

Keeping Visitors On The Right Track: Sign and Barrier Research at Mount Rainier

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Editor's Note: This is the third report by the authors on noncompliant visitor behavior at Mount Rainier.

Paradise Meadows is one of the most popular and accessible areas in Mount Rainier NP (MORA). Thousands of park visitors stop at Paradise Meadows each day during peak season to hike, eat, view the mountain, and tour the visitor center. Off-trail hiking is a major source of human impact that creates social trails and related erosion throughout the several thousand acres of subalpine meadows. With up to 5,000 visits a day, even a small proportion of visitors leaving established trails and deviating onto the meadows has a significant adverse impact. Managers at Paradise Meadows need data on the effect of various control strategies to protect the environment from inappropriate and destructive behavior.

Since off-trail hiking can cause severe damage to fragile natural environments, trailside signs, barriers, and other visitor control techniques represent the last opportunity for resource managers to deter inappropriate activities in such locations. To test the effectiveness of such strategies, the University of Washington Cooperative Park Studies Unit administered several experiments at Paradise Meadows. These experiments are presented as a case study in the applications of social science methods to natural resource management.

METHODS

The research at MORA assessed the efficacy of alternative trailside sign texts, barrier types, and uniformed personnel in deterring off-trail hiking. Altogether, we studied the behavior of 17,416 visitors at three sites in the meadow in an experiment designed to compare the effectiveness of six different types of signs. Throughout each observation day, researchers systematically rotated all experimental signs at each site to control for bias due to lack of randomization. Constructed of a standard engraved brushed metal and bolted onto brown steel posts, the signs were positioned about knee high along the trail. The topography of the meadows and the position of the signs made it difficult to pass the experimental sites and fail to see the signs (see sidebar for a description of the experimental sign contents).

Experimental Signs

The experiment design used one stake, six sign treatments, and a control (no sign). The signs read: (1) "No Hiking - Meadow Repairs" (the standard NPS meadow sign), (2) "Stay On The Paved Trails And Preserve The Meadow" (new preservation appeal sign), (3) international red circle/crosshatch sign with a hiker's profile (symbolic sign), (4) "No Off-Trail Hiking"--combination of a prohibitory message with the same hiker symbol--(hybrid), (5) "Off-Trail Hikers May Be Fined" (threatened sanction), (6) short stake (approximately 1/2 m or 1 1/2 ft high) with a small version of the symbolic sign (stake), (7) "DO NOT TREAD, MOSEY, HOP, TRAMPLE, STEP, PLOD, TIP-TOE, TROT, TRAIPESE, MEANDER, CREEP, PRANCE, AMBLE, JOG, TRUDGE, MARCH, STOMP, TODDLE, JUMP, STUMBLE, TROD, SPRINT, OR WALK ON THE PLANTS" (humorous sign), and (8) control (no sign).

At one site, each experimental sign was alternately displayed either once at the behavior observation site or several times along the trail leading up to the observation site. Researchers collected data on the behavior of subjects exposed to the experimental signs (preservation appeal, symbolic, hybrid, sanction, and humorous signs). We designed this procedure to determine if the initial effect of a novel sign would be different from repeated exposure to that sign as the novelty diminished.

At a different experiment site, a uniformed NPS employee was alternately present and absent through entire sign treatment rotations on random days. The female employee wore a class A field uniform with green jeans or shorts, a NPS short sleeve shirt, and a forest green NPS baseball cap. She did not wear the class A dress uniform with a more military or authoritarian appearance. The employee did not approach visitors to enforce rules, but was clearly visible along the trail at the experimental sign site during the appropriate data collection periods.

In another component of the study, a barrier experiment included behavioral data on 6,006 subjects at three sites. At these sites, we studied the effect of two types of trailside barriers. The experiment consisted of systematic rotation of (1) a split rail fence, (2) a yellow polypropylene rope supported by lathe posts placed at knee height (approximately), and (3) a control (no barrier). Due to the more permanent nature of barriers, each was erected on each site for several days.

Trained personnel observed visitors from unobtrusive sites, and visitors could not infer that they were under observation. Data were recorded on standardized observation sheets, and additional qualitative comments and observations were logged into daily journals. Data described each participant, group, and compliant or noncompliant behavior in the presence of the signs or barriers, and the behavior of other parties in close visual proximity. We defined noncompliance as off-trail hiking where the subjects deviated off the trail in the immediate proximity of the signs or barriers.

RESULTS

The Sign Experiment

The sign experiment results indicate that trailside signs significantly reduce off-trail hiking in comparison to no sign (a control). In comparisons between signs, each sign was statistically compared to the next most effective sign in a step-wise procedure to determine how the effective signs might be grouped.

Different signs varied significantly in observed rates of noncompliance (table 1). The threatened sanction sign was more effective than the next best treatment, the new preservation appeal (chi square = 10.0, $p = .0016$), and reduced off-trail hiking by 75% in comparison to the control. The next four most effective signs (new preservation appeal, humorous, hybrid, symbolic) were not significantly different. However, the symbolic sign was not significantly more effective than the old standard sign. Thus, the new preservation appeal, humorous, and hybrid signs represent middle-range effectiveness. The old standard and the symbolic signs are a third range of effectiveness, and the old standard "Meadow Repairs" sign is the least effective. Off-trail hiking rates did not

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differ significantly from the control (chi square = 3.3, $p = .0684$) when visitors were exposed to the stake.

The research also addressed the potential for a novelty effect on hiker behavior of the presence of unusual signs placed singularly or repeatedly on the trailside. We investigated whether repeated exposure to an unusual, novel sign causes a change in the effectiveness of the unusual sign type. Data analysis revealed that there was not a significant difference in compliance rates when the repeated preservation appeal, symbolic, or sanction signs were present or absent. There was, however, a significant difference in compliance rates between single and repeated exposures to the hybrid sign; off-trail hiking increased [this is surprising] when the sign was present several times along the trail corridor.

Characteristics of Off-trail Hikers

At experimental sites, the majority (58%) of all off-trail hikers were white adults. However, a disproportionate number

were non-white (a large percentage of whom were foreign). Some Asian tour groups were even observed being led off-trail by their tour leaders. Although adults accounted for 58% of all noncompliant behavior, analysis of the data indicated that teens and children were more likely to deviate off-trail.

The majority of off-trail travel (78%) occurred when other parties in the vicinity of the party under observation stayed on the trails. However, the probability of off-trail hiking increased when the offending hikers could view noncompliance by others in their general vicinity. Finally, when the observed noncompliance occurred among a group of visitors, a large proportion or all of the group was likely to walk off-trail.

The Barrier Experiment

The data from the barrier experiment sites are presented in table 2. The yellow polypropylene rope barrier was significantly more effective in deterring off-trail hiking than the split rail fence. On average, ropes were over twice as effective as split rail fences in reducing noncompliance. Both barriers significantly reduced off-trail hiking in comparison to no barrier (the control).

Uniformed Personnel

Noncompliance almost disappeared in the presence of the uniformed employee (table 3). Interestingly, additional analyses revealed that the positive effect of signs remained evident; that is, signs still had a significant, although slight, deterrent effect on off-trail hiking in the presence of the uniformed person.

Management Implications

The statistical analyses indicate that the threatened sanction sign is the most effective. Indeed, the next most effective sign (preservation appeal) had a noncompliance rate nearly twice as

Table 1

Sign Text by Visitor Compliance Mount Rainier Sign Study

Sign Text	Compliance Status ¹		Row Totals
	C	NC	
Sanction (Row)	98.3%	1.7%	100%
(Column)	13.8%	5.5%	13.5%
(Count)	1957	33	1990
Preservation Appeal	96.7%	3.3%	100.0%
	11.3%	9.2%	11.2%
	1596	55	1651
Humorous	96.6%	3.4%	100.0%
	11.3%	9.5%	11.3%
	1607	57	1664
Hybrid	96.4%	3.6%	100.0%
	14.8%	13.0%	14.7%
	2095	78	2173
Symbolic	95.9%	4.1%	100.0%
	15.2%	15.3%	15.2%
	2155	92	2247
Old NPS Standard	95.1%	4.9%	100.0%
	13.0%	15.7%	13.1%
	1837	94	1931
Stake	94.7%	5.3%	100.0%
	9.8%	12.8%	9.9%
	1386	77	1463
Control (no sign)	93.1%	6.9%	100.0%
	10.9%	19.0%	11.2%
	1539	114	1653
Column Totals	95.9%	4.1%	100.0%
	100.0%	100.0%	100.0%
	14172	600	14772

Missing Cases = 0
Chi-Square = 77.5,
Cramer's V = .07

$p = .0000$

¹C = Complier

NC = Noncomplier

Table 2

Barrier Type by Visitor Compliance Mount Rainier Barrier Study

Barrier Type	Compliance Status ¹		Row Totals
	C	NC	
Rope (Row)	97.9%	2.1%	100%
(Column)	22.3%	8.0%	21.5%
(Count)	759	16	775
Split Rail	95.1%	4.9%	100.0%
	49.5%	43.7%	49.1%
	1682	87	1769
Control	90.9%	9.1%	100.0%
	28.2%	48.2%	29.3%
	960	96	1056
Column Totals	94.5%	5.5%	100.0%
	100.0%	100.0%	100.0%
	3401	199	3600

Missing Cases = 0
Chi-Square = 44.7,
Cramer's V = .11

$p = .0000$

¹C = Complier

NC = Noncomplier

high as the sanction sign. A cluster of signs of nearly equal effect, including the preservation appeal, humorous, and hybrid signs, follow the sanction sign. All remaining signs were either significantly less effective (symbolic and old standard signs) or essentially ineffective (stake).

We did not assess the effect of the sanction sign on the visitor experience. Thus, this sign should be used with caution and only when adverse environmental impacts dictate stringent measures. Other less intrusive signs may suffice to reduce visitor impacts in many circumstances.

There does not appear to be a novelty effect related to the unfamiliar, experimental signs; they worked equally well as a deterrent to off-trail hiking in multiple or single exposures. However, there was some indication of a novelty effect specific to the hybrid sign.

The effect of the presence of a uniformed employee suggests that off-trail hikers are not ignorant of agency expectations regarding appropriate behavior. Evidently, a uniformed park employee in the immediate vicinity of a sensitive area will greatly reduce noncompliant behavior. Without further research, we do not understand the psychological basis for the effectiveness of the uniformed employee. It appears, however, to be one of the most effective deterrents.

The use of both barrier types improved visitor cooperation. Even the least effective barrier (split rail) proved advantageous, as 46% less noncompliance was observed in its presence in comparison to the control (no barrier). At a third site (data not presented), the rope barrier also reduced off-trail hiking at a popular snow play area, but noncompliance remained very high. Although not directly compared to the signs in this study, rope barriers may not be more effective than threatened sanction signs in deterring off-trail hiking.

Vandalism and littering literature consistently suggests that "vandalism [littering] begets more vandalism [littering]." A similar pattern of behavior was also observed in relation to off-trail hiking. Furthermore, when noncompliance occurred within a party, it often involved a large proportion of the group, indicating a likely peer effect relating to noncompliant behavior.

Both youths and foreign visitors disproportionately engaged in off-trail hiking. Perhaps specific communications could be directed toward these visitor subpopulations. However, the primary visitor management strategies must concentrate on the majority of the off-trail hikers--white adults.

CONCLUSIONS

The Mount Rainier study tested the effectiveness of selected social control techniques designed to deter off-trail hiking. Such behavior can cause immense damage, both environmentally and aesthetically, and this problem has been noted in most outdoor recreation areas. Furthermore, the park efforts at rehabilitation of the resources (e.g., high standard trails and meadow restoration) can only be effective if the continuing problem of human impact is also contained.

The park has attempted to influence visitor behavior with naturalist programs and passive communications which emphasize the importance of low impact use of the area and appreciation of nature. An implicit assumption of this strategy is that noncompliant visitor behavior (e.g., off-trail hiking) is caused by a lack of knowledge about, or appreciation for, proper use of the resource. The objective of this communication approach is to motivate behavior by creating a pro-social psychological state in which recreationists view behavior desired by park managers as satisfying personally desired goals.

Exposure to a message does not ensure that it will be accepted or understood by all people, and many other visitors may never see or hear the messages. Some proportion of park visitors will always be unaffected by even the best communication strategies. In these circumstances, the last chance to influence undesirable behavior of day hikers on a park trail occurs with their exposure to behavioral cues located at or near areas where such behavior occurs.

Barriers and signs represent an opportunity to affect the behavior of those visitors who were not influenced by or exposed to other park communication efforts. Similarly, the presence of a uniformed employee may also create a salient reminder of appropriate behavior.

The study established that onsite behavioral cues do influence behavior. To accomplish their purpose, onsite cues must provide motivational incentives that are understood and effective among diverse populations. The observed variable effects of signs, barriers, and the presence of uniformed employees on noncompliant visitor behavior suggest that decisions on the use of on site cues must include more consideration of the type of intervention and the impact of such visitor controls on the behavior and recreation experience of the visitors. The studies represent an important first step in the necessary behavioral research to assist resource managers in controlling undesirable visitor behavior.

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Table 3

Uniform Presence by Visitor Compliance Mount Rainier Barrier Study

Treatment	Compliance	Status ¹	Row Totals
	C	NC	
Uniform Present			
(Row)	99.4%	0.6%	100.0%
(Column)	33.0%	10.8%	32.6%
(Count)	2522	16	2538
Uniform Absent			
(Row)	97.5%	2.5%	100.0%
(Column)	66.1%	88.6%	67.4%
(Count)	5123	132	5255
Column Totals			
(Row)	98.1%	1.9%	100.0%
(Column)	100.0%	100.0%	100.0%
(Count)	7645	148	7899
Missing Cases = 32			
Chi-Square = 32.2 p = .0000			
Cramer's V = .065			

¹C = Complier

NC = Noncomplier