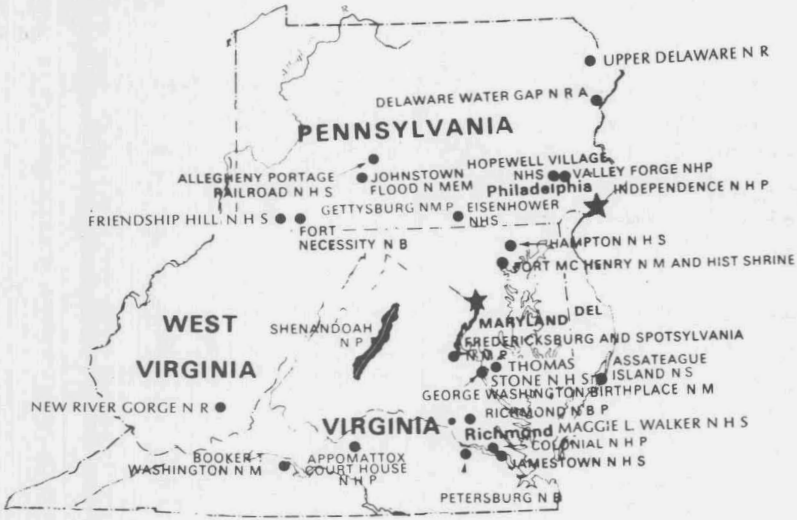
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# MID-ATLANTIC REGION

# RESEARCH/RESOURCES MANAGEMENT REPORT

U.S. DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

MID-ATLANTIC REGIONAL OFFICE
143 SOUTH THIRD STREET
PHILADELPHIA, PENNSYLVANIA 19106

FINAL REPORT

May 18, 1988

# AN ANALYSIS OF VISITOR IMPACTS AND REHABILITATION METHODS FOR BACKCOUNTRY CAMPSITES AT SHENANDOAH NATIONAL PARK

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# INTRODUCTION

In the late 1970's and early 80's, Shenandoah National Park received more backcountry use on a per acre basis than any area within the National Park System. The resulting environmental impacts in popular camping areas were obvious even to the casual observer and detracted significantly from many visitors' backcountry/wilderness experience. Even though camping adjacent to or within sight of trails, shelters or roads was prohibited by regulation, significant impact within these zones was prevalent. Campsites were typically chosen next to trails due to terrain suitability, outstanding views, proximity to water or simply because of convenience to the camper. Because of their high visibility, many campsites adjacent to trails drew repeated illegal use. Other popular camping areas, although in accordance with Park regulations, were severely impacted due to long term repeated use. Both legal and illegal camping caused similar types of resource impacts: trampled vegetation, large areas of exposed, eroded, and compacted soils, damage to trees, multiple fire rings and charcoal litter, and food remnants and trash.

The nature and extent of these environmental impacts along with methods for rehabilitating such impacts were unknown. Therefore, beginning in 1981, Shenandoah Resource Manager David Haskell and District Rangers initiated a parkwide study. The objectives of the study were to provide quantitative information

on the type and degree of impact on backcountry resources from camping and to determine the most effective methods of rehabilitating severely impacted campsites.

# METHODS

The study plan called for both an inventory of backcountry campsites and an evaluation of campsite rehabilitation procedures. This work was divided into three phases:

## Phase I

Initiated in 1981, all campsites adjacent to, or easily located from trails, were mapped on U.S. Geological Survey 7.5' maps and inventoried using the Impacted Backcountry Campsite Inventory form in Appendix 1. Each campsite inventory included: 1) campsite number, park district, and date; 2) trail code and trail name; 3) size of impacted area ($m^2$); 4) distance from water (m); 5) distance from trail (m); 6) elevation (ft); 7) slope (%); 8) aspect (8 categories); 9) presence and type of campsite developments; 10) degree of erosion (4 categories); and 11) vegetation type (9 types).

A campsite rehabilitation study was also initiated in 1981. Fifteen campsites, five in each of three elevation ranges (<2,000 ft., 2,000-3,000 ft., and >3,000 ft.) were to be selected for rehabilitation. These campsites were restricted to three trails in each park district (North, Central, and South) with known impact problems.

Campsite rehabilitation work was done in the fall on all sites and included the following:

1) loosening of the soil to a depth of 3 inches with a mattock and council tool to reduce soil compaction and increase water infiltration, and
2) incorporation into the soil of partially decomposed leaves and twigs to improve fertility and soil humus, and
3) placement of large rocks, branches, and small logs in the campsite area to renaturalize the site and discourage future use,

Color photographs were taken from permanently marked photo points before and after rehabilitation work and each September for two years. Phase I campsites were not posted against camping but ongoing law enforcement efforts regarding illegal camping were continued.

Phase II

All campsites along the three selected trails from each park district were reinventoried during September and October of 1982. From these sites, fifteen additional sites were to be selected and rehabilitated using the elevation range breakdown described above. In addition to the rehabilitation methods described above, several new methods were employed on separate groups of campsites in 1982 : 1) the erection of "No Camping" signs, 2) the placement of natural barriers such as logs,

branches, and rocks along access trails, or 3) the soil was not loosened. Specific treatment methods were noted on site forms. Color photographs were taken from permanently marked photo points as described in Phase I.

Campsites rehabilitated in 1981 were evaluated in September 1982 using the Campsite Rehabilitation - Site Evaluation form in Appendix 1. Each campsite rehabilitation assessment included: 1) site number, park district, and date; 2) trail code and trail name; 3) previous impacted area ($m^2$); 4) present impacted area ($m^2$); 5) percent recovered (%); 6) dominant plant species on recovered area; 7) signs posted (Y/N); 8) barriers erected (Y/N); and 9) number of law enforcement actions for site over the survey period.

Phase III

All campsites along the three selected trails from each park district were to be reinventoried during September and October of 1983. The 30 rehabilitation sites in each district were evaluated again in September 1983 using the Campsite Rehabilitation - Site Evaluation form.

Shenandoah District Rangers conducted all campsite inventories and rehabilitation work, including site selection and rehabilitation evaluation. In December of 1985 all data was sent to Regional Research Biologist Jeff Marion for coding, computer data entry, and analysis. Results were presented to Park staff in March 1986.

## RESULTS AND DISCUSSION

### Campsite Inventory

One thousand and eleven campsites were inventoried during the three-year period (Table 1). More than half of the campsites were in the Central District (N=623), followed by the South District (N=288); the North District had the fewest (N=100). Rangers from the three districts estimated that approximately 80% of the campsites in their districts were inventoried. Based on this estimate there were approximately 1200 backcountry campsites in Shenandoah National Park during the study period. District Rangers note that most of the campsites not inventoried are those along rarely used trails and those located well off the more commonly used trails.

The average elevation for all campsites was 2070 feet but ranged from 800 to 4000 feet. The majority of the higher elevation campsites (>2500 feet) were found in the Central District (N=206) with campsites in the North District having the lowest elevations (Table 1).

Sixty-eight percent of the campsites (N=692) had either fire rings or fire scars, in spite of regulations which prohibit wood fires in the backcountry (Table 1). Evidence of fire building was most prevalent in the Central District where 73 percent (N=445) of the campsites had fire rings or scars.

Table 1. Campsite inventory information by park district.

| Parameter | Park District | | | Park Totals |
|---|---|---|---|---|
| | North | Central | South | |
| | --- number of sites --- | | | |
| Inventoried Campsites | 100 | 623 | 288 | 1011 |
| Elevation | | | | |
| 0-1500 ft | 51 | 188 | 92 | 331 |
| 1501-2500 ft | 34 | 217 | 141 | 392 |
| > 2500 ft | 15 | 206 | 53 | 274 |
| Campfires | | | | |
| Fire Rings | 73 | 414 | 61 | 548 |
| Fire Scars | 0 | 31 | 113 | 144 |
| None | 27 | 168 | 110 | 305 |
| Soil Erosion | | | | |
| Light | 55 | 202 | 91 | 348 |
| Moderate | 34 | 263 | 157 | 454 |
| Heavy | 10 | 133 | 35 | 178 |
| Severe | 1 | 21 | 1 | 23 |
| Vegetation Type[1] | | | | |
| Oak/Laurel | 2 | 159 | 34 | 195 |
| Oak/Hickory | 22 | 40 | 29 | 91 |
| Mixed Cove | 5 | 63 | 72 | 140 |
| Red Oak/Mixed Hardwood | 32 | 115 | 79 | 226 |
| Pine | 7 | 3 | 0 | 10 |
| Hemlock | 8 | 224 | 35 | 267 |
| Mixed Pine/Hardwood | 24 | 13 | 25 | 62 |
| Early Successional | 0 | 1 | 11 | 12 |
| Open | 0 | 2 | 1 | 3 |
| | --- average --- | | | |
| Elevation (ft) | 1727 | 2193 | 1921 | 2070 |
| Distance From Water (m) | 30 | 160 | 117 | 136 |
| Distance From Trail (m) | 15 | 33 | 59 | 39 |
| Campsite Size ($m^2$) | 56 | 56 | 48 | 54 |
| Erosion Index[2] | 1.6 | 2.0 | 1.8 | 1.9 |

[1] - Mixed Cove: Poplar/Ash/Maple/Sassafras,
Early Successional: Locust/Cherry/Walnut,
Open: Grass, Shrubs, Tree Seedlings/Saplings.

[2] - Numerical codes (1=Light, 2=Moderate, 3=Heavy, 4=Severe) were assigned to soil erosion categories to obtain a soil erosion index. Values were averaged for groupings of sites to permit relative soil erosion comparisons.

Campsite soil erosion, subjectively judged in categories ranging from light to severe, was not a problem on most campsites. Eighty percent of the campsites (N=802) had light or moderate levels of soil erosion (Table 1). Soil erosion was judged to be higher on campsites in the Central District (average erosion index = 2.0) and lowest on campsites in the North District (average erosion index = 1.6) (Table 1).

Campsites were found in all nine primary vegetation types; they were most common in the Hemlock (N=267), Red Oak/Mixed Hardwood (N=226), and Oak/Laurel (N=195) types, and least common in the Open (N=3) and Early Successional (N=12) types (Table 1).

On the average, campsites were located approximately 136 meters from the nearest water source. However, campsites in the North District were typically only 30 meters from water while the higher elevation Central District campsites averaged 160 meters.

Backcountry camping regulations require all campsites to be located out of view of primary trails. This requirement was evaluated on almost half of the inventoried campsites, 82 percent of which were in view of the trails. The average campsite distance from trails was 39 meters, ranging from 15 meters in the North District to 59 meters in the South District (Table 1).

Finally, campsite size, or the size of the impacted area, ranged from 2 to 998 square meters with a parkwide average of 54 square meters (Table 1). There was surprisingly little variation in average campsite size between park districts, although the South District was slightly lower with an average size of 48 square meters (Table 1).

Factors Affecting Campsite Impacts

A number of ecological and visitor use related factors can affect the type and amount of impact occurring at backcountry campsites. Use estimates for backcountry campsites are unavailable so this discussion will be limited to the ecological and geographical factors included in the inventory process.

A comparison of average campsite sizes and degree of campsite soil erosion by vegetation type (Table 2), reveals that the Early Successional vegetation type exhibits the least amount of impact and the Hemlock vegetation type exhibits the most. A review of the average campsite sizes by vegetation type might lead one to conclude that camping should be avoided, where possible, in coniferous vegetation types such as Hemlock, Pine, and Mixed Pine/Hardwood. There are a number of possible explanations for larger campsite sizes in these vegetation types, however. It may be that groundcover vegetation in these cover types are more easily trampled and removed by recreation activity. Alternatively, it may be that the groundcover vegetation associated with these denser cover types is naturally

Table 2. Size of impacted area and degree of erosion by vegetation type, elevation, distance to water, and distance to trail for all inventoried campsites (N=1011).

| Parameters | Campsite Size ($m^2$) | Erosion Index[1] |
|---|---|---|
| | average | |
| Vegetation Type[2] | | |
| Oak/Laurel | 39±8[3] | 1.9±0.2 |
| Oak/Hickory | 49±15 | 1.7±0.1 |
| Mixed Cove | 40±10 | 2.1±0.1 |
| Red Oak/Mixed Hardwood | 52±8 | 1.6±0.1 |
| Pine | 66±52 | 1.9±0.7 |
| Hemlock | 72±14 | 2.1±0.1 |
| Mixed Pine/Hardwood | 64±29 | 1.8±0.2 |
| Early Successional | 24±7 | 1.2±0.2 |
| Elevation | | |
| 0-1500 ft | 59±8 | 1.9±0.1 |
| 1501-2500 ft | 59±11 | 2.0±0.1 |
| > 2500 ft | 39±6 | 1.8±0.1 |
| Distance to Water | | |
| 0-10 m | 54±6 | 2.0±0.1 |
| 11-35 m | 64±14 | 1.8±0.1 |
| > 35 m | 47±8 | 1.8±0.1 |
| Distance to Trail | | |
| 0-15 m | 46±6 | 1.8±0.1 |
| 16-35 m | 51±9 | 1.9±0.1 |
| > 35 m | 62±11 | 1.9±0.1 |

[1] - Numerical codes (1=Light, 2=Moderate, 3=Heavy, 4=Severe) were assigned to soil erosion categories to obtain a soil erosion index. Values were averaged for groupings of sites to permit relative soil erosion comparisons.

[2] - Mixed Cove: Poplar/Ash/Maple/Sassafras,
Early Successional: Locust/Cherry/Walnut,
Open: Grass, Shrubs, Tree Seedlings/Saplings.

[3] - Mean values include 95% confidence intervals.

sparse and evaluators simply estimated larger campsite sizes. Finally, it may be that campsites in these particular cover types receive more recreational use. Given these problems it would be inappropriate to recommend the shifting of existing use to avoid or promote camping use in specific vegetation types.

With respect to elevation, campsites above 2,500 feet generally were smaller and had less soil erosion (Table 2). This may be due to lower use levels at the higher elevations.

Campsites intermediate in distance from water were larger, on the average, than campsites closer to or further from water (Table 2). Campsites close to the water may be geographically restricted in size by steep slopes, as indicated by the higher soil erosion index for these sites (Table 2). Campsites at greater distances from water most likely receive considerably less use.

Campsite sizes increased with increasing distance from trails (Table 2). This may indicate that many visitors are camping well off the trails, although, as reported earlier, as many as 82 percent of the campsites are still within sight of a trail.

Campsite Rehabilitation

Actual implementation of the campsite rehabilitation study differed somewhat from that described in the Methods section. The numbers of campsites selected for rehabilitation work during

1981 and 1982 differed from the 15 per year specified (Table 3). For instance the South District rehabilitated more than 15 sites the first year and fewer the second year. The total however, was still 30, as planned. Furthermore, some of the campsites rehabilitated initially in 1981 were also rehabilitated one or more times in 1982 and 1983 while others received no additional rehabilitation work. This was done in response to rehabilitated sites being camped on again. Each time a site was found to have been camped on it was rehabilitated again.

Campsites were selected for rehabilitation by District Rangers according to study guidelines. The length of the growing season is influenced by elevation, therefore campsites were selected from high, middle and low elevation ranges. Since other site parameters vary so widely in the Park, no attempt was made to further stratify the selection. A wide range of vegetation types, aspects, and other environmental features was included in this selection.

Rehabilitation success was evaluated by obtaining the difference in campsite sizes between years, dividing this difference by the earlier year's size, and multiplying by 100. For example, rehabilitation success for the entire study period would be computed as follows: ((1981 campsite size - 1983 campsite size)/1981 campsite size) * 100. Rehabilitation success, based on change in campsite sizes from 1981 to 1983, is shown in Figure 1.

Table 3. Campsite rehabilitation information by park district.

| Parameter | Park District North | Central | South | Park Totals |
|---|---|---|---|---|
| | number of sites | | | |
| Rehabilitated Campsites | | | | |
| Started in 1981 | 25 | 15 | 21 | 61 |
| Started in 1982 | 5 | 15 | 8 | 28 |
| Total (1981/82) | 30 | 30 | 29 | 89 |
| Soil Erosion (1981) | | | | |
| Light | 14 | 1 | 9 | 24 |
| Moderate | 8 | 4 | 13 | 25 |
| Heavy | 2 | 6 | 0 | 8 |
| Severe | 0 | 3 | 0 | 3 |
| Vegetation Type[1] | | | | |
| Oak/Laurel | 1 | 6 | 2 | 9 |
| Oak/Hickory | 11 | 2 | 1 | 14 |
| Mixed Cove | 0 | 7 | 5 | 12 |
| Red Oak/Mixed Hardwood | 3 | 3 | 13 | 19 |
| Pine | 0 | 1 | 0 | 1 |
| Hemlock | 7 | 11 | 0 | 18 |
| Mixed Pine/Hardwood | 8 | 0 | 4 | 12 |
| Early Successional | 0 | 0 | 5 | 5 |
| Visible from Trail | 18 | 5 | 12 | 35 |
| | average | | | |
| Elevation (ft) | 2358 | 2427 | 2414 | |
| Distance From Water (m) | 10 | 681 | 89 | |
| Distance From Trail (m) | 20 | 33 | 54 | |
| Campsite Size ($m^2$) | 67 | 71 | 64 | |
| Erosion Index[2] | 1.5 | 2.8 | 1.6 | |

[1] - Mixed Cove: Poplar/Ash/Maple/Sassafras,
Early Successional: Locust/Cherry/Walnut,
Open: Grass, Shrubs, Tree Seedlings/Saplings.

[2] - Numerical codes (1=Light, 2=Moderate, 3=Heavy, 4=Severe) were assigned to soil erosion categories to obtain a soil erosion index. Values were averaged for groupings of sites to permit relative soil erosion comparisons.

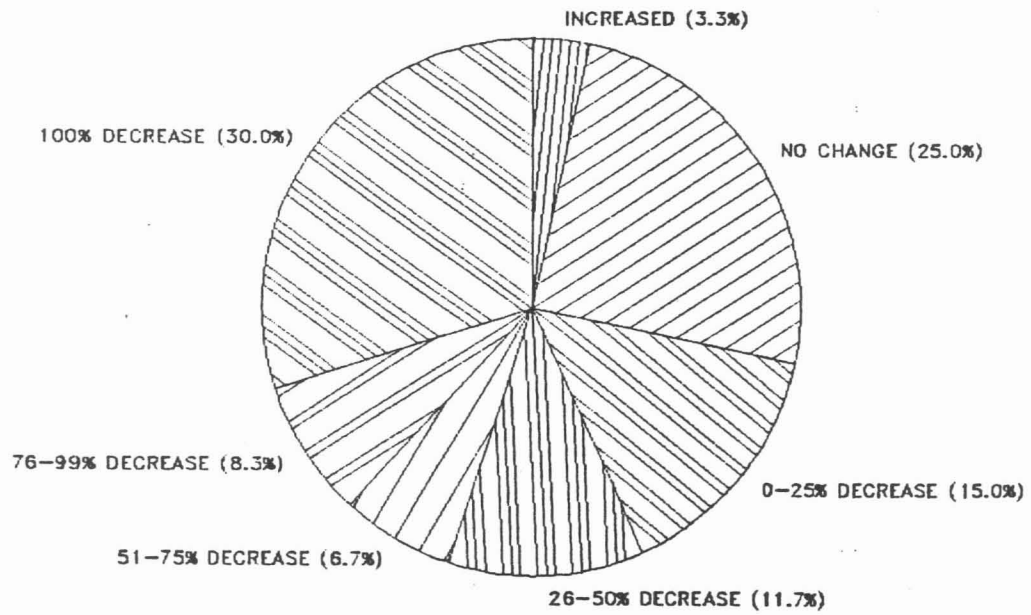



Figure 1. Rehabilitation success from 1981 to 1983 as indicated by changes in campsite size. Numbers in parentheses () indicate the percent of rehabilitated campsites which either increased or decreased in size by the specified amount. Percentages are based on a sample size of 60 campsites (29 campsites had missing data for campsite size in 1981).

In general, the rehabilitation work was successful: one-third of the campsites selected for rehabilitation work decreased 100 percent in size; 45 percent of the campsites decreased more than 50 percent in size (Figure 1). Only 3.3 percent of the campsites increased in size and 25 percent of the campsites remained the same size.

A decrease in campsite size does not, however, imply complete ecological recovery. Initial estimates of campsite sizes were based largely on a determination of campsite boundaries as evidenced by pronounced differences in vegetative ground cover and litter disturbance between onsite and offsite areas. Campsite size estimates following rehabilitation work were most likely based on the size of areas subsequently used by campers, as evidenced by removal of logs, branches and rocks, and by the flattening of vegetative groundcover and litter. Complete recovery, as defined by other studies, might require a decade or more under conditions of no recreational use.

A comparison of rehabilitation success for campsites first rehabilitated in 1981 to those first rehabilitated in 1982 is shown in Figure 2. Campsites rehabilitated in 1981 decreased in size by 26 percent the first year and by seven percent the second year. Campsites rehabilitated for the first time in 1982 decreased in size by only 14 percent the first year. The greater success for those sites first rehabilitated in 1981 could be due to the overturning of the soil as described under Phase I, Methods Section.

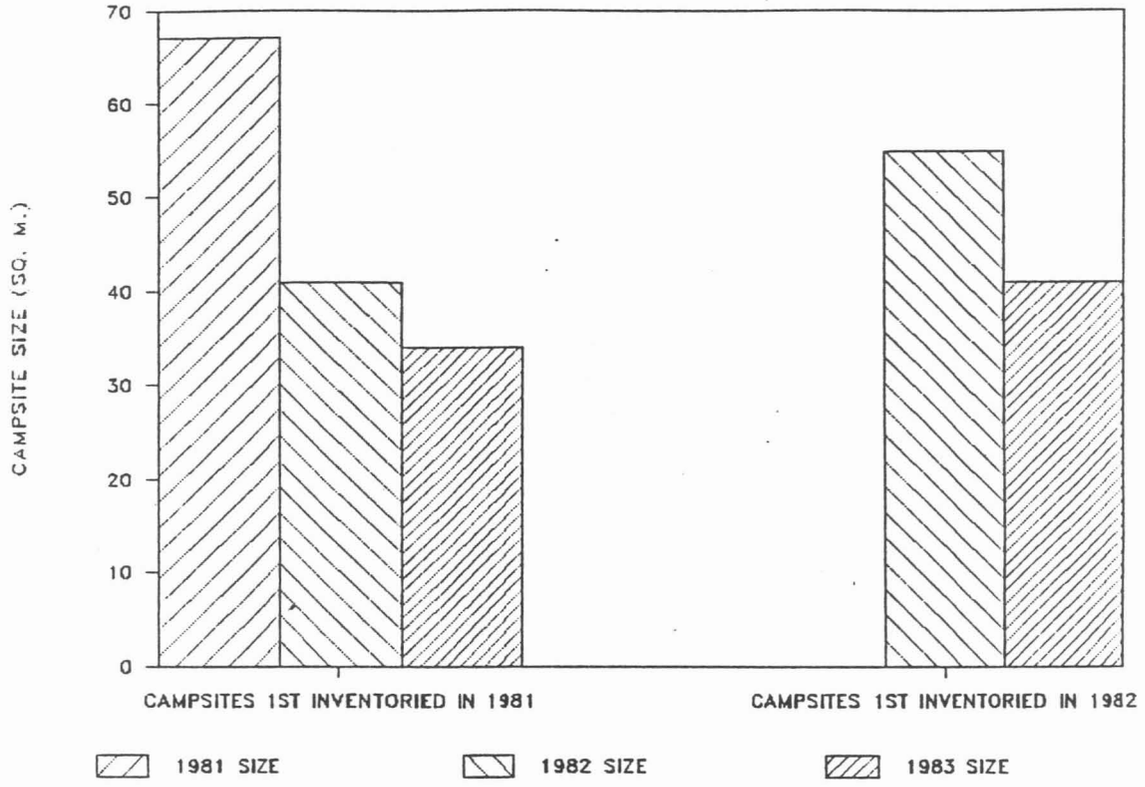



Figure 2. Campsite sizes by year for campsites first inventoried and rehabilitated in 1981 and those first inventoried and rehabilitated in 1982.

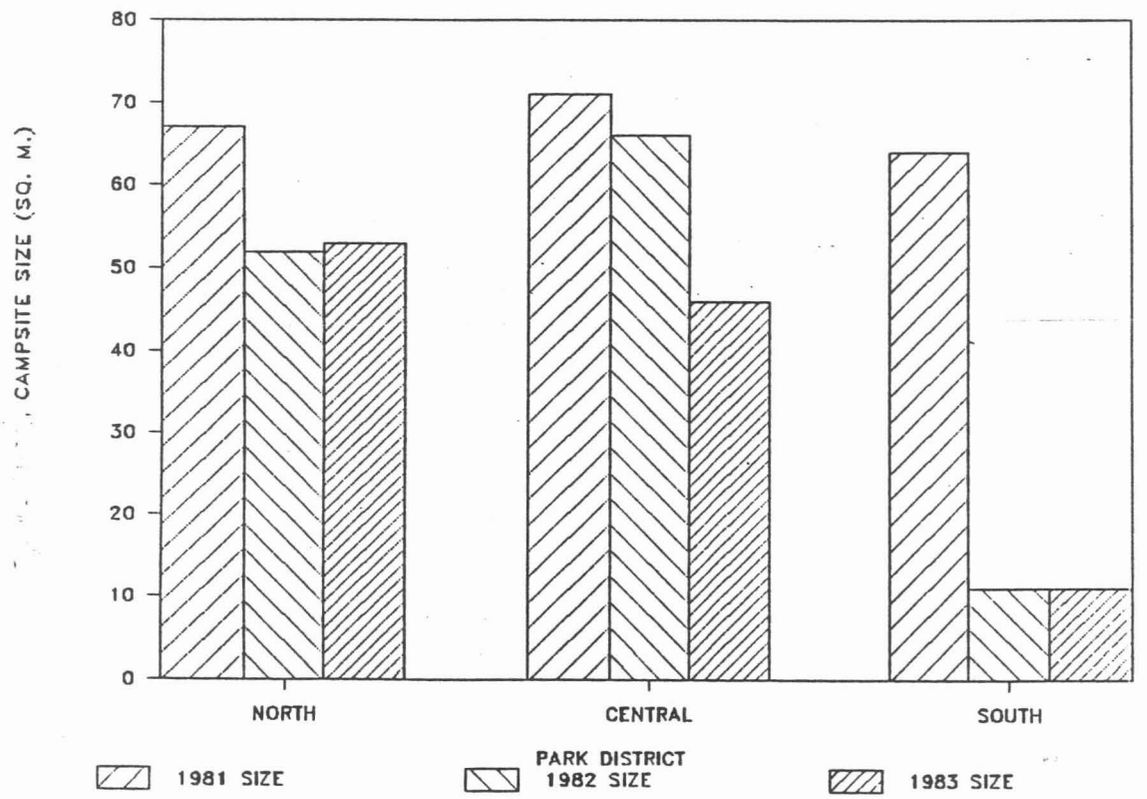



Figure 3. Campsite sizes by year for rehabilitated campsites in each of three park districts.

Campsites selected for rehabilitation in 1981 were also larger than those started in 1982 (Figure 1). Many of these campsites continued to be used and a minimum size necessary for camping might prohibit the campsites from decreasing below a certain limit unless all use is eliminated.

Rehabilitation success by park district, based on an examination of campsite sizes from 1981 to 1983, is shown in Figure 3. The most pronounced finding illustrated here is the dramatic success of rehabilitation in the South District between 1981 and 1982. Many of the rehabilitated campsites in the South District were in the vicinity of Appalachian trail shelters which were reopened for use during the study period. District Rangers noted that these campsites received considerably less use as campers shifted back to the shelters. The South District also receives less camping use than the Central and North Districts.

Factors Affecting Campsite Rehabilitation Success

A number of factors, including environmental, use-related, and management-related, will be examined in an effort to assess their influence regarding the effectiveness of the rehabilitation work. This discussion will be limited to the factors for which information was collected, although other factors, such as amount of campsite use, are clearly important.

Environmental Factors - Campsites at lower elevations (1000-1999 feet) had considerably lower rehabilitation success, as measured by percent reduction in campsite size from 1981 to 1983, than campsites at intermediate and high elevations (Figure 4). Lower elevation campsites are typically located along rivers and streams and receive high levels of use. These sites also often occur in dense hemlock stands, under which recovery of ground vegetation would be expected to proceed more slowly. Campsites with heavy to severe soil erosion ratings prior to rehabilitation had lower rehabilitation success than campsites with light to moderate erosion ratings (Figure 5). Steep topography and heavy camping use are the primary factors responsible for elevated levels of soil erosion. These findings might be interpreted to indicate that rehabilitation success is highest for campsites with light to moderate levels of camping use and located in areas of minimal slope.

Rehabilitation success was highest for campsites in the Early Successional vegetation type (100 percent) and lowest for campsites in the Mixed Pine/Hardwood (11 percent), Hemlock (20 percent), and Pine (28 percent) vegetation types (Figure 6). As described earlier, recovery of ground vegetation would be expected to proceed more rapidly in vegetation types with greater sunlight penetration. This is supported by research conducted in other areas. Research has also shown that the composition of ground vegetation in more open plant communities, typically dominated by grasses and sedges, is more resistant to

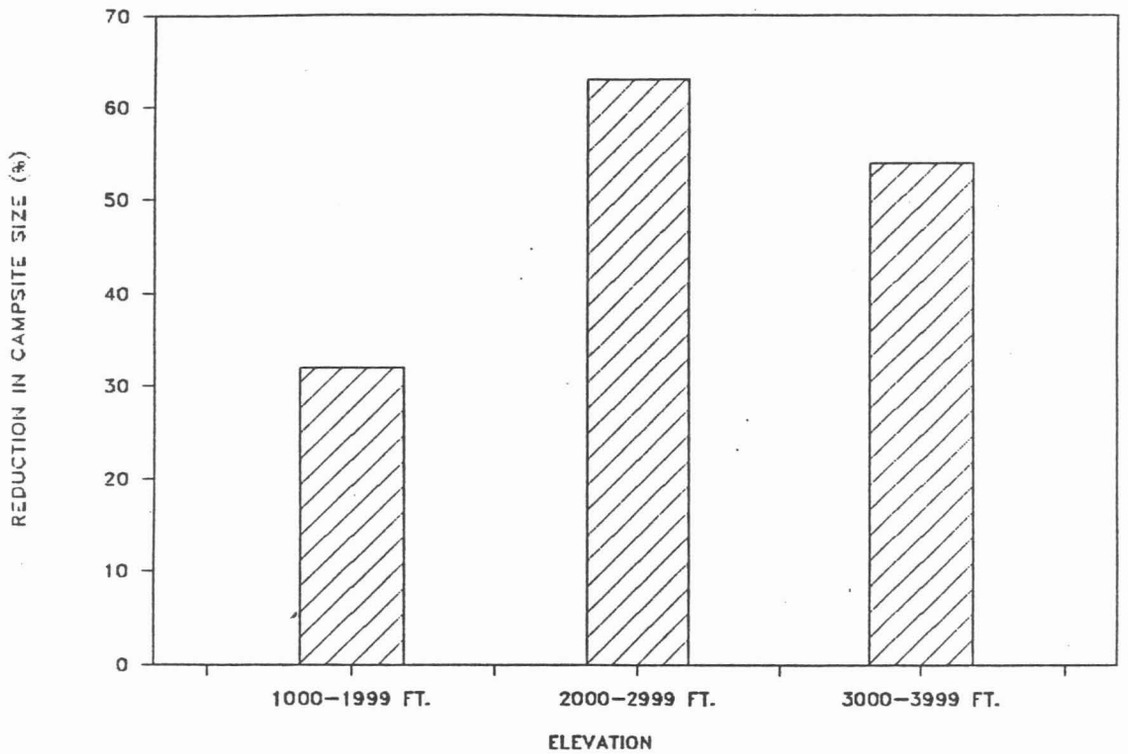



Figure 4. Percent reduction in campsite size between 1981 and 1983 for three elevation ranges.

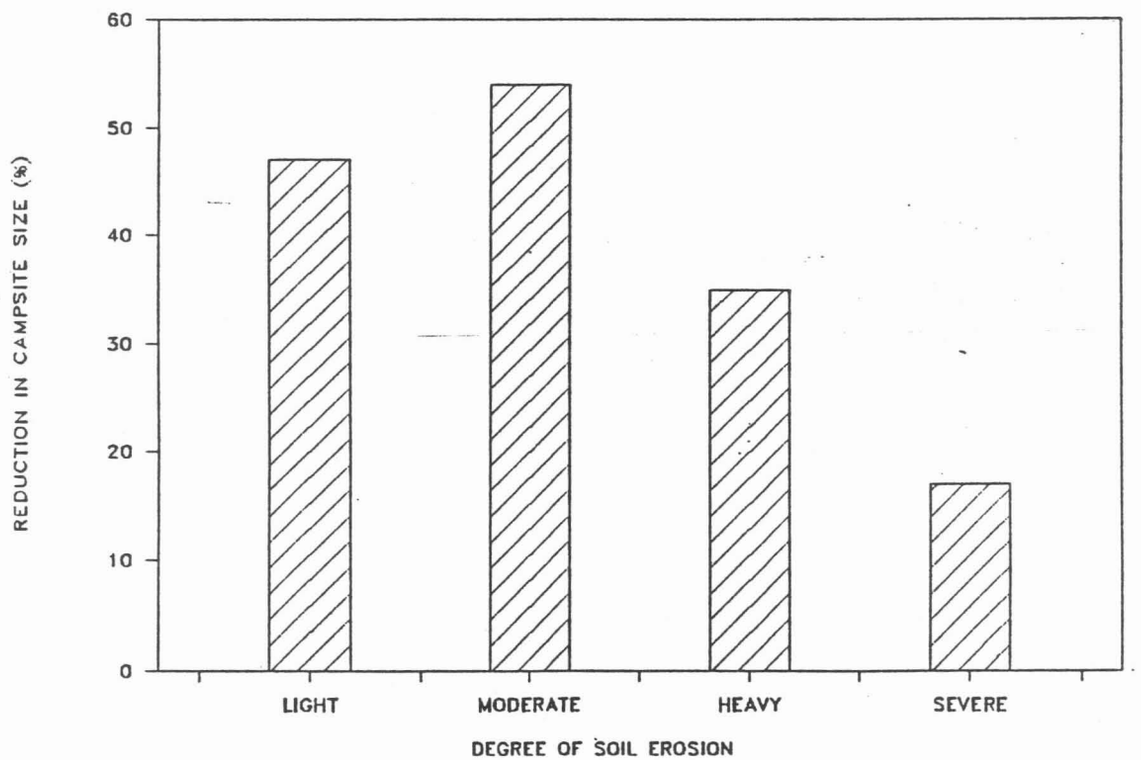



Figure 5. Percent reduction in campsite size between 1981 and 1983 for four soil erosion categories.

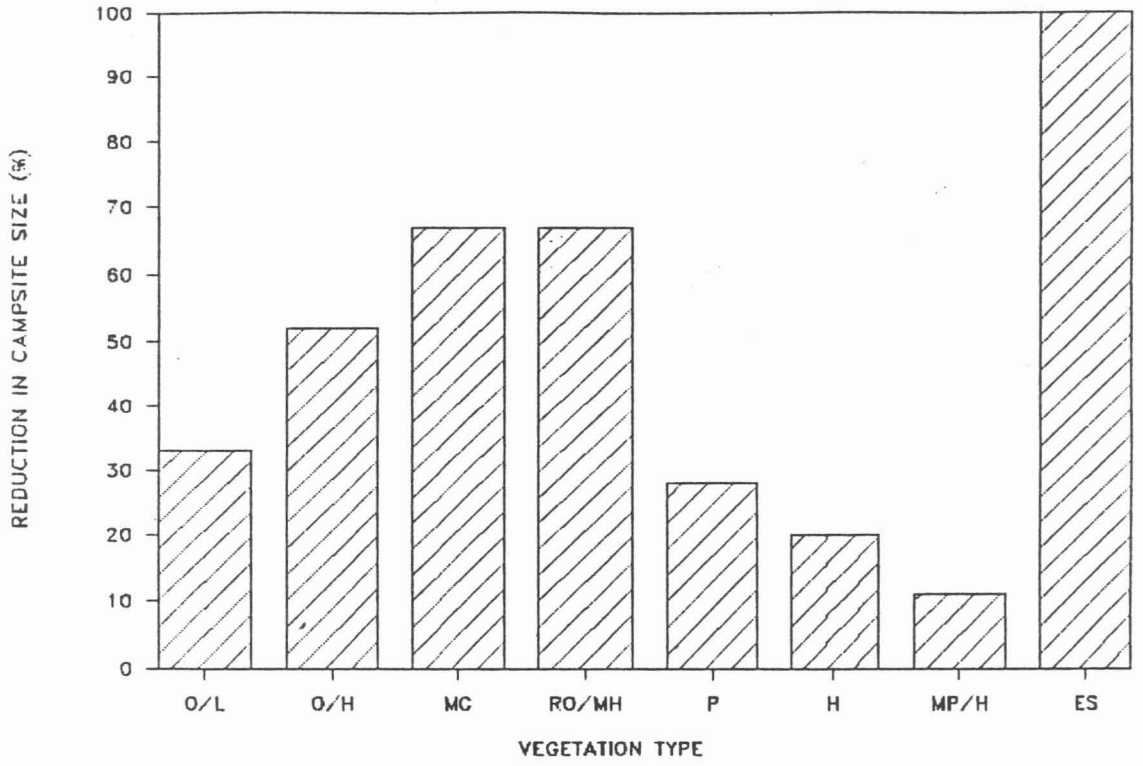



Figure 6. Percent reduction in campsite size between 1981 and 1983 for eight vegetation types: O/L - Oak/Laurel, O/H - Oak/Hickory, MC - Mixed Cove, RO/MH - Red Oak/Mixed Hardwood, P - Pine, H - Hemlock, MP/H - Mixed Pine/Hardwood, ES - Early Successional.

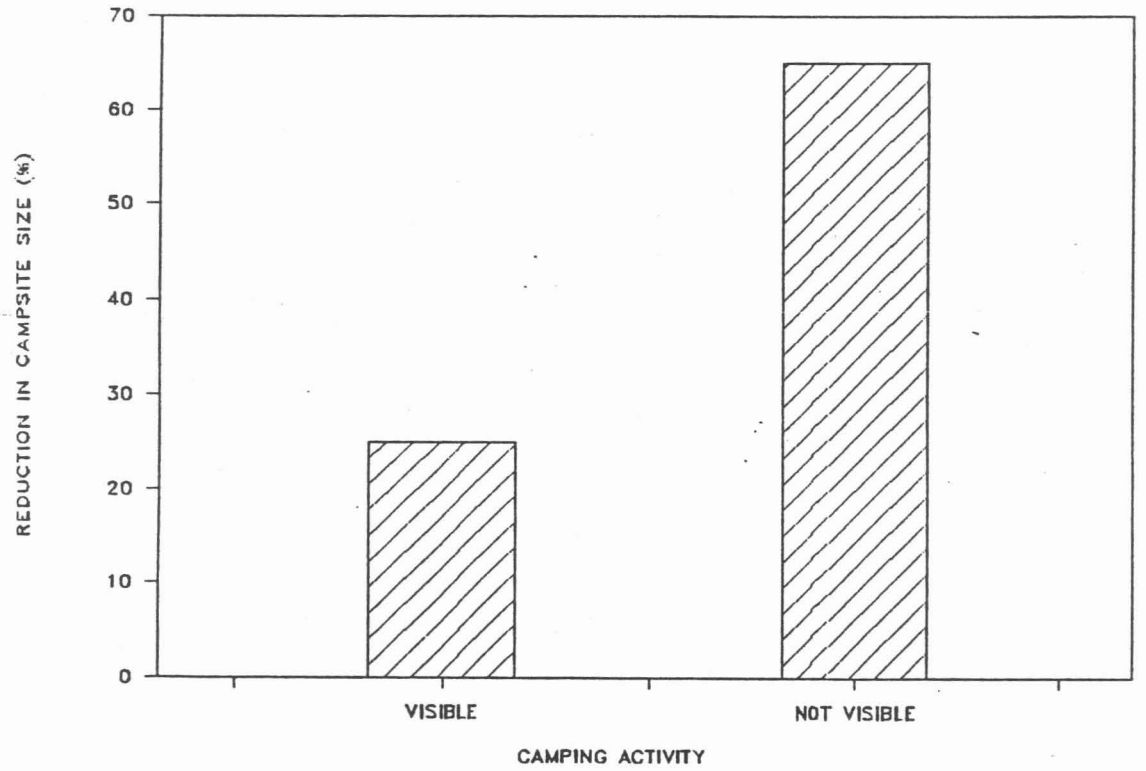



Figure 7. Percent reduction in campsite size between 1981 and 1983 for campsites with and without visible signs of camping activity following rehabilitation work.

trampling than the broad-leaved ground vegetation typical of plant communities with closed or dense overstories.

Use-Related Factors - Because the campsites were located in the backcountry, it was not possible to either alter or closely monitor the amount of camping use the sites received prior to or following rehabilitation work. However, rangers did track the number of law enforcement actions for illegal camping and commented on visible signs of campsite use during the study period. As expected, rehabilitation success was considerably higher for campsites which had no apparent use (Figure 7). It should also be noted that campsites which were successfully closed to use may well have received less use and been less impacted prior to the study than campsites with visible evidence of camping.

Rehabilitation success was also higher for campsites which were not visible from the nearest primary trail (Figure 8). As above, it is probable that campsites not visible from the trail received less use and impact before and after rehabilitation than "illegal" campsites which are within view of the trail. However, rehabilitation success for campsites very close to the trail (0-16 meters) was high, while campsites intermediate in distance from the trail (17-33 meters) was low (Figure 9). Backcountry rangers note that the campsites closest to the trail are obvious illegal campsites, and were generally avoided by campers following rehabilitation work.

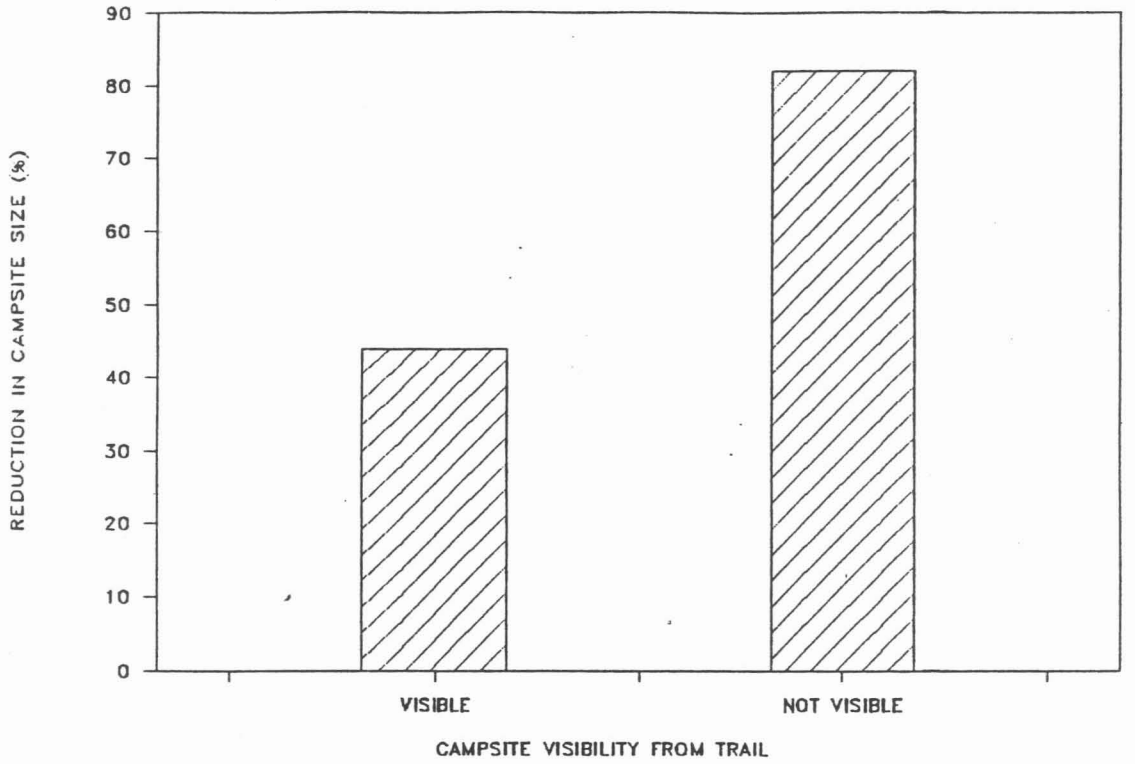



Figure 8. Percent reduction in campsite size between 1981 and 1983 for campsites visible and not visible from the nearest primary trail.

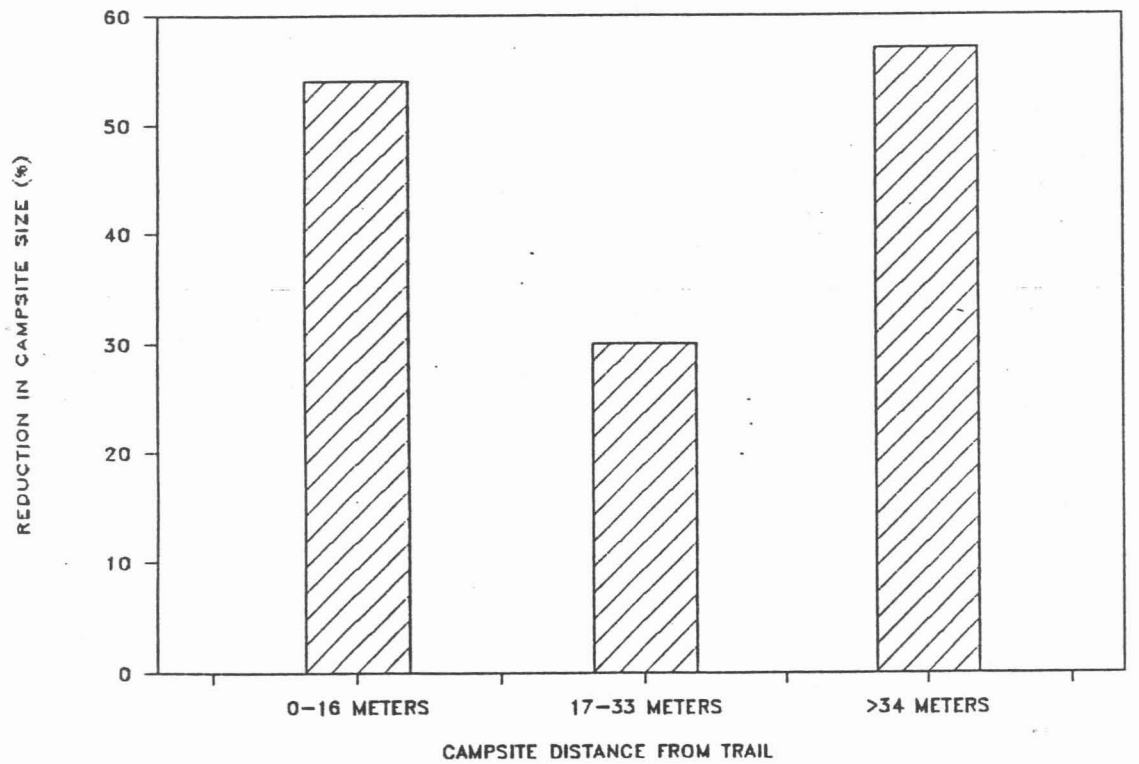



Figure 9. Percent reduction in campsite size between 1981 and 1983 for three distance from trail categories.

In contrast, campsites intermediate in distance are typically used the most by campers, who wish to obey the regulations but who are generally unwilling to hike significant distances off the trail to set up camp.

Results from rehabilitation success by distance from water mirror the distance from trail results discussed above (Figure 10). Again, park camping regulations, which prohibit camping within 25 feet of any stream or spring, appear to have increased rehabilitation success for campsites close (0-8 meters) to water. It is interesting to note that campsites located more than 34 meters from water had better rehabilitation success (77 percent) than campsites located more than 34 meters from trails (57 percent) (Figures 9 and 10). This may merely indicate that visitors are more concerned with distance to a water source than distance to the trail in selecting their campsites; campsites further from water recover more quickly because they receive less use.

**Management-Related Factors** - Several combinations of rehabilitation techniques were tried during 1982 to evaluate their effectiveness. These included the placement of natural barriers on campsites and along access trails, the erection of "No Camping" signs on campsites, and the omission of soil loosening. Unfortunately, documentation concerning which campsites did not receive soil loosening was insufficient for an evaluation of its effectiveness.

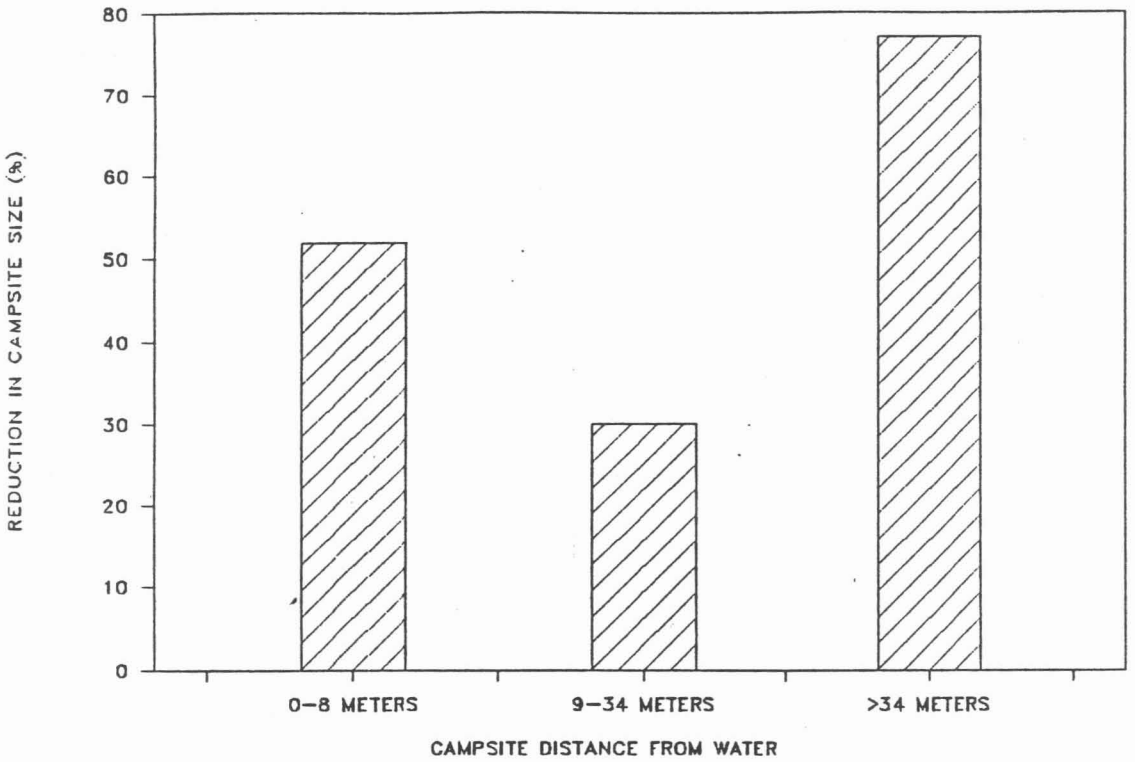



Figure 10. Percent reduction in campsite size between 1981 and 1983 for three distance from water categories.

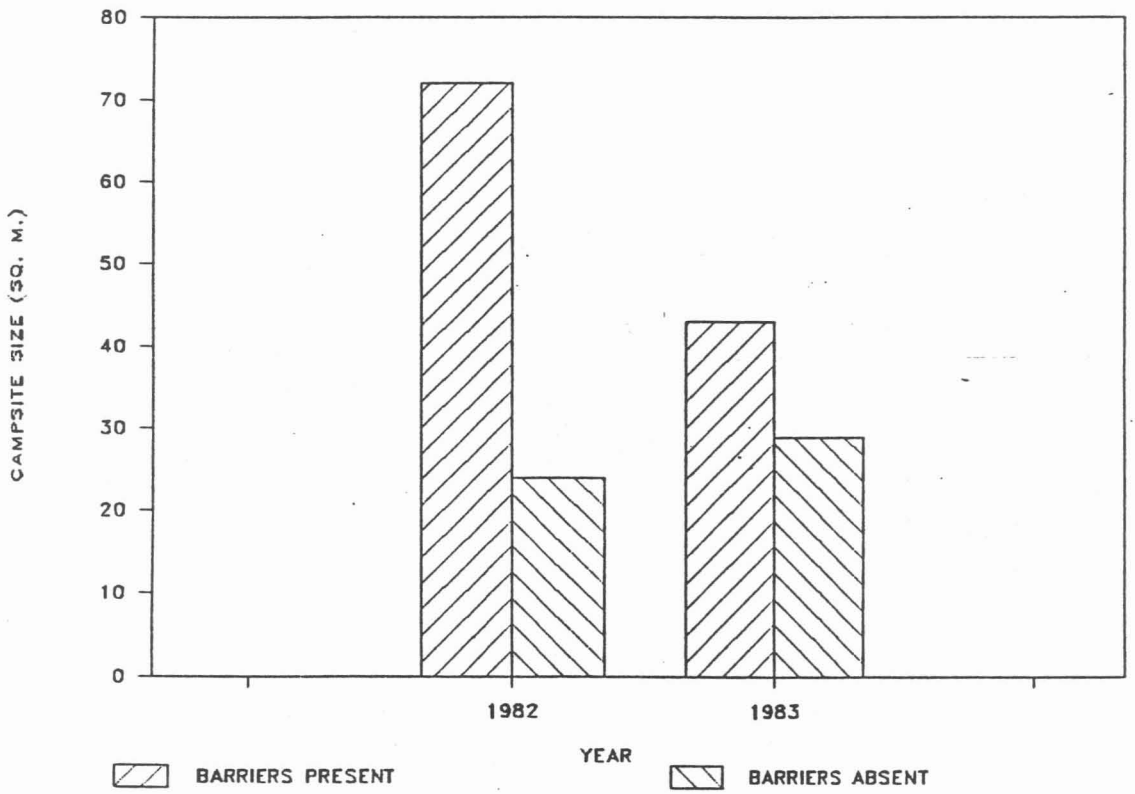



Figure 11. Campsite sizes by year for campsites with erected barriers present and absent.

The placement of natural barriers, such as logs, branches, and rocks, on campsites and along access trails appears to be an effective method for discouraging campsite use. Campsites receiving such treatment decreased from an average size of 72 square meters in 1982 to 43 square meters in 1983, while campsites without barriers increased slightly in size (Figure 11). However, it should be noted that natural barriers had to be reestablished many times during 1982 due to their occasional removal by campers.

The erection of "No Camping" signs on selected rehabilitated campsites was also effective in prohibiting further campsite use. Signs were erected primarily on the larger campsites which decreased in size from an average of 60 square meters in 1982 to 35 square meters in 1983 (Figure 12). Campsites without signs increased slightly in size.

An assessment was also made of the general type of groundcover vegetation found on the rehabilitating campsites. The most common vegetation type was grass, followed by ferns, herbs, and tree seedlings (Figure 13). As noted previously, other research has clearly established that the grass and sedge growth forms are particularly resistant to recreational trampling.

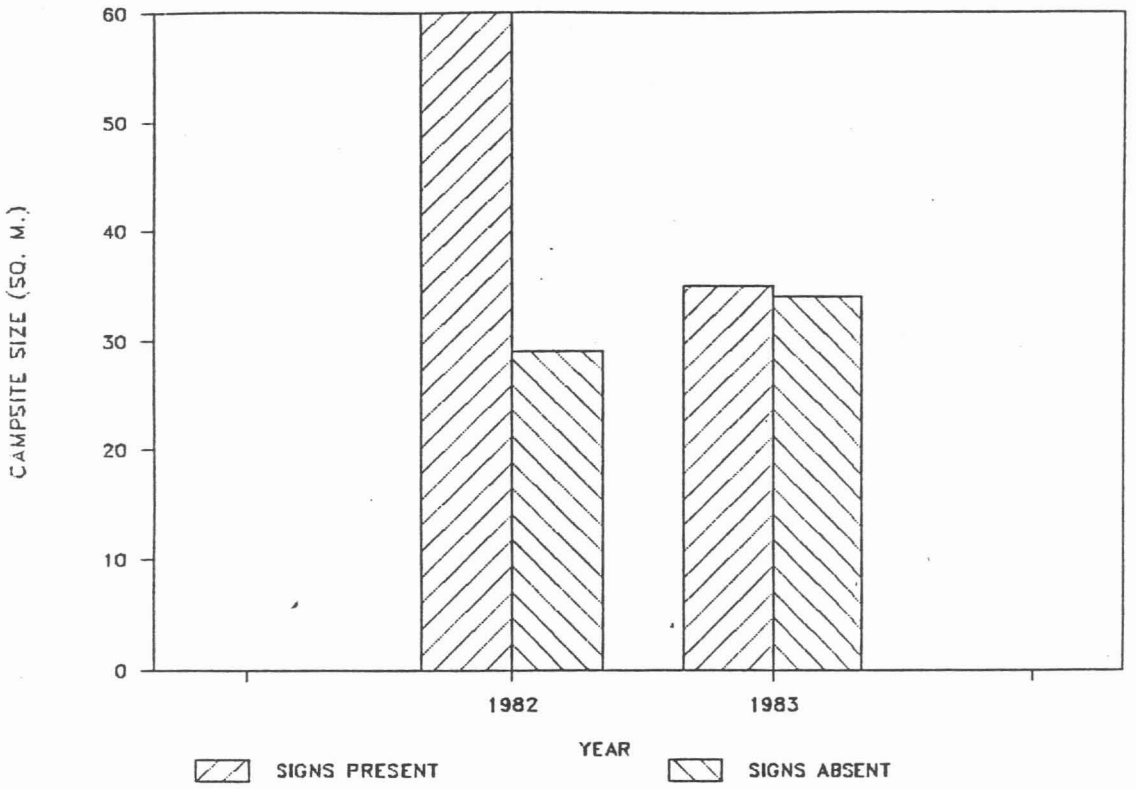



Figure 12. Campsite sizes by year for campsites with "No Camping" signs present and absent.

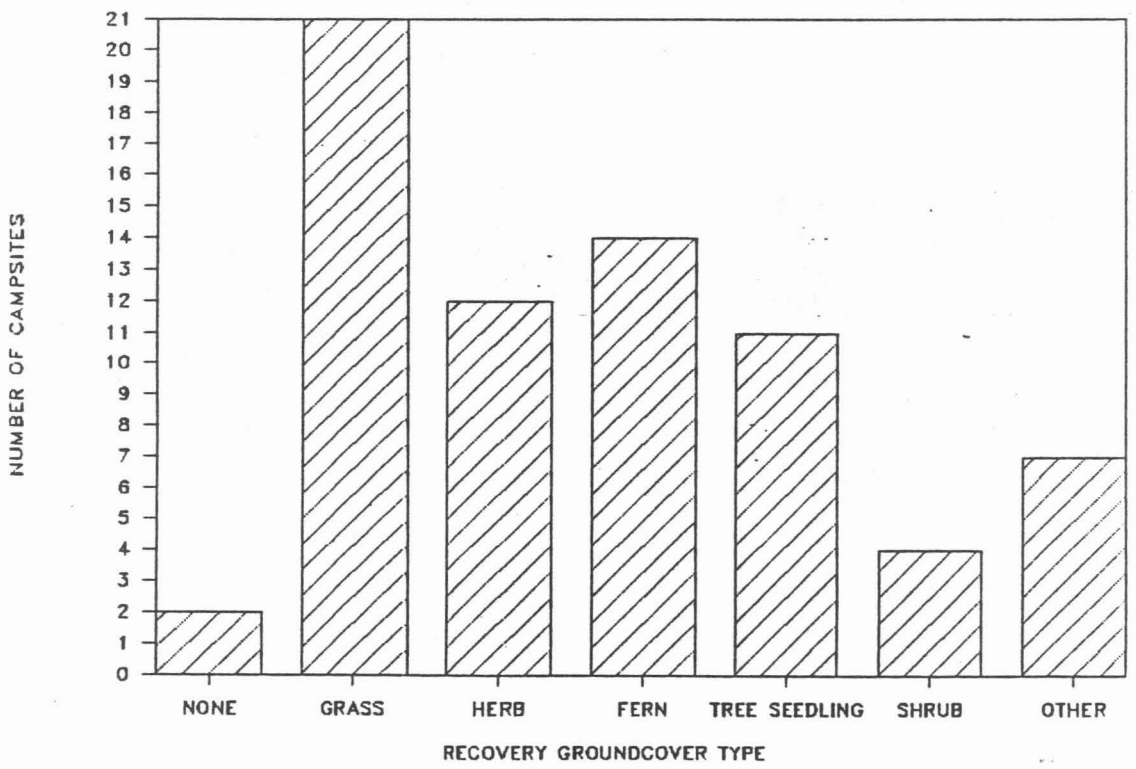



Figure 13. Number of campsites for seven categories of groundcover found on rehabilitating campsites.

## Study Limitations

This study was designed to inventory impacted backcountry campsites and to test practical methods of rehabilitating selected sites. It was not designed as a purely scientific study with statistical analysis of the results being a primary consideration. Therefore the analysis of program results in this paper was often difficult to achieve because of basic project design inadequacies. There also was some slight inconsistencies between districts in the way the sites were rehabilitated. In light of these factors, conclusions drawn from the rehabilitation data should only be viewed as generalizations and are not conclusive.

# MANAGEMENT RECOMMENDATIONS

This campsite inventory and rehabilitation study was initiated in response to heavy and rapidly increasing backcountry camping use in the 1970's and early 80's. Although this use has decreased and stabilized through the mid 1980's, the management concerns over this use and its' associated environmental impacts are still present. Little was known about the number and distribution of campsites and environmental impacts at the outset of the 1970's "back-to-nature" movement. It is important that a management program based on solid information be in place before similar increases in backcountry use occur in the future. The following management recommendations, grouped into four areas: inventory and monitoring, rehabilitation, research, and visitor education/enforcement, are offered with this goal in mind.

Inventory and Monitoring. Environmental impacts are inevitable in areas receiving heavy recreational use. A variety of impact assessment and monitoring systems have been developed for areas where the preservation of natural conditions is a primary management goal. These management-oriented systems provide site-specific inventory and impact assessment information for a number of important resource impacts such as campsite area, barren core area, vegetation loss, tree damage and root exposure, access trails, cleanliness, and extent of user-constructed development. It is recommended that such a

system be developed and implemented at Shenandoah National Park. While the work which was done for this study and the less intensive impact rehabilitation work continued to the present is a start, it is not complete enough in terms of the number of inventory and impact assessment parameters to satisfy good statistical evaluation of the results.

When periodically reapplied as part of an impact monitoring program, good assessment procedures can produce a database providing an objective record of site conditions over time. This information can be used to set campsite impact standards and to compare actual conditions to standards over time. Trends can be detected and evaluated so that corrective actions can be taken before severe or irreversible impacts occur. Relationships between specific impacts and physical site or use-related inventory information may even suggest appropriate management actions. Furthermore, an impact monitoring program provides a mechanism for evaluating the success or failure of the resource protection measures implemented to correct substandard conditions.

Rehabilitation. In general, the rehabilitation work appears to have effectively reduced further use of the campsites included in the study, allowing recovery to begin. Specific rehabilitation methods such as the use of "No Camping" signs and the placement of natural barriers on campsites and access trails also appeared to be effective. However, as noted previously, complete ecological recovery would likely require a decade or

more under conditions of no use. If impact monitoring is initiated, campsites could be ranked by type and extent of impact. Campsites with the most impact or those exceeding management standards could then be closed and rehabilitated using these techniques.

Research. This study points out the need for research concerning three general topics: 1) impact management strategies as they relate to Shenandoah camping policy and regulations, 2) impact monitoring, and 3) campsite rehabilitation and recovery.

1) Impact Management Strategies. Currently, Shenandoah National Park embraces a visitor dispersal impact management strategy. For example, campers are required to camp out of view of any trail and other camping party. However, campers are not encouraged or required to camp only in areas showing no evidence of previous camping. Such an enhanced visitor dispersal strategy is recommended as it would further encourage the distribution of visitor use over as much area as possible, thus reducing severe impacts at any given site. In contrast, a visitor concentration strategy is designed to minimize impacts by encouraging or requiring visitors to camp on a limited number of well-established sites. Managers can then concentrate use on the most damage resistant sites and avoid fragile, easily-damaged areas.

In an effort to allow backcountry users maximum flexibility in selecting campsites, alternatives other than dispersed camping have not been recently considered. Prior to 1973, backcountry camping was allowed only in designated camping areas. However, the unprecedented surge of backcountry use in the 1970's resulted in large severely impacted and crowded sites, providing what most visitors considered to be a poor camping experience. Use limits were not established for campsites nor was it feasible at this time to implement a reservation system to regulate use. Given these circumstances and problems a decision was made to adopt a dispersed camping system in 1973.

However, by 1980 problems were also encountered under the new dispersal strategy, including unacceptable levels of campsite impact in popular areas and complaints from visitors who were unable to locate legal campsites during peak use periods. It was fortunate that backcountry camping use began to decline in the 1980's. This decline resulted in a slowing of the rate of impact and allowed much needed rehabilitation work to be accomplished. By 1987 backcountry camping had decreased nearly 50 percent from the 1977 level. However, it is recommended that management alternatives to cope with future backcountry use "booms" be evaluated now, while time is available to develop an acceptable plan of action.

It is recommended that research be conducted at Shenandoah to evaluate the current backcountry camping policy and any other alternative that could be used in the future to reduce impact yet provide for a good backcountry and/or wilderness experience. Additional biological and social science studies could provide much of the information necessary for formulating specific camping policies, regulations, and visitor education programs.

2. Impact Monitoring. If a campsite inventory and impact assessment program is deemed necessary, research is recommended to assist in its development. Research could identify the inventory and resource impact parameters to be included in the system; develop, test, and document impact assessment procedures; and develop a computer database and necessary programming (compatible with the Park's Geographic Information System). Research could also make recommendations regarding an appropriate carrying capacity-based management framework, such as the Limits of Acceptable Change planning and management system. Such a framework would allow managers to define and monitor campsite impact standards and implement appropriate management responses when standards are exceeded.

3. Campsite Rehabilitation and Recovery. Additional research to more thoroughly evaluate rehabilitation techniques and recovery rates could also be beneficial. In particular, long-term studies are needed to evaluate the type, amount, and rates of recovery on closed campsites receiving various types of

# CONCLUSION

The National Park Service operates under dual legal mandates requiring the "preservation" of natural environments and their ecological processes while still permitting full public access and "use" of these environments. This often results in a management paradox for park managers faced with the balancing of recreational uses and their associated resource impacts. In the past, managers often relied on intuitive judgements to assess resource change. This was perhaps appropriate when visitor use was low. However, increasing urban populations seeking to recreate in natural environments, particularly in the east where there are few wildland areas, will necessitate more objective impact assessment and monitoring methods operating within well-defined resource protection and visitor management frameworks.

The campsite inventory and rehabilitation study described in this report was initiated in recognition of the needs described above. The parkwide inventory conducted between 1981 and 1983 documented the number and distribution of backcountry campsites in all three park districts. Inventory and impact assessment information was collected on 1011 campsites. This information is valuable in establishing baseline conditions against which information collected in the future can be compared. A concurrent campsite rehabilitation study also provided useful information documenting the effectiveness of several methods for

closing campsites and speeding the recovery process.

While these studies provide necessary baseline information, they may not be sufficient to address the many management concerns discussed above relating to the need for balancing increasing recreation use pressures with the legal mandate to preserve natural environments. With this goal in mind, several management recommendations are proposed in the subject areas of inventory and monitoring, rehabilitation, research, and visitor education. In particular, it is recommended that further research be conducted to: 1) evaluate the effectiveness of alternate impact management strategies, 2) evaluate the effectiveness of various campsite rehabilitation techniques, 3) develop and recommend an appropriate carrying capacity-based planning and management framework, 4) design a multiple-parameter campsite inventory and impact monitoring program, 5) evaluate methods to educate visitors concerning recreation resource impacts and minimum impact camping techniques, and 6) evaluate alternative methods for increasing visitor compliance with camping regulations.

Increasing recreational use pressures on a limited wildland resource, such as Shenandoah National Park, will require the intensification of wildland resource and visitor management efforts. Effective management policies based on objective scientific information is essential if the wildland qualities of naturalness and limited human-related impacts are to be maintained. The value society places on wildland environments

lies in their continued "naturalness". Recreational impacts, if not monitored and controlled, will compromise the inherent value of wilderness and ultimately reduce the quality of recreational experiences.

# APPENDIX 1

## CAMPSITE IMPACT ASSESSMENT AND REHABILITATION FORMS

IMPACTED BACKCOUNTRY CAMPSITE INVENTORY

Project: 4840-RMVP-N-61

(1) Site number _____ District_____ Date_____

(2) Trail code_____ Trail name_____

(3) $M^2$ impacted area (Area=3.14 $Xradius^2$) _____

(4) Distance from water (M) _____

(5) Distance from trail (M) _____

(6) Elevation_____ (7) Slope _____ (8) Aspect_____

(9) Campsite developments Yes _____ No _____ Type _____
(Trenching, firerings, scarred trees, structures, other)

(10) Degree of erosion: Light _____ Moderate _____ Heavy _____ Severe_____

(11) Vegetation type _____

A. Oak/laurel
B. Oak/hickory
C. Mixed cove: poplar/ash/maple/sassafras
D. Red oak/mixed hardwood
E. Pine
F. Hemlock
G. Mixed pine/hardwood
H. Early successional; locust/cherry/walnut
I. Open: grass/brush/small saplings

Notes:

_____

_____

_____

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_____

_____

_____

_____

Investigator_____

CAMPSITE REHABILITATION-SITE EVALUATION

Project 4840-RMVP-N-61

(1) Site number _____ District _____ Date _____

(2) Trail code _____ Trail name _____

(3) Previous $M^2$ impacted area _____ (4) Present $M^2$ Impacted area _____

(5) % recovered _____ (6) Dominant plant species on recovered area;

(a) _____

(b) _____

(c) _____

(7) Signs posted; Yes _____ No _____

(8) Barriers errected Yes _____ No _____

(9) Number of law enforcement actions for site( for survey period) .

Notes: _____

_____

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Investigator _____

FINAL REPORT

May 18, 1988

# AN ANALYSIS OF VISITOR IMPACTS AND REHABILITATION METHODS FOR BACKCOUNTRY CAMPSITES AT SHENANDOAH NATIONAL PARK

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# INTRODUCTION

In the late 1970's and early 80's, Shenandoah National Park received more backcountry use on a per acre basis than any area within the National Park System. The resulting environmental impacts in popular camping areas were obvious even to the casual observer and detracted significantly from many visitors' backcountry/wilderness experience. Even though camping adjacent to or within sight of, trails, shelters or roads was prohibited by regulation, significant impact within these zones was prevalent. Campsites were typically chosen next to trails due to terrain suitability, outstanding views, proximity to water or simply because of convenience to the camper. Because of their high visibility, many campsites adjacent to trails drew repeated illegal use. Other popular camping areas, although in accordance with Park regulations, were severely impacted due to long term repeated use. Both legal and illegal camping caused similar types of resource impacts: trampled vegetation, large areas of exposed, eroded, and compacted soils, damage to trees, multiple fire rings and charcoal litter, and food remnants and trash.

The nature and extent of these environmental impacts along with methods for rehabilitating such impacts were unknown. Therefore, beginning in 1981, Shenandoah Resource Manager David Haskell and District Rangers initiated a parkwide study. The objectives of the study were to provide quantitative information

on the type and degree of impact on backcountry resources from camping and to determine the most effective methods of rehabilitating severely impacted campsites.

# METHODS

The study plan called for both an inventory of backcountry campsites and an evaluation of campsite rehabilitation procedures. This work was divided into three phases:

## Phase I

Initiated in 1981, all campsites adjacent to, or easily located from trails, were mapped on U.S. Geological Survey 7.5' maps and inventoried using the Impacted Backcountry Campsite Inventory form in Appendix 1. Each campsite inventory included: 1) campsite number, park district, and date; 2) trail code and trail name; 3) size of impacted area ($m^2$); 4) distance from water (m); 5) distance from trail (m); 6) elevation (ft); 7) slope (%); 8) aspect (8 categories); 9) presence and type of campsite developments; 10) degree of erosion (4 categories); and 11) vegetation type (9 types).

A campsite rehabilitation study was also initiated in 1981. Fifteen campsites, five in each of three elevation ranges (<2,000 ft., 2,000-3,000 ft., and >3,000 ft.) were to be selected for rehabilitation. These campsites were restricted to three trails in each park district (North, Central, and South) with known impact problems.

Campsite rehabilitation work was done in the fall on all sites and included the following:

1) loosening of the soil to a depth of 3 inches with a mattock and council tool to reduce soil compaction and increase water infiltration, and
2) incorporation into the soil of partially decomposed leaves and twigs to improve fertility and soil humus, and
3) placement of large rocks, branches, and small logs in the campsite area to renaturalize the site and discourage future use,

Color photographs were taken from permanently marked photo points before and after rehabilitation work and each September for two years. Phase I campsites were not posted against camping but ongoing law enforcement efforts regarding illegal camping were continued.

Phase II

All campsites along the three selected trails from each park district were reinventoried during September and October of 1982. From these sites, fifteen additional sites were to be selected and rehabilitated using the elevation range breakdown described above. In addition to the rehabilitation methods described above, several new methods were employed on separate groups of campsites in 1982 : 1) the erection of "No Camping" signs, 2) the placement of natural barriers such as logs,