

Fourteeners Use Estimates: Methods

Data Sources

Two data sources were used in conjunction to reach the hiking/climbing use estimates reported above: the Colorado Fourteeners Initiative's 2015 Sustainable Trails Program counters and the 14ers.com 14er Checklist Statistics.

Sustainable Trails Counters

Beginning in 2014, the Colorado Fourteeners Initiative (CFI) has been accumulating data on peak use by placing TRAFx infrared sensors on 14er summit routes. The placement of each counter is carefully chosen to provide the best possible data on 14er use. Where possible counters are placed above all trail intersections or turn-offs to additional major attractions in order to only count hikers and climbers intending to summit. Counters are concealed in cairns or in tree foliage to avoid impacting users' experiences and lessen the risk of tampering. In most cases the counters are set up as early as possible in late spring/early summer and are taken down mid-fall before they become buried by serious snowpack. While winter use of the occurs, the number of skiers and mountaineers may be reasonably assumed to be very small in comparison to the number of climbers and hikers who access the peaks in the summer and fall. In addition, the ecological impacts of humans moving over snow and ice are orders of magnitude smaller than those of people hiking over delicate alpine flora. For these reasons CFI's fourteener use estimates focus primarily on the summer and fall spanning from May to October/November.

In 2015, seven peaks (counting Grays/Torreys and Redcloud/Sunshine each as one route) had Sustainable Trails counters monitoring their use: Grays/Torreys, Handies Peak, Mount Elbert, Mount Democrat, Quandary Peak, Castle Peak, and Redcloud/Sunshine. On Handies Peak counters were placed on both of the most frequently used approaches (American Basin and Grizzly Gulch) and Mount Elbert counters monitored all three of the most frequented approaches (Black Cloud, Northeast Ridge, and Southeast Ridge). In most cases the data was somewhat incomplete, either because counters were set up after early season hiking began to ramp up or because tampering/rock movement caused blocked sensors and data gaps in the middle of the summer season. These data gaps were filled either by utilizing 2014 data for the same peaks over the missing time frames or by utilizing use relationships between peaks with gaps and nearby peaks' data over the missing time frames. There were such serious problems with the placement and readings of the 2015 Democrat counter that the entire dataset was deemed unreliable and was not used in this analysis, leaving six data points for 2015 peak use.

More information about CFI's Sustainable Trails Program may be found online at 14ers.org.

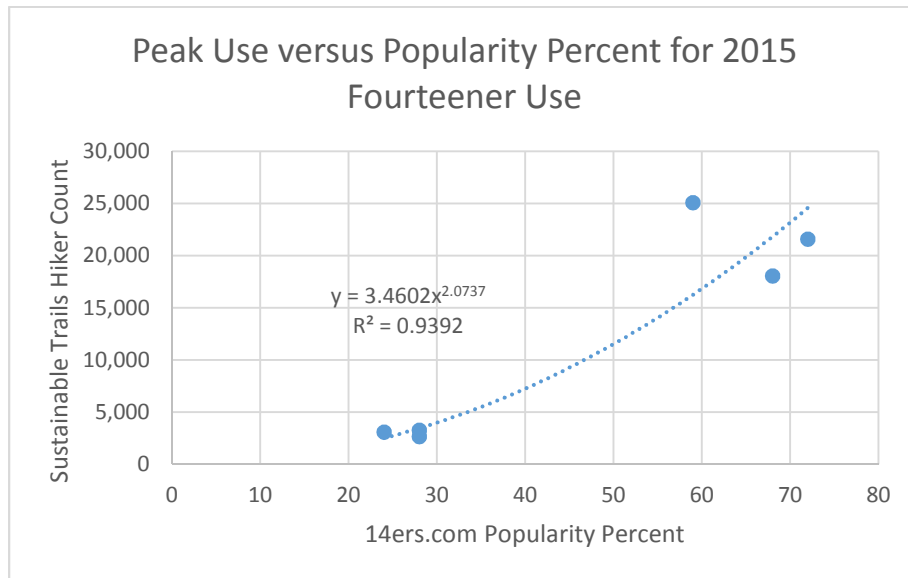
14ers.com 14er Checklist Statistics

The online forum 14ers.com acts as an 'Online 14er Guidebook' providing, among other things, route descriptions, directions, maps, elevation profiles, and peak condition reports on each of Colorado's peaks over 14,000 ft. The site feature '14er Checklists' allows users to record which peaks they have summited and how many times they have repeated a peak. '14er Checklists Statistics' reports information such as the number of users who have personal peak lists, the average number of 14ers each of these users has summited, and, most importantly, what percent of these users has summited each of the fourteeners. As of July 2016, 14,159 people had personal 14er checklists contributing to the overall 14er checklist statistics. While 14ers.com does not provide any meaningful insight into absolute numbers of people climbing each peak, the Peak Popularity

Statistics provides valuable information on the relationships between the popularity of different peaks, allowing extrapolation of concrete use estimates from comparison to those peaks for which TRAFx data is available.

Correlation Methods

The 14,159 people who have online 14ers.com personal peak checklists may not be considered a representative sample of all people who climb 14ers. By the nature of the site, these people could be labeled enthusiasts, as is evidenced by the statistic that the average number of 14ers summited by a checklist user is 19. As a result, a direct linear correlation between 14ers.com popularity percent and TRAFx count may not be assumed: 14ers.com users are much more likely to have climbed difficult, low use peaks than the average 14er hiker, under-representing the difficult peaks and over-representing the easier, more commonly climbed peaks. However, as the peaks covered by Sustainable Trails counters span very high use trails (Grays/Torreys) to medium/low use trails (Castle) we were able to arrive at a non-linear trend line which fits our existing data to a high degree of accuracy and allows us to forecast the other peaks with a reasonable degree of confidence.



An analysis of several different correlation fit options revealed that the best R² value was achieved with an exponential equation. This matches a qualitative assessment of peak use trends as exponentially more out-of-town visitors and inexperienced hikers may be expected to summit the highest use peaks.

As popularity percent checklist data is available for all 58 Colorado 14ers (including the following named peaks over 14,000 ft that do not meet the criteria for inclusion as "ranked" 14ers: North Eolus, North Maroon, Conundrum, and Mt. Cameron peaks), the fit equation can be used to interpolate and extrapolate the annual use of each of the peaks for which CFI does not have reliable Sustainable Trails data.

Comparisons to Additional Data Sources

There are in many cases relatively significant discrepancies between this study's use estimates and external use estimates from such sources as trailhead registers, technical memos, and Rocky Mountain National Park reports. However, as this study's use estimates are neither consistently above nor consistently below the external use estimates and there are in most cases factors which render the external estimates unsuited to reliably predict the type of use examined in this study, this does not significantly diminish our confidence in the

overall annual use estimates. The table below does not represent a comprehensive list of all external use estimates and their comparisons to CFI estimates but rather a representative subset of those estimates which have been deemed most reliable and most appropriately comparable to the CFI estimates.

Peak	CFI Estimate	External Estimate	% Difference	External Source	Notes
Longs Peak	8,400	9,600	+14%	RMNP Report	Date range from May 20- October 14 2002, high degree of confidence
Mt. Yale	7,300	6,500	-11%	USFS Trailhead Register, 1996	Data over 20 years old: 14er use has significantly increased over the past two decades. However, not all trailhead signatories may summit.
		11,000	+51%	USFS TRAFx monitor at Denny Creek trailhead, 2013	Denny Creek trailhead serves several other destinations, only a fraction of counted hikers may summit Mr. Yale
La Plata	6,900	3,000	-56%	USFS Trailhead Register, 1996	Data over 20 years old: 14er use has significantly increased over the past two decades. However, not all trailhead signatories may summit.
Maroon Bells	950	338	-64%	CMC Summit Register, 2001	Data 15 years old: 14er use has significantly increased. Also, not all summiters may sign register
Bierstadt	22,500	23,000 (extended to equal TRAFx date range- direct count summit adjusted ~17,000)	+2.2%	ARNF Transportation System Study, 2012	Direct count (adjusted to only include summiters using hike length statistics within report) only includes June 20-September 3 while CFI estimates span use from May through early November. Date extension based on 2014 Quandary use trends

Total Use Estimate Methods

Because several sets of 14ers are located close together with standard summit routes that require a hiker or climber to summit one peak to access the next one, we deemed that it would be inappropriate to arrive at range and overall use estimates by merely adding up the number of users expected to reach each summit each year. This would result in multi-peak climbers being double counted and would diminish the relevance of our estimates for purposes such as anticipating hiker impact upon trails and determining their economic contributions to surrounding areas. For the following peak groups this was dealt with by counting only the first or most frequently visited peak and assuming that the vast majority of the traffic on the later peak(s) comes from the first: Shavano/Tabogauche, Oxford/Belford, Redcloud/Sunshine, Democrat/Lincoln/Bross, Grays/Torreys. The following peaks are often, though far less frequently, completed in conjunction with other peaks, and as a result their contributions are counted but decreased by approximating the percent of users who are climbing only the peak in question: Mount Evans, Mount Columbia, Sunlight Peak, and Ellingwood Point. As

a result of these modifications, the range by range and overall use estimates should be a reasonable to conservative approximation of the total number of fourteener summit trips per year.

Sources of Error

The most significant source of error in the current annual use estimates is the relatively small number of TRAFx peak use data points currently available for analysis, particularly on the lowest use peaks. Castle Peak was the least frequently used peak monitored in 2015, but according to 14ers.com checklist statistics it ranks 34th of the 58 and could therefore be classified as more medium than low use, meaning that the correlation equation may not appropriately approximate use patterns on the most infrequently visited peaks. While the TRAFx counters are certainly the most reliable source of data available to us at the present moment, they too are imperfect. They cannot distinguish between human and animal passersby, may not accurately count groups in which hikers are close together or are moving extremely slowly, are vulnerable to data gaps when sensors become blocked, and do not record hikers on days when data is downloaded. The choice to only count summer/fall usage and the methods used to avoid double counting multi-peak hikers are intended to ensure that our estimates err on the side of conservative low-end estimates. This serves to avoid inflating potential environmental and economic implications of fourteener use but may diminish the accuracy of current estimates. The decisions on how to reduce the contributions of peaks hiked in series are entirely based on qualitative judgements of CFI staff from their own experiences and impressions, and a more rigorous survey of users would be required to arrive at a more quantitatively justifiable adjustment scheme. Finally, many of the fourteeners have several mapped and accepted summit routes of which only the most frequently used one, two, or in the case of Mt. Elbert three are monitored by TRAFx counters. This means that hikers taking atypical routes do not contribute to TRAFx use estimates.

Future Directions for Research

The expansion of the Sustainable Trails Program will significantly improve the accuracy of CFI's fourteener use estimates. In 2016 the program has been expanded to 20 counters and we anticipate that following the 2016 season the CFI count to 14ers.com correlation equation will be modified based off of the more complete data to better describe peak use across all of the fourteeners. There are some limits on the ability of the Sustainable Trails program to fully monitor all fourteener access. First, it is not practical from either a financial or a time based perspective to place counters on all fourteener routes. Second, counters may not be installed in designated wilderness areas meaning that peaks on which the entirety of the summit route lies within wilderness cannot be legally monitored. As a result of these and other factors a secondary source of fourteener use data such as the 14ers.com Checklist Statistics Peak Popularity report will, for the foreseeable future, be required to estimate all peak use.

Sources

Drews, Carl. "Digitized Maroon Peak Summit Register, deposited by/property of the Colorado Mountain Club." *The Highest Lake*. Raw Data 2000-2002, Copyright 2002.

McLaughlin, Paul. *Climbing the Longs Peak Keyhole Route*: Rocky Mountain National Park Continental Divide Research Learning Center, 2008.

National Forest Service Trailhead Register Data, 1988-1996. N.d. Raw data. Mount Massive, Mount Elbert, La Plata Peak, Huron Peak, Belford/Oxford/Missouri, Harvard/Columbia, Mount Yale.

Resource Systems Group in Cooperation with Colorado State University and Utah State University. *ARNF Transportation System Alternatives Study: Technical Memo 3.3- Summary of Data Findings Guanella Pass Scenic Byway Summer 2012*. Rep. N.p.: U.S. Department of Transportation, Federal Highway Administration, Central Federal Lands and U.S. Forest Service, February 28, 2013.