Some Observations on CAMPGROUND TRAMPLING & Ground Cover Response

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WILBUR F. LAPAGE received his Bachelor's and Master's degrees at the University of New Hampshire, and studied social research methods at the University of Michigan's Institute for Social Research. He joined the Forest Service in 1959 and worked on the recreation survey of the Wasatch National Forest, in Utah and Wyoming. In 1962, he transferred to the Northeastern Forest Experiment Station's recreation research project in Warren, Pennsylvania, becoming project leader in 1964. Currently, he is a member of the Station's recreation research staff located at the New York State College of Forestry, Syracuse, New York.

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Trampling, a Threat to Natural Growth

TRAMPLING of recreation sites frequently has been reported as a serious threat to the natural attractiveness of developed recreation areas (Clawson 1959, DeVoto 1953, James and Ripley 1963). Previous studies of the impact of trampling upon soils and plants have been restricted almost entirely to after-the-fact analyses of forested parks and playgrounds that have been used and over-used for decades (LaPage 1962, Lutz 1945, Magill and Nord 1963, Meinecke 1929). Much valuable information about species tolerance levels and rates of decline has never been collected because after-the-fact studies make it impossible to reconstruct the appearance of soils and plants at different stages of park use. However, Wagar (1964) made a major advance in gaining information about species tolerance when he studied simulated recreation conditions in which different intensities of recreation use were applied to a narrow range of soils and vegetation to measure their reaction to trampling.

A more useful method of gaining the needed information would be to measure vegetative change concurrently with actual recreation use. Therefore, in 1963, the Northeastern Forest Ex-

periment Station began a continuing study to record changes that occur in the composition and density of ground cover on a series of permanent plots located throughout 17 units of a 40-unit campground in the new Buckaloons camping area in the Allegheny National Forest.

The Buckaloons campground is located on a flood plain of the Allegheny River in northwestern Pennsylvania. The soil here is Chagrin silt loam, a deep, well-drained, and productive soil originating from sediments of sand, silt, and gravel washed down from the glaciated upland. The vegetation present at the time the campground was established was that of a typical abandoned field containing an abundance of grass, moss, violets, goldenrod, asters, and associated species. Parts of the field were overgrown with a fairly dense stand of hawthorne, which provided some screening between camping units, but no shade.

The past 3 years of observation on these plots have produced several interesting and useful clues about the nature of trampling in an old-field type campground.

First-Year Findings

Just before the campground was opened to the public in June 1963, the low-growing vegetation on all plots was photographed, and plant density and species composition were determined by using a transparent 4-inch-square grid containing 100 evenly spaced dots (fig. 1). Plant density was recorded as the percent of living or dead ground cover (attached vegetation) present on six randomly selected 4-inch-square sampling units within each plot. Before camping use, most of the plots contained a dense 100-percent cover, averaging 11 species per campsite.

Re-examination of the plots in September 1963, after a season of use, revealed a reduction in the abundance of vegetative cover as well as fewer plant species present. The average loss of plant cover for all campsites was found to be 45 percent. Campsites that had received 150 camper-days of use throughout the summer averaged less than a 10-percent loss in vegetative cover. However, loss of vegetative cover increased to 60-percent for 300 camper-days of use (fig. 2).

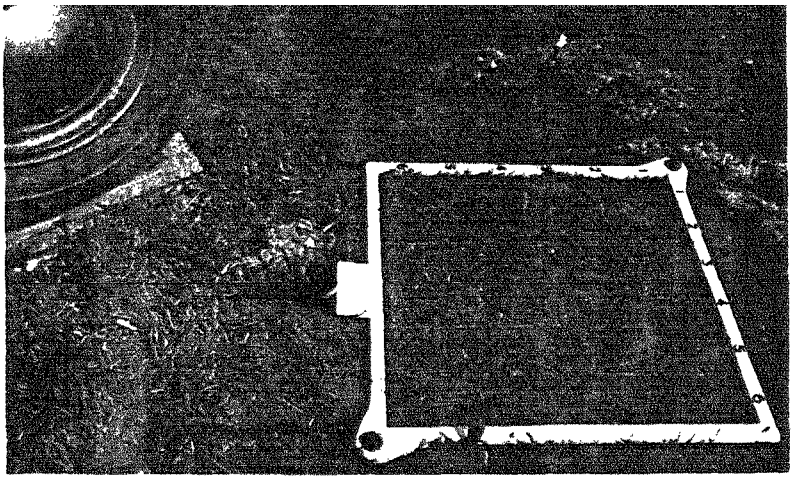


Figure 1.—Four permanent sample plots like this one were located at the center of each campsite. No restrictions were placed on trailer parking or other activities so that all sites would experience normal camping pressures.

The logarithm of camper-days use and reduction of ground cover, presented in figure 2, provides the best description of the relationship and explains 78-percent of the variation in ground cover present at the end of the first year. This curvilinearity indicates, for this site at least, that restricting the average amount of use to 200 campers or fewer per season might be a feasible way of minimizing native cover loss.

Such severe restrictions are hardly an economic use of developed resources and may only be prolonging the inevitable anyway. Subsequent observations made during the second and third years suggest that the original ground cover composition is probably destined for replacement by more resistant species.

Reductions in the number of species making up the ground cover were not significant during the first year. Throughout the 17 sites, the average number of species declined from 11 to 9.

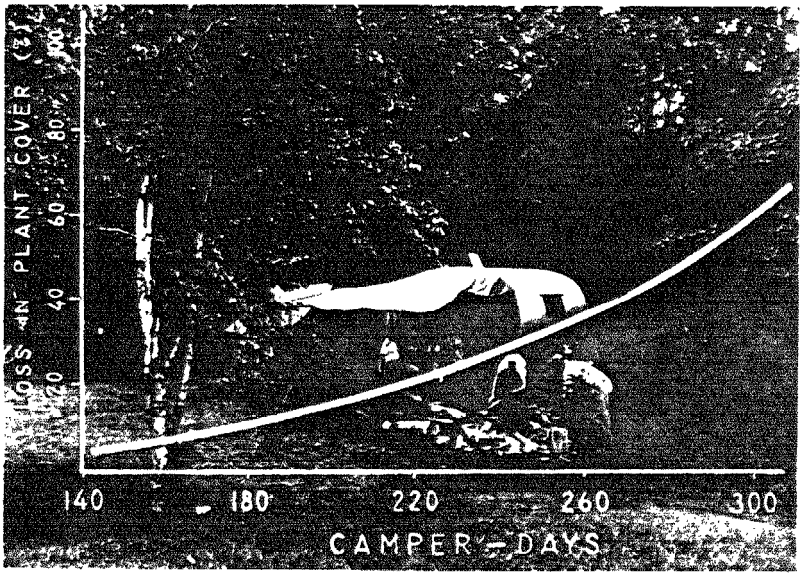


Figure 2.—Loss of ground cover (as a percent of original cover) on an old field campground during the first year of campground use. This relationship is expressed by the formula:
Log % cover loss = −6.991 + 3.541 log camper-days.

Three campsites actually showed a slight increase in the number of species present.

The plants most seriously reduced at the close of the season were the larger species such as goldenrod and asters. Those specimens that remained were usually restricted to a single basal rosette. Also, large carpets of moss, present in the spring, were badly damaged by fall.

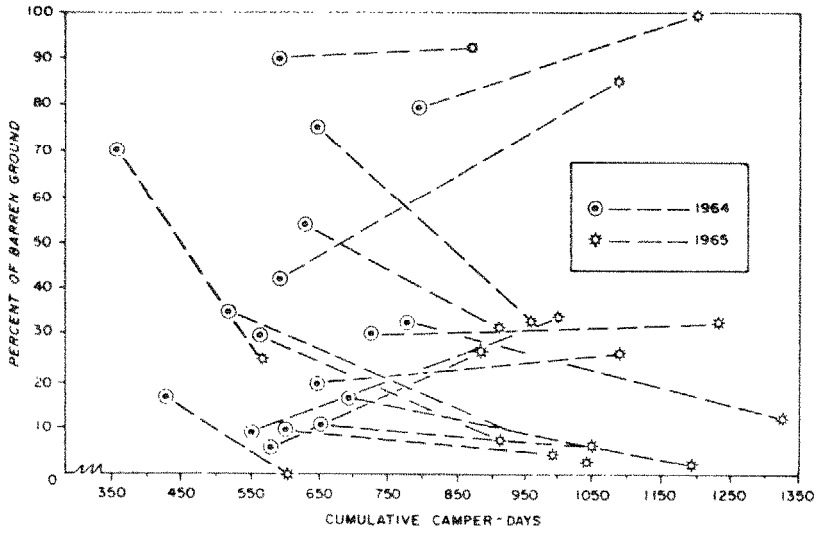
A fairly distinct size rule seemed to be operating in favor of the smaller annual plants during this first year. Small-leaf plants such as yarrow, sheep sorrell, and oxalis fared better than violets and cinquefoil, but not as well as the narrow-leaved grasses. Even among the grasses, the size rule seemed to operate, with orchard grass showing less tolerance to trampling than bluegrass or bent grass. This superior tolerance of grasses over dicotyledonous herbs agrees with the findings of Wagar (1964) on plant response to simulated recreation use in Michigan, and with that of Bates (1935) on the vegetation of compacted footpaths in England.

Second-Year Findings

From the fall of 1963 to the spring of 1964 the study sites received little use and recovered nearly half of the vegetation lost during the previous camping season, leaving them approximately 26-percent barren at the start of the second summer. By fall, cover losses had again increased, but only to 37-percent of the area. This 9-percent gain in cover over the previous fall occurred during an exceptionally dry summer when camping use had increased from an average of 237 days in 1963 to 351 days per site in 1964.

The variation present in campsite cover conditions by the fall of 1964 reflected a direct relationship with total campsite use, but showed no relationship with second-year use-intensity alone. Apparently the strong effect of the first year of use on the area continued to be evident after 2 years of cumulative use. However, as the barren ground became revegetated with a more re-

Figure 3.—The distribution of barren ground in 1964 and 1965 according to the intensity of cumulative use. The variability in plot condition in 1964 alone reflects a direct relationship with use intensity. This direct relationship had disappeared by the fall of 1965. The change in plot condition from 1964 to 1965 (dashed lines) shows no consistent relationship with cumulative use.



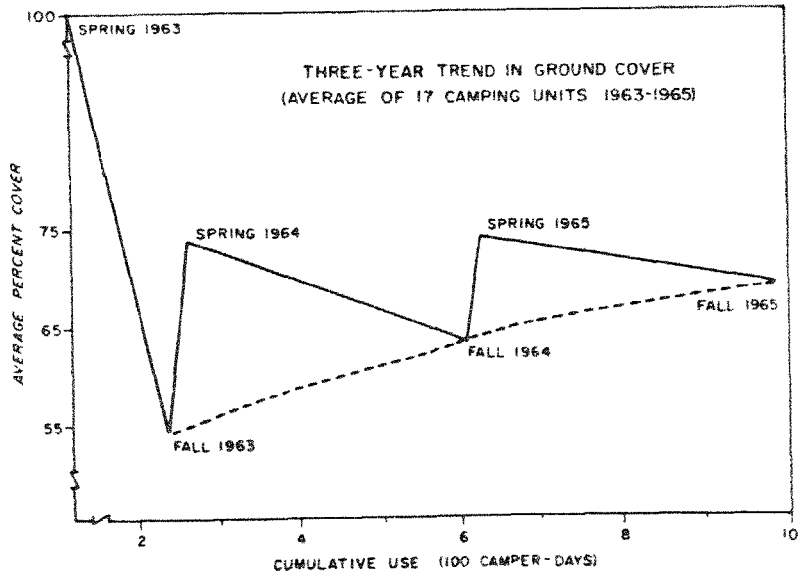
sistant cover, the relationship between barren ground and cumulative man-days of use weakened and disappeared entirely by the end of 1965 (fig. 3).

Most of the original species present in early 1963 had become less abundant by the fall of 1964. Although the field originally supported a dense growth of goldenrod, only an occasional stunted specimen could be found. Some of the original species, particularly bluegrass, had greatly increased in abundance. And a new species that thrives on compacted sites—path rush—had become increasingly common. The average number of species per campsite was reduced to six by the end of the second season.

Third-Year Findings

The relationship between use intensity and campsite condition became even more erratic in 1965. Under increasing pressures of use, some sites continued to lose ground cover, others gained, and still others barely changed (fig. 3).

Figure 4. — Annual and seasonal change in average ground cover on 17 campsites subjected to normal camping pressures.



Average campsite use increased to 368 camper-days, and average barren area stood at 31 percent in the fall after a recovery to 26 percent in the spring (fig. 4). The change in campsite condition from the end of the second to the end of the third camping season reflected a general pattern of increasing cover occurring simultaneously with increasing use (fig. 3). This general improvement in campsite condition was clearly the result of more resistant species taking over the barren ground previously occupied by the original plant community.

Although occasional specimens of the broad-leaved community have survived, and a few pioneer species have appeared, the total number of species has declined steadily during these 3 years of campground use. Both the total species represented and the average numbers of species per campsite have been reduced by more than 50 percent.

	Total species (No.)	*Average per site (No.)*
1963:		
Spring	37	11
Fall	29	9
1964:		
Spring	31	11
Fall	23	6
1965:		
Spring	19	6
Fall	17	5

By an annual ranking of species according to their frequency of occurrence (maximum frequency would be 17) it is possible to arrive at some tentative conclusions concerning the relative tolerance of various species to trampling (table 1).

Among the relatively tolerant species, bluegrass moved from a rank of 3 in 1963 to 17 in 1965; path rush appeared on 2 sites in the fall of 1963 and spread to 9 sites 2 years later, and bent grass was one of the 3 most abundant species every year. Among broad-leaved plants, clover was the only species to demonstrate any real tolerance of trampling.

Rapidly declining species that were originally abundant were cinquefoil, goldenrod, wild strawberry, and fescue, which were all eliminated; and yarrow, oxalis, sheep sorrel, and moss, which were seriously reduced over the 3-year period.

Table 1.—*Plant species present and their frequencies of occurrence during spring and fall examinations for 3 years of camping-use*

Species[1]	Frequency					
	1963		1964		1965	
	Spring	Fall	Spring	Fall	Spring	Fall
Cinquefoil *(Potentilla)*	14	5	10	2	1	0
Yarrow *(Achillea)*	14	10	10	5	5	3
Bent grass *(Agrostis)*	13	15	16	13	16	13
Fecue *(Festuca)*	13	10	4	3	1	0
Goldenrod *(Solidago)*	12	4	9	0	0	0
Hair-cup moss *(Polytrichum)*	11	8	13	9	8	3
Wood sorrel *(Oxalis)*	10	7	9	1	0	1
Sheep sorrel *(Rumex)*	9	11	12	5	5	4
Speedwell *(Veronica)*	9	4	10	3	1	0
Violet *(Viola)*	9	9	11	5	7	4
Wild strawberry *(Fragaria)*	8	7	7	1	0	0
Timothy *(Phleum)*	6	0	2	3	3	3
White heath aster *(Aster)*	5	3	0	0	0	0
Buttercup *(Ranunculus)*	4	3	3	2	4	1
Loosestrife *(Lythrum)*	4	2	3	0	0	0
Plantain *(Plantago)*	3	5	6	5	6	4
White campion *(Lychnis)*	3	6	4	4	6	3
Clover *(Trifolium)*	3	3	10	7	8	9
Orchard grass *(Dactylis)*	3	1	3	2	4	2
Bluegrass *(Poa)*	3	11	12	14	15	17
Sedge *(Carex)*	2	2	2	1	0	0
Nettel *(Urtica)*	2	0	1	0	0	0
Foxtail *(Setaria)*	2	2	4	0	0	0
Heal-all *(Prunella)*	2	2	0	0	0	0
Milkwort *(Polygala)*	2	0	0	0	0	0
Grapefern *(Botrychium)*	1	0	0	1	0	0
Dandelion *(Taraxacum)*	1	1	0	0	0	0
Hawthorne *(Crataegus)*	1	1	2	0	0	0
Field mint *(Mentha)*	1	0	0	0	1	0
Hawkweed *(Hieracium)*	1	1	1	1	0	0
Bindweed *(Convolvulus)*	1	1	0	0	0	0
Wild rose *(Rosa)*	1	0	1	0	0	0
Wild onion *(Allium)*	1	0	0	0	0	0
Wild carrot *(Daucus)*	1	1	3	0	0	0
Field madder *(Galium)*	1	0	0	0	0	0
Wild parsnip *(Pastinaca)*	1	1	1	0	0	0
Elder *(Sambucus)*	1	0	0	0	0	0
Path Rush *(Juncus)*	0	2	3	6	8	9
Chickweed *(Cerastium)*	0	0	4	2	3	2
Bluet *(Houstonia)*	0	0	1	0	0	0
Fall panicum *(Panicum)*	0	0	2	5	2	4
Mustard *(Brassica)*	0	0	0	0	0	1

[1]All species identifications are tentative because specimens were often badly mutilated by trampling and could not be removed from the plots for detailed examination without damaging the study's basic objective of determining plant survival under actual trampling conditions.

Discussion

Maintenance of a vigorous ground cover is probably not a primary concern of most campground managers. However, trampling, as it affects long-term recreation-management goals has an undeniable influence on site preservation. And this campground with its abundant and varied ground cover provides an ideal opportunity to study campground ecology. Although only 3 years of observation have been compiled, several interesting and potentially useful aspects of trampling have been uncovered.

Ground cover losses were generally higher on camping units with stationary picnic tables. Movable tables apparently help to spread the wear and prevent the early formation of paths between fireplace, table, and parking space.

Revegetation with bent grass, bluegrass, and path rush was often best in areas where large patches of moss had died, but where enough stems had remained to trap the wind-blown seed and hold it against bare soil. Campground management could probably duplicate this effect by spreading a thin layer of straw on bare spots immediately after the Labor Day weekend. A logical extension of this revegetation process would be the direct seeding of these grasses, accompanied by restrictions on use during the late fall and early spring months when sites are damp and most easily compacted.

Some of the most lightly used campsites were also the ones that experienced the greatest loss of ground cover. In each of these cases some unusual circumstance of campsites use was evident as the probable cause of accelerated wear. Loose, abrasive, gravel that had strayed from the campground roads, from the built-up tent pads, or from crumbling fireplaces (fig. 5) was frequently found on campsites that had experienced an unusually heavy cover loss. Other sites used lightly, but effectively screened from sun and air for extended periods of time by plastic ground cloths and canvas tent floors, also experienced excessive loss of vegetation.

These observations indicate that trampling, expressed simply as man-days of use, is not an adequate measure of the impact of camping on vegetation. Some measure of the quality or character

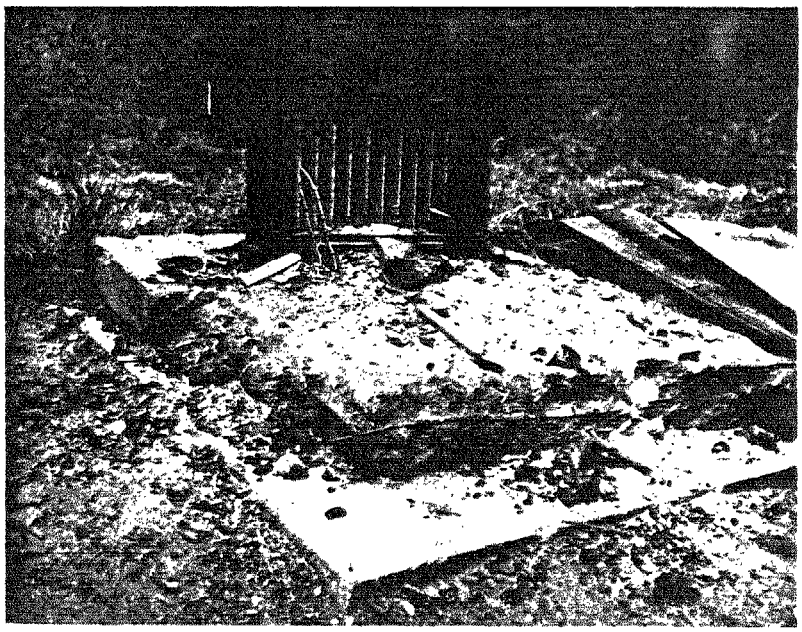


Figure 5.—Rubble from this disintegrating fireplace is scattered over a wide area, and its abrasive action underfoot will accelerate the destruction of existing ground cover.

of recreation use is needed that will explain the destruction of ground cover more realistically than simple use intensity does.

The following conclusions have resulted from observations on this study to date:

- An initial and inevitable heavy loss of ground cover follows the onset of camping-use, and the extent of the loss is strongly related to the intensity of first-year use, expressed as camper-days.
- The plant species composition of the original cover undergoes a gradual rearrangement, in which the more compaction —and drought-resistant species become increasingly abundant.
- During the second, third, and following years the recreation-tolerant species advance while the original less-resistant species continue to retreat, with the result that the cover does

not respond to continued trampling in the same direct way that it did during the first year.

At present a more resistant ground cover is spreading over these campsites. From observations at other recreation areas it seems inevitable that this second growth will also decline under sustained trampling. Continued observation will make it possible to document the rate and nature of this decline.

But, similar studies will be needed of other sites and cover types. Ideally, these studies should include three distinct phases. During the initial phase those plant species of the original community that have the highest natural tolerance to trampling are identified. Second, by observing the subsequent decline of these species, it will be possible to determine their limits of endurance. This information should be of value in formulating realistic recreation-site management objectives. And, in the third and final phase, various methods of site rehabilitation can be tested to provide remedial measures for those recreation areas where plant tolerance limits have been exceeded.

These findings, along with those from similar studies on different sites, will help to provide guidelines for the design and intensive management of campgrounds to improve their ability to provide a sustained supply of high quality outdoor recreation experiences.

Literature Cited

Bates, G. H.
1935. VEGETATION OF FOOTPATHS, SIDEWALKS, CART-TRACKS, AND GATEWAYS. J. Ecol. 23: 470-487.

Clawson, Marion
1959. THE CRISIS IN OUTDOOR RECREATION. Amer. Forests 65(3): 22-31, 40-41.

DeVoto, Bernard.
1953. LET'S CLOSE THE NATIONAL PARKS. Harpers 207(1241): 49-52.

James, George A., and T. H. Ripley.
1963. OVERUSE—A THREAT TO OUR DEVELOPED RECREATION AREAS. Amer. Recreation J. 4(3): 5-6.

LaPage, Wilbur F.
1962. RECREATION AND THE FOREST SITE. J. Forestry 60: 319-321.

Lutz, H. J.
1945. SOIL CONDITIONS OF PICNIC GROUNDS IN PUBLIC FOREST PARKS. J. Forestry 43: 121-127.

Magill, A. W., and E. C. Nord.
1963. AN EVALUATION OF CAMPGROUND CONDITIONS AND NEEDS FOR RESEARCH. U. S. Forest Serv. Res. Note PSW-4, 8 pp., illus. Berkeley, Calif.

Meinecke, E. P.
1929. THE EFFECT OF EXCESSIVE TOURIST TRAVEL ON THE CALIFORNIA REDWOOD PARKS. 20 pp. California State Printing Office, Sacramento.

Wagar, J. Alan.
1964. THE CARRYING CAPACITY OF WILD LANDS FOR RECREATION. Forest Sci. Monog. 7. 24 pp., illus.