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Subject: 2009 Non-motorized Counts

The first phase of non-motorized separated pathways was constructed along Teton Park Road from Dornan's to South Jenny Lake, primarily in 2008. Non-motorized visitors travelled along Teton Park Road before this separated pathway was constructed. Automated counters were installed along the pathway to track its usage. There is uncertainty on the accuracy of these automated counters, and they do not count non-motorized visitors who still choose to travel along the main road. Using automated counters to count non-motorized users on road shoulders, where they can be mixed with automobile traffic, is problematic. Non-motorized users on the road shoulders were counted by hand in 2007 before construction began.

This memo summarizes the effort to hand count non-motorized users in 2009 in order to (1) assess the accuracy of the automated counters, (2) catch the number of non-motorized visitors travelling on the road shoulder, and (3) compare non-motorized use with the 2007 hand counts.

Data Sources

Three sources of data were analyzed: automated counters, hand counts, and automated cameras. Figure 1 shows a hand count location next to an automated counter that is mounted on an existing sign post.

Figure 1: Automated Counter and Hand Count Location

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The approximate locations of the six automated counters are shown in Figure 2. These counters are expected to keep track of the number of pathway users. They do not separate the count by direction or mode (i.e., bicycling, walking, jogging, rollerblading). The total count is recorded for each one-hour time period.

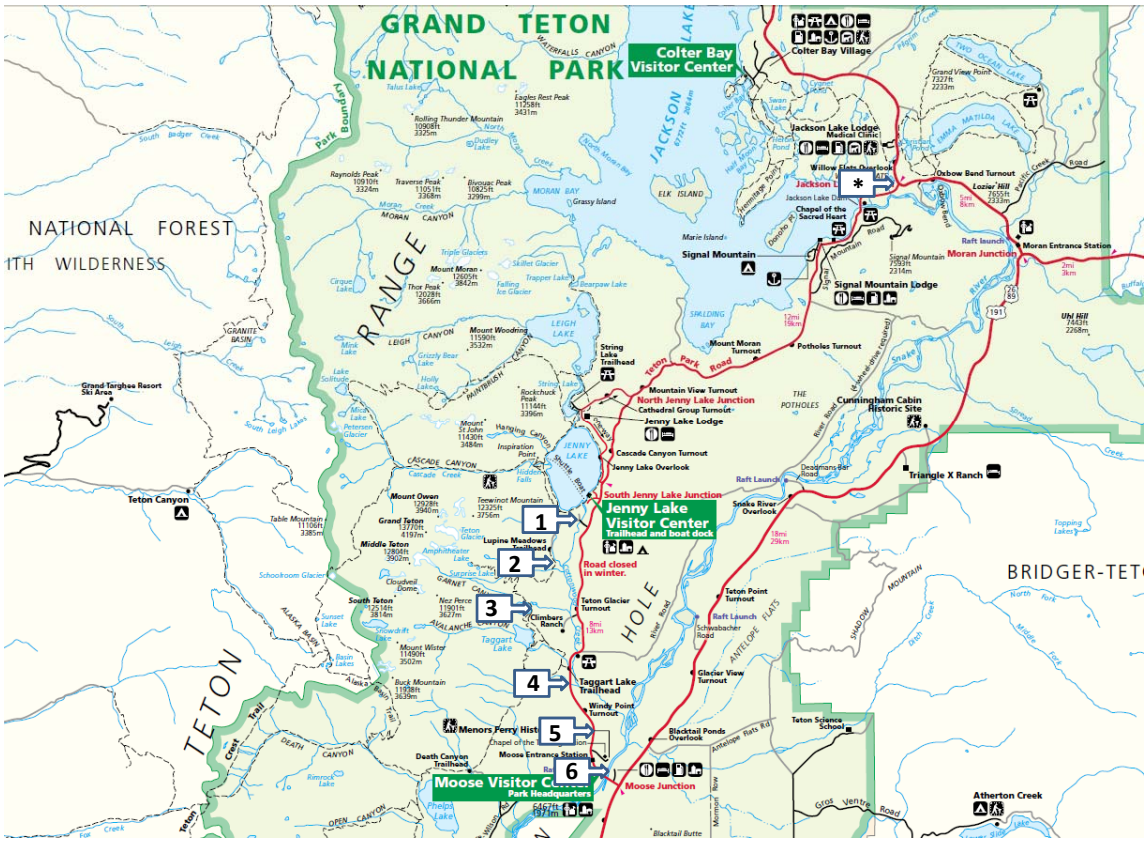

Figure 2: Automated Counter Locations

Hand counts were taken over a three-day period in August 2009. This resulted in two to three hours of counts at five different locations. Hand counts were taken at four of the six automated counter locations (locations 1, 3, 5 and 6 as shown in Figure 2), and near Jackson Lake where no pathways currently exist. The student collecting data recorded the direction, mode, number in a group, and time. He also recorded this for non-motorized users on the shoulder of the main roadway.

Automated cameras were also installed by Park staff along the pathway. These cameras are equipped with motion detectors that would cause the camera to take a photo of every pathway user. Each photo file is time stamped. When a user takes several seconds to move through the camera's detection zone, the camera may take several photos of a single pathway user during a single pass. The photos were viewed to determine the time, direction, and mode of each non-motorized user. Picture data from the two cameras located near automated count stations were collected for the same three-day period as the hand counts:

- Camera A, located 470 meters south of automated counter 2; and
- Camera B, located 385 meters south of Counter 4.

Notice that the hand counts and camera counts are from different locations. The hand count locations were chosen at random without knowledge of the camera locations. It is unfortunate that the camera counts cannot be directly compared with the hand counts.

Automated Counter Error

One-hour totals were compared between the hand counts and the automated counters (Table 1). Numbers from the automated counters ranged from 0 to 64 percent lower than the hand-count numbers. When pooling all the hours together, the automated counter is estimated to be on average 39 percent low. Further investigation of the data was performed to find a systematic reason for this error. No relationship could be found to link the error to group size, total usage, or mode type.

Table 1: Comparison of Hourly Hand Counts to Automated Counts

Location Name	Counter Number	Date	Day of Week	Hour Beginning	Automated Counter	Hand Count	Error
Windy Point to Moose	5	8/21/2009	Friday	4 PM	21	25	-16%
		8/21/2009	Friday	5 PM	10	12	-17%
		8/21/2009	Friday	6 PM	5	5	0%
Moose to Dornan's	6	8/22/2009	Friday	11 AM	5	6	-17%
		8/22/2009	Friday	12 PM	19	28	-32%
Highlands to Taggart Lake Trailhead	3	8/22/2009	Saturday	3 PM	10	28	-64%
		8/22/2009	Saturday	4 PM	22	42	-48%
		8/22/2009	Saturday	5 PM	5	13	-62%
Jenny Lake to Lupine Meadows	1	8/23/2009	Sunday	10 AM	30	45	-33%
		8/23/2009	Sunday	11 AM	15	23	-35%
		8/23/2009	Sunday	12 PM	21	39	-46%
Total					163	266	-39%

The hourly error of the automated counters when compared to the number of unique users seen in photos taken by the automated cameras had a much greater range (100 percent low to 500 percent high) than the hand count comparison. The larger percentage of errors typically occurred during hours when the count was small (i.e., less than 5). Again, no systematic reason for the error could be found. The daily totals comparing the automated counter numbers and the counts from the camera photos are shown in Table 2.

Table 2: Comparison of Daily Counts from Cameras and Automated Counters

Location Name	Counter Number	Date	Day of Week	Automated Counter	Automated Camera	Error
Lupine Meadows to Highlands	2	8/21/2009	Friday	180	229	-21%
		8/22/2009	Saturday	143	167	-14%
		8/23/2009	Sunday	64	103	-38%
Taggart Trailhead to Windy Pt	4	8/21/2009	Friday	103	133	-23%
		8/22/2009	Saturday	50	107	-53%
		8/23/2009	Sunday	25	96	-74%
Total				565	835	-32%

The automated counters are on average low by 32 and 39 percent compared to the camera counts and the hand counts, respectively. The error was not consistent and ranged significantly for hourly and daily totals. The camera counts could not be directly compared to hand counts due to location. However, since the analysis showed a similar average error when comparing the automated counter's numbers to hand counts (39 percent) and camera counts (32 percent), the cameras would appear to be accurate at capturing photos of users.

Descriptive Statistics of Pathway Use

The mode split found by the hand counts in 2009 was 97 percent bicycle, 2 percent pedestrian, and 1 percent rollerblade. The mode splits for the camera counts in 2009 were 96 percent bicycle, 3 percent pedestrian, and 1 percent rollerblade.

Using the photos from the automated cameras, research staff attempted to visually match individuals' departure and arrival times at the cameras to determine if theirs was a one-way or round trip. The percentage of users who returned to Camera A (signifying a round trip) ranged from 49 percent on Friday to 22 percent on Sunday. The percentage of users who returned to Camera B ranged from 23 percent on Friday to 11 percent on Saturday. Note that many of the pathway users could have returned in the dark and not been caught by the camera. The percentages of user trip types for the two automated camera locations are shown in Table 3.

Table 3: Percent of Users that Returned to the Camera Stations

Location Name	Camera Number	Date	Day of Week	Round Trip	Northbound Only	Southbound Only
Lupine Meadows to Highlands	A	8/21/2009	Friday	49%	22%	29%
		8/22/2009	Saturday	39%	46%	15%
		8/23/2009	Sunday	22%	65%	13%
Taggart Trailhead to Windy Pt	B	8/21/2009	Friday	23%	73%	4%
		8/22/2009	Saturday	11%	81%	7%
		8/23/2009	Sunday	14%	65%	21%

Of the bike travelers making a round trip at Camera A, 7 percent started southbound and had an average round-trip time of 59 minutes, and 93 percent started northbound and had an average round-trip time of one-hour and 18 minutes. The longest trip was just over 3 hours. The directional split for walkers/joggers was 11 percent starting southbound and 89 percent starting northbound. Trip times ranged from a few minutes to just over an hour.

Of the bicyclists making a round trip at Camera B, 23 percent started southbound and had an average round-trip time of one-hour and 51 minutes, and 77 percent started northbound and had an average round-trip time of one-hour and 6 minutes. The longest trip time was just over 3 hours. All six recorded walkers/joggers started northbound. Trip times ranged from a few minutes to a little over two hours. One rollerblading round trip was recorded starting northbound and lasting 26 minutes.

Comparison Across Years

Hand counts for a similar weekend in 2007, before construction of the pathway, can be compared to the 2009 counts. Table 4 shows the daily hand counts from 2007. Non-motorized use in late August ranged from 14 to 34 non-motorized users per day.

Table 4: Hand Counts Pre-Construction

Location Name	Date	Day of Week	Hand Count
Taggart Trailhead	8/24/2007	Friday	14
	8/25/2007	Saturday	34
	8/26/2007	Sunday	33
Jenny Lake	8/24/2007	Friday	27
	8/25/2007	Saturday	30
	8/26/2007	Sunday	34

As shown in Tables 1 and 2, daily use in 2009 was in the range of 100 to 200 non-motorized users. Clearly, non-motorized usage has increased significantly since the pathway was constructed. A very few non-motorized users are still travelling on the roadside and not the pathway as shown in Table 5.

Table 5: Hand Counts Including Roadside Users

					Hand Count		
Location Name	**Counter Number**	**Date**	**Day of Week**	**Hour Beginning**	**Pathway**	**Roadside**	**Percent Roadside**
Windy Point to Moose	5	8/21/2009	Friday	4 PM	25	0	0%
		8/21/2009	Friday	5 PM	12	0	0%
		8/21/2009	Friday	6 PM	5	0	0%
Moose to Dornan's	6	8/22/2009	Friday	11 AM	6	1	17%
		8/22/2009	Friday	12 PM	28	3	11%
Highlands to Taggart Lake Trailhead	3	8/22/2009	Saturday	3 PM	28	0	0%
		8/22/2009	Saturday	4 PM	42	0	0%
		8/22/2009	Saturday	5 PM	13	0	0%
Jenny Lake to Lupine Meadows	1	8/23/2009	Sunday	10 AM	45	0	0%
		8/23/2009	Sunday	11 AM	23	0	0%
		8/23/2009	Sunday	12 PM	39	0	0%
Signal Mountain	N/A	8/23/2009	Sunday	2 PM	N/A	3	100%
		8/23/2009	Sunday	3 PM	N/A	3	100%
		8/23/2009	Sunday	4 PM	N/A	4	100%

The non-motorized mode in 2007 was 99 percent bicycle, with the hand counts noting only an occasional pedestrian. As mentioned previously, the mode split for the hand counts in 2009 was 97 percent bicycle, 2 percent pedestrian, and 1 percent rollerblade.

Summary

Hourly totals from the automated counters should be used with caution as they could be inaccurate. Random errors will be reduced by aggregating the automated counts into daily and weekly totals. These daily and weekly totals from the automated counter should be multiplied by a factor of 1.6 to adjust for the approximate systematic error found in the analysis.

The automated camera counts could not be directly compared to the hand counts, but they appear to accurately capture most of the users because, when compared to the automated counts, they show an average error similar to that of the hand counts.

Construction of the pathways has significantly increased non-motorized use, although some users still use the road shoulder.

The mode split has changed little since the pathway was constructed, with the bicycle still being the dominant mode. However, the 2009 counts did include a number of people on rollerblades, a mode that was not seen in the pre-construction counts of 2007.