Acadia National Park

National Park Service
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Using Signs to Reduce Visitor-Built Cairns: Gorham Mountain Trail, Acadia National Park

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EXECUTIVE SUMMARY

Hikers in Acadia National Park frequently add to cairns that mark trails, knock them down, or build their own cairns and other rock objects. Many of these rocks are removed from thin mountain soils exposing more soil and plants to erosion. Extra cairns and other objects also degrade the mountain landscape and may create safety problems if hikers stray off trail. In the summer of 2003, we conducted a second experiment using educational signs to combat the issue of tampering with cairns. The first experiment was in 2002 on the South Ridge Cadillac Mountain Trail (Jacobi 2003a), where we found a statistically significant improvement in the condition of cairns after signs were installed.

On a one-mile section of the Gorham Mountain Trail, we built 32 Bates cairns. Bates cairns are generally made from four stones in a pagoda-like structure, and they are very easy to monitor for alterations. For 30 days, we monitored the condition of the cairns every five days, restoring them to their original condition on each hike. We then installed three signs at either end of the trail section and in the middle, and repeated the monitoring runs every five days for 30 days, restoring their condition on each hike. Our hypothesis was that the signs would reduce visitor tampering with cairns.

The average percent of intact cairns increased from 38% (n=12) to 57% (n=18) with the addition of signs. The average percent of cairns with added rocks decreased from 41% (n=13) to 30% (n=10). *Neither of these changes was statistically significant at the .05 level,(p=0.068, one tail).*

Based on the results of both studies, we recommend continuing and expanding the use of these signs. Our justification for this was the substantial improvement in each study (nearly 20%), though it was not statistically significant in the second case. All three signs should remain on the Cadillac Mountain South Ridge Trail. Although hiker use is moderate, this area has always had a problem with cairn building and rock dislocation. On Gorham Mountain the middle sign should be removed, and the first (lower) sign and the summit sign remain. High use of this trail makes it an ideal opportunity to educate visitors. The use of these signs should also be expanded to the Penobscot Mountain Trail. One sign should be placed where cairns begin on the south ridge and another buried in the summit cairn. This trail receives moderate to heavy use and is another excellent opportunity to educate visitors. We do not recommend further expansion at this time. We note that there have been no complaints about these signs and no vandalism either.

Five years in to an active program of Leave No Trace education it is difficult to claim much progress has been made in reducing rock dislocation. Clearly, signs alone, while helpful, will not solve the problem. However, all other options have not been exhausted. Use of space in the Cadillac Mountain summit gift shop may help reach many visitors. There is little LNT education occurring in park campgrounds. More nonagency media, such as tourist publications, guidebooks, and maps may be available depending on cooperation from authors and publishers. Information about the rationale and history of Bates cairns needs to be more widely disseminated because they are different, and may be viewed as nontraditional.

ACKNOWLEDGEMENTS

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INTRODUCTION

Rock cairns have long been the standard trail markers to guide hikers in areas where there are no trees. Early trail enthusiasts built cairns to mark trails on most of the exposed granite summits and ridges of Acadia National Park more than 100 years ago. Today these trails offer outstanding views to thousands of hikers of the surrounding mountains and the spruce-clad islands of the Maine archipelago.

Doubtless, early trail builders were sometimes frustrated by hikers adding to cairns, knocking them down, or building new ones. Hikers added rocks to the summit cairns regularly as an ongoing tradition in many areas. One hundred years ago it was a small problem. With several thousand hikers striding off into Acadia via trails every summer day, it is a substantial ongoing problem for park managers. Few hikers realize how much they have altered the natural summit landscape with the relentless shuffling and reshuffling of rocks. We will refer to the various manifestations of this problem (adding rocks, building cairns and other objects, destroying cairns) as rock dislocation.

Park managers consider rock dislocation a problem for three reasons:
1. Natural resource degradation: rocks are removed from pockets of shallow mountain soil, exposing the soil to erosion and damaging habitat for plants and animals such as small invertebrates; extra cairns lead people off trail adding to soil and vegetation loss;
2. Visitor experience degradation: the natural landscape (the main reason Acadia was created) is degraded by the additional cairns and other rock objects constructed by hikers;
3. Safety: when visibility is low, extra cairns may lead people off trail into hazardous areas, or cause them to become lost; this problem is more acute in winter.

Over the past few years, park staff have tried to educate hikers about the applicable Leave No Trace Principle, *Leave What You Find*, in a variety of ways. We educated park staff to educate visitors. We constructed a cairn exhibit for the visitor center. We wrote articles for the local newspaper and park publications. We sent staff and volunteers out on trails to talk to hikers. But we have not had any quantitative method of measuring the success of these efforts. Although we may have made some headway, the difficulty of reaching several thousand hikers every day is immense.

OBJECTIVES

In this report, we present the results of a second experiment using trailside signs to educate hikers to *Leave What You Find*. In our first study (Jacobi 2003a), when we added signs, the number of intact cairns on the Cadillac Mountain South Ridge Trail increased from 64% to 81%, a statistically significant improvement. Here, we try the same experiment on a much busier hiking trail up Gorham Mountain. Our hypothesis again is the alternate hypothesis - that the use of signs will reduce the occurrence of the rock dislocation behaviors.

METHODS

Gorham Mountain is a granite dome 525 feet above sea level with trail access along Ocean Drive in Acadia National Park (Figure 1 – next page). The Gorham Mountain Trail begins at a parking area a little south of Thunder Hole and reaches the summit a mile later after traversing the entire south ridge of the mountain. Ocean views are scattered along the lower part of the trail where there is considerable forest; they are almost continuous on the upper part, where there are extensive ledges with only scattered trees. The trail continues north from the summit. Trail censuses from the past five years (Jacobi 2003b), show how popular the trail is with visitors. Censuses have been conducted once each year in early August; all hikers entering the trail between 9:00 a.m. and 4:00 p.m. are counted. For the Gorham Mountain Trail, the five counts made (1999-2003) ranged from a low of 245 to a high of 302 hikers. For comparison, Cadillac South Ridge counts ranged from 81-146 (including hikers starting at the top). Cadillac South Ridge Trail is 3.5 miles long to the summit vs. the one mile for Gorham Mountain.

We used the same signs for this experiment that were used for the Cadillac Mountain South Ridge Trail. This text of this sign read:

"Cairns are carefully placed piles of rocks built by trail crews to mark trails and guide hikers. Adding to cairns or building other cairns or rock objects detracts from the natural landscape, causes soil erosion and plant loss, and misleads hikers. Do not add to or build cairns or other rock objects. Leave the mountain and the rocks as you find them."

On June 25, 2003, we constructed 32 Bates cairns marking the one mile section of trail from the parking area to the summit of Gorham Mountain[1]. Bates cairns are a simple four stone cairn (Figure 2) pioneered at Acadia by early pathmaker Waldron Bates around the turn of the century. The Bates cairn is very simple to observe and measure changes to, unlike the traditional conical cairn built of many rocks. Park staff revived the Bates cairn in 2001 (conical cairns had been used for many years) for two reasons. First, it was historic, and reestablishing Bates cairns would restore some historic integrity to the trails. And second, Bates cairns would be easier to build and maintain.

FIGURE 2: BATES CAIRN

Cairns were in two discontinuous sections. The lower ¼ mile had ten cairns on it from near the trailhead to just beyond the Cadillac Cliffs Trail junction and the plaque honoring Waldron

[1] We had built 50 plus Bates cairns here in 2002. Almost all had been destroyed in the off-season, with some of the rocks used actually disappearing.

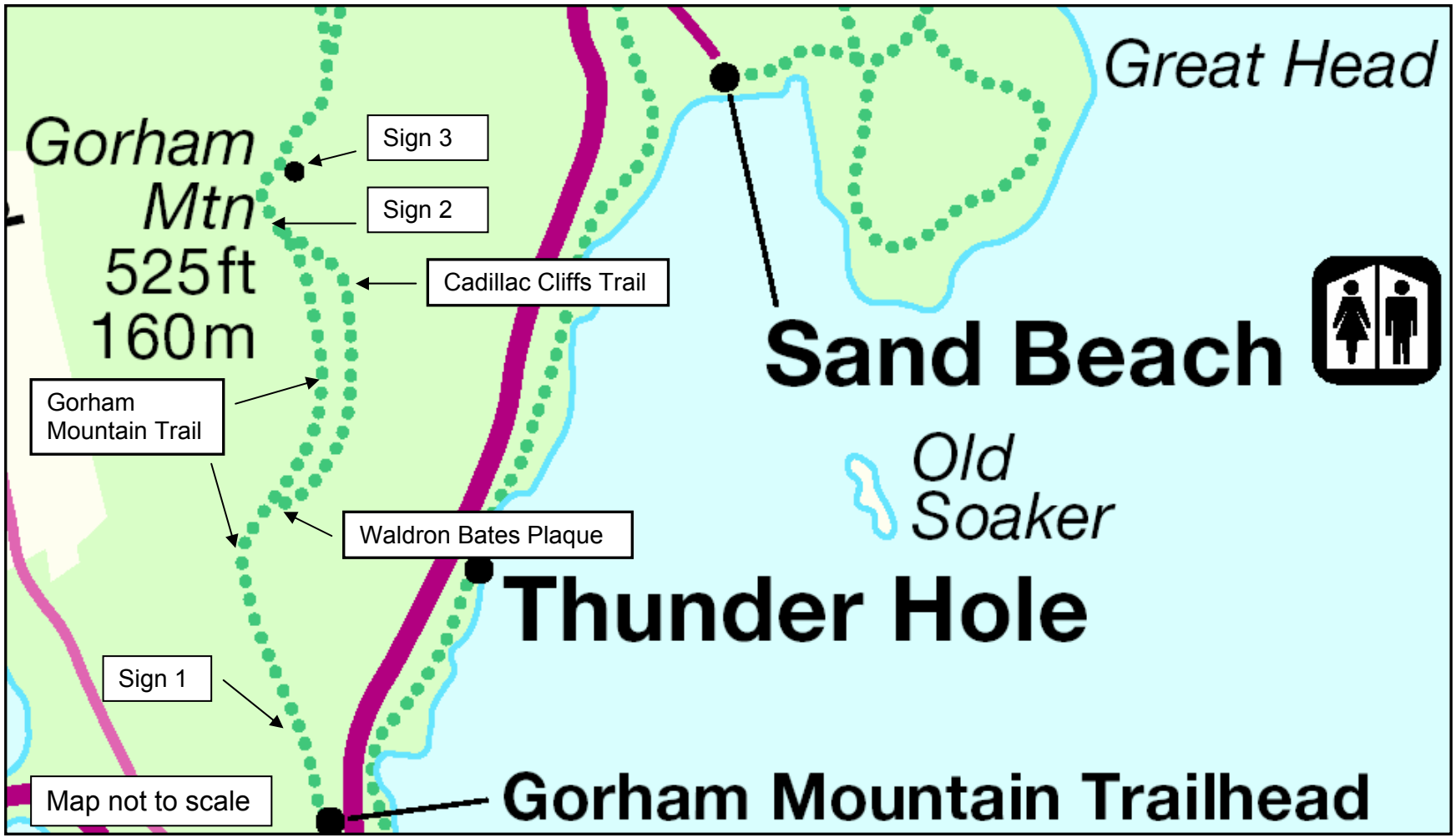

FIGURE 1: SIGN LOCATIONS, GORHAM MOUNTAIN TRAIL

Bates. A largely forested section of trail ran from this point past the upper junction with the Cadillac Cliffs Trail to the first large open ledge. The remaining cairns (n=22) ran from just beyond this upper junction to the summit more or less continuously.

From June 25 to July 25, we hiked this trail section south to north (to the summit) every five days recording data about the condition of each cairn. We recorded the number of intact cairns, cairns destroyed (knocked down), cairns with added rocks, cairns with removed pointer rocks (the top rock, which points in direction of the trail), copycat Bates cairns, and other copy cat conical cairns. We also recorded the presence of other rock art. During each hike we restored cairns to their original condition, and destroyed all other cairns and rock art.

On the morning of July 25, we installed the signs at three locations: Sign 1 – near the trailhead at the first cairn hikers encounter; Sign 2 - at the beginning of the second section of cairns, and Sign 3 - embedded in the summit cairn.

Over the next 30 days (July 25 – August 24), we once again hiked the trail again every five days recording cairn condition data, restoring the Bates cairns, and destroying other cairns and rock objects.

Statistical methods were as follows. Our hypothesis again is the alternate hypothesis testing two variables: 1. Intact cairns: the mean number of "intact cairns" *without signs* will be less than the mean number *with signs*; and 2. Cairns with added rocks: the mean number of "cairns with added rocks" *without signs* will be greater than the mean number *with signs*. These dislocations of rocks occurred most frequently. For each of these means, we calculated the percentage based on 32 cairns. We then performed a two sample means test for independent variables (without signs, with signs) for "intact cairns" and "added rocks", where the variances are not known. With sample sizes less than 30, we first performed an F test. Because we failed to reject the hypothesis that the variances were equal for the F test, we then performed a t test (degrees of freedom=10) with an alpha of .05 to test for differences in the means. All analyses were conducted in Quattro pro 6.0 software.

RESULTS

By far the most common cairn alteration was adding rocks, followed by removing the pointer rock. Other alterations were relatively uncommon, although we know from experience hikers have sometimes destroyed six or more cairns in a short period. Data for all variables are shown in Table 1.

The average percent of intact cairns increased from 38% (mean=12.2) to 57% (mean=18.3) with the addition of signs. The average percent of cairns with added rocks decreased from 41% (mean=13.2) to 30% (mean=9.7). *Neither of these differences in means was statistically significant at the .05 level (p=0.068, one tail)*. Therefore, we must reject each alternate hypothesis. Although there was substantial improvement, the treatment (signs) did not demonstrate a statistically significant improvement in either variable at the .05 level. A statistical worksheet, including descriptive statistics, the F test, and the t test, are in Appendix 1.

Table 1: Condition of Cairns Along the Gorham Mountain Trail With and Without the Use of Signs.

Date	Total Cairns	Intact Cairns	Cairns Destroyed	Cairns with Added Rocks	Cairns with Removed Rocks	Copycat Bates Cairns	Other Copycat Cairns
Without Signs (Control)							
06/25/2003	32	32	0	0	0	0	0
06/30/2003	32	11	2	13	7	0	0
07/05/2003	32	9	1	15	11	0	1
07/10/2003	32	10	7	7	8	1	2
07/15/2003	32	9	0	20	0	0	0
07/20/2003	32	23	0	9	1	1	0
07/25/2003	32	11	1	15	6	0	3
	Total	73	11	79	33	2	6
	Average	**12.2**	1.83	**13.2**	5.5	.3	1
	Percent (Avg/32)	**38%**	5.7%	**41%**	17%	-	-
With Signs (Experiment - signs installed 7/25)							
07/25/2003	32	32	0	0	0	0	0
07/30/2003	32	11	0	11	0	0	0
08/04/2003	32	8	3	15	5	0	0
08/09/2003	32	28	0	4	0	0	0
08/14/2003	32	18	6	12	1	4	0
08/19/2003	32	23	0	9	0	0	0
08/24/2003	32	22	1	7	2	0	0
	Total	110	10	58	8	4	0
	Average	**18.3**	1.7	**9.7**	1.3	.7	0
	Percent (Avg/32)	**57%**	5.2%	**30%**	4.2%	-	-

DISCUSSION

The failure to find a statistically significant improvement in the test variables may be partly attributed to the number of cairns on the Gorham Mountain Trail (N=32) being half of that on the Cadillac South Ridge Trail (n=67). The small number of data points (6) probably does not help either. Nonetheless the percentage increase was considerable and similar to that on the Cadillac South Ridge Trail in 2002. It's just that the starting point without signs was much lower on the more heavily used Gorham Mountain trail.

We recognize that just one or a few hikers may be responsible for most of the Bates cairn alterations between each monitoring hike. Perhaps the signs themselves prompt those few contrary visitors to do exactly what we ask them not to do. It's easy to add a rock or remove the pointer from a Bates cairn. Is it more tempting to add a rock to a Bates cairn than a traditional conical cairn? Children in particular may be tempted to add rocks with or without the encouragement of parent. We know from an observational study on Cadillac Mountain (Turner and LaPage 2002) that children are involved in some cairn building activity. We also know that

some rocks used are far too large for children to be manipulating. It would be useful to know who is manipulating cairns along trails, and what percent of visitors engage in this behavior. This could be the focus of further research.

Based on the results of these two studies, we recommend continuing and expanding the use of these signs. The justification is that the problem is widespread and requires a continuing effort on many fronts. In each of the two studies, signs demonstrated a substantial (though not always statistically significant) improvement. All three signs should remain on the Cadillac Mountain South Ridge Trail. Although hiker use is moderate, this area has always had a problem with cairn building and rock dislocation. On Gorham Mountain the middle sign should be removed, and the first (lower) sign and the summit sign remain. High use of this trail makes it an ideal opportunity to educate visitors. The use of these signs should be expanded to the Penobscot Mountain Trail; one sign should be placed where cairns begin on the south ridge and another buried in the summit cairn. This trail is receives moderate to heavy use and is another excellent opportunity to educate visitors. We do not recommend further expansion at this time. We note that there have been no complaints about these signs and no vandalism either.

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APPENDIX 1: STATISTICS AND MEANS TESTING FOR INTACT CAIRNS AND CAIRNS WITH ADDED ROCKS.

	Intact Cairns		
	Control		Treatment
25JUN03	32/32		
30JUN03	11	30JUL03	11
5JUL03	9	04AUG03	8
10JUL03	10	09AUG03	28
15JUL03	9	14AUG03	18
20JUL03	23	19AUG	23
25JUL03	11	24AUG03	22
	73		110
	12.16667		18.33333
	0.380208		0.572917
		Continued	
		29AUG03	18
		03SEP03	31
		08SEP03	28
		15SEP03	21
		22SEP03	23
		30SEP03	30
		7OCT03	25
		14OCT	18
			194
			24.25

Column 1		***Column 1***	
Mean	12.16667	Mean	18.33333
Standard Err	2.19722	Standard Err	2.875181
Median	10.5	Median	20
Mode	9	Mode	NA
Standard De	5.382069	Standard De	7.607014
Variance	28.96667	Variance	57.86667
Kurtosis	5.430034	Kurtosis	-1.29971
Skewness	2.298687	Skewness	-0.30229
Range	14	Range	20
Minimum	9	Minimum	8
Maximum	23	Maximum	28
Sum	73	Sum	110
Count	6	Count	6
Confidence L	4.306473	Confidence L	6.086767

F-Test: Two-Sample for Variances

	Variable 1	***Variable 2***
Mean	18.33333	12.16667
Variance	57.86667	28.96667
Observations	6	6
df	5	5
F	1.997699	
P(F<=f) one-	0.232876	
F Critical one	5.050329	

t-Test Two Sample Assuming Equal Variance

	Variable 1	***Variable 2***
Mean	18.33333	12.16667
Variance	57.86667	28.96667
Observations	6	6
Pooled Varia	43.41667	
Hypothesized	0	
df	10	
t	1.620999	
P(T<=t) one-	0.068042	
t Critical one-	1.812461	
P(T<=t) two-t	0.136085	
t Critical two-	2.228139	

	Added Rocks		
	Control		Treatment
25JUN03	32/32		
30JUN03	13	30JUL03	11
5JUL03	15	04AUG03	15
10JUL03	7	09AUG03	4
15JUL03	20	14AUG03	12
20JUL03	9	19AUG	9
25JUL03	15	24AUG03	7
	79		58
	13.16667		9.666667
	0.411458		0.302083
		Continued	
		29AUG03	8
		03SEP03	1
		08SEP03	1
		15SEP03	5
		22SEP03	7
		30SEP03	2
		7OCT03	7
		14OCT	6
			37
			4.625

Column 1		***Column 1***	
Mean	13.16667	Mean	9.666667
Standard Err	1.763384	Standard Err	1.4671
Median	14	Median	10
Mode	15	Mode	NA
Standard De	4.665476	Standard De	3.88158
Variance	21.76667	Variance	15.06667
Kurtosis	-0.41334	Kurtosis	-0.31776
Skewness	0.072541	Skewness	-0.17669
Range	13	Range	11
Minimum	7	Minimum	4
Maximum	20	Maximum	15
Sum	79	Sum	58
Count	6	Count	6
Confidence L	3.73309	Confidence L	3.105854

F-Test: Two-Sample for Variances

	Variable 1	***Variable 2***
Mean	13.16667	9.666667
Variance	21.76667	15.06667
Observations	6	6
df	5	5
F	1.44469	
P(F<=f) one-	0.34814	
F Critical one	5.050329	

t-Test Two Sample Assuming Equal Variance

	Variable 1	***Variable 2***
Mean	13.16667	9.666667
Variance	21.76667	15.06667
Observations	6	6
Pooled Varia	18.41667	
Hypothesized	0	
df	10	
t	1.412613	
P(T<=t) one-	0.094064	
t Critical one-	1.812461	
P(T<=t) two-t	0.188127	
t Critical two-	2.228139	