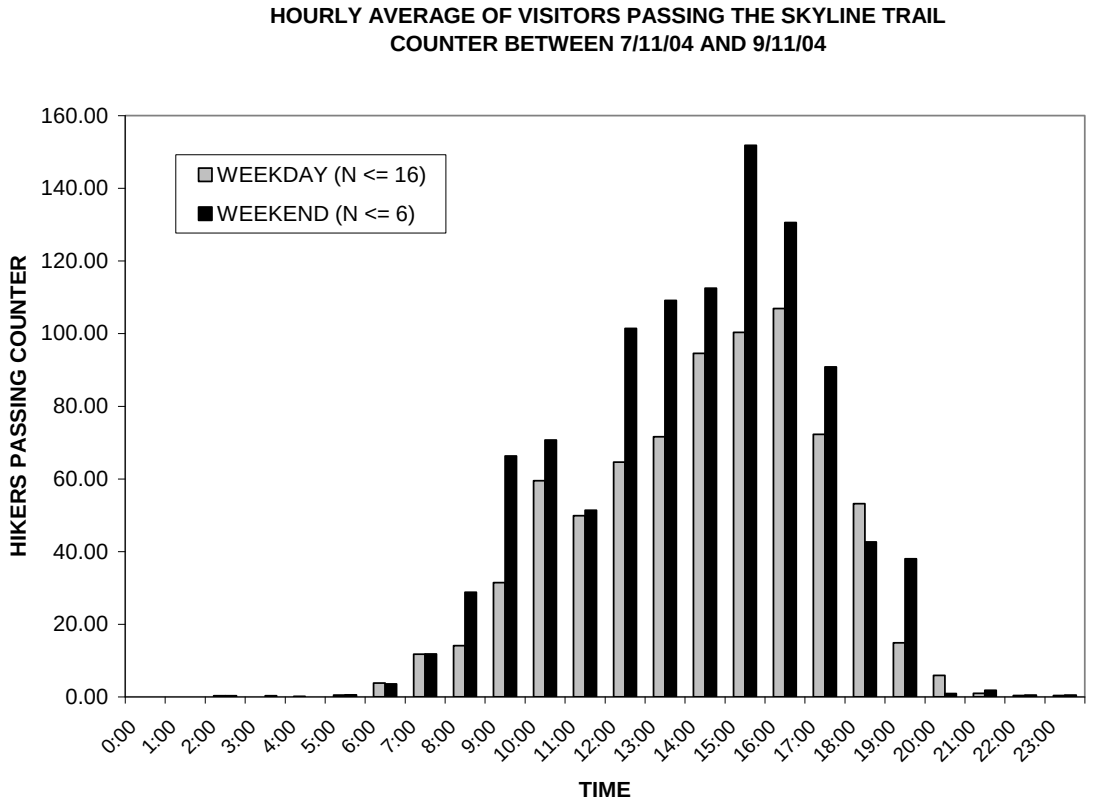


Figure 44. Hourly distributions of visitors passing Skyline Trail counter. Note that counts were adjusted using the correction factor estimated from the validation results.

7.2 Waypoint Results for Paradise Meadow Trails

Paradise Meadow is found at an altitude of 1,650 meters on the South side of Mount Rainier. Every summer, the network of paved and gravel trails running through the meadow allows a quarter-million hikers (NPS 2004, Vande Kamp 2001) to view the sub-alpine wildflowers and mountain scenery of the park. Off-trail hiking damages vegetation in many areas of the meadow (Rochefort and Swinney 2000) and use estimates (Vande Kamp and Zweibel 2004) are consistent with observations that visitor movement on popular trails is impeded by high visitor density during peak periods.

Waypoint studies were conducted in 2003 and 2004 to assess the hiking patterns of day-hikers using the network of trails running through Paradise Meadow.

7.2.1 Location

Waypoint surveys were conducted by field workers stationed at signs A, B, C, and D, at trailheads near parking areas and facilities in the Paradise developed area. Figures 45 and 46 below shows the approximate locations of all the waypoint signs used in the 2003 and 2004 studies.

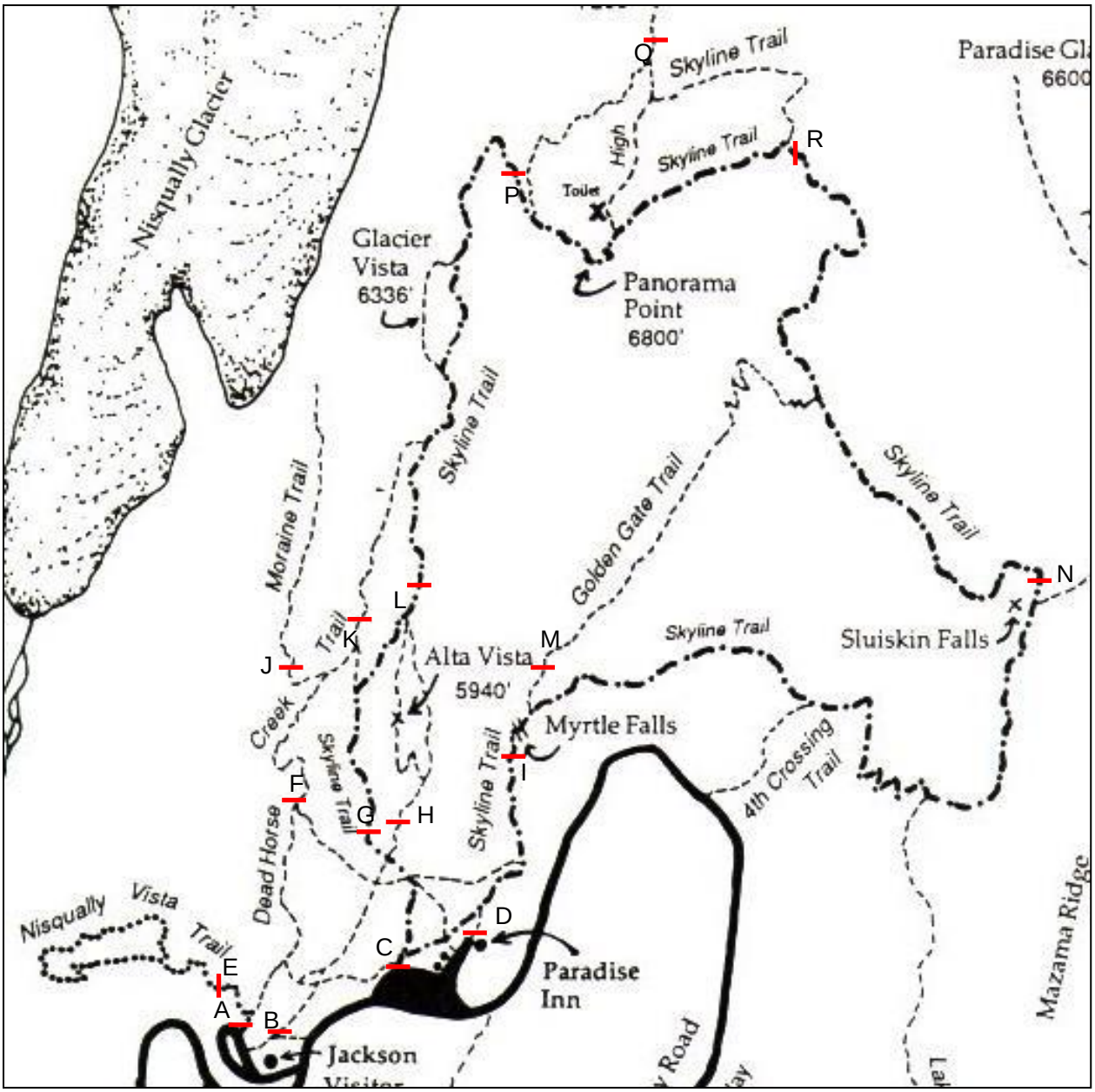


Figure 45. Locations of waypoint signs for 2003 Paradise Meadow Waypoint Survey.

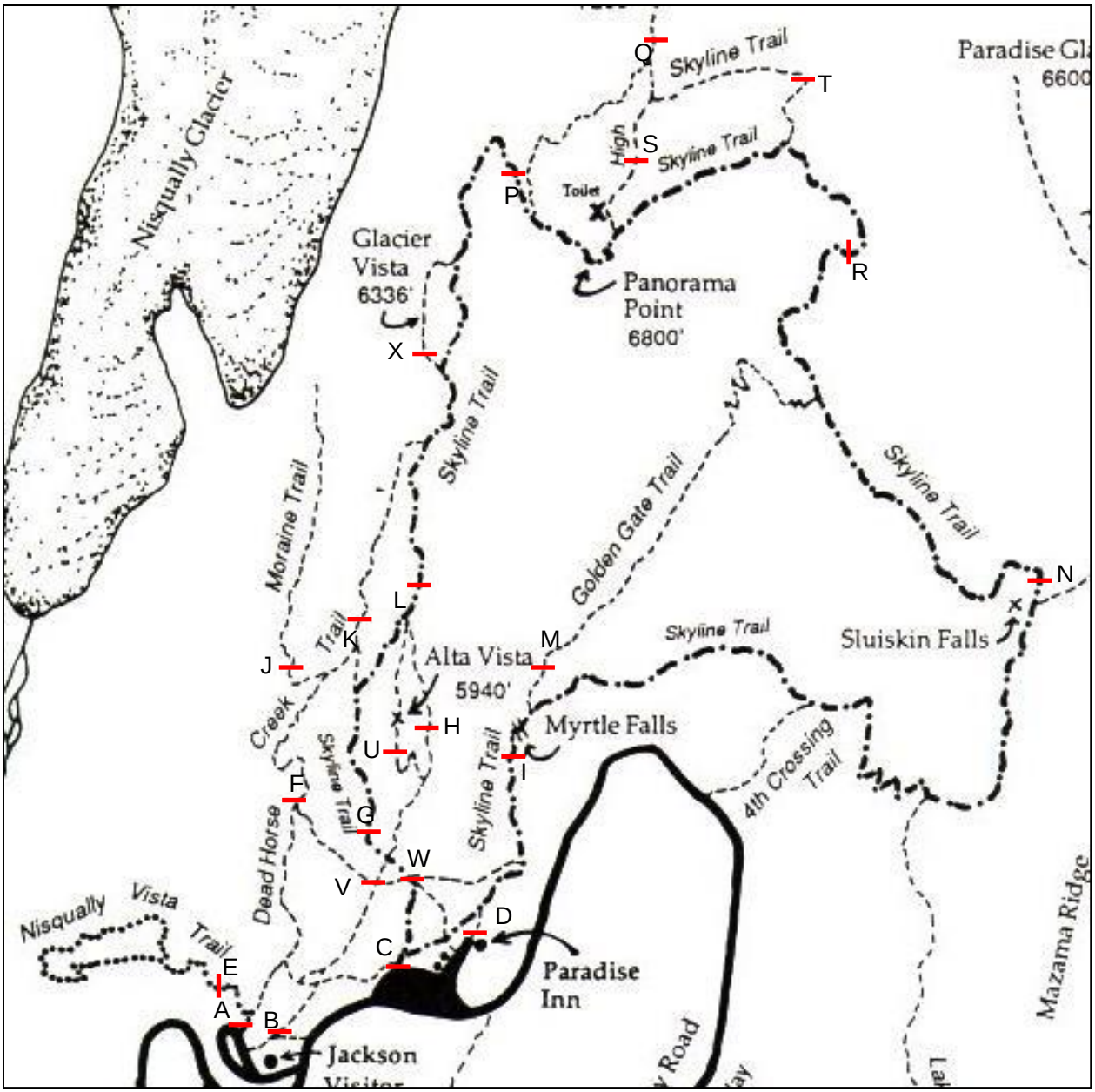


Figure 46. Locations of waypoint signs for 2004 Paradise Meadow Waypoint Survey.

7.2.2 Instruments

The waypoint cards handed out to day-hikers were of the standard design described in section 3.2 above.

7.2.3 Sample

2003 Sample. Data were collected on 2 weekend days, August 23 and 24. On those days, every third day-hiking party passing one of the four entry points was asked to participate in the study. At Paradise Meadow, a small proportion of visitors are overnight hikers (either climbers or backpackers). If it was unclear whether a party was day-hiking or were camping overnight,

workers asked for hikers' destinations.

A total of 351 parties were asked to participate in the study. Of those parties, 265 returned their cards (75.5%), 69 failed to return cards (19.6%), and 17 refused to participate or could not participate due to foreign language issues (4.8%).

2004 Samples. Data were collected during two three-day periods: Friday, July 9 to Sunday, July 11, and Friday, August 27 to Sunday, August 29. On those days, every third day-hiking party passing one of the four entry points was asked to participate in the study. If it was unclear whether a party was day-hiking or were camping overnight, workers asked for hikers' destinations. The samples are discussed separately because hiking patterns were different in the July time period due to snow that remained on many trails.

In July, a total of 309 parties were asked to participate in the study. Of those parties, 247 returned their cards (79.9%), 42 failed to return cards (13.6%), and 20 refused to participate or could not participate due to foreign language issues (6.5%).

In August, a total of 462 parties were asked to participate in the study. Of those parties, 369 returned their cards (79.9%), 62 failed to return cards (13.4%), and 31 refused to participate or could not participate due to foreign language issues (6.7%).

7.2.4 Limitations

Several issues create potential limitation on the use of the Paradise Meadow waypoint data to estimate numbers or patterns of visitor use. The first issue is that some hiking parties entered the trail network without passing a survey worker. Most notably, an unknown number of visitors used the stairway opposite the Paradise Inn entrance (just southwest of waypoint D). Thus, the number of hiking parties passing the four surveyed entry points can not be used to estimate the total number of hiking parties using the meadow. Informal observation of visitor behavior near the Paradise Inn entrance, as well as other potential entries to the trails suggests that the underestimation is no more than 20 percent (and is probably much less).

A second limitation of the waypoint data arises from the small number of days that were sampled. Many hiking parties were surveyed, but all three time periods covered sunny, summer weekends. Thus, the hiking patterns observed during those times are unlikely to represent patterns on weekdays or weekends with poor weather. Some surveys were collected on Friday, but the data are not sufficient to support statistical analysis of weekday and weekend differences.

Two final limitations concern several issues affecting the usefulness of the 2003 data. First, the lack of the route information provided by the waypoints added to the 2004 waypoint study limits the usefulness of the 2003 data. The 2004 hiking patterns can provide a basis for estimating the missing route information in the 2003 data. However, the benefits of such estimation (e.g., a larger sample of hiker itineraries on which to base a simulation model) must be weighed against the drawback of assuming that the hiking patterns in 2003 and 2004 were sufficiently similar to support it.

Second, and more importantly, the number of survey workers in 2003 was not sufficient to cover all four entry points at all times. Thus, waypoints A, B, and D were not sampled for several hours during the course of the two-day study, and hikers entering at waypoint C are over-represented in the data set. This represents a sampling bias that requires correction before the 2003 data can be properly interpreted.

7.2.5 Results

Party size. The average party size in 2003 was 3.32 (SD = 1.92). In 2004 the average was 3.26 (SD = 2.08).

Hiking patterns. The proportion of hiking parties entering Paradise Meadow from the four surveyed entry points (waypoint A, B, C, and D) is best estimated using the 2004 data because sampling in 2003 was biased to over-represent waypoint C (see section 7.1.4 above). Table 8 below shows the proportion of parties entering each waypoint during July and August of 2004.

Entry Point	Proportion of Hiking Parties (July 9 - 11, 2004)	Proportion of Hiking Parties (August 27 - 29, 2004)
A	**.18**	**.18**
B	**.19**	**.18**
C	**.35**	**.36**
D	**.28**	**.28**

Table 8. Proportion of hiking parties entering at each of four waypoints in Paradise Meadow.

Patterns of hiking behavior are related to the time of year (and related snow-coverage of trails) at which they enter. Thus, analyses of the recorded waypoints focus on 2004 data and are reported separately for the July and August samples in the table below.

Analyses showed that waypoint sign I at Myrtle Falls was passed by the highest percentage of visitors in both July and August of 2004 (40.8% and 47.2%, respectively). The largest differences between the July and August data were found for waypoints P, N, R, and X (August percentages were between 8% and 11% higher). These differences suggest that a higher proportion of hiking parties made longer loop hikes in August, when trails were free of the intermittent snow patches present for the July hikers.

Waypoint	Percent of Parties Passing (July, 2004)	Percent of Parties Passing (August, 2004)
E	13.9	12.2
F	11.2	14.7
G	24.3	29.5
H	10.1	7.0
I	40.8	47.2
J	0.0	1.7
K	16.5	19.2
L	15.4	22.2
M	21.0	24.0
N	4.1	14.5
P	11.2	21.2
Q	2.6	6.0
R	5.6	16.0
S	6.7	9.5
T	5.2	9.7
U	3.4	3.7
V	25.8	24.7
W	33.7	36.7
X	3.4	11.5

Table 9. Percent of hiking parties passing waypoints in Paradise Meadow.

Hiking durations. The average duration of day-hikes on the Paradise Meadow trail network was 90 minutes (SD = 72) in July and 119 minutes (SD = 88) in August. Again, these figures (both the increased mean time and increased standard deviation) suggest that more hikers took longer hikes in August when the trails were free of snow. Hike durations were 234 minutes (SD = 65) for parties that reported reaching the Panorama Point area (including parties that went on past Pebble Creek/waypoint Q). The figure below shows a skewed distribution of hiking durations for all hikers, with a peak for durations of 30 to 60 minutes and a tail reaching out to durations approaching four hours. Longer hikes were clearly more common in August than in July.

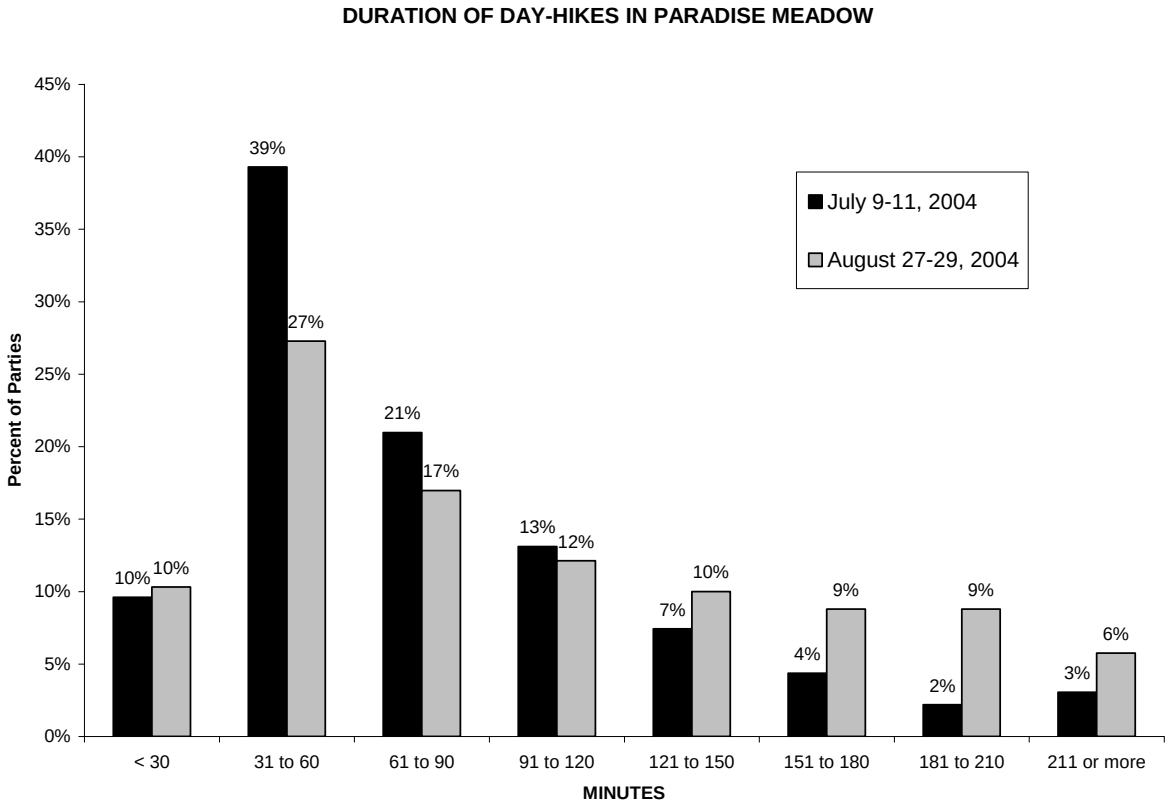


Figure 47. Durations of day-hikes in Paradise Meadow.

Informal observation of visitors hiking on the Paradise Meadow trail network suggests that parties often make short stops to rest, view scenery, and take photographs. However, longer stops generally occur in a limited number of sites. A small amount of information was collected in 2003 concerning the duration that visitors stopped at attraction sites in Paradise Meadow. However, many visitors found it difficult to recall the locations and durations of the times they stopped hiking. In addition, survey workers often found it difficult to talk with returning parties while maintaining the sampling interval for entering parties (particularly at the busiest entry point, waypoint C). Thus, a relatively small number of respondents described the places they stopped and the duration of their stops.

In 2004, systematic observation was used to estimate the duration of visitor's stops at the three attraction sites most commonly mentioned as stop locations in 2003. These data showed that visitors to Myrtle Falls stopped an average of 7 minutes with a standard deviation of 6 minutes (N = 125). Stops at Alta Vista averaged 3 minutes with a standard deviation of 5 minutes (N = 104), and stops at Panorama Point averaged 16 minutes with a standard deviation of 15 minutes (N = 70). These numbers were generally consistent with the 2003 data but were based on the more reliable, systematic observation method of data collection.

7.3 Waypoint Results for Sunrise Area Trails

Sunrise is found at an altitude of 1,951 meters on the Northeast side of Mount Rainier. It is the second-most popular visitor destination in MORA, and offers excellent views of the

mountain and a variety of trails to destinations such as Shadow Lake, Mount Fremont, and Burroughs Mountain.

Waypoint studies were conducted in 2003 and 2004 to assess the hiking patterns of day-hikers using the network of trails in the Sunrise Area. Readers should note that additional information about use of Sunrise Area trails was collected using an electronic trail counter on the Shadow Lake Trail (see Section 5.2).

7.3.1 Location

Waypoint surveys were conducted by field workers stationed at signs A, B, and C, at trailheads near parking areas and facilities in the Sunrise developed area. Figure 48 below shows the approximate locations of all the waypoint signs used in the study.

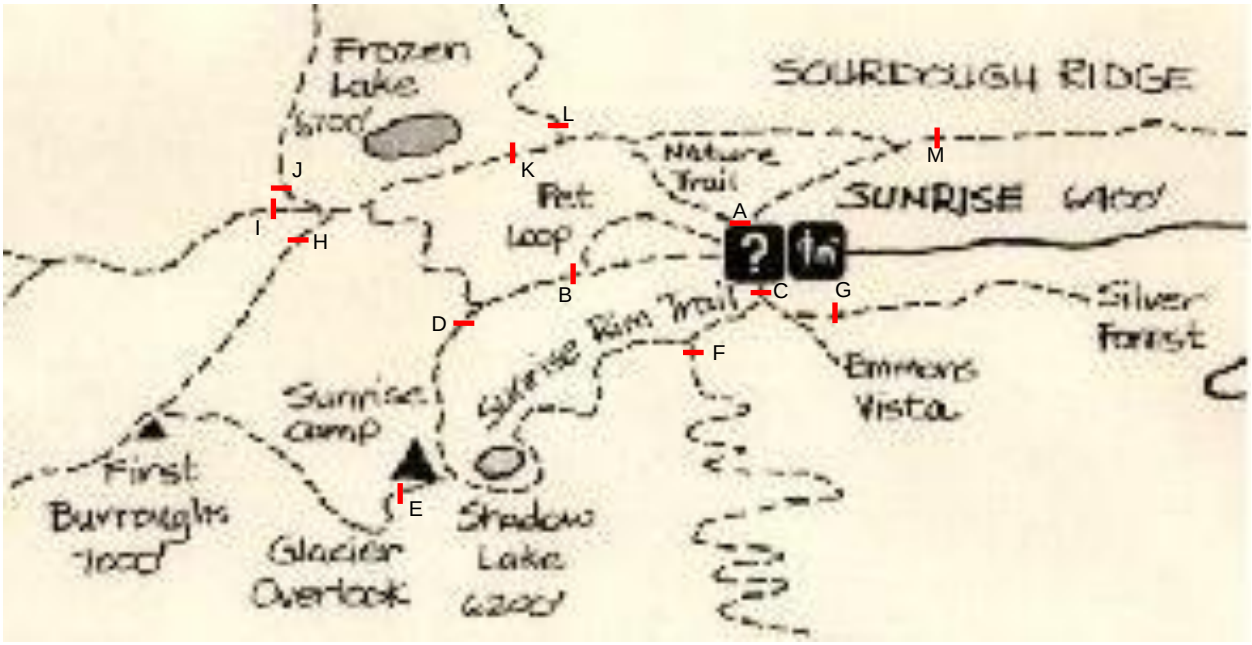


Figure 48. Locations of waypoint signs for 2003 and 2004 Sunrise Area Waypoint Survey.

7.3.2 Instruments

The waypoint cards handed out to day-hikers were of the standard design described in section 3.2 above.

7.3.3 Sample

2003 Sample. Data were collected on 2 days, Friday, July 18 and Saturday, July 19. On those days, every third day-hiking party passing one of the three entry points was asked to participate in the study. At Sunrise, a small proportion of visitors are overnight backpackers. If it was unclear whether a party was day-hiking or was camping overnight, workers asked for hikers' destinations.

A total of at least 145 parties were asked to participate in the study. Of those parties, 127 returned their cards (87.6%), 18 failed to return cards (12.4%), and at least 1 refused to participate or could not participate due to foreign language issues (0.8%). The survey workers in 2003 misunderstood instructions and generally failed to record instances when hiking parties refused to participate in the survey. Thus, the response rate was actually slightly lower than the percentage reported above.

2004 Sample. Data were collected during one three-day period: Friday, July 16 to Sunday, July 18. On those days, every third day-hiking party passing one of the three entry points was asked to participate in the study. If it was unclear whether a party was day-hiking or was camping overnight, workers asked for hikers' destinations.

A total of 248 parties were asked to participate in the study. Of those parties, 206 returned their cards (83.1%), 28 failed to return cards (11.3%), and 14 refused to participate or could not participate due to foreign language issues (5.6%).

7.3.4 Limitations

The single primary limitation on the use of the Sunrise area waypoint data arises from the small number of days that were sampled. Many hiking parties were surveyed, but the sampled time periods cover only three complete days and two partial days, and all the complete days were on sunny, summer weekends. Thus, the hiking patterns observed during those times are unlikely to represent patterns on weekdays or weekends with poor weather. Some surveys were collected on Fridays, but the data are not sufficient to support statistical analysis of weekday and weekend differences.

7.3.5 Results

Party size. The average party size in 2003 was 3.24 (SD = 3.17). In 2004 the average was 3.16 (SD = 2.88).

Hiking patterns. The proportion of hiking parties entering Sunrise area trails from the three surveyed entry points (waypoint A, B, and C) in 2003 and 2004 is shown in the table below.

Entry Point	Proportion of Hiking Parties 2003	Proportion of Hiking Parties 2004
A	**.63**	**.68**
B	**.11**	**.10**
C	**.26**	**.22**

Table 10. Proportion of hiking parties entering at each of four waypoints in Sunrise area.

Patterns of hiking behavior at Sunrise are strongly related to the point at which parties enter the trail network. Thus, analyses of the recorded waypoints are reported separately for the different entry points in the table below.

Analyses showed that waypoint sign K on Sourdough Ridge was passed by the highest percentage of parties who entered at waypoint A (84.3%). The most commonly passed waypoint for parties who entered at waypoint B was D (59.1%), and the waypoint most commonly passed by parties who entered at waypoint C was G (51.1%). The patterns of waypoint data suggest that most visitors (understandably) select the entry point nearest the destination of their hike.

Waypoint	% of "A" Entry Parties Passing	% of "B" Entry Parties Passing	% of "C" Entry Parties Passing
D	13.7	59.1	22.2
E	10.5	31.8	20.0
F	0.0	0.0	0.0
G	0.0	0.0	51.1
H	27.5	36.4	11.1
I	20.3	0.0	0.0
J	26.8	0.0	4.4
K	84.3	40.9	13.3
L	7.2	0.0	0.0
M	0.0	0.0	0.0

Table 11. Percent of hiking parties passing waypoints in Sunrise area.

Hiking durations. The average duration of day-hikes on Sunrise area trails was 111 minutes (SD = 84) in 2003 and 129 minutes (SD = 85) in 2004. These durations were not significantly different, $F(1, 329) = 3.64$, $p = .057$. The figure below shows a skewed distribution of hiking durations for all hikers, with a peak for durations of 30 to 90 minutes and a tail reaching out to durations of more than five hours. About 12 percent of hike durations were more than four hours.

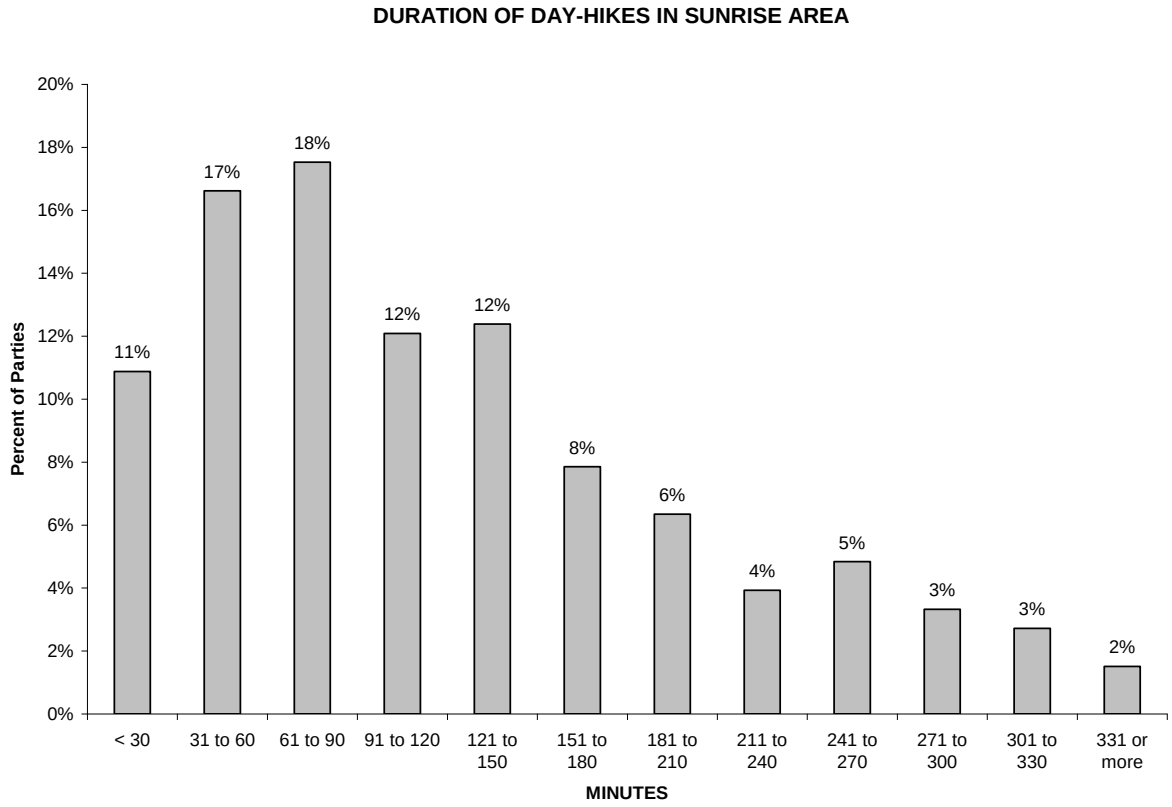


Figure 49. Durations of day-hikes in Sunrise area.

7.4 Trail Counter Results for Naches Peak Trail (Tipsoo Lake Area)

Tipsoo Lake is found at an altitude of 1,536 meters on the East side of Mount Rainier. It is a popular destination for visitors who wish to take short hikes around the lake or longer hikes on the Naches Peak Loop Trail. The trails offer breathtaking views of the Mountain, a look at beautiful subalpine meadows, and an abundant supply of huckleberries in late summer and early fall. The formal parking capacity of the picnic area lot is 45 vehicles, with additional spaces for 10 vehicles in the overlook parking area southeast of the lake (BRW 1994). In addition, some visitors park in the lot located north of Chinook Pass on USFS property.

In order to better describe day-hiking use of the Tipsoo Lake area, and to provide a potential means of validating simulation models of visitor use, a trail counter was installed on the Naches Peak Trail in 2005. It was located about 100 meters from the southern terminus of the loop trail near the location of the sign denoting waypoint "J" in the waypoint study (see Figure 52).

7.4.1 Validation Results: Naches Peak Trail

Due to demands on limited survey worker time, the counter installed on the Naches Peak Trail was only observed to collect validation data for a very brief period. Even these limited observations were lost with the loss of data recorded prior to 8/3 (see Section 7.4.2 below). Although it is uncertain whether the counter consistently recorded all visitor passages, the

validation results for other counters suggest that most counters were either accurate, or undercounted the number of passing hikers. Thus, the counts from the Naches Peak Trail counter can be considered a reasonable minimum estimate of the number of hikers using this trail in the Tipsoo Lake area.

7.4.2 Data Cleaning and Limitations of Data: Naches Peak Trail

The trail counter was in place and functioning starting on July 12. However, the data collected before August 4 were lost due to a download error. A trail counter malfunction resulted in missing data from August 13 to August 22. Thus, data are available describing the use of Naches Peak Trail for August 3, 13:00 to August 13, 13:00, and from August 22, 14:00 to September 14, 15:00.

The count data were examined for outlier values that may have resulted from trail counter malfunction that produced spurious counts. Initial inspection suggested that the trail counter worked incorrectly on August 23 and 24. Data from those days were subsequently removed from the dataset.

7.4.3 Descriptive Data: Naches Peak Trail

Because the Naches Peak Trail counter recorded only 30 complete days between August 4 and September 14, a chart showing those data would form only a weak basis for estimating the pattern of use for the entire season. Regression analyses of those 14 days, however, showed that the daily counts were strongly related to the total number of vehicles entering the Nisqually entrance of MORA (r = .896). Thus, the vehicle counts were used to estimate the number of visitors passing the Naches Peak Trail counter (i.e., Naches Peak Count = ((Vehicle Count * .211) – 93). The following chart shows those estimated daily counts of hikers. The counts show a strong weekend/weekday effect, with peak use on July 31 (421 hiker passages) and moderate use on the Labor Day holiday. The 95th percentile day was 387 hiker passages. The average count (during the observed period[4]) was 79 on weekdays, with a standard deviation of 49. On weekends, the average count was 237, with a standard deviation of 99. Median counts were 66 and 238 for weekdays and weekends, respectively.

[4] Note that use during the observed period was lower (on average) than use earlier in the summer. Thus, the average use levels provided probably underestimate true levels of average use during the peak summer visitation season.

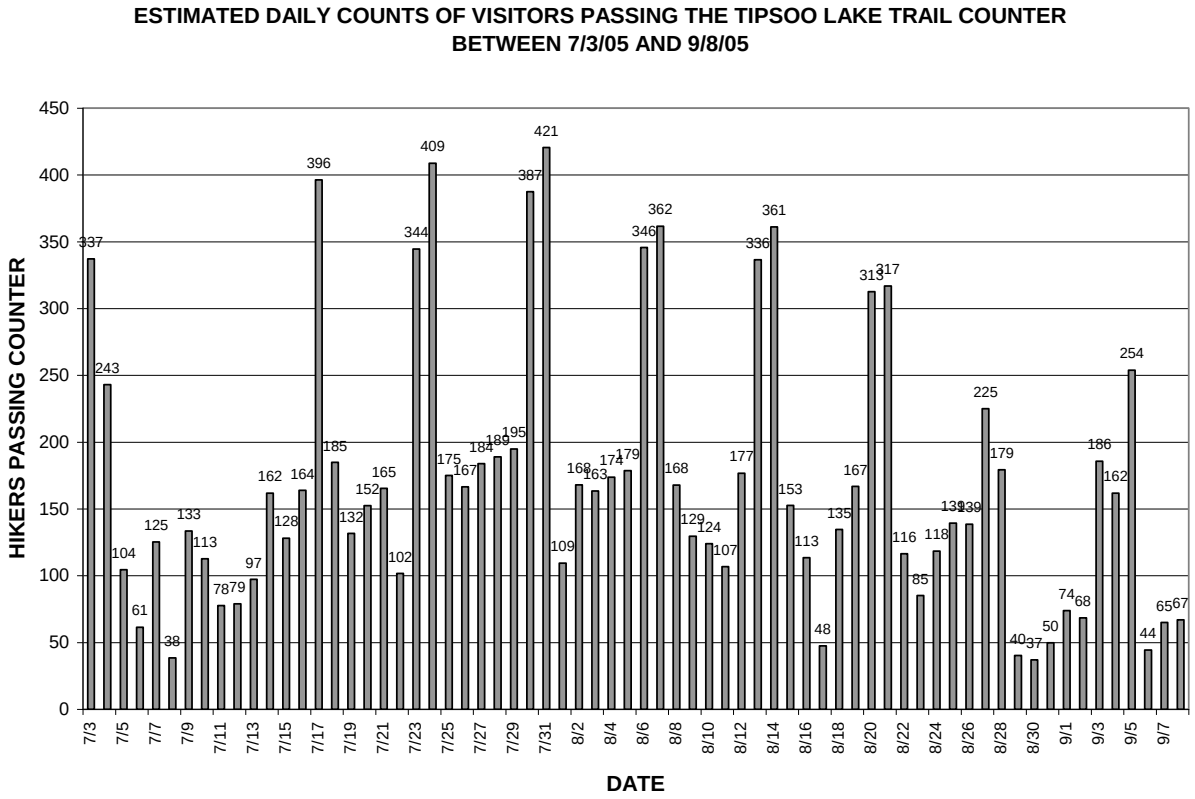


Figure 50. Estimated daily counts of visitors passing Naches Peak (Tipsoo Lake area) Trail counter.

The hourly distribution of hikers passing the Naches Peak Trail counter shows a bell-shaped distribution with peak use occurring between 13:00 and 15:00.

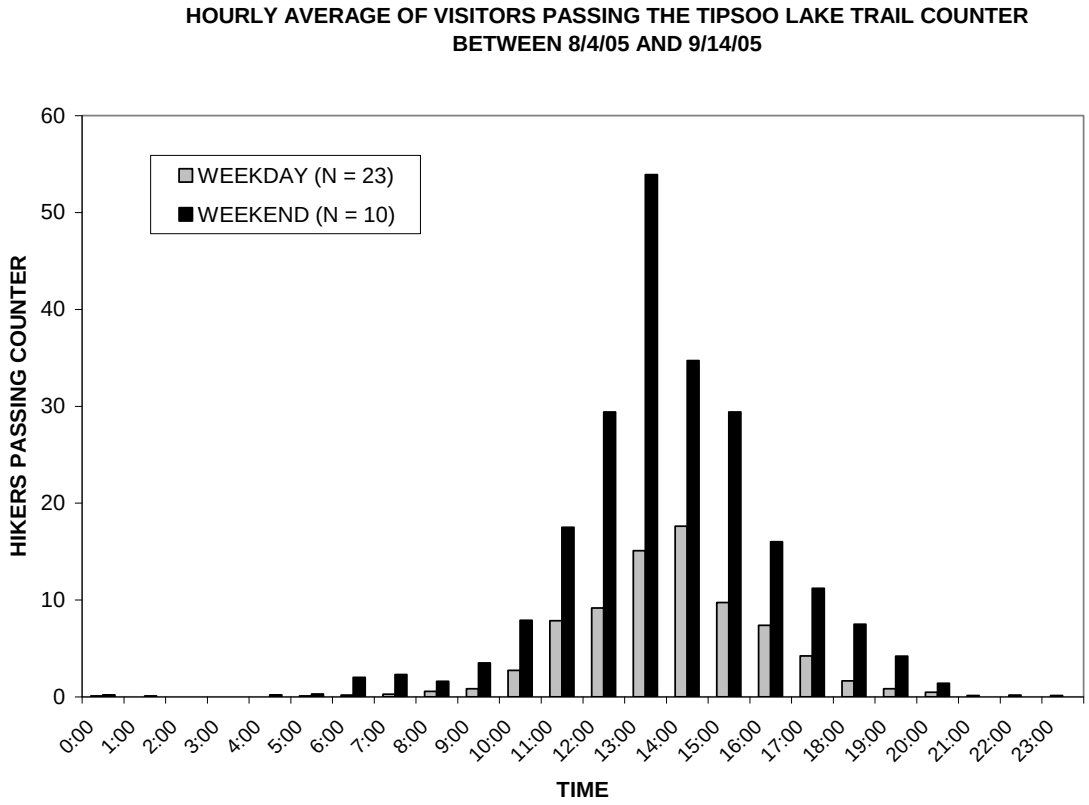


Figure 51. Hourly distributions of visitors passing Naches Peak (Tipsoo Lake area) Trail counter. Note that counts were adjusted using the correction factor estimated from the validation results.

7.5 Waypoint Results for Tipsoo Lake Trails

Tipsoo Lake is found at an altitude of 1,536 meters on the East side of Mount Rainier. It is a popular destination for visitors who wish to take short hikes around the lake or longer hikes on the Naches Peak Loop Trail. The trails offer breathtaking views of the Mountain, a look at beautiful subalpine meadows, and an abundant supply of huckleberries in late summer and early fall. The formal parking capacity of the picnic area lot is 45 vehicles, with additional spaces for 10 vehicles in the overlook parking area southeast of the lake (BRW 1994). In addition, some visitors park in the lot located north of Chinook Pass on USFS property.

A waypoint study was conducted in 2005 to assess the hiking patterns of day-hikers using the trails in the Tipsoo Lake area.

7.5.1 Location

Waypoint surveys were conducted by field workers stationed at waypoint A, near the picnic area parking lot, and waypoint B, near the strip of lake-overlook parking. Figure 52 below shows the approximate locations of all the waypoint signs used in the study.

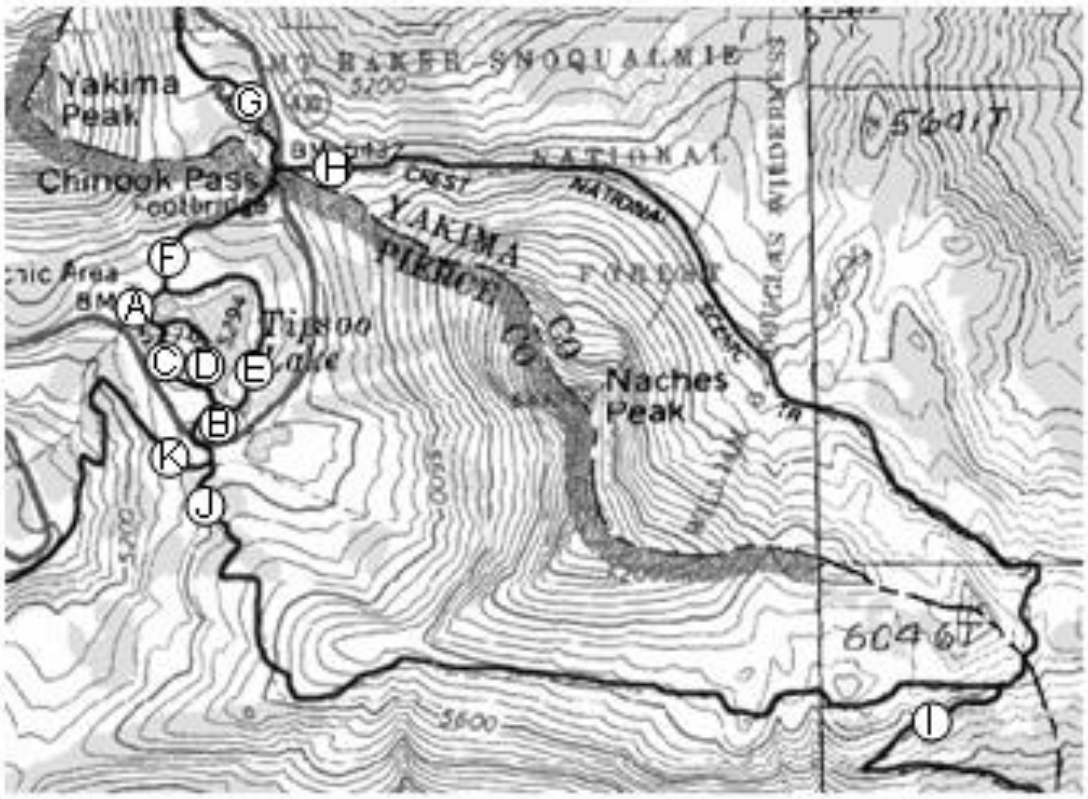


Figure 52. Locations of waypoint signs for 2005 Tipsoo Lake Waypoint Survey.

7.5.2 Instruments

The waypoint cards handed out to day-hikers were of the standard design described in section 3.2 above.

7.5.3 Sample

Data were collected on 20 days (14 weekdays and 6 weekend days) between June 24 and August 26, 2005. On sampled days, it was intended that all parties parking at the NPS lots located near Sign A or B who took walks/hikes would be asked to participate in the study. On the busiest days, a small proportion of parties parking at the lot near Sign A were not approached.

A total of 714 parties were asked to participate in the study, 602 (84.3%) at Sign A and 112 (15.7%) at Sign B. The table below shows the refusal rate and rate at which cards were not returned.

	Contacted at Sign A	Contacted at Sign B
Refused to Participate	59 (9.8%)	9 (8.0%)
Card not Returned	18 (3.0%)	10 (8.9%)
Card Returned	525 (87.2%)	93 (83.1%)
Total Cards Distributed	602	112

Table 12. Response rate at the two Tipsoo Lake contact points.

7.5.4 Limitations

The primary limitation on the use of the Tipsoo Lake waypoint data arises because an unknown number of visitors parked at the Chinook Pass parking area on USFS land and entered the trail system from the north (i.e., past waypoint G). Such visitors were not included in the waypoint study sample. Thus, estimates of visitor use based on the waypoint study would underestimate total use of the Tipsoo Lake trails. Accordingly, the estimates of use provided below can be considered reasonable minimum estimates, with the assumption that some additional visitors parked at Chinook Pass and hiked the trails around Tipsoo Lake and Naches Peak.

7.5.5 Results

Party size. The average party size was 3.21 (SD = 2.42). Party sizes were significantly larger at Sign A (3.36 persons) than at Sign B (2.82 persons); $t(677) = 2.05$, $p = .041$.

Hiking patterns. Consistent with the size of the parking areas, many more parties entered the Tipsoo Lake trails from waypoint A (84.3%) than at Sign B (15.7%).[5]

Analyses of the recorded waypoints showed that 72.9 percent of hiking parties used the trails on the shore of Tipsoo Lake (i.e., they passed waypoint E or D). An additional 6.6 percent of parties (those who recorded only an entry and exit waypoint) were likely to have used those trails without passing the waypoint signs.

The Naches Peak loop was hiked by 28.3 percent of parties, and an additional 6.1 percent of parties hiked on one side or the other of the Naches Peak loop as an "out and back" hike. Only 5.1 percent of parties hiked on the PCT toward Dewey Lake (i.e., passed waypoint I).

The trail from the main parking area (waypoint A) to the highway overpass was used by 34.1 percent of parties (i.e., they passed waypoint F), but only 2.0 percent of parties hiked north on the PCT (i.e., passed waypoint G). None of the contacted parties hiked west on the Eastside Trail (i.e., passed waypoint K).

[5] Note that the percentage of hiking parties beginning their hikes at waypoint A or B is different from the percentage of parties that pass waypoint A or B at some point during their hike.

Waypoint	Percent of Visitors Passing
A	86.2
B	44.6
C	31.7
D	57.7
E	53.4
F	34.1
G	2.0
H	30.8
I	5.1
J	31.9
K	0.0

Table 13. Percent of hiking parties passing waypoints at Tipsoo Lake.

Hiking durations. The average duration of day-hikes on Tipsoo Lake trails was 70 minutes (SD = 74). However, approximately half the hikes were less than 30 minutes in duration. The figure below shows a bimodal distribution of hiking durations for all hikers, with a peak for durations of 15 to 29 minutes and a second peak for durations of 120 to 179 minutes.

Parties who stayed in the vicinity of Tipsoo Lake (i.e., who did not cross the highway to the Naches Peak loop or hike north on the PCT) hiked for an average of 25 minutes.

Parties who hiked the Naches Peak loop and did not continue toward Dewey Lake hiked for an average of 147 minutes. Parties who continued toward Dewey Lake hiked for an average of 243 minutes.

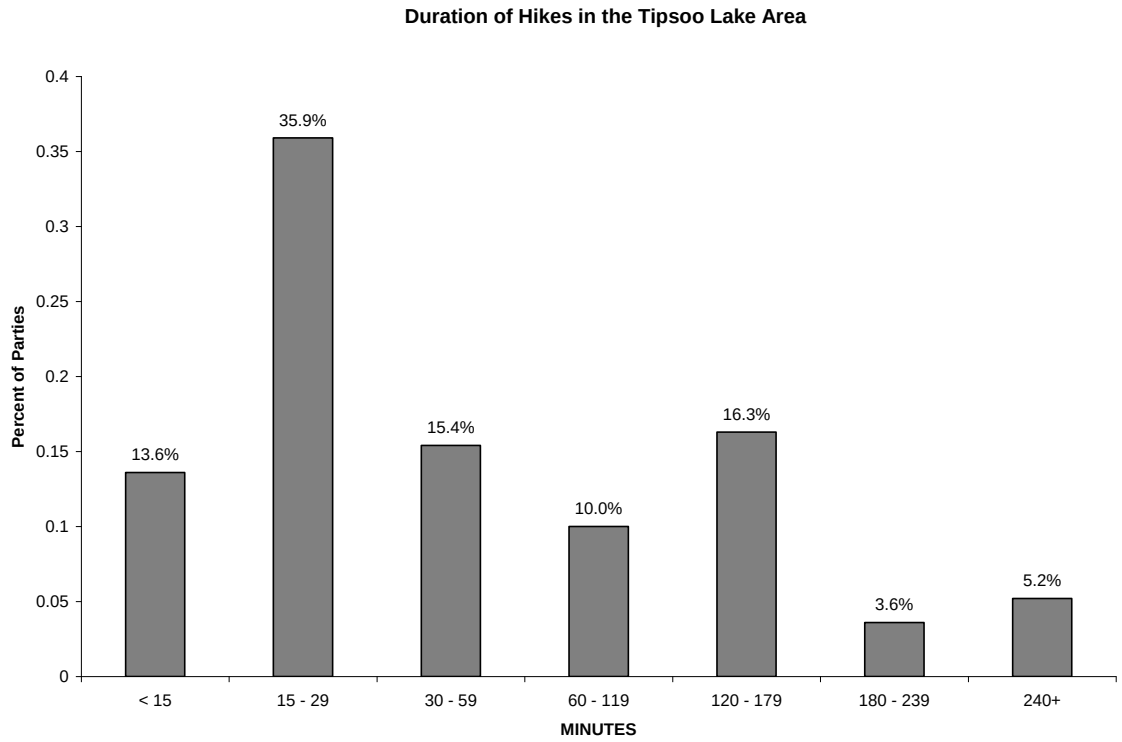


Figure 53. Durations of day-hikes in Tipsoo Lake area.

Entry Rates. Because (with a few exceptions) all entering parties were asked to participate in the survey, the number of contacted parties on the sampled days can be used to estimates the total rate of entries from NPS parking areas. On weekends, an average of 54.1 parties set off from NPS parking areas to take hikes in the Tipsoo Lake area, and an average of 27.7 parties hiked on weekdays. Again, it is important to note that some parties not included in this study parked at the USFS lots near Chinook pass and hiked in the Tipsoo Lake area. The figures below show the hourly distribution of hiking entries on weekends and weekdays (respectively).

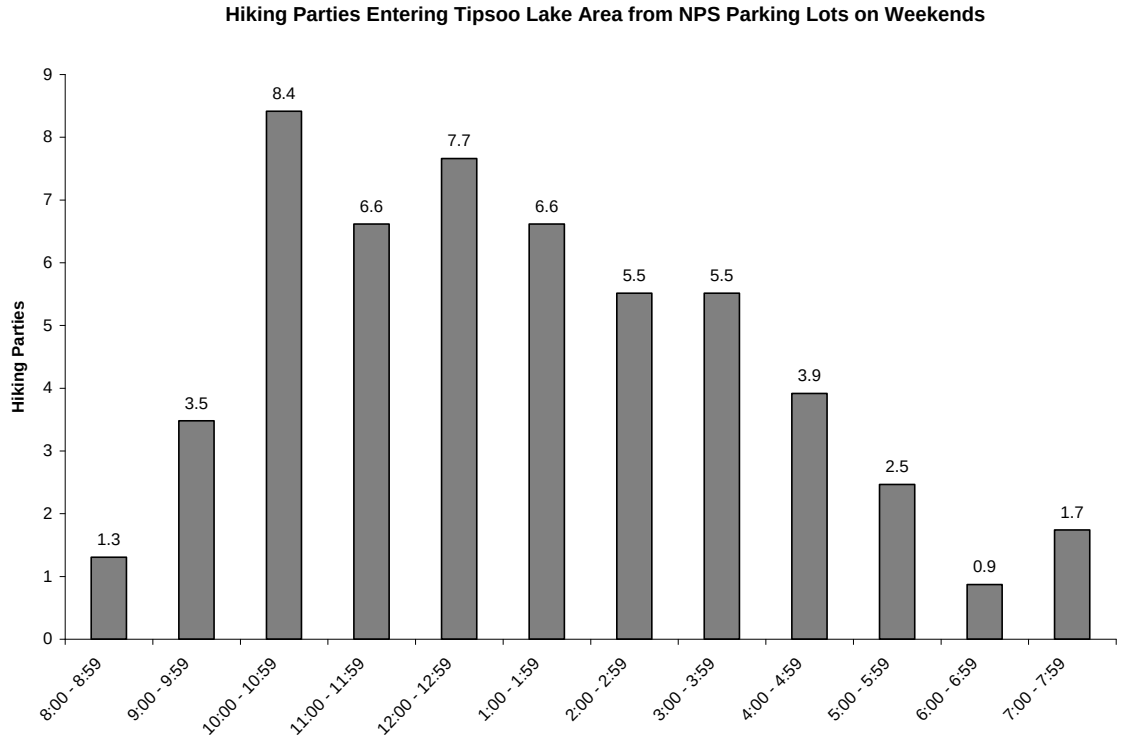


Figure 54. Weekend rates of entry to Tipsoo Lake area from NPS parking lots.

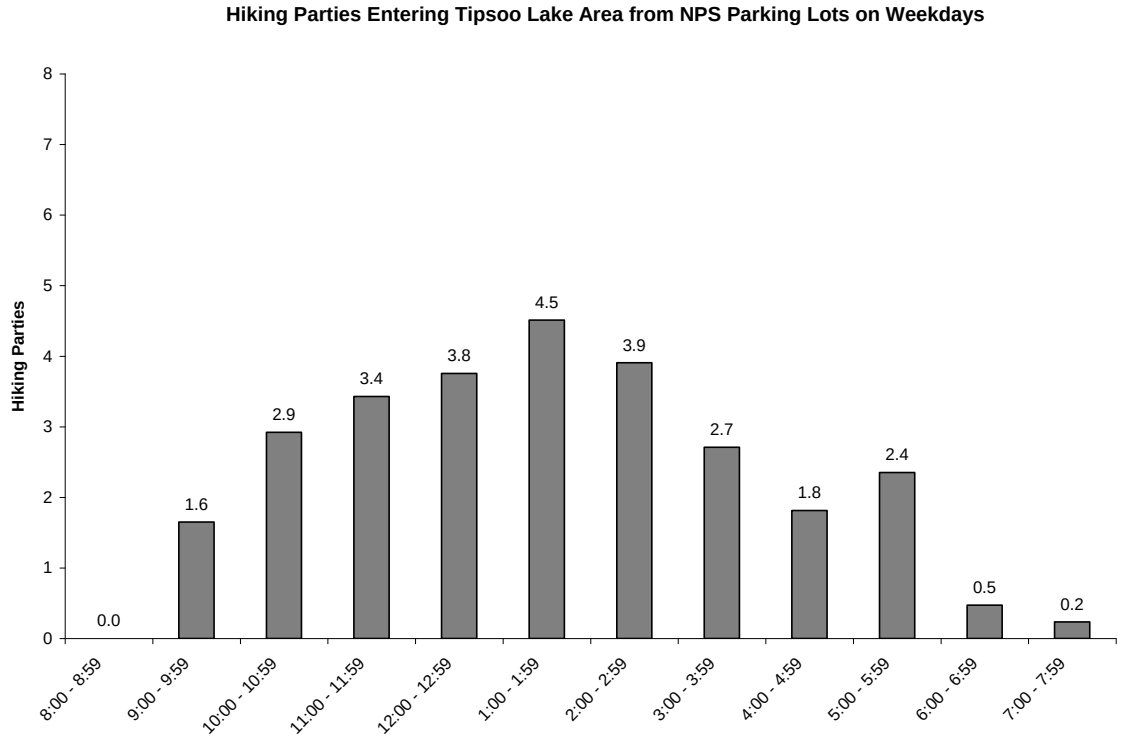


Figure 55. Weekday rates of entry to Tipsoo Lake area from NPS parking lots.

8. RECOMMENDATIONS FOR FUTURE RESEARCH

It is infeasible to propose that MORA should gather and maintain descriptions of visitor use in every area of the park. However, limitations of the data presented in this report suggest particular management zones or attraction sites where information might be most useful.

8.1 Continued Monitoring of Paradise Meadow Visitor Use

Although it may be the most studied area of MORA, Paradise Meadow remains an area worthy of focus. Construction of the new visitor center and related changes in the infrastructure of the area will alter use in the built area of Paradise, but may also change patterns of visitor use throughout Paradise Meadow. In combination with the status of Paradise as the most visited area of MORA, the possibility of such change (and associated impacts resulting from the altered use) justify future monitoring of use levels and visitor distribution.

8.2 The Challenge of Measuring Use in Little-used Areas

Simply scanning the table of contents for this document shows that most description of visitor use has been focused on the relatively small areas of the park that are heavily used by visitors. Very little quantitative information about visitor use of the Pristine, Primitive, and Semi-primitive Trail zones has been collected. Some efforts have been made to address this information need. For example, in 2005 Trailmaster trail counters were installed on a number of remote trails throughout MORA (Piastuck, Morin, Conner, and Hodgson 2005). However, a variety of problems with the trail counters severely limited the amount of useful data that were collected. Such problems are not unusual in efforts to describe use in little-used locations. The basic problem is simple – the number of users is so small that even a few spurious events can create "noise" that limits the interpretation and usefulness of the information, even if the function of the counters is checked systematically.

MORA managers could benefit from improved information about visitor use in the Pristine, Primitive, and Semi-primitive Trail zones, but the problems with existing measuring tools are so great that it may not be wise to invest heavily in efforts to deploy and maintain the types of trail counters and other counting methods used in other areas of the park. Instead, an effort might be made to talk with managers of other recreational areas (NPS, USFS, or State Parks) to determine whether other methods are sufficiently promising to merit investigation and/or widespread use at MORA.

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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environment and cultural values of our national parks and historical places, and providing for enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interest of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under US administration.

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