

ENVIRONMENTAL RESPONSE TO NATURAL RESOURCE MANAGEMENT REGIMES: TWENTY YEARS OF VISITOR IMPACTS IN THE BOB MARSHALL WILDERNESS

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Abstract: In the summer of 2002, 19 campsites within the Bob Marshall Wilderness were examined to determine the amount of recreational impact occurring on these sites. The findings from this study were compared with findings from a study undertaken by Cole in 1981. Both studies utilized the same sites and the same methods. Comparison of the two studies was conducted to determine if any trends were occurring on these campsites over the 21-year span. Campsites were compared according to their use type, whether stock use or backpacker. Sites classified in 1981 as horse use sites incurred the most impacts, such as increased tree damage, while sites classified as backpacker sites showed general improvements. However, without knowledge of the actual use patterns on these sites, it cannot be assumed that a particular user group is the primary cause of the impacts. Leave No Trace ethics practiced by backpackers insist on using already impacted sites, and this may account for some of the findings found in this study. Visitor education may provide managers with a means to decrease visitor impacts. Tree damage, such as that caused by tying stock to trees or visitors cutting branches off for firewood, remains the greatest impact found on these sites. Educating visitors in proper stock handling practices, as well as encouraging visitors to search for firewood away from the campsite could decrease the amount of tree damage found on these campsites.

Introduction

The Bob Marshall Wilderness Complex (BMWC)

comprises the Bob Marshall, the Great Bear, and the Scapegoat Wilderness Areas. These wilderness areas contain 1.5 million acres of lands that remain relatively untouched by man. Opportunities for recreation abound in these Wilderness areas with backpacking, horse packing, river rafting, fishing, and hunting as the primary activities that attract visitors to the BMWC. These areas are preserved according to the 1964 Wilderness Act, which states that wilderness areas are places where it, "...generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable." (P.L. 88-577).

Recreational use in the BMWC has increased since its inclusion into the National Wilderness Preservation System (Lucas 1980; Cole 1983; Cole and Hall 1992). With this increased use, keeping the resource protected as prescribed under the 1964 wilderness act has become a challenge. In response to this, managers of the Bob Marshall Wilderness Complex adopted the "Limits of Acceptable Change" (LAC) in 1981. The LAC process focuses mainly on detecting changes in key indicators of resource conditions, such as camp area, bare soil, and trampled vegetation. An unacceptable change in the indicator's condition, for example bare soil exceeding the acceptable limit, triggers a management action to address the causes of the changes. Since much of the impact caused by recreational use occurs at the campsites, inventorying and assessing campsite impacts are a vital component of the LAC process.

An initial collection of campsite impact measurements within the Bob Marshall Wilderness was conducted in 1981 as part of the LAC planning process (Cole 1983). For that study, Cole located and monitored thirty-five campsites. Although the overall conditions of campsites were found to be comparable with those found in similar backcountry settings, Cole noted that: "Campsites were unusually large...and tree damage was severe. Such impacts were particularly pronounced on sites used by outfitters and large parties with stock" (1983).

In keeping with the LAC planning process, Cole and Hall (1992) reexamined 29 of the original 35 sites in 1990. They noted that: "The general trend [in condition] on established campsites was one of slight improvement. However, most improvement

occurred on sites that had not yet been used during the 1990 season. The types of impact that are continuing to increase are enlargement of campsite area and, perhaps, an increase in tree damage..." (1992).

Cole and Hall reported a 34% increase in campsite area in the intervening years with an average increase of 29 square meters (Cole and Hall 1992). With no subsequent monitoring of campsite impacts, managers of the Bob Marshall Wilderness cannot identify whether these sites are still increasing in size.

Study Area

The study area included 19 of the original 35 sites studied by Cole in 1981. These campsites were located in low elevation forests and grasslands located along the South Fork of the Flathead and the Danaher Rivers in the Bob Marshall Wilderness Complex. Five of these campsites are used primarily by backpackers, thirteen campsites are used by private parties with stock, and one is a seasonal outfitter camp (Cole 1983).

Methods

Methods used in this study repeated those of Cole and others in 1981 and 1990. Center points for the campsites were located using witness trees. For each site, maps from the 1981 study identified three witness trees per site and included the azimuths and distances from those trees to the center points. A pin locator was used to confirm the center point by locating a 40-penny nail, which was left at the centers in 1981. A GPS reading was taken at the center point of each camp to allow managers to locate these sites with more accuracy in future studies.

Campsite area and the devegetated central core were identified for each campsite by measuring to the outer edge of the impacted campsite and to the first significant amount of vegetation (respectively) every 16 degrees from the center point (figure 1).

Quantification of tree damage were then conducted within the established campsite boundary by counting the number of exposed roots, broken and cut branches, scars, and nails evident on each of the trees found within the campsite. A count of felled trees and seedlings was also taken within the campsite.

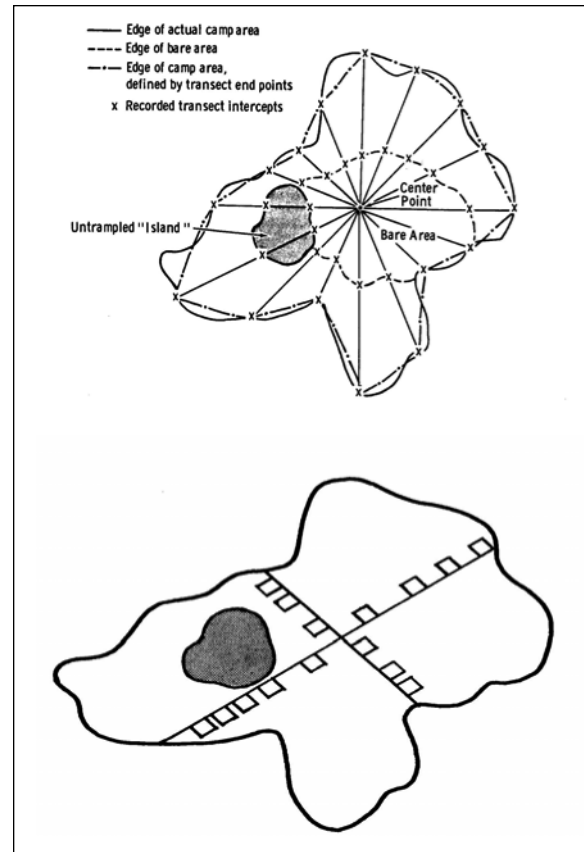


Figure 1. Radial transect method used to determine camp area and barren core & layout of 15 quadrats to assess percent cover of bare soil, rock, root/tree, and vegetative cover.

To assess the condition of each campsite, a maximum of 15 one square meter quadrats were established along two transects on each campsite (figure 2). This was accomplished using two cloth tapes that were laid perpendicular to one another. The intersection of the two tapes covered the center point of the campsite. Within each quadrat, the percent cover of bare soil, rock, root/tree, and vegetation were recorded. Vegetation composition, as well as their respective percent cover, was also identified. Duff depths were also taken within each quadrat. Quadrats provide a means to assess the condition of the entire campsite by taking up to 15 random samples from across the campsite.

Comparisons of campsite conditions were done using the SPSS statistical software package. Due to the small sample size, Nonparametric Tests were used. The Wilcoxon Signed Ranks Test was used to determine the significance of campsite condition changes within each classified use type between

1981 and 2002. For example, the camp areas of all backpacker sites in 1981 were compared to the camp area of those same sites in 2002. The Two-Sample Kolmogorov-Smirnov Z Test was used to determine significance of campsite condition changes between the campsites of the two different user type classifications. For example, the percent of vegetation cover observed on backpacker sites was compared to the percent vegetation cover observed on the horse use sites. This comparison was computed separately for the conditions in 1981 and in 2002.

Results

Within use classification use types

Analysis of the backpacker sites indicated no significant changes in the amount of tree damage on the sites from 1981 to 2002. For this study, tree damage is defined as the presence of nails in the trees, ax marks, carvings, exposed roots, scars, and other miscellaneous damage. Horse use sites are on the other end of this spectrum. The number of exposed roots on these sites increased 161% over the intervening 21 years. In 1981 the mean number of exposed roots on the horse use sites was 8.2 ± 7.8 . By 2002, that number jumped to 21.4 ± 23 incidents per site. The number of trunk scars less than 1ft² also increased on the horse use sites. In 1981, the average number of scars per site was 5.6 ± 5.13 and in 2002 the number increased to 13.1 ± 8.4 , a 132% change. However, not all indicators of tree damage increased on the horse use sites.

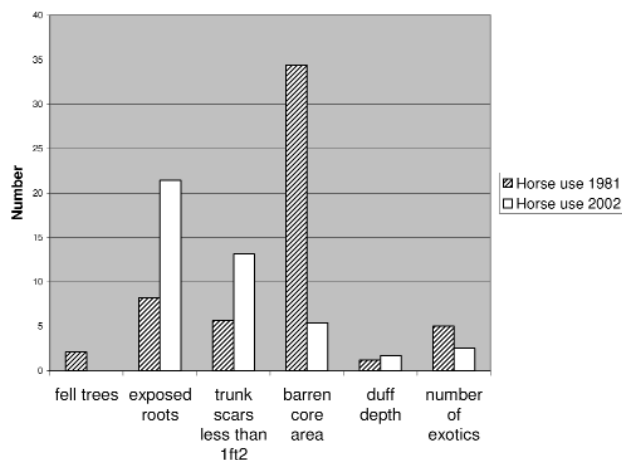


Figure 2. Significant changes on horse use sites between 1981 and 2002.

The number of fell trees decreased by 100%, changing from an average of 2.1 ± 2.1 fell trees in 1981 to 0 in 2002. Backpacker sites and horse use sites showed no significant changes in campsite area between 1981 and 2002. However, horse use sites did experience a 56% decrease in the barren core area over that time period, decreasing from a mean of 34.4 ± 26.8 m² in 1981 to 5.4 ± 11.8 m² in 2002.

Analysis of campsite conditions were evaluated using the percent coverage of bare soil (not barren core), living trees and roots, stone, total vegetation, as well as the duff depth.

Out of these, backpacker sites only showed significant changes in the percent of total vegetation coverage. In 1981, backpacker sites indicated a mean of $16.8 \pm 15.3\%$. This percentage increased by 37% in 2002, with the sites experiencing a mean of $27.9 \pm 20.9\%$ vegetative cover. Horse use sites showed improvements over the intervening years in regards to campsite conditions. The percentage of bare soil across the entire campsite decreased 53%. In 1981, the percentage of bare soil on these sites averaged $19.5 \pm 20.8\%$, and in 2002 that percentage decreased to $9.15 \pm 20.8\%$. Duff depth also improved on the horse use sites. Comparison of these sites across the 21 years indicates a 39% increase in the amount of duff present on these sites.

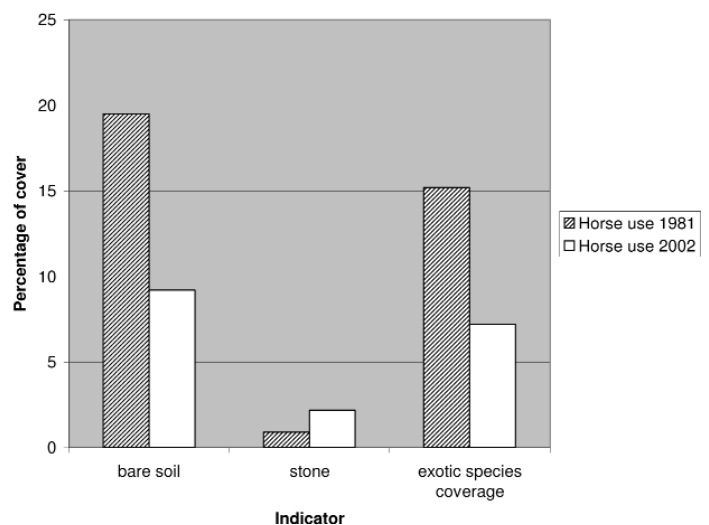


Figure 3. Significant changes in percent cover of three campsite condition indicators on horse use sites between 1981 and 2002.

The sites improved from a mean duff depth of 1.2 ± 1.6 cm in 1981 to 1.7 ± 1.6 cm in 2002. However, not all of the indicators improved for the horse use sites. The percentage of rocks found on the site increased by 145%. In 1981, the mean percentage was $.9 \pm 5.4\%$ and in 2002 that percentage increased to $2.2 \pm 4.6\%$.

The final analysis that was conducted within each use category was the change in the number and percent coverage of exotic species on the campsites. While backpacker sites indicated no significant changes over the 21-year period, horse use sites experienced a decrease in both the numbers of exotic species and their respective vegetative cover. In 1981, these sites had an average of 5 ± 2 exotic plant species per site, resulting in a mean coverage of $15.2 \pm 10.6\%$. In 2002, the number of exotics decreased to a mean of $2.5 \pm .9$ plants and their resulting vegetative cover similarly decreased to an average of $7.2 \pm 5.6\%$.

Between classification use types

Comparisons of campsite impacts observed in 2002 were conducted between the two classified types of use (table 1). For tree damage, the only indicator that was significant between the backpacker and horse use sites was the number of cut branches found on trees within the campsite boundary. Horse use sites incurred more cut branches than backpacker sites did. Backpacker sites experienced an average of $.5 \pm 1$ cut branch per site while horse use sites indicated a mean of 11.3 ± 8.4 incidents of cut branches per site in 2002.

Campsite area was also significantly different between the two use type classifications. In 2002, all of the horse use campsites were larger than the backpacker sites. The average horse use campsite is 257.4 ± 98.7 , with the smallest camp area observed being 98.7m^2 . The average backpacker campsite area in 2002 is 64.1m^2 , with the largest camp area measuring 89.7m^2 . On average, the backpacker campsites are one-fourth the size of the horse use sites.

Backpacker sites and horse use sites did not differ significantly in regards to the number of seedlings, the number of trees, the number of trees that were mutilated, the number of trees with cut branches, the number of dead stumps, or the number and respective coverage of exotic species. These two

classifications of campsites also showed no significant differences in percent vegetative cover, bare soil, stone, living trees and roots, or the depth of the duff layer.

Table 1. — Significance of difference in indicators between classified use types using Kolmogorov-Smirnov Z test.

Statistic		Type of use		Significance
		Backpacker	Horse	
Camp area (m ²)	1981	110	235	0.039
	2002	64	257	0.006
Cut branches	1981	11.5	13.2	.981
	2002	.5	11.3	.016

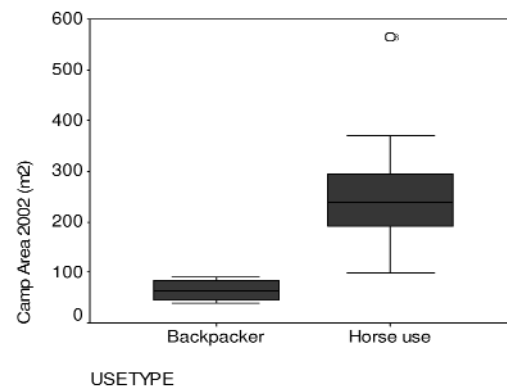


Figure 4. Box plots of camp areas based on the classified use type.

Discussion

Given the small sample size for the sites classified as backpacker campsites, any changes between 1981 and 2002 would have to be extreme in order for them to indicate statistical significance. Some of the changes observed may have shown significance had the sample size been larger. As a result, the only statistically significant change within the backpacker sites was a 37% increase in vegetative cover. Sites classified as horse use did not have this problem due to the larger sample size.

Sites that were classified as horse use sites in 1981

are still receiving the greatest amount of impacts. Tree damage on these sites is still the largest impact, and it is cumulative, meaning that any damage that occurs during the year adds to the damages caused from the previous seasons of use. Much of this damage is attributed to visitors tying their stock to trees. Not only does this pose the potential for girdling of the trees, it also increases the amount of exposed roots from the stock trampling the soil surrounding the base of the tree.

Barren core area appears to be decreasing on both use types. This decrease is more pronounced on sites that are classified as horse use sites. One possible reason for this is the lateness of the summer season in 2002. When examined in early July, only one fifth of the sites appeared to have any use, so seasonal revegetation may be accounting for the decrease in barren core area.

Campsite location, in relation to site ecology, also played a role in the revegetation seen between the two use type classifications. Parties with stock often tend to use sites classified as grasslands with a greater abundance of graminoids present. "Sites located under an open forest canopy and dominated by graminoids were highly resistant, while those under a closed canopy and dominated by forbs were less resistant" (Marion and Cole, 1995). This could prove to be an important factor for managers deciding on which campsites to allow stock use on.

Results indicate a decrease in the amount of exotic species present on the campsites. Management actions implemented in the intervening 21 years could account for this finding. Since 1981 the requirement for certified weed seed hay has been implemented in the national wilderness system. Also active weed management techniques such as spraying of camp areas and meadows near trails have been implemented by the Flathead National Forest (Ash, 2003).

Sites classified as horse use sites are also experiencing a decrease in the amount of bare soil present across the entire camp. Data from the study does not provide support for a concrete explanation for this, but one possibility is a change in use patterns that has led to the increased camp areas of these sites. Use patterns on these sites may have shifted from the campsite centerpoint

established in 1981. By this analogy, as the camp size increases, the visitors are spread their use over a greater area, resulting in dispersed rather than concentrated impacts to the soil. Had the camp areas remained the same size, increased use levels would have decimated the vegetation, resulting in an increase in bare soil and decrease in vegetation.

One important aspect to mention is that these sites were classified according to use types in 1981. Since then, backcountry ethics have changed the way visitors use the areas. Some of the sites classified as horse use also receive backpacker use (Ash, 2003). Results indicate that the conditions on these two types of campsites are at different ends of the spectrum, with backpacker sites showing either improvements or no change at all, and horse use sites increasing in size and amount of tree damage. What our data doesn't provide us with is an estimation of the use levels these sites receive, or the percentage of each use type that camp on sites previously classified as horse use. One possibility for the lack of change on backpacker sites is that an increased number of backpackers use the already impacted sites when traveling through the Bob Marshall. Leave No Trace camping ethics urge backpackers to use already disturbed sites when traveling rather than creating new sites. This shift in the use of campsites could account for the growing gap between sites classified as backpacker and horse use.

Conclusions

Implications for managers from this study indicate that while most indicators and impacts are remaining stable there is still room for improvement, as impacts such as tree damage appear to be increasing. Are the impacts that appear to be increasing indicative of a certain type of user or use? A visitor use study, repeating the methods used by Lucas in 1985 will provide managers with a more complete picture of type of use occurring. In 1985, Lucas concluded that backpacking use was increasing while parties traveling with stock were decreasing in numbers, however findings from this study do not support that conclusion. Increases in certain types of impacts, such as tree damage are more indicative of increasing stock use in the Bob Marshall. Also, the backpacker sites showed little change while the horse use sites received the largest amount of impacts. The LAC plan has capped outfitter use

and required outfitters to dismantle large camps. Outfitters have been encouraged to adopt techniques that reduce amount of impact they produce, such as turning stock out away from camp when not needed. A visitor use study would determine if other use types, such as private parties with stock or backpackers are responsible for the increasing impacts found in this study. Understanding use levels and types will give managers a clearer target as to where to concentrate their education efforts.

Techniques that parties with stock could utilize to reduce these impacts would be to turn their stock out away from camp by using electric fences and hobbles. This would reduce the amount of tree damage and exposed roots occurring in these camps. Leave No Trace wilderness ethics have had positive effects with backpackers reducing their impacts, the same could be applied to parties traveling with stock, with a concentrated educational program.

Managers can also reduce impacts through selecting campsites for heavy use in areas that are more resilient. Open canopy grassland sites would be better suited for larger parties traveling with stock as the seasonal recovery is greater on these sites as opposed to closed canopy sites with primarily forbs present. Also concentrating use on already impacted sites reduces the overall amount of impact occurring. Especially given that most of the impact that occurs on a campsite occurs the first few times it is used.

References

- Ash, G. 2003. Personal interview, Wilderness Ranger, Spotted Bear Ranger District, U.S. Department of Agriculture, Flathead National Forest.
- Cole, D.N.1983a. Campsite Conditions in the Bob Marshall Wilderness, Montana. Res. Pap. INT-312. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 18 p.
- Cole, D.N.1989. Wilderness Campsite monitoring Methods: A Sourcebook. Gen. Tech. Rep. INT-259. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 57 p.
- Cole, D.N.1989, Some Principles to Guide Wilderness Campsite Management, paper included in Managing Americas Enduring Wilderness Resource, Proceedings of the Conference, Minneapolis, MN. Sept. 1989, edited Lime, D.W., University of Minnesota, St Paul, MN. Pg.706.
- Lime D.W. 1990, Managing Americas Enduring Wilderness Resource Department of Forest Resources, College of Natural Resources, University of Minnesota, St. Paul, MN.
- Cole, D.N., Hall, T.E. 1992, Trends in Campsite Condition: Eagle Cap Wilderness, Bob Marshall Wilderness, and Grand Canyon National Park. Res. Pap. INT-453. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 40 p.
- Leung Y., Marion J. L. 2000, Recreation Impacts and Management in Wilderness: A State-of - Knowledge Review, USDA Forest Service Proceedings RMRS-P-15-VOL-5.
- Lucas, R. C. 1985, Visitor Characteristics, Attitudes, and Use Patterns in the Bob Marshall Wilderness Complex, 1970-1982. Research paper INT-345, Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 32 p.
- McCool, S.F., Lucas, R. C. 1989, Managing Resources and People in Wilderness: Accomplishments and Challenges, paper included in Managing Americas Enduring Wilderness Resource, Proceedings of the Conference, Minneapolis, MN. Sept. 1989, edited Lime, D.W., University of Minnesota, St Paul, MN. P.706.
- Marion, J. L., and Cole, D.N. 1995. Spatial And Temporal Variation in Soil And Vegetation Impacts On Campsites, Ecological Applications 6(2). 1996 by the Ecological Society of America.

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