

Monitoring and Analyzing Winter Backcountry Use in the Upper Gunnison Valley 2017-2018

Douglas Shaw

Abstract

Crested Butte and the Upper Gunnison Valley (UGV) are renowned for backcountry access which is revered by, and beneficial to, innumerable winter recreation groups. Certain characteristics of the valley, including the long winters, exceptional snowfall, and extremely cold temperatures have turned the area from a mining town to a tourist destination that thrives due to its outdoor opportunities. Currently, the UGV's backcountry is regulated by a Winter Travel Management Plan (WTMP) that was designed and created more than twenty years ago. Since its implementation, the tools available for backcountry access have improved dramatically. Coupled with a 2015 United States Forest Service ruling that declared, "a system of routes and areas to provide for over-snow vehicle use" must be established for all winter use areas, this study set out to collect a baseline dataset concerning the recreational use of winter trailheads in the UGV.

To do this, game-style digital trail cameras were installed at eight locations from which the UGV backcountry is traditionally accessed. Data was downloaded from the cameras often, saved on an external hard drive, images were filed by trailhead and date, and analyzed. This information is presented in both spreadsheet and graph forms, providing data for individual forms of recreation as well as similar user groups (e.g., non-motorized, mechanized, motorized). In addition to the electronic monitoring, students were enlisted to perform real-time data acquisition in the field in order to help verify the accuracy of the cameras. This study presents a broad view of local backcountry use trends, while also providing valuable lessons learned during the introductory study. Finally, teaching aids have been included that can bolster future studies of this nature.

Introduction

Crested Butte and the Upper Gunnison Valley (UGV) are well known for broad backcountry opportunities available to diverse recreational groups throughout the seasons. Above all, the region is renowned for the ease with which one can access backcountry for innumerable winter recreational activities. Outdoor recreation is a major draw for both locals and tourists while also being a significant driver of the local economy. The tourism industry alone is the single largest contributor to Gunnison County's economy, responsible for nearly 36% of the accrued capital. Although summer generates approximately half of the region's tourism, winter recreation is unquestionably essential to the economic survival of the town's contemporary character (Gunnison County Community Development and Geographic Information Services, 2014).

This was not always the case. Beginning in the late 1800's, Crested Butte saw an influx of people from all over the world who came chasing their dreams of striking it rich in the silver and gold mining industry. Not long after, the area became an important hub for the

Denver and Rio Grande Railroad, which was fundamental to mining in the West Elk Mountains and the development of other mining towns on the Western Slope. Not long after the silver and gold reserves dried up, coal mining became an essential industry in Crested Butte. Mining and related operations continued in one form or another until the middle of the 20th century.

1960 saw an extreme reversal of fortune for Crested Butte and the UGV when legend Dick Eflin and colleague Fred Rice formed Crested Butte LTD, acquired the Malensek Ranch (later to be *Mount Crested Butte*), and began the task of obtaining permits to operate a ski area from the Gunnison National Forest Supervisor E.W. Stein. The ski area at Mt. Crested Butte opened for business on Thanksgiving Day, 1961 with nothing more than a rope tow on loan from Western State College and a Doppelmeier T-bar. 1962 saw the addition of base area facilities, a gondola, and the realization that Crested Butte's destiny would be in great contrast to its recent past (Miller, 2005 and Colorado Ski and Snowboard Hall of Fame, 2005).

Due to the efforts of Eflin and Rice, Crested Butte is now the destination haven for a diverse range of enthusiast groups during both the winter and summer seasons. Although visitation rates are historically at a maximum during the summer months, concerns regarding the future of winter backcountry recreation, access, and opportunities were the motivation for the following research. Local conditions such as long winters, plenty of snowfall, extremely cold temperatures, and easy access for all sorts of activities have attracted enthusiasts forming myriad special interest groups. Attractions like Crested Butte Nordic (50 km of groomed trails) and the Crested Butte Mountain Bike Association (CBMBA) network of groomed fat bike trails (>80 km) further solidify the town's draw. Pastimes include, but are not limited to, skiing (Nordic and Alpine Touring (AT)), snowboarding and noboarding, snowshoeing, fat biking, and snowmobiling.

At present, dispersed winter recreation throughout the UGV backcountry is regulated by a Winter Travel Management Plan (WTMP), enforced by the United States Forest Service (USFS). The plan was designed and implemented more than twenty years ago (Storch, 1995). Since its introduction, the technologies supporting backcountry travel have advanced immensely; snowmobiles have become drastically lighter and more powerful, splitboard and AT equipment are becoming commonplace, entire new forms of backcountry travel have been developed (e.g., fat bikes, snow bikes, tracked side by sides', more), and avalanche safety gear is more effective and available than ever (Figures 1-4). This has created an environment in which habitual resort skiers and snowboarders are more likely to access backcountry terrain due to the ease with which that terrain can be accessed and powder can be skied (Rivers and Menlove, 2006).

Moreover, a 2015 United States Forest Service (USFS) ruling that declared, "a system of routes and areas to provide for over-snow vehicle use" must be established for all winter use areas (USDA, 2015). Although the UGV has an existing WTMP, it is reasonable to believe that the plan will be reevaluated to create a new travel management rule (TMR) for the area. Quantitative data regarding backcountry travel and use in the UGV will be a

valuable resource to help inform this decision-making process (Svajda, et al., 2016). This study was designed to collect such data in the most comprehensive manner possible.



Figures 1 and 2. Shown for contrast is a mid-1990's Polaris RMK700 snowmobile (above, left); once the pinnacle of snowmobile technology. Today these are noteworthy because of their "lead sled" moniker which illustrates the machines disproportionate power to weight rating, a direct byproduct being the undesirable characteristic of sinking in snow. Capabilities are not enhanced by the short track and paddle (~133x1.25"), conventional equipment of the day. Beside the lead sled (above, right) is essentially a modern incarnation of the same machine; this 2017 Polaris RMK800 is inordinately more effective for backcountry travel. Note the elongated track (163x2.6") and increased suspension travel (illustrated by the distance from the snow to the bottom of the machine/tunnel). Numerous improvements over the years have made these machines far more capable than their predecessors.



Figure 3. An example of over-snow vehicle progression. Pictured is a Geo Tracker which has been modified through the addition of Side by Side/UTV tracks for the purpose of shuttling owners to and from Irwin, CO.



Figure 4. Avalanche recovery gear is far more advanced than could have been imagined when the current WTMP was designed. Shown above is an avalanche airbag; an airbag typically charged with gaseous carbon-dioxide that can instantly be deployed in the event of an avalanche to keep the user above moving snow.

Methods

In order to create the most complete dataset possible, trailhead monitoring was carried made possible through the use of infrared/motion activated cameras that served as an indirect-counting method. This technique has been formally defined as “using electrical and mechanical counting devices, self-activated or time-lapse photography, and remote sensing techniques” (James, 1971). Motion-activated photography also produced accurate total counts (daily, user group, trailhead), information about direction of movement, method of travel and propulsion, user type, and even group size. In addition, the equipment required little maintenance once calibrated, produced well-defined results, and ultimately was relatively inexpensive (Hollenhorst et al., 1992).

Game-style digital trail cameras were installed at eight locations from which the UGV backcountry is traditionally accessed (Figure 5). The total number of days monitored varied between each location due to a number of reasons, including limited equipment, technical difficulties, and incorrect setup (these will be discussed further in the results section). For future work, Appendix A includes pictures of camera placement and a detailed description about the best practices for each location.

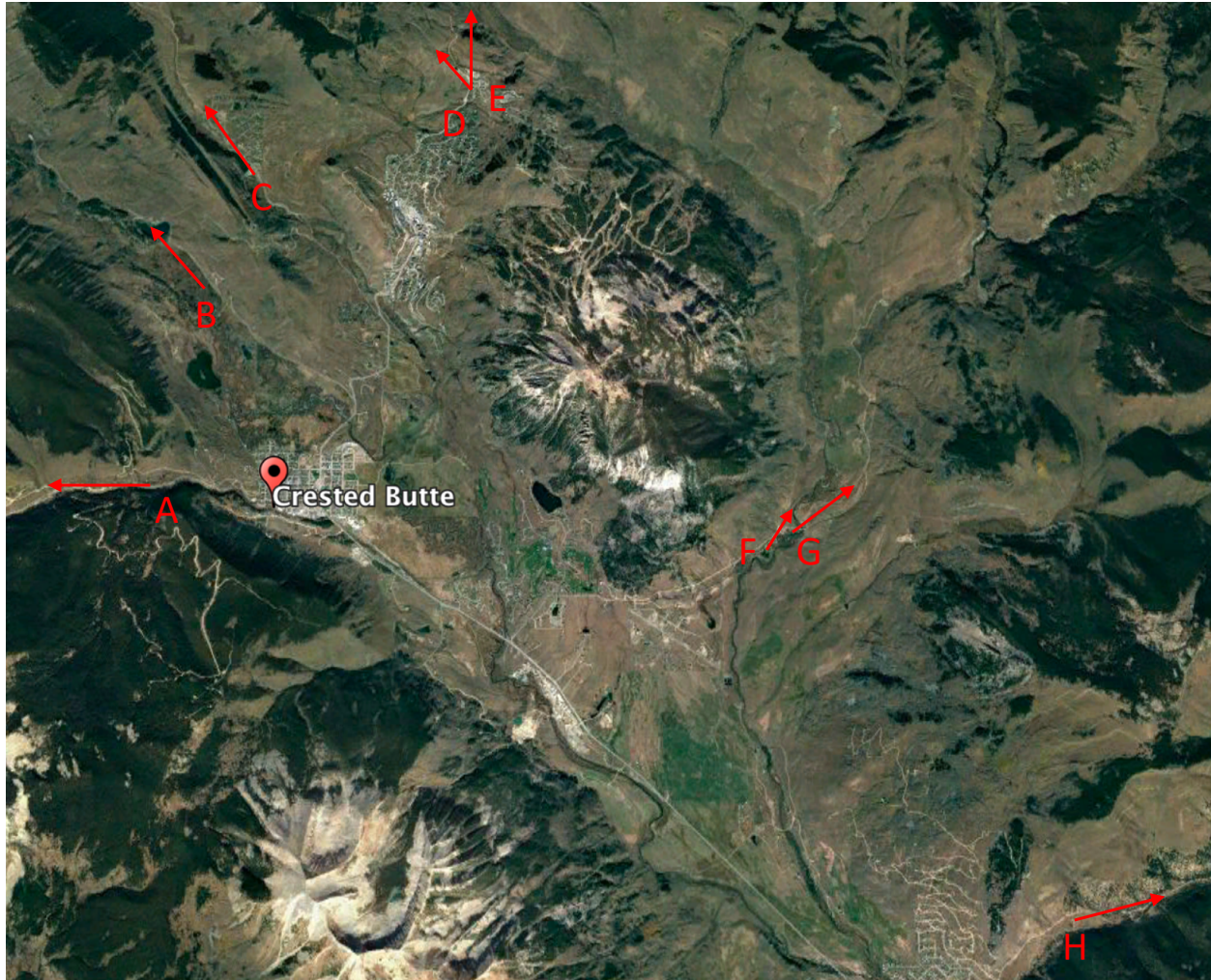


Figure 5. Locations at which data was collected. A. Kebler Pass Trailhead B. Slate River Road Trailhead C. Washington Gulch Trailhead D. Snodgrass Trailhead E. Gothic Corridor Trailhead F. Brush Creek Trailhead G. Brush Creek Road H. Cement Creek Road Trailhead (Image: Google Earth, 2018).

Images were downloaded from the cameras two to three times each week. This frequency helped ensure that the memory cards did not become full, the batteries always had power, and the cameras were facing the desired direction. This practice proved to be beneficial after the multiple times that bystanders interfered with the equipment (e.g., covering lenses, moving units). An external hard drive kept by Dr. Melanie Armstrong at Western State Colorado University (WSCU) operates as the storage facility for all images and data associated with this project.

Excel spreadsheets were drafted for each trailhead with day/date on the (-) Y axis and user group on the (+) X axis. Pictures were analyzed in one day increments, making sure to never study less than a full day (this was to avoid double counts if revisiting at a later date). Initially the count was recorded using a classic “tally” in which the number five would be signified by four vertical lines with a slash running through them. This proved to be inefficient due to the paper it would have eventually wasted and the time spent writing and

counting. To streamline the process a dozen *Tally Clicker*'s were purchased; these are the small counters that have a loop on top for your finger, a 4-place numeric display above a label indicating user group, top mounted button for raising the number (+1), and a reset knob on the side. A custom tray was then fabricated out of 2" X 1" tubing with the seam side 2" face removed, 3/4" angle iron tacked perpendicular onto the end of the tubing to avoid movement, and a duct tape wrap around all edges to ensure a tight fit and good grip (Figure 6). In this tray, clickers were grouped in the same order as they occurred on the spreadsheets.

User groups were added to each spreadsheet as they appeared at each trailhead. Users were only counted on their way out into the backcountry to avoid counting the same user multiple times during a single outing. On the other hand, if someone made more than one distinct trip during a day, they would be counted as such (e.g., someone goes out in the morning, comes back to the trailhead later, then goes back out for a second trip). Motorized vehicles were given a single count unless the vehicle was determined to be a "hybrid" vehicle (meaning that it was being used as a mode of transport for skiers/snowboarders/etc.), in which case its count reflected the number of skiers/snowboarders/etc. using that vehicle. Appendix B includes detailed descriptions of each user group.

To help verify the legitimacy of collected information, three assistants were enlisted to perform real-time monitoring in the field. Work was generally carried out during the daylight hours (e.g., 0800 – 1530), on weekends, and at the Kebler, Slate, Washington Gulch, Gothic/Snodgrass, and Brush Creek Trailheads. Specific times were chosen by the students, based on availability and known periods of use. For the sake of diversity, a small percentage of the days studied took place during the work week. Worksheets containing the same user groups/categories as the existing database were provided in order to maintain continuity between groups of data. Observations were entered into spreadsheets and compared to data that was collected from the trail cameras during the corresponding time frame. This information can be found alongside comparisons to corresponding time frames in Appendix C.

Finally, trail monitoring took place starting after the first significant snowfall (December 21, 2017) and ended the weekend after the ski area closed (April 16, 2018). These specific dates were established as borders to the study because they represented the limits of suitable backcountry snow. The 2017-2018 winter produced specific difficulties due to less than average snowfall. This issue was apparent by the early emergence of dirt at most trailheads and may have contributed to a low total user count throughout the UGV. On the other hand, it is possible that the total number of users may increase by an order of magnitude during normal snowfall (while the ratio of users across trailheads might stay the same). One consequence of the drought was an earlier than average "shut down" of winter trailheads; as such the cameras at those trailheads were removed from the field earlier than others. Future studies might start earlier and/or end later, snow load dependent.



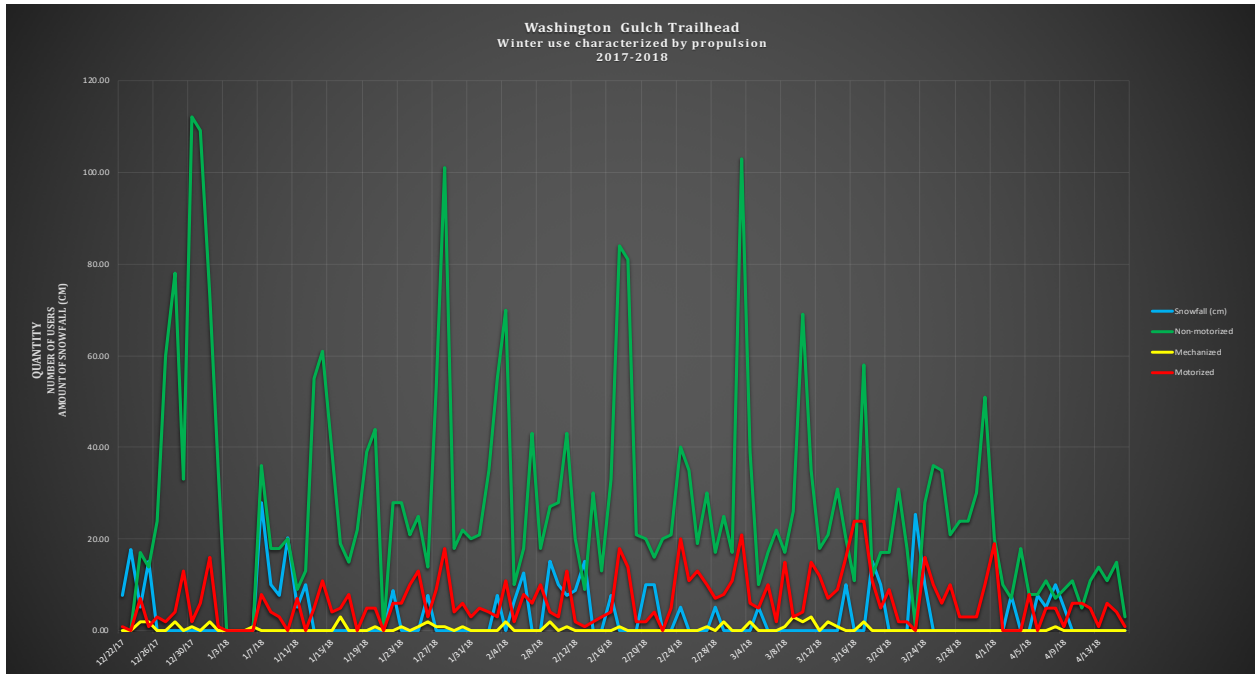
Figure 6. Tally Clickers used to count the data that was collected in the field. After counting a handful of days on paper it was determined that using these tools would be the only efficient way to count the enormous catalogue of figures connected to this project. The tray holding the clickers is made of out 2"x1" tubing with one 2" face removed (the seam side), 3/4" angle iron tacked onto the ends to limit movement, and a duct tape wrap around the edges for a tight fit and finish.

Results

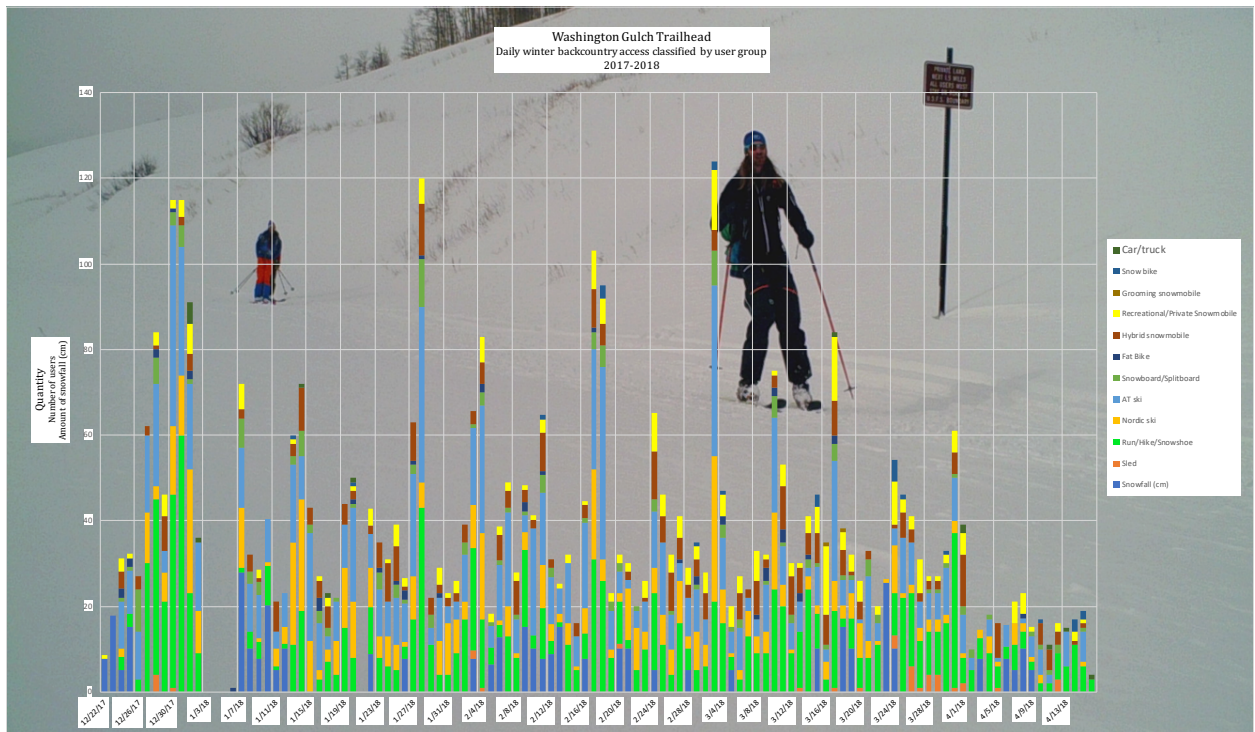
This study set out to collect an exhaustive baseline dataset concerning the recreational use of winter trailheads in the UGV. The collected information may not provide the encyclopedic dataset anticipated, but it does present a broad view of the local trends (Table 1, Graphs 1&2). While initial plans for this work relied solely on the use of digital photography equipment to monitor users, the inclusion of students engaged in intermittent real-time monitoring proved to be indispensable when it came to quality control (Table 2). Complications, issues, and faults identified during the quality control process, and which spawned the incomplete conclusions during the 2017-2018 season, will be valuable lessons learned and teaching aids that can bolster future studies of this nature.

	A	B	C	D	E	F	G	H	I	J	K
1	Compiled winter trailhead use data										
2			Total					Average Daily			
3	Trailhead	Days monitored	All Users	Non-Motorized	Mechanized	Motorized		All Users	Non-Motorized	Mechanized	Motorized
4											
5	Brush Creek Road	41.00	534.00	488.00	18.00	28.00		13.02	8.27	0.31	0.47
6	Brush Creek Trailhead	90.00	1412.00	1392.00	18.00	2.00		15.69	14.97	0.19	0.02
7	Cement Creek	44.00	773.00	557.00	30.00	186.00		17.57	12.66	0.68	4.23
8	Gothic Corridor	84.00	3427.00	3187.00	216.00	24.00		40.80	35.81	2.43	0.27
9	Kebler Pass	60.00	5022.00	372.00	10.00	4640.00		83.70	6.20	0.17	77.33
10	Slate River Road	112.00	3465.00	2514.00	111.00	840.00		30.94	21.67	0.96	7.24
11	Snodgrass	103.00	5776.00	5629.00	120.00	27.00		56.08	48.95	1.04	0.23
12	Washington Gulch	113.00	4004.00	3222.00	47.00	735.00		35.43	27.77	0.41	6.34

Table 1. Highlights of the data collection project. Daily use data broken down by user group can be found for each trailhead in Appendix C.



Graph 1. Washington Gulch Trailhead use as characterized by the means of propulsion for the 2017-2018 winter season. A complete set these graphs for all trailheads can be found in Appendix D.

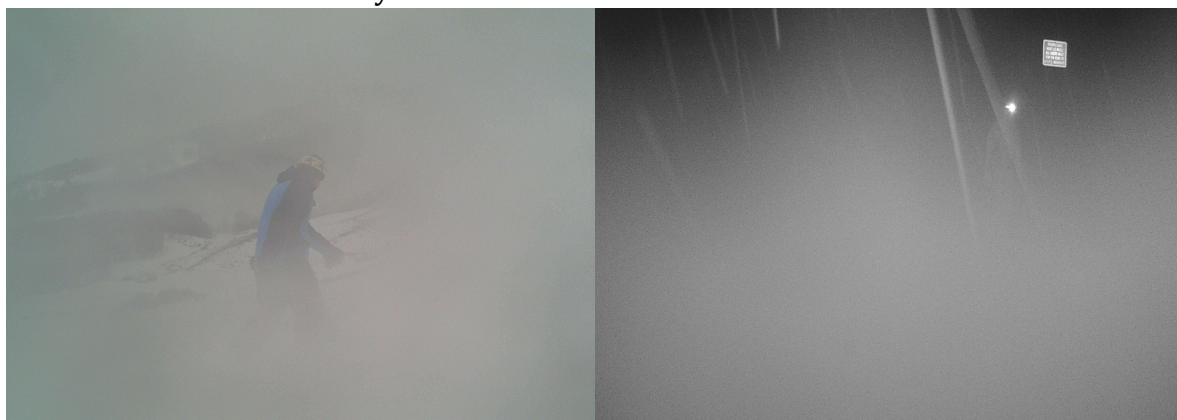


Graph 2. Washington Gulch Trailhead use broken down by individual user groups, 2017-2018 season. A complete set of these graphs, including all trailheads studied, can be found in Appendix D.

Average percent difference across all trailheads and user groups (Field observations v. IR camera data)																			
	Snowfall	Sled	Walk/Run/	Nordic Ski	AT Ski	Snowboard	Noboard/	Fat Bike	Unknowr	Hybrid Sno	Grooming	Recreation	Rental Sno	Snow bike	Side by Side,	Car/Truck	Snowcat	Total	
Brush Cree	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Gothic/Sno	0.00%	0.00%	0.00%	0.00%	10.00%	-33.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	2.63%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.92%
Kebler	0.00%	0.00%	-100.00%	0.00%	-100.00%	0.00%	0.00%	0.00%	0.00%	-13.33%	0.00%	7.69%	42.86%	28.57%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	14.29%	0.00%	-32.26%	133.33%	0.00%	0.00%	0.00%	0.00%	0.00%	-1.14%
	0.00%	0.00%	0.00%	50.00%	-93.75%	-100.00%	0.00%	0.00%	0.00%	37.50%	0.00%	39.47%	204.76%	400.00%	0.00%	0.00%	0.00%	0.00%	30.19%
Slate	0.00%	0.00%	-82.61%	-58.33%	-75.00%	-100.00%	0.00%	-100.00%	0.00%	-54.55%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-69.64%
	0.00%	0.00%	-18.75%	-100.00%	-36.36%	0.00%	0.00%	-100.00%	0.00%	-61.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-46.94%
	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	15.38%	-10.00%	100.00%	0.00%	0.00%	0.00%	0.00%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	15.15%
	0.00%	0.00%	0.00%	0.00%	-100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Washington	0.00%	0.00%	7.69%	16.67%	-21.05%	200.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.85%
	0.00%	0.00%	7.69%	-50.00%	-78.95%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-34.62%
	0.00%	0.00%	16.67%	0.00%	-10.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-100.00%	0.00%
	0.00%	0.00%	6.25%	-4.76%	0.00%	40.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	-31.25%	-38.10%	-6.67%	20.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-23.81%
	0.00%	0.00%	11.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-20.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Average	0.00%	0.00%	-8.25%	-11.44%	-24.22%	13.33%	0.00%	-11.76%	0.00%	-3.59%	0.00%	-10.59%	22.41%	25.21%	0.00%	-5.88%	0.00%	0.00%	-7.24%

Table 2. Percent difference between real-time monitoring and trail camera data for all possible days during which students worked in the field. Data for individual days and/or trailheads can be found in Appendix D.

Analyzing data proved to be acutely straightforward with a few notable exceptions, such as camera interference, camera placement, and distance to the subject/from the parking area. “Camera interference” relates to a number of different inputs, including nature, bystanders/trailhead users, and even researcher error. The primary way in which nature interfered with the equipment was through snowfall; it was not uncommon for the lens of the camera to end up packed with snow after a storm (Figures 7 & 8). Of course, this was not an issue with all cameras every storm, because they all faced slightly different directions; snow packing was directly related to the direction of incoming wind. In the future, this problem could be mitigated by fabricating a box with a small visor to cover the lens and deflect snow. People interfered in a number of different way; someone covered a lens with mud, another camera was used as a hat rack, cameras were occasionally spun around their mounting post to an essentially worthless angle, and at one time the batteries were removed (Figures 9 & 10). Researcher error was limited to allowing cameras batteries to run flat at one point, and when the problem was discovered there were no new batteries on hand to remedy the issue.



Figures 7 & 8. An example of a camera lens covered in snow after a storm. Not always was the snow translucent; often it was opaque (figure 8).



Figures 9 & 10. An example of someone actively messing with the camera. Finding material on the lens was a rare, and bothersome, problem.

Another obstacle encountered during this season involved camera proximity and angle to the trailhead. The cameras used in this study have to be within 23 meters (75 feet) of the target to capture it. Some trailheads (e.g., Cement Creek, Washington Gulch, Brush Creek Trailhead, Snodgrass, Gothic) provided the ideal infrastructure to setup equipment and fully document users. These areas typically had a post within a few feet of the trailhead/parking area, on which the equipment could be affixed, in order for the camera to function properly. If the camera was too far from the trailhead/road/parking area (approximately more than 7.62 meters or 25 feet), then data acquisition was often poor. This is because the users were able to pick up enough velocity before passing the camera that they would essentially move into- and back out of- frame before the camera was able to take a picture. In many cases this problem could be documented, and the user counted, based off of tracks in the snow and/or roost in the picture (Figures 11, 12, 13). To avoid redundancies, more detailed information can be found in Appendix A.



Figures 11 & 12. The above pictures illustrate an example of the camera shutter speed issue discussed in the text. Note the time, date, and additional snowmobile tracks (indicated in the picture on the right with black dotted lines). These pictures were taken contiguously.

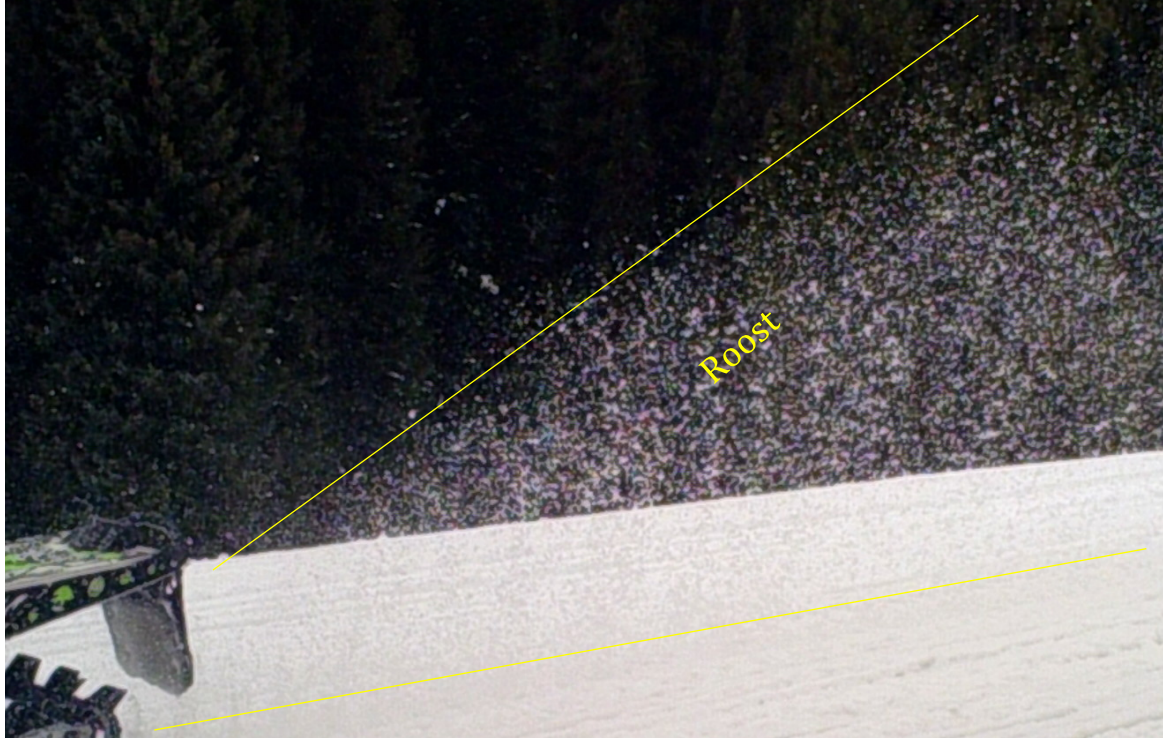


Figure 13. This picture clearly illustrates the roost (snow being kicked up by, and flying behind, the snowmobile) that is often seen in pictures which may not actually contain the machine producing that roost. This characteristic can be used to determine the direction and mode of transportation in pictures with no apparent user.

Conclusion

The aim of the first year of this study was to design a program to monitor trailhead use that could differentiate between user groups in the field. After the design of the study was formulated and finalized, it was put into service for a period of time (up to 117 days, location dependent). Throughout the study, data was accumulated and compiled in a manner which is straightforward and easy to digest and/or reference. That data has since been assembled in the appendices which present the material in easy to read, visual/graphical, and exhaustive forms (See appendices B & C). If this work is continued in the future, it will produce data necessary for statistical analysis of usage as well as a baseline for estimated trends in the future. The information collected thus far, when provided to community sponsors, should be useful when making comments regarding the future of winter travel in the UGV.

Some unintended consequences of hurdles can be seen in the results. While some trailheads were monitored for comparable lengths of time, no two provided reliable data for an equal number of days. Reasons for discrepancies include botched camera placement/orientation, equipment failure due to batteries or incorrect settings, lack of clarity by virtue of snowpack, mud, or other organics interfering with the lens, nonorganic interference (e.g., gear hanging over the camera), and even lack of sufficient equipment.

Concepts and plans have been developed and included in an attempt to minimize these issues during future work, although a season of problem-free data collection may require more testing and tuning.

Finally, it should be noted that this study took place during a season with an abnormally low amount of snowfall. This drought is likely responsible for a lower rate of backcountry travel than during an average season. With this in mind, the assumption could be made that the ratio of backcountry users across trailheads may be similar during average, and even above average, seasons. Future work could benefit from running statistical analyses of use vs. fresh snowfall, use vs. trailhead, user group vs. trailhead, and more.

Acknowledgements

This project would not have come to fruition without the confidence, input, motivation, support, expertise, and insights brought to the table by Dr. Melanie Armstrong of the WSCU MEM program. Thanks Melanie, it seems like last week we were just beginning to kick around the idea of monitoring a few trailheads during limited windows of time. Time flies when there's none of it. I'd also like to thank the project's community sponsors, *Silent Tracks* and *Share the Slate*. Whether you were writing grants to help procure equipment or delineating classic backcountry trends, this work would not have been possible without you. I cannot forget Christina Frank, thanks for putting up with the late nights, stress, and serious lack of skiing this past year; and of course, my family, thanks for always being there when I needed a paper edited at the eleventh hour. And of course, all the other people who helped by providing knowledge, details, connections, and other crucial elements (in no particular order): Michele Veltri, Matt McCombs, Phil Chamberland, William A. (Tony) Smith, Gregg Grossman, the Town of Crested Butte, and many more that I'm certainly forgetting right now.

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