Monitoring Inter–Group Encounters in Wilderness

Alan E. Watson, Rich Cronn, and Neal A. Christensen

Abstract

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Many managers face the challenge of monitoring rates of visitor encounters in wilderness. This study (1) provides estimates of encounter rates through use of several monitoring methods, (2) determines the relationship between the various measures of encounter rates, and (3) determines the relationship between various indirect predictors of encounter rates and actual encounter rates.

Exit surveys, trip diaries, wilderness ranger observations, trained observers, mechanical counters, trailhead count observations, and parking lot vehicle counts were used to develop better understanding of the relationship between these various monitoring methods. The monitoring methods were tested at Alpine Lakes Wilderness in Washington.

Encounter rates differed dramatically from weekdays to weekend days at high-use places studied. Estimates of encounter rates also varied substantially across methods used. Rather than conclude what method is best, this report seeks to help the manager decide which method is most appropriate for use in a particular wilderness, given the issues being addressed. It should also help alleviate some of the problems managers have in prescribing monitoring systems, by forcing more precise definition of indicators.

Keywords: recreation, use levels, crowding, use estimation, observation, surveys

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Cover photo: Snow Lake, Alpine Lakes Wilderness. Photo by John Daigle.

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Introduction

Historically, researchers (and subsequently managers) have considered inter–group encounters as a primary threat to, and therefore an indicator of, solitude opportunities in wilderness. Because of that, a measure of inter–group encounters has been included in many Limits of Acceptable Change (LAC) plans as such an indicator (or indicators, typically including a measure of encounters while traveling and encounters while camping).

Quite often wilderness planners adopt these encounter indicators, confident that they are relevant to solitude and that they will be simple to monitor. When technicians are charged with monitoring these indicators, however, there is often some disappointment. Sometimes the technician will find that the indicator is not defined specific enough to assure precise monitoring. The technician may also find it impractical to provide enough data to determine whether standards are met or not. This is so particularly in cases where a probability of exceeding some encounter level is part of the standard; for example, there is 80 percent probability of seeing less than 10 groups per day. One current source of concern is the number of LAC planners who have decided not to include an indicator of the solitude factor because of these monitoring problems. The other source of concern is the number of plans that retain encounter indicators, whereas when asked about monitoring methods, managers often admit that they are not monitoring in a way that will determine whether standards are met; therefore, standards are meaningless.

For these reasons, our intent is to develop greater understanding of alternative encounter monitoring methods with the hope that this understanding will create confidence in selected monitoring activities. In this report we investigate differences in encounter estimates produced from different kinds of monitoring methods. We estimate encounter rates along trails, at lake destinations for day hikers, and at overnight camping locations for campers. This report estimates visitor perceptions of encounter levels using both trailhead exit surveys and self–administered trip diaries. We also estimated encounter rates from wilderness ranger observations of groups they encountered, and with trained observers. In addition to the various direct measures of encounters and perceptions of encounters, we have indirect measures of total use such as mechanical counts, trailhead observations of traffic entering and exiting, and some parking lot vehicle counts.

The objectives of this report follow:

- Provide estimates of encounter rates by various methods

- Determine the relationship between the various measures of encounter rates

- Determine the relationship between the various indirect predictors of encounter rates and actual encounter rates.

Study Area

The Alpine Lakes Wilderness, on the Mt. Baker–Snoqualmie and Wenatchee National Forests, offers some variety in experiences available to the recreation visitor. While many remote mountain tops and pristine meadows have little recreational use, many trails and lake basins receive extremely heavy use. As many as 10,000 visitors each year are believed to take the relatively short drive from the Seattle metropolitan area with a population of about 2 million people, to a single trailhead providing access to lakes in this Wilderness. These 10,000 visitors to this particular trailhead are spread over a use period from early July until late September. A high percentage of visitation occurs on weekends and most visitors are only inside the Wilderness for part of a single day.

Visitation to two specific high–use, multiple–lake combinations was studied in 1991. These multiple–lake combinations each have

one easily accessible lake with a high concentration of day users. The two most accessible lakes also have substantial numbers of campers and associated resource damage. The other lake, or lakes, in each of the two combinations receives substantially less day use, but still receives a combination of day and overnight use sufficient to be considered high–use places. Additional hikes of 2 miles or more make access to these second lakes slightly more difficult, therefore offering different social and resource impact conditions.

Snow Lake and Gem Lake

The primary trailhead access for hiking to Snow Lake and Gem Lake is less than 50 miles from downtown Seattle, WA. The driving access is good, with the trailhead at the end of a paved road, only about 1 mile from Interstate 90. Snow Lake is only about 3 miles from the parking area. Gem Lake is another 2 miles, with some additional gain in elevation.

Rachel Lake and Ramparts Lakes

This lake combination is only slightly farther from Seattle (about a 2–hour drive from Puget Sound), just off the Interstate 90 corridor. The moderately difficult hike to Rachel Lake is 3.8 miles. Hiking another 2 miles and a gain of 400 feet elevation brings one to Ramparts Lakes. While Rachel Lake is heavily forested, the additional distance and elevation gain to Ramparts Lakes brings one to a subalpine landscape.

Methods

There were six systems employed in the Alpine Lakes Wilderness study areas to measure or relate to visitor encounter levels. Three direct and three indirect counting systems were used. Systems can be further categorized as (1) providing estimates of visitor perceptions of encounter levels or (2) providing estimates of actual encounter levels.

Exit Surveys (Direct Measure of Visitor Perceptions of Encounter Levels)

Exit surveys are the direct measure of visitor perceptions of encounter levels. Brief exit surveys were administered at the trailheads serving the two study areas. On sample days, a local National Forest employee administered an OMB-approved on–site questionnaire to exiting visitors (including a section on numbers of encounters). Encounter questions were recorded for different trip segments including:

- Between the trailhead and the first lake (entering and exiting),
- At the first lake (during the visitor's presence),
- Between the first and second lake (entering and exiting), and
- At the second lake (during the visitor's presence).

Exiting visitors were asked to estimate the number of encounters in which they were within speaking distance (approximately 25 feet) of another group (defined as one or more hikers) and the number of encounters where they were not within speaking distance of the encountered group. There were almost no encounters listed in which the group was outside speaking distance; therefore, all encounters were utilized, regardless of distance. Two people from each group were asked to complete the questionnaire. The forms for day and overnight visitors differed slightly. Surveys were administered on 13 randomly selected sample days for each trailhead, 8 hours each day during the summer of 1991.
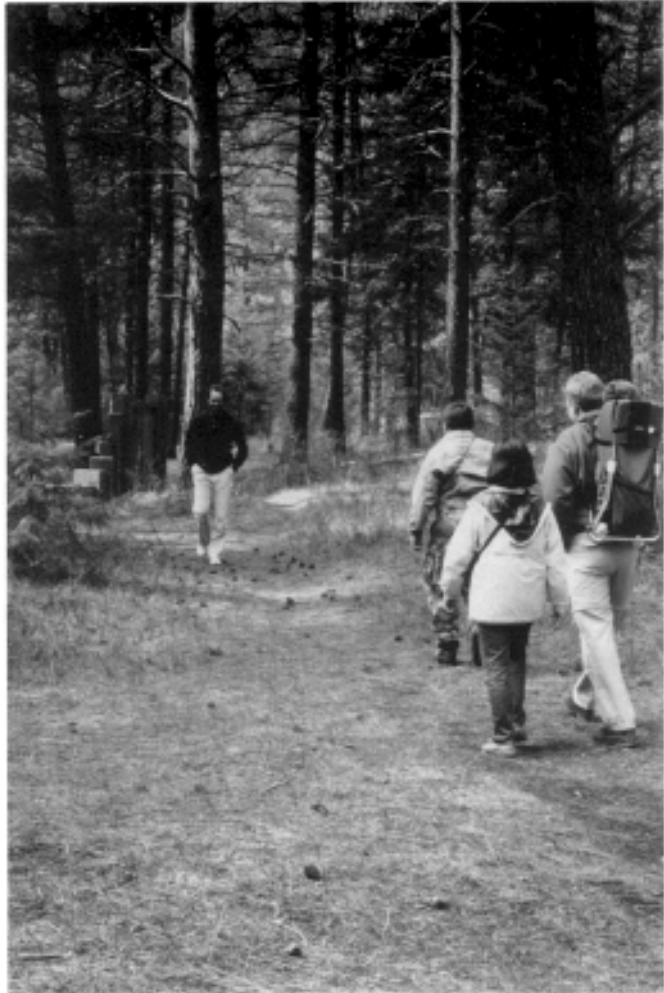
Trip Diaries (Direct Measure of Visitor Perceptions of Encounter Levels)

Trip diaries are the direct measure of visitor perceptions of encounter levels). Trip diaries were administered at the Alpine Lakes Wilder-

ness through a self–registration station. This self–registration station asked for visitor cooperation in gaining better understanding of use levels at the particular lake system on selected sample days. On these sample days, the self–registration station was visible at the trailhead to all visitors. The self–registration process consisted of one card that was to be completed and left at the self-registration station upon entry into the wilderness, and another card that contained questions about encounter levels for each day of the visit. This second card was intended for the visitor to carry and complete during the trip. This second card—the trip diary— was to be returned at the registration station on the way out, or mailed back to the researchers if the visitor exited on a day when the registration station was not in place. All diary registration cards contained postage. This monitoring system was applied on a convenience sampling basis for one weekend at each of the two trailheads, with correlated readings from the mechanical counter—a necessity to allow comparison of results to other systems. The self–registration system was not used at the same time and place the exit interview was conducted. Interest was in exploratory application at these heavily used access points as well as the magnitude of the estimates of encounters produced.

Estimates of round-trip encounter levels derived from self-reports and rangers' observations do not differ significantly. Photo by Alan Watson.

Trained Observers (Direct Measure of Actual Visitor Encounter Levels)

The trained observer method is a direct measure of actual visitor encounter levels. On every trailhead exit survey day, trained observers traveled assigned trail segments recording encounters, observing encounter levels as people arrived at study lakes, and making evening observations about campsite occupancy at these lakes. The trail travel and lake observations were keyed to a selected visitor group. A trained observer followed a se-lected group at a comfortable distance along the trail and at the lake to record encounters. Observations at lakes were for a standardized time of 30 minutes. Observations of campsite occupancy at the lakes occurred shortly before dark, with a re–check early in the morning before other research duties were pursued. As in the exit survey, encounters were recorded and classified as within speaking distance or not within speaking distance. Again, however, the number of people who were seen by observers that did not come within speaking distance of each of the visitor groups being followed during the entire study duration was so low that encounters of both types were summed for the overall encounter measure.

Ranger travel is not keyed to visitor travel speed nor is it intended to reflect the range of use conditions present.

Wilderness Ranger Observations
(Indirect Measure of Actual Visitor Encounter Levels)

This system is classified as an indirect measure because it is really measuring the federal employees' encounters and assuming some relationship to the rate of encounters for visitors. Ranger travel is not keyed to visitor travel speed, nor is it intended to reflect the range of use conditions present. During the duration of this study, wilderness rangers took 20 day trips to Snow Lake, 2 day trips to Gem Lake, 7 day trips to Rachel Lake, and 10 day trips to Ramparts Lakes.

Mechanical Counters
(Indirect Measure of Actual and Perceived Encounters)

During the study period, mechanical counters were used to provide total visitor traffic counts along the two trails between parking areas and study lakes. A photoelectric counter was used near the beginning of the Snow Lake trail, and a seismic sensor pad counter was attached to a footbridge about ½ mile up the Rachel Lake trail. Accuracy esti-

mates were developed through observation methods employed during the trailhead surveys. At these times the interviewer recorded the beginning and ending numbers on the traffic counter, along with an accurate listing of number of individuals, number of groups, direction of travel, and the time and date of the observation period. Observation periods were for 2 hours each, 8 hours per day.

Trailhead Counts (Indirect Measure of Actual and Perceived Encounters)

Each interviewer attempted to keep an accurate count of groups entering and exiting during the 8–hour sample day. Party size and direction of travel were also recorded.

Parking Lot Vehicle Counts (Indirect Measure of Actual and Perceived Encounters)

The interviewers at Snow Lake could easily observe the number of vehicles in the parking lot from the location they were doing the surveys. They recorded the highest number of vehicles present during each of the four 2–hour

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survey periods each day. At the Rachel Lake trailhead, vehicle numbers were not easily seen from the survey point, therefore these interviewers did not record this information.

Results

Each encounter monitoring method was used to develop an estimate of encounters with groups and individuals during visits to the lake drainages during the summer of 1991. Results obtained from each method are compared where possible.

Trail Encounters

There was some preliminary analysis needed before deciding how to present the trail encounter data. First, we were interested in knowing if encounter levels differed for visitors, depending on whether they were moving in the direction of the lake or toward the exterior trailhead entry/exit point. For the various trail segments (trailhead to Snow Lake, Snow Lake to Gem Lake, trailhead to Rachel Lake, Rachel Lake to Ramparts Lakes), encounters entering were compared to encounters exiting. If these numbers were not different, the primary unit of analysis could be the particular segment, regardless of direction of travel. In fact, table 1 shows that trained observer estimates of encounter levels are *not* different depending on direction of travel. Low traffic volume to Gem Lake makes it difficult to detect differences when weekend and weekday observations are examined separately. When pooled, data from Gem Lake are the exception, with observed exits exceeding those entrances for both numbers of individuals and numbers of groups seen.

In contrast with the trained observer method, visitor perceptions from the trailhead survey tended to produce lower estimates of average encounter levels on the way out than on the way in to the two easiest access lakes (table 2). Based on this, it was decided to use the number

Table 1. Comparison of trail encounter levels while entering and exiting the wilderness for 52 randomly selected 8-hour sample days, during summer 1991: trained observers.

Lake	Type of day	Groups encountered Daily mean, entering	Daily mean, exiting	*p*	Individuals encountered Daily mean, entering	Daily mean, exiting	*p*
Snow	WD	10.80	8.00	0.39	22.80	20.00	0.70
	WED	24.66	27.93	0.69	62.09	67.13	0.80
Gem	WD	0.25	2.20	0.14	0.25	3.60	0.08
	WED	0.83	5.20	0.11	2.67	11.20	0.08
Rachel	WD	3.39	4.33	0.58	7.69	9.47	0.67
	WED	20.00	15.00	0.59	43.25	34.57	0.69
Ramparts	WD	0.40	0.86	0.37	0.70	1.86	0.23
	WED	1.67	2.00	0.77	3.50	5.00	0.63
Comparison of trained observer encounter levels while entering/exiting, all days combined.							
Snow	-	18.05	20.46	0.66	43.38	49.46	0.65
Gem	-	0.60	3.70	0.05	1.70	7.40	0.05
Rachel	-	7.29	7.73	0.89	16.06	17.46	0.85
Ramparts	-	0.88	1.38	0.37	1.75	3.31	0.28

Key: WD = weekdays; WED = weekend days.

"Daily mean, entering" and "Daily mean, exiting" = the mean number of groups or individuals encountered while traveling in that direction.

of encounters along a specific trail segment as the basic unit of comparison (regardless of travel direction) for the self–report and trained observer methods. This was done because of strong support of this position provided by the analysis of the trained observer data, and also because this decision serves to increase the number of observation points for statistical comparisons.

Second, we wanted to know if rates of encounters along these trail segments differed on weekends and weekdays. Through the analysis shown in tables 3 and 4, it is apparent that there are substantial differences between trail encounter rates on weekend days and trail encounter rates on weekdays for most trail segments. Weekend day encounter rates tend to be substantially higher. Because of this consistent difference, we decided to compare all encounter rate estimates separately for weekends and weekdays.

Separating estimates by trail segments was not possible for the diary and the ranger observations. Encounter estimates produced by these

Table 2. Comparison of trail encounter levels while entering and exiting the wilderness for 52 randomly selected 8-hour sample days, during summer 1991: self report.

		Groups encountered			Individuals encountered		
		Daily	Daily		Daily	Daily	
	Type	mean,	mean,		mean,	mean,	
Lake	of day	entering	exiting	p	entering	exiting	p
Snow	WD	7.83	6.44	0.07	20.63	11.73	0.00
	WED	19.51	15.53	0.00	59.68	47.57	0.02
Gem	WD	7.60	6.13	0.60	11.00	9.50	0.60
	WED	6.40	8.75	0.32	17.69	19.54	0.77
Rachel	WD	6.56	3.87	0.01	17.00	9.00	0.01
	WED	13.10	8.24	0.00	33.12	21.02	0.01
Ramparts	WD	5.24	2.44	0.00	11.83	5.25	0.01
	WED	13.20	13.48	0.95	33.14	34.06	0.92
Comparison of trained observer encounter levels while entering/exiting, all days combined.							
Snow	-	16.60	13.10	0.01	49.90	38.70	0.01
Gem	-	6.80	7.70	0.59	16.00	15.90	0.98
Rachel	-	9.70	5.90	0.00	25.50	15.00	0.00
Ramparts	-	10.60	9.70	0.77	25.90	24.70	0.85

Key: WD = weekdays; WED = weekend days.

"Daily mean, entering" and "Daily mean, exiting" = the mean number of groups or individuals encountered while traveling in that direction.

Table 3. Weekday/weekend day comparisons of encounters for 52 randomly selected 8-hour sample days, during summer 1991: trained observer.

| | | Snow Lake trail | | | Gem Lake trail | | | Rachel Lake trail | | | Ramparts Lakes | | |
| | Type | Daily | | | Daily | | | Daily | | | Daily | | |
Measurement	of day	mean	p	Tukey[a]	mean	p	Tukey[a]	mean	p	Tukey[a]	mean	p	Tukey[a]
# groups	WED	26.54	0.01	A	2.82	0.37	A	16.82	0.00	A	1.83	0.02	A
	WD	9.47		B	1.33		A	3.89		B	0.59		B
# individuals	WED	65.00	0.00	A	6.55	0.14	A	37.73	0.00	A	4.25	0.03	A
	WD	21.47		B	2.11		A	8.64		B	1.18		B

Key: WD = weekdays; WED = weekend days.

[a]Tukey's letter designation for means. Means sharing the same letter are not different at $\propto = 0.05$

Trailhead car counts can be excellent predictors of inter-group encounters in high-use areas. Photo by Alan Watson.

two forms could only be compared for round-trip estimates. The self–report survey data, however, could be compiled in a way that was comparable to the diary and ranger observations (round-trip measures).

The tendency is for lower estimates of *groups* encountered using self-report measures and higher estimates using trained observer measures at the easy-access, heavier-used trail segments (table 5). However, estimates of *individuals* encountered are not statistically differ-

ent for these methods at easy-access, heavier trail segments. At more lightly used, distant trail segments, however, self–report estimates are higher than trained observer estimates. Table 6 indicates that estimates of round-trip encounter levels derived from visitor self–reports (SR) and wilderness rangers' observations (R) do not differ significantly. Diary reports (D) tend to produce estimates similar to self–report and ranger observations, though sometimes they produce lower encounter estimates.

Table 4. Weekday/weekend day comparisons of encounters for 52 randomly selected 8-hour sample days, during summer 1991: self-report.

| Measurement | Type of day | Snow Lake trail | | | Gem Lake trail | | | Rachel Lake trail | | | Ramparts Lakes | | |
		Daily mean	p	Tukey[a]	Daily mean	p	Tukey[a]	Daily mean	p	Tukey[a]	Daily mean	p	Tukey[a]
# groups	WED	17.66	0.00	A	6.80	0.76	A	10.82	0.00	A	13.33	0.02	A
	WD	7.15		B	7.37		A	5.28		B	3.88		B
# individuals	WED	57.78	0.00	A	18.44	0.08	A	27.12	0.00	A	33.59	0.00	A
	WD	16.36		B	10.25		A	13.00		B	8.74		B

Key: WD = weekdays; WED = weekend days.

[a]*Tukey's letter designation for means. Means sharing the same letter are not different at ∝ = 0.05*

Lake Encounters

For day users, self–report measures of encounters at lakes tended to not be similar to estimates produced by trained observers after only observing encounter rates for the first 30 minutes after a visitor arrived at a lake (table 7). In the two instances where there were differences in the number of groups and individuals encountered, the self–report measure produced a higher encounter rate than the trained observer estimated. The self–issued diary data produced highly variable results, possibly due to low compliance with the self–registration request. For this reason, self–issued diaries at high-use places like Snow Lake do not offer good estimates of encounter rates. At slightly locations with lower use intensity like the Rachel Lake trail, however, diaries produced reasonably good estimates of self–reports and trained observer methods.

Diary data were also very poor for overnight campers who reported groups camping within sight or sound of their own campsite on the last

Table 5. Comparison of self-report and trained observer estimates of total groups and total individuals encountered along a trail segment for 52 randomly selected 8-hour sample days, during summer 1991.

Lake	Type of day	Variable name	Form	Daily mean	Std. dev.	Tukey letter[a], $\propto = 0.05$	p	N
Snow	WED	Groups	TO	26.5	20.0	A	0.01	26
			SR	17.7	17.9	B		693
	WD	Groups	TO	9.5	6.9	A	0.12	19
			SR	7.2	6.2	A		238
	WED	Individuals	TO	65.0	49.4	A	0.42	26
			SR	53.8	69.6	A		714
	WD	Individuals	TO	21.5	15.4	A	0.27	19
			SR	16.4	19.6	A		236
Gem	WED	Groups	SR	7.4	6.1	A	0.03	30
			TO	2.8	4.5	B		11
	WD	Groups	SR	6.8	5.0	A	0.01	15
			TO	1.3	1.9	B		9
	WED	Individuals	SR	18.4	15.5	A	0.02	27
			TO	6.6	8.1	B		11
	WD	Individuals	SR	10.3	4.7	A	0.00	12
			TO	2.1	2.9	B		9
Rachel	WED	Groups	TO	16.8	13.8	A	0.05	11
			SR	10.8	9.1	B		117
	WD	Groups	SR	5.3	5.6	A	0.22	130
			TO	3.9	4.4	A		28
	WED	Individuals	TO	37.7	31.9	A	0.22	11
			SR	27.1	26.7	A		129
	WD	Individuals	SR	13.0	17.3	A	0.20	130
			TO	8.6	10.6	A		28
Ramparts	WED	Groups	SR	13.3	17.0	A	0.02	66
			TO	1.8	1.8	B		12
	WD	Groups	SR	3.9	2.3	A	0.00	33
			TO	0.6	1.0	B		17
	WED	Individuals	SR	33.6	38.6	A	0.01	68
			TO	4.3	5.0	B		12
	WD	Individuals	SR	8.7	7.1	A	0.00	34
			TO	1.2	1.9	B		17

Key: WD = weekdays; WED = weekend days; SR = self-report data; TO = trained observer data.

[a]*Tukey's letter designation for means. Means sharing the same letter are not different at $\propto = 0.05$*

night of their visit. Considering only the data derived from trained observers and the trailhead self–report survey, these two methods produced similar results at Snow Lake (table 8). At Rachel Lake and Ramparts Lakes, results were expected to be different, with self–reports expected to be higher than trained observer estimates.

Table 6. Comparison of self-report, wilderness ranger observations, and self-issue diary estimates of round-trip encounter levels.

Lake	Type of day	Observation	Form	Daily mean	Std. dev.	Tukey letter[a], $\propto = 0.05$	N
Snow	WED	Groups	R	42.9	23.6	A	15
			SR	34.5	28.1	A	317
			D	13.8	14.7	B	22
	WD	Groups	D	19.7	13.8	A	3
			SR	14.3	10.2	A	112
			R	9.3	2.3	A	3
	WED	Individuals	R	122.8	75.0	A	16
			SR	106.0	113.0	AB	338
			D	39.6	33.3	B	22
	WD	Individuals	D	60.3	45.3	A	3
			SR	33.1	28.6	A	109
			R	28.3	9.7	A	4
Gem	WED	Groups	SR	15.4	10.0	A	12
			R	10.0	9.5	A	3
			D	7.0	7.8	A	3
	WED	Individuals	SR	36.6	10.0	A	11
			R	29.0	20.1	A	3
			D	21.7	24.7	A	3

(No diary records are present for weekdays at Gem Lake)

Lake	Type of day	Observation	Form	Daily mean	Std. dev.	Tukey letter[a], $\propto = 0.05$	N
Rachel	WED	Groups	SR	21.6	13.7	A	55
			D	10.8	6.4	B	21
			R	9.0	7.1	AB	2
	WD	Groups	R	10.6	5.2	A	5
			SR	10.5	9.4	A	61
			D	5.2	3.7	A	13
	WED	Individuals	SR	54.2	43.1	A	64
			D	32.3	20.6	A	23
			R	26.0	11.3	A	2
	WD	Individuals	R	29.0	15.1	A	5
			SR	26.4	28.6	A	62
			D	17.6	10.8	A	14
Ramparts	WED	Groups	R	29.0	18.8	A	5
			SR	26.9	31.8	A	31
			D	14.0	7.1	A	4
	WED	Individuals	R	75.2	55.5	A	6
			SR	69.4	70.9	A	32
			D	43.0	14.5	A	4

(No diary records are present for weekdays at Ramparts Lakes)

Key: WD = weekdays; WED = weekend days; SR = self-report form; R = ranger observations; D = trip diary.[a]Tukey letter designation for mean. Means sharing the same letter are not different at $\propto = 0.05$

Table 7. Comparison of self-report, trained observer, and self-issued diary estimates of encounter levels at lakes.

Lake	Type of day	Variable	Form	Daily mean	Std. dev.	Tukey letter[a], ∝ = 0.05	N
Snow	WED	Groups	SR	11.2	10.1	A	269
			TO	10.0	5.2	AB	13
			D	3.4	3.8	B	10
	WD	Groups	SR	4.7	7.9	A	99
			D	4.0	-	A	1
			TO	2.8	2.6	A	14
	WED	Individuals	SR	31.2	43.7	A	291
			TO	24.8	12.7	A	13
			D	10.6	11.7	A	11
	WD	Individuals	SR	11.4	9.6	A	99
			D	8.0	-	A	1
			TO	7.4	9.3	A	14
Gem	WED	Groups	SR	3.5	1.9	A	11
			D	3.5	0.7	AB	2
			TO	1.1	1.1	B	9
	WD	Groups	SR	3.9	3.3	A	8
			TO	0.5	0.8	B	6
			D	-	-	-	0
	WED	Individuals	D	9.0	-	AB	1
			SR	7.8	3.4	A	11
			TO	2.4	2.3	B	9
	WD	Individuals	SR	3.8	1.5	A	5
			TO	2.0	4.0	A	6
			D	-	-	-	0
Rachel	WED	Groups	SR	6.5	4.6	A	45
			D	6.2	4.9	A	11
			TO	4.3	3.0	A	9
	WD	Groups	SR	3.8	2.7	A	45
			D	2.3	3.2	AB	4
			TO	1.9	2.2	B	18
	WED	Individuals	D	21.6	24.4	A	14
			SR	16.5	12.8	A	54
			TO	10.9	8.5	A	9
	WD	Individuals	D	15.2	9.9	A	5
			SR	9.2	7.1	A	45
			TO	4.6	4.8	B	18
Ramparts	WED	Groups	D	16.0	-	A	1
			SR	7.3	4.0	AB	13
			TO	3.7	3.5	B	7
	WD	Groups	SR	1.1	1.2	A	12
			TO	0.9	1.3	A	10
			D	-	-	-	0
	WED	Individuals	SR	20.3	10.9	A	18
			D	16.0	-	A	1
			TO	10.6	8.7	A	7
	WD	Individuals	SR	2.3	1.5	A	10
			TO	1.4	2.0	A	10
			D	-	-	-	0

Key: WD = weekdays; WED = weekend days; SR = self-report; TO = trained observer; D = trip diary.[a]Tukey letter designation for mean. Means sharing the same letter are not different at ∝ = 0.05

Table 8. Comparison of self-report, trained observer, and self-issued diary estimates of campsite encounters.

Lake	Type of day	Variable	Form	Daily mean	Std. dev.	Tukey letter[a], $\propto = 0.05$	N
Snow	WED	Groups	SR	1.4	1.7	A	33
			D	1.3	1.2	A	3
			TO	1.2	1.3	A	26
	WD	Groups	D	10.0	-	A	1
			TO	1.1	1.3	B	46
			SR	0.4	0.9	B	11
	WED	Individuals	SR	4.2	3.9	A	36
			TO	3.0	3.5	A	26
			D	2.3	2.5	A	3
	WD	Individuals	D	30.0	-	A	1
			TO	4.0	5.6	B	46
			SR	0.4	1.1	AB	7
Gem	WED	Groups	SR	2.5	3.5	A	2
			TO	0.0	0.0	A	2
			D	0.0	-	A	1
	WD	Groups	TO	0.5	0.6	A	4
			SR	0.0	-	A	1
			D	-	-	-	0
	WED	Individuals	SR	20.0	-	A	1
			TO	0.0	0.0	A	2
			D	0.0	-	A	1
	WD	Individuals	TO	0.8	1.0	A	4
			SR	0.0	-	A	1
			D	-	-	-	0
Rachel	WED	Groups	D	8.7	1.2	A	3
			SR	4.1	5.4	B	11
			TO	1.1	1.0	C	29
	WD	Groups	D	10.0	-	A	1
			SR	1.1	1.2	B	16
			TO	0.5	0.7	B	20
	WED	Individuals	D	29.3	11.0	A	3
			SR	16.8	22.2	A	8
			TO	2.4	2.9	B	29
	WD	Individuals	D	30.0	-	A	1
			SR	3.4	4.5	B	14
			TO	1.1	1.6	B	20
Ramparts	WED	Groups	D	5.0	1.0	A	3
			SR	4.4	3.8	A	18
			TO	1.4	1.1	A	9
	WD	Groups	SR	0.0	-	A	3
			TO	0.0	-	A	5
			D	-	-	-	0
	WED	Individuals	SR	18.2	15.9	A	13
			D	11.0	1.4	AB	2
			TO	3.2	2.8	B	9
	WD	Individuals	SR	0.0	-	A	4
			TO	0.0	-	A	5
			D	-	-	-	0

Key: WD = weekdays; WED = weekend days; SR = self-report; TO = trained observer; D = diary.[a]Tukey letter designation for mean. Means sharing the same letter are not different at $\propto = 0.05$

Relationship Between Trailhead Traffic and Mechanical Counts

Coordinated observations of visitor traffic provided a means of validating the mechanical counters. Regression analysis with the mechanical count or vehicle count data as the independent variable, and the numb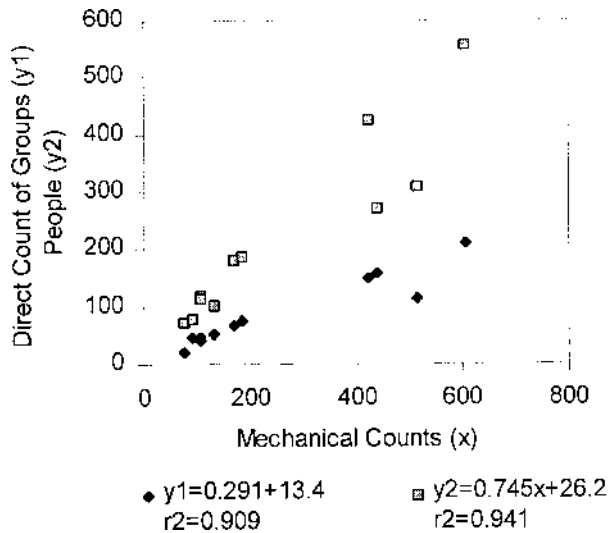er of visitors (and groups of visitors) as the dependent variable, gives us a good understanding of the relationship between these variables. Table 9 provides the raw counts of traffic from each of the four methods, and table 10 shows more specific car count details at the Snow Lake trailhead. Figures 1 through 3 show the specific relationships between mechanical counters (and vehicle counts) and the number of groups (and individuals) entering each of the two trailheads. Differences in predictive relationships for the two trailheads are assumed to be a combination of:

1. accuracy of the measurement device (the counter at Snow Lake was a photoelectric beam counter near the trailhead, and the counter at Rachel Lake was a seismic sensor attached to a small footbridge about 1/2 mile up the trail) and

2. environmental factors, such as the ability to walk side–by–side past the Snow Lake trail counter and the possibility for a group to pause on the footbridge thereby causing multiple counts along the Rachel Lake trail.

$y1=0.291+13.4$ $\quad$ $y2=0.745x+26.2$
$r2=0.909$ $\quad\quad\quad\quad$ $r2=0.941$

Figure 1. Illustration of relationship between mechanical counts and direct counts of groups (and individuals) entering Snow Lake trailhead.

$y1=1.34x+9.92$ $\quad$ $y2=3.41x+15.7$
$r2=0.933$ $\quad\quad\quad\quad$ $r2=0.915$
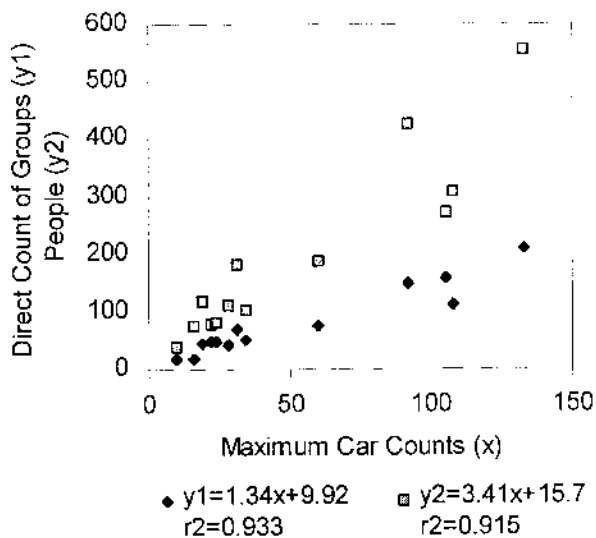
Figure 2. Illustration of relationship between trailhead car counts and direct counts of groups (and individuals) entering Snow Lake trailhead.

$y1=0.226x+0.344$ $\quad$ $y2=0.551x+0.593$
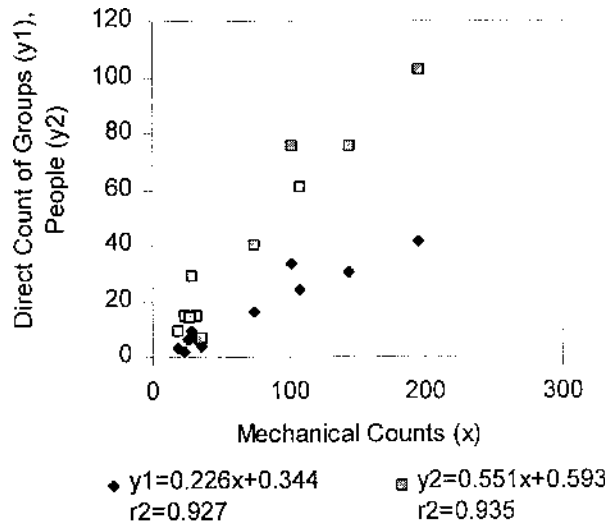$r2=0.927$ $\quad\quad\quad\quad$ $r2=0.935$

Figure 3. Illustration of relationship between mechanical counts and direct counts of groups (and individuals) entering Rachel Lake trailhead.

Counts made by an observer of encounters during the first 30 minutes that a visitor was at a lake closely approximated total encounters reported at the lake.

Table 9. Summary information on indirect counting methods: mechanical counts, direct counts, and maximum car counts.

Trailhead	Type of measure	All days Daily mean	SD[a]	Weekdays Daily mean	SD[a]	Weekends Daily mean	SD[a]
Snow	# groups counted/day	80.2	58.9	38.7	13.8	129.0	53.6
	#individuals counted/day	195.0	155.0	86.4	27.8	321.0	146.0
	Mechanical counts/day	237.0	200.0	85.3	45.9	389.0	175.0
	Maximum cars/day	52.5	42.2	21.9	7.9	88.2	36.8
Rachel	# groups counted/day	28.2	26.8	17.0	19.1	53.5	25.8
	# individuals counted/day	71.5	67.8	44.2	47.6	133.0	71.1
	Mechanical counts/day	65.1	56.0	40.8	39.0	120.0	52.3

The number of observations for each of these measures is as follows:

  # groups/day: Snow & Rachel = 13   *# mechanical counts/day: Snow & Rachel = 13*

  # individuals/day: Snow & Rachel = 13   *# cars/day: Snow = 13, Rachel = 0*

[a]*SD = Standard Deviation.*

Table 10. Cars parked in the Snow Lake parking lot. Average number of cars parked in the Snow Lake lot during 2-hour blocks, broken down by weekday and weekend day. There were 13 observation days—7 on weekdays and 6 on weekend days.

Time block	Number of cars in lot on weekdays Mean	SD[a]	Number of cars in lot on weekend days Mean	SD[a]
10 am - 12 pm	11.7	6.0	49.0	18.6
12 pm - 2 pm	18.0	7.1	75.7	32.9
2 pm - 4 pm	19.5	6.4	87.8	36.6
4 pm - 6 pm	16.3	4.9	63.2	25.7

[a]*Standard Deviation.*

Understanding these relationships should contribute to greater validity in use estimates produced from these mechanical counters.

Relationship Between Indirect Predictors and Encounter Estimates

The success of the indirect measures to predict encounter rates within the wilderness was much greater than anticipated (table 11). The limitations are also clear by looking at differential success levels across the application attempts. First, it can be said that use of a mechanical counter, car counts, groups entering, or individuals entering can be excellent predictors of inter–group encounters along the trail between the trailhead and Snow Lake. These indirect measures predict self–reports of encounter levels better than they predict trained observer estimates, though success is high at predicting both. Along the Rachel Lake trail (between the trailhead and the lake), mechanical counter and trailhead counts of traffic by Forest Service personnel provide more accurate predictions of trained observer estimates of encounters than those provided by self–reports. When prediction capabilities are ex-

amined for the trail segment from Snow Lake to Gem Lake (which has much lower use concentration than the segment from the trailhead to Snow Lake, or the segment from the trailhead to Rachel Lake), prediction ability falls off dramatically. The trail segment from Rachel Lake to Ramparts Lakes, however (which has more use than the trail from Snow Lake to Gem Lake), has encounter rates that can be predicted from the indirect measures at a moderately accurate rate (explaining as much as 85 percent of the variation).

The success pattern of predicting encounters at lakes from the indirect measures is similar to that for predicting encounters along the trails (table 12). Trailhead survey values are most accurately predicted; the predictive ability is greatest for the heaviest used location—Snow Lake. Encounters at Rachel Lake are also predicted quite well with approximately two–thirds of the variation in encounter levels explained by the predictors. Encounters at Ramparts Lakes are only slightly less successfully predicted than at Rachel Lake, and the least successful prediction attempt is at Gem Lake, which is where we would be least likely to encounter other hikers.

Table 11. Estimated slopes and intercepts of the regression lines for the relationship between encounter measures (y) and indirect predictors (x) along trails

Encounter measure (y)	Indirect predictor (x) Mechanical counts	Car counts	Groups entering	Individuals entering
Trailhead to Snow Lake, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, roundtrip	y = 0.0572x + 8.392	y = 0.2773x + 6.812	y = 0.4389x + 4.913	y = 0.1471x + 6.598
(r-square)	(0.9039)	(0.9406)	(0.8648)	(0.8131)
Individuals, roundtrip	y = 0.1960x + 16.85	y = 0.9328x + 11.11	y = 1.561x + 2.272	y = 0.5397x + 6.666
(r-square)	(0.9411)	(0.9406)	(0.9427)	(0.9419)
Groups, one-way	y = 0.0292x + 4.226	y = 0.1395x + 3.422	y = 0.2265x + 2.359	y = 0.1322x + 2.590
(r-square)	(0.9136)	(0.9441)	(0.8902)	(0.8297)
Individuals, one-way	y = 0.1004x + 7.943	y = 0.4792x + 4.861	y = 0.8051x + 0.02164	y = 0.2779x + 2.509
(r-square)	(0.9324)	(0.9330)	(0.9416)	(0.9388)
Trained Observer				
Groups, one-way	y = 0.0475x + 5.579	y = 0.2458x + 2.773	y = 0.4140x + 0.3507	y = 0.1322x + 2.590
(r-square)	(0.6879)	(0.7692)	(0.7802)	(0.6657)
Individuals, one-way	y = 0.1228x + 10.87	y = 0.6136x + 5.014	y = 1.0401x - 1.2614	y = 0.3381x + 3.758
(r-square)	(0.7426)	(0.7885)	(0.8094)	(0.7163)

Cont'd.

Table 11. (Cont'd.)

Encounter measure (y)	Indirect predictor (x) Mechanical counts	Car counts	Groups entering	Individuals entering
Trailhead to Rachel Lake, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, roundtrip	y = 0.1514x + 2.872	Not available	y = 0.6141x + 3.889	y = 0.2535x + 3.478
(r-square)	(0.8036)		(0.7300)	(0.7323)
Individuals, roundtrip	y = 0.3653x + 9.724	Not available	y = 1.475x + 12.28	y = 0.6181x + 10.96
(r-square)	(0.6644)		(0.5978)	(0.6178)
Groups, one-way	y = 0.1454x - 0.3499	Not available	y = 0.5918x + 0.6764	y = 0.2522x - 0.139
(r-square)	(0.5998)		(0.5403)	(0.5601)
Individuals, one-way	y = 0.3709x - 1.682	Not available	y = 1.485x + 1.393	y = 0.6439x - 1.174
(r-square)	(0.6360)		(0.5541)	(0.5951)
Trained Observer				
Groups, one-way	y = 0.1286x + 1.231	Not available	y = 0.5202x - 0.3480	y = 0.2182x - 0.822
(r-square)	(0.9175)		(0.8291)	(0.8590)
Individuals, one-way	y = 0.2916x - 3.008	Not available	y = 1.171x - 0.8711	y = 0.4951x - 2.083
(r-square)	(0.9050)		(0.8050)	(0.8475)
Snow Lake to Gem Lake, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, roundtrip	y = 0.0141x + 14.11	y = 0.0985x + 11.88	y = 0.1909x + 9.911	y = 0.0774x + 9.577
(r-square)	(0.0662)	(0.1372)	(0.1819)	(0.2795)
Individuals, roundtrip	y = 0.0588x + 21.42	y = 0.2276x + 21.55	y = 0.5190x + 14.12	y = 0.2161 + 12.67
(r-square)	(0.3145)	(0.2012)	(0.3693)	(0.5982)
Groups, one-way	y = 0.0008x + 7.582	y = 0.011x + 7.100	y = 0.0236x + 6.759	y = 0.0172x + 5.887
(r-square)	(0.0017)	(0.0132)	(0.0230)	(0.0892)
Individuals, one-way	y = 0.0295x + 9.612	y = 0.1266x + 9.219	y = 0.2420x + 6.499	y = 0.1047x + 5.455
(r-square)	(0.0295)	(0.1266)	(0.2420)	(0.1047)
Trained Observer				
Groups, one-way	y = 0.0068x + 1.222	y = 0.0482x + 0.1389	y = 0.0685x + 0.0004	y = 0.0148x + 0.997
(r-square)	(0.1740)	(0.4189)	(0.2920)	(0.1223)
Individuals, one-way	y = 0.0139x + 2.306	y = 0.0927x + 0.3702	y = 0.1326x + 0.0817	y = 0.0313x + 1.786
(r-square)	(0.0139)	(0.0927)	(0.1326)	(0.0313)
Rachel Lake to Ramparts Lakes, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, roundtrip	y = 0.1435x - 0.0787	Not available	y = 0.5967x + 0.4916	y = 0.2557x - 0.511
(r-square)	(0.6132)		(0.5554)	(0.5714)
Individuals, roundtrip	y = 0.3808x - 3.204	Not available	y = 1.508x + 0.6631	y = 0.6417x - 1.015
(r-square)	(0.3808)		(0.5871)	(0.6261)
Groups, one-way	y = 0.0679x + 0.6066	Not available	y = 0.2651x + 1.254	y = 0.1106x + 0.994
(r-square)	(0.6039)		(0.5049)	(0.5098)
Individuals, one-way	y = 0.1711x + 0.6132	Not available	y = 0.7088x + 1.572	y = 0.3082x + 0.369
(r-square)	(0.5861)		(0.5531)	(0.6065)
Trained Observer				
Groups, one-way	y = 0.0208x - 0.3613	Not available	y = 0.0868x - 0.2538	y = 0.0366x - 0.351
(r-square)	(0.8506)		(0.8130)	(0.8356)
Individuals, one-way	y = 0.0518x - 1.157	Not available	y = 0.2085x - 0.7723	y = 0.0885x - 1.038
(r-square)	(0.7863)		(0.7019)	(0.7334)

Table 12. Estimated slopes and intercepts of the regression lines for the relationship between encounter measures (y) and indirect predictors (x) at lakes.

Encounter measure (y)	Indirect predictor (x) Mechanical counts	Car counts	Groups entering	Individuals entering
Snow Lake, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, day users	y = 0.0225x + 1.717	y = 0.1040x + 1.317	y = 0.1569x + 0.9675	y = 0.1471x + 6.598
(r-square)	(0.8097)	(0.8041)	(0.6546)	(0.6977)
Individuals, day users	y = 0.0621x + 3.894	y = 0.3000x + 1.759	y = 0.4750x - 0.0806	y = 0.1650x + 1.167
(r-square)	(0.8834)	(0.9034)	(0.8103)	(0.8184)
Trained Observer				
Groups, day users	y = 0.0169x + 1.4188	y = 0.0779x + 1.209	y = 0.1134x + 1.097	y = 0.0378x + 1.551
(r-square)	(0.6099)	(0.6162)	(0.4671)	(0.4353)
Individuals, day users	y = 0.0339x + 5.982	y = 0.1590x + 5.034	y = 0.2191x + 5.273	y = 0.0796x + 5.500
(r-square)	(0.3671)	(0.3731)	(0.2531)	(0.2799)
Rachel Lake, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, day users	y = 0.0448x + 1.769	Not available	y = 0.1743x + 2.178	y = 0.0721x + 2.057
(r-square)	(0.6761)		(0.5647)	(0.5685)
Individuals, day users	y = 0.1230x + 2.642	Not available	y = 0.4854x + 3.666	y = 0.2023x + 3.272
(r-square)	(0.6685)		(0.5743)	(0.5872)
Trained Observer				
Groups, day users	y = 0.0292x + 0.4786	Not available	y = 0.1282x + 0.5314	y = 0.0516x + 0.495
(r-square)	(0.7014)		(0.7488)	(0.7127)
Individuals, day users	y = 0.0636x + 1.5141	Not available	y = 0.2667x + 1.818	y = 0.1054x + 1.810
(r-square)	(0.5634)		(0.5464)	(0.5025)
Ramparts Lakes, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, day users	y = 0.0416x - 0.2527	Not available	y = 0.1834x - 0.3609	y = 0.0749x - 0.443
(r-square)	(0.6131)		(0.5822)	(0.5788)
Individuals, day users	y = 0.1153x - 1.2979	Not available	y = 0.5038x - 1.089	y = 0.2026x - 0.910
(r-square)	(0.5959)		(0.6231)	(0.6341)
Trained Observer				
Groups, day users	y = 0.0316x - 0.6002	Not available	y = 0.1153x - 0.1737	y = 0.0492x - 0.329
(r-square)	(0.6876)		(0.5041)	(0.5314)
Individuals, day users	y = 0.0810x - 1.887	Not available	y = 0.3200x - 1.1799	y = 0.1338x - 1.504
(r-square)	(0.7258)		(0.6223)	(0.6310)
Gem Lake, Alpine Lakes Wilderness				
Trailhead Surveys				
Groups, day users	y = -0.008x + 4.473	y = 0.0075x + 3.910	y = -0.017x + 4.940	y = -0.002x + 4.449
(r-square)	(0.0039)	(0.0130)	(0.0242)	(0.0019)
Individuals, day users	y = 0.0141x + 2.806	y = 0.0695x + 2.208	y = 0.1119x + 1.548	y = 0.0378x + 2.083
(r-square)	(0.8434)	(0.8620)	(0.7967)	(0.8474)
Trained Observer				
Groups, day users	y = 0.0024x + 0.3950	y = 0.0170x + 0.0221	y = 0.0289x - 0.1813	y = 0.0091x - 0.003
(r-square)	(0.1850)	(0.4370)	(0.4362)	(0.3929)
Individuals, day users	y = 0.0059x + 0.8183	y = 0.0331x + 0.2857	y = 0.0595x - 0.2158	y = 0.0211x - 0.035
(r-square)	(0.2747)	(0.4026)	(0.4493)	(0.5058)

Conclusions

The first observation made from the analysis was that encounter rates differ dramatically from weekdays to weekend days. At least this is the case at these high-use lakes and along the trails leading to them. We would generally expect areas in most wildernesses that are easily accessible and close to trailheads to have significantly more visitors on the weekends than during the week. Whether this effect extends to the core area of wildernesses or not, we do not know from this study. There would likely be some weekend day/weekday effect, but maybe not as drastic at places deeper into wilderness. This information is most relevant when we consider if we are meeting standards set for solitude opportunities. We need to acknowledge that at least at these high-use places we are much more likely to exceed standards on weekend days than on weekdays. When we set standards, we should consider this extreme variation, not just look at average or median use and encounter rates across all days. It is likely that there also are other influences on variation in use and encounter rates (for example, hunting season, fishing season, fall foliage prime for viewing, holidays, etc.).

The second set of observations from the analysis would be about the comparisons of the various monitoring methods. Visitor perceptions of group encounter frequencies were lower than those of trained observers on the heaviest use trails. Estimates of numbers of individuals encountered did not differ, however, though variability was substantial for both methods. On the more lightly used trail segments, self–report measures produced significantly higher encounter estimates than did the trained observer method. What we must keep in mind is that these two different monitoring methods are measuring different things. One is measuring visitors' perceptions of encounter levels, and the other is measuring the perceptions of encounters for someone trained and paid to develop the estimate. This analysis is not intended to reveal that one method is wrong and one is right because they both differ in the encounter rates estimated. Rather, it helps us to understand that they are different things, and monitoring systems can be developed for either objective. We also found that self–reports did not differ significantly from wilderness rangers' observations of encounters while on patrol. This suggests that wilderness ranger observations of encounters may be an acceptable substitute measure of visitor perceptions of encounters. However, these counts may underestimate actual encounters in some cases and overestimate in others. If our indicator related to solitude opportunities is worded in a way which suggests that visitor perceptions of encounters is the influential factor related to solitude, then ranger observations may be a good monitoring method. However, if we adopt an indicator related to actual encounters in the wilderness, wilderness ranger observations do not serve as well for a substitute measure.

While self–report measures of encounters, through use of a self–issued diary, have proven to be quite effective in low-use places, response rate may be low at heavily used places. However, it is not clear what level of response is necessary for this type of monitoring. Self–issued diaries to monitor encounter rates at a place like Alpine Lakes Wilderness would provide a substantial amount of information for the principal access routes and for popular, easily accessible destinations; however, the degree of representation of the population is unknown. For more internal locations—maybe beyond the transition zone where the traffic is lower and the type of visitor and visit is likely to be different—this type of monitoring technique may also be useful, with anticipated improvements in registration rates, as well.

When encounters at popular destinations were monitored using different methods, it was found that in the case of counts made by an observer of encounters during the first 30 minutes a visitor was at the lake, these counts closely estimated total encounters reported while at the lake. Most of the encounters that

visitors have at these popular destination locations occur in early, relative initial stages of the visit. It is while the visitor is trying to figure out the terrain and the opportunities available on first arriving that most of the other opportunities that are present are encountered. With this initial information, a visitor can find a place where a limited number of additional contacts will be made.

Another way to compare these various methods of monitoring wilderness encounters is to examine the results that each method would provide when a statement of conditions is compared to a standard. This, after all, is the intended purpose for this type of monitoring. Let us find out if different conclusions would be drawn from the different monitoring methods. Table 13 illustrates differences in conclusions

Table 13. Relationship between reported encounters along trails and standard[a] (12 people per day) by different monitoring methods.

Location	Monitoring method	Distance	Observations	Proportion out of standard
Snow Lake Trail	Ranger observations	Roundtrip (w/lake)	20 days	100% (of total trips)
	Self-report	Roundtrip (w/lake)	13 days	80% (avg. # trips/day)
	Self-report	Roundtrip (w/lake)	591 people	82% (of total trips)
	Self-report	Roundtrip (trail)	13 days	68% (avg. # trips/day)
	Self-report	Roundtrip (trail)	591 people	72% (of total trips)
	Self-report	One-way (trail)	13 days	47% (avg. # trips/day)
	Self-report	One-way (trail)	1,182 people	60% (of total trips)
	Trained observer	One-way (trail)	13 days	70% (avg. # trips/day)
	Trained observer	One-way (trail)	45 observed groups	78% (of total trips)
Gem Lake Trail	Ranger observations	Roundtrip (w/lake)	2 days	100% (of total trips)
	Self-report	Roundtrip (w/lake)	8 days	66% (avg. # trips/day)
	Self-report	Roundtrip (w/lake)	30 people	63% (of total trips)
	Self-report	Roundtrip (trail)	8 days	49% (avg. # trips/day)
	Self-report	Roundtrip (trail)	30 people	47% (of total trips)
	Self-report	One-way (trail)	8 days	39% (avg. # trips/day)
	Self-report	One-way (trail)	60 people	30% (of total trips)
	Trained observer	One-way (trail)	10 days	10% (avg. # trips/day)
	Trained observer	One-way (trail)	20 observed groups	10% (of total trips)
Rachel Lake Trail	Ranger observations	Roundtrip (w/lake)	7 days	100% (of total trips)
	Self-report	Roundtrip (w/lake)	14 days	82% (avg. # trips/day)
	Self-report	Roundtrip (w/lake)	144 people	84% (of total trips)
	Self-report	Roundtrip (trail)	14 days	76% (avg. # trips/day)
	Self-report	Roundtrip (trail)	144 people	76% (of total trips)
	Self-report	One-way (trail)	14 days	41% (avg. # trips/day)
	Self-report	One-way (trail)	288 people	50% (of total trips)
	Trained observer	One-way (trail)	14 days	38% (avg. # trips/day)
	Trained observer	One-way (trail)	39 observed groups	41% (of total trips)
Ramparts Lakes Trail	Ranger observations	Roundtrip (w/lake)	10 days	90% (of total trips)
	Self-report	Roundtrip (w/lake)	12 days	68% (avg. # trips/day)
	Self-report	Roundtrip (w/lake)	60 people	78% (of total trips)
	Self-report	Roundtrip (trail)	12 days	59% (avg. # trips/day)
	Self-report	Roundtrip (trail)	60 people	72% (of total trips)
	Self-report	One-way (trail)	12 days	30% (avg. # trips/day)
	Self-report	One-way (trail)	120 people	44% (of total trips)
	Trained observer	One-way (trail)	12 days	4% (avg. # trips/day)
	Trained observer	One-way (trail)	29 observed groups	4% (of total trips)

[a]USDA Pacific Northwest Region.

based on the different monitoring methods. For example, the Forest Service Pacific Northwest Region standard of 12 people encountered per day in a transition zone within a wilderness was adopted as a trail standard. In the example, the standard was applied to round-trip visits by rangers (including trail travel and time at the lake), round-trip reports by visitors (including both trail travel and time spent at the lake), round-trip visitor reports for trail travel only (without including time spent at the lake), and one–way trips for trained observers (not including time at the lake because encounters for the round trip were not obtained for the observed groups).

From this example in table 13, the ranger observations for round trips into Snow, Gem, and Rachel Lakes show that encounters were out of standard for 100 percent of the time. For Ramparts Lakes, encounters were out of standard for 90 percent of the time. The more accurate conclusion from these records is that this is the proportion of the trips that rangers made into the area in which they encountered more people than the standard specifies as acceptable.

In contrast, using the self–report round-trip measure (including time at the lakes, the monitoring that is most comparable to the ranger observations), 82 percent of visitors to Snow Lake encountered conditions that were outside the acceptable standard, 63 percent of Gem Lake visitors had trips that exceeded the standard, 84 percent of Rachel Lake visitors experienced conditions that were outside of the standard, and 78 percent of Ramparts Lakes visitors found encounter conditions outside of the standard.

Another way to look at this standard would be to examine the average proportion of visitors per day that had encounter levels above the standard. From this perspective, for Snow Lake, an average day would be one where 80 percent of visitors had encounters over the standard, for Gem Lake it would be 66 percent, for Rachel Lake 82 percent, and for Ramparts Lakes trail 68 percent.

The self–report and trained observer methods were also compared. One–way trips along the trail to the lakes and along the trail to Snow Lake were surveyed using trained observers. Experienced observers found that 78 percent of the groups experienced out-of-standard conditions; yet only 60 percent of visitors surveyed on those same days reported out-of-standard conditions. Experienced observers at Gem Lake reported 10 percent of the groups experienced out-of-standard conditions; however, 30 percent of the visitors at Gem Lake reported (self-report) out-of-standard social conditions along the trail. Continuing comparing the results of trained observers, the numbers were much more comparable for Rachel Lake, with 41 percent of observed groups having trips where social conditions along the trail were out of standard, and 50 percent of visitors reporting (self-report) conditions exceeding the standard of 12 people encountered. For Ramparts Lakes, much like Gem Lake, self–reports indicated a much higher proportion of trips (44 percent) out of standard than observations indicated (4 percent).

Though we concluded earlier that self–report measures of lakeside encounters were estimated fairly accurately by 30-minute observations of visitors as they arrived at the lakes, one would derive slightly different conclusions using information from the two methods to compare to standards. If we adopt the 12-people-per-day standard used previously as a standard for lakeside contacts (an arbitrary decision, imagining the immediate lakeside area as an opportunity class itself, and this a relevant standard for encounters), we would find from the self–report method that 42 percent of visitors at Snow Lake experienced conditions out of standard, compared to the 48 percent out of standard concluded from the trained observer data (table 14). For Gem Lake, the proportion out of standard would be 4 percent from self–reports and none (0 percent) from observations; at Rachel Lake, 23 percent from self–reports and 11 percent from observations. Ramparts Lakes visitors were experiencing conditions out of standard on 33 percent of their trips according to self–report measures, and 15 percent of their trips according to observations. These different monitoring methods

are giving us different results because they are measuring different things.

The success of the indirect measures of trail traffic to predict the different measures of encounter rates exceeded expectations. From the analysis and results, it is suggested that no matter whether one is interested in actual or perceived encounter levels, one could be highly successful at predicting these conditions from outside the wilderness. Mechanical counters, trailhead counts of pedestrian traffic, or parking lot vehicle counts may be efficient methods of monitoring encounter levels for relatively high use trail segments and destinations. This analysis suggests that as use declines (because of moving deeper into the wilderness, or possibly other reasons such as access, remoteness of trailhead location, etc.), the ability to predict encounters from external indirect measures decreases. At places like Ramparts Lakes, the method may still be useful, depending on the level of accuracy desired, but less frequented places with more difficult access may require other monitoring techniques. Self–issued diaries or ranger/volunteer monitoring techniques are possibilities.

Table 14. Relationship between reported encounters at lakes and standard[a] (12 people per day) by different monitoring methods.

Location	Monitoring method	Observations	Proportion out of standard
Snow Lake	Self-report	13 days	30% (avg. # trips/day)
	Self-report	528 people	42% (of total trips)
	Trained observer	13 days	42% (avg. # trips/day)
	Trained observer	27 observed groups	48% (of total trips)
Gem Lake	Self-report	7 days	2% (avg. # trips/day)
	Self-report	23 people	4% (of total trips)
	Trained observer	8 days	0% (avg. # trips/day)
	Trained observer	15 observed groups	0% (of total trips)
Rachel Lake	Self-report	14 days	23% (avg. # trips/day)
	Self-report	109 people	33% (of total trips)
	Trained observer	12 days	11% (avg. # trips/day)
	Trained observer	27 observed groups	15% (of total trips)
Ramparts Lakes	Self-report	9 days	23% (avg. # trips/day)
	Self-report	38 people	17% (of total trips)
	Trained observer	10 days	10% (avg. # trips/day)
	Trained observer	17 observed groups	18% (of total trips)

[a] USDA Pacific Northwest Region.

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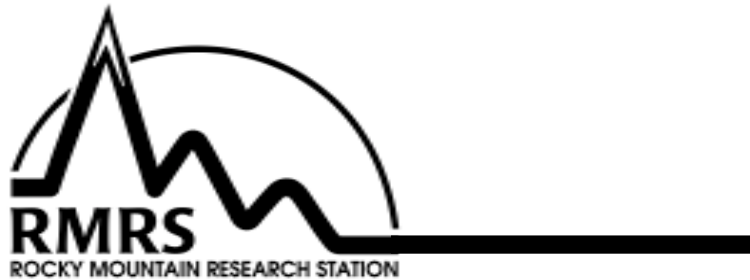
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