MANAGEMENT REPORT

TRAIL AND CAMPSITE EROSION SURVEY

FOR

GREAT SMOKY MOUNTAINS NATIONAL PARK

Part I: Introduction and Methods

Management Report No. 16

U. S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SOUTHEAST REGION

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Susan Power Bratton
Matthew G. Hickler
James H. Graves

Uplands Field Research Laboratory
Great Smoky Mountains National Park
Gatlinburg, Tennessee 37738

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Great Smoky Mountains National Park, like many other recreation areas, has experienced a tremendous increase in visitation over the last decade. During 1975, recreation visits were estimated at 8,541,500 and during 1976 this increased to 8,991,500. Between 1963 and 1975 total visits increased by 63 percent.

The recent backpacking "craze" has resulted in a disproportionately high use in backcountry camping. In 1975, there were an estimated 105,200 backcountry campers, a 53 percent increase over 1972 and a 250 percent increase over 1963. Backcountry hiking increased 33 percent from 1963 to 1975 (to 222,305 visitors) and horseback riding increased 63 percent (to 51,407 visitors). Camping in organized groups increased 61 percent between 1972 and 1975.[1]

The National Park Service now faces increasing pressures on all the resources of the park, both natural and man-made. The trail system was largely developed during the 1930's at a time when enthusiastic backpackers were a rarity and the American public was not nearly as mobile as they are at present. Even though a majority of the trails built by the CCC and the National Park Service were well designed,

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[1] All figures from GRSM press releases and summaries of monthly public use for 1963 and Forms 10-157 and R-45 for December, 1975 as quoted in Environmental Assessment Alternatives for the Draft Management Plan November, 1976.

there are now eroded areas in most sections of the park. Backcountry campers crowd certain sites and trample the forest understory. Firewood is in short supply near many backcountry sites. The evidences of human use range from trash to mudholes to cut stumps.

The purpose of this study was to investigate the trail and campsite system of the park, to determine its adequacy in light of present visitor use, and to provide information for park managers.

The problems encountered in determining patterns of backcountry use are very complex and are correlated to such diverse factors as visitor attitude and education, knowledge and orientation of the park staff, the carrying capacity of different types of trails, access to roads, and the availability of campsites. This study directly approaches only one aspect of backcountry use, the deterioration of trails and campsites. The original intention of the investigators was to locate high impact areas, damaged areas and trouble spots. No attempt was made to directly consider patterns of visitor use or visitor preferences (for example, quantifying the importance of day hikers as opposed to backpackers on a particular section of trail). Most comments on usage patterns are from field observations of the investigators or other park staff. The study does, however, attempt to quantify the physical conditions as they now exist for different trails and campsites in different sections of the park.

The data analysis presented in the following report is intended to at least partially answer the following questions:

1. Which trails have areas of severe erosion or extensive mud-holes?
2. Which sections of trail are under used or can tolerate considerably more impact?
3. Which trails, with minor changes in maintenance, could absorb more hiker use?
4. Which trails are eroding due to horse or vehicle use?
5. How are trail conditions related to forest type, slope, elevation, and other environmental variables?
6. How do trail conditions vary from one section of the park to another?
7. Which campsites are the most heavily damaged?
8. What is the impact of the campsites on the native flora?
9. What are the patterns of illegal camping in the park?
10. Are concentrated enforcement or damage problems related to illegal sites? If so, where?
11. Where should new legal sites be established?
12. Where do poor trail conditions indicate that no new sites be established or old sites be removed?
13. If zone camping were initiated, where would people be likely to camp?

14. Under a zone system, what are the carrying capacities for different parts of the park?
15. Where should the park be encouraging people to go? Discouraging use?
16. Where should additions be made to the trail system? Sections removed or rerouted?
17. Which sections of trail are presently limiting the establishment of sensible long-distance hiking routes that would minimize the impact of backpackers?
18. Where is horse use presently limiting foot traffic?

The campsite and the trail data presented here should also serve as a rough base for future comparisons. At present, we do not know which trails are still deteriorating and which have stabilized. We do not know which campsites are still spreading out across the forest floor and which remain the same size from year to year. A number of trails have sustained considerable erosion damage in the past, but we do not know if the process is continuing. The following project is a first attempt at establishing a coordinated data base for back-country management. Since hiker use is unlikely to decrease in the near future, an information system must be established which will not only pinpoint present problems, but may provide some indications of where problems are just developing.

Trail Maintenance

In the Great Smoky Mountains National Park, the word "trail" may mean anyone of several things. The park has a rather large number of roads included in the trail system. Some of these are truly jeep trails and are only passable with a four-wheel-drive vehicle, but many are surfaced and can be traversed by an automobile. A good example of the latter would be Bote Mountain Road which goes to within a mile and a half of Spence Field as a gravel road and has been negotiated by a school bus. In a recent move (1976) by the National Park Service to bring more of the park into wilderness status, a substantial percentage of these roads have been closed to all vehicles, including those driven by Park Service personnel. These roads are not to be resurfaced or graded, but are to be allowed to revert to foot trail width.

Trails not passable by jeeps are also variable in maintenance standards. Some horse trails are maintained to 2-meter width (very nearly the width of jeep trails). Some heavily used foot trails are also quite wide and are surfaced with gravel. A few stretches of foot trail in the park, including Laurel Falls Trail and Cosby Nature Trail, are surfaced with asphalt. The standard cut for a foot and horse trail tends to be about 120 centimeters or four feet. Newer trails, such as the Lake Trail and some little-used trails,

have narrower cuts. In some cases, such as the steeper parts of the Lake Trail, there may be no trail at all.

Much of the trail system in the park was developed by the CCC Program during the 1930's. Not all the trails have the same origin, however. Some of the trails are placed on old settler roadbeds or old railroad grades from logging days. Some roads have been built by the National Park Service. Many of the 120-centimeter trails were built by CCC and were planned as part of a park trail system. Some trails, especially those on ridge tops, are old manways which were opened for use with little or no engineering. Examples of these are the trail from Porter's Flat to the Appalachian Trail, and the ridge top section of trail from Tricorner to Round Bottom.

The care taken in establishing a route has varied tremendously. The CCC trails are usually well-graded, of uniform width, and often have stonework on steep corners. Old railroad grades usually climb gradually, switch back on steep slopes, and frequently have stonework, bridges, and surfacing material. Old wagon roads are rather erratic in design. They may crisscross streams or run up the shoulders of ridges. They frequently show evidence of severe erosion occurring long before their use as trails. Many accumulate water or are on steep grades. Manways are often placed on the

shoulders of ridges or run along creeks. These are the paths of least resistance when an area has not been cleared, but the slopes chosen may be unstable under heavy use.

The trail maintenance crews are organized separately for the two different districts (north and south) of the park. Each side is further divided into sub-districts. Width of the trails, grading and brush cutting has not always been standard from one district of the park to the other. The placement and organization of campsites tend to vary by sub-district and have, in general, been left to the discretion of local rangers.

The park has standards for trail maintenance which have varied somewhat with different park administrations. The standards in force at the time of this survey are shown in Figure 1.

The park does not have set standards for backcountry campsites in terms of size, distance from streams, etc., and in general, has not formally surveyed sites to provide an impact assessment before establishment. Most campsites in the park have no formal limit other than local topography. Campsite development varies from other than a numbered wooden marker on a tree (the marker may be

missing) to intensive development including hitchracks, fireplaces camp circles, picnic tables, bear barrels and privies. The park maintains a series of shelters, most of which are on the Appalachian Trail. These shelters are of stone or logs and are three sided, although many have a bear fence on the open side. These sites have outhouses and may have picnic tables and fireplaces. Horse camps are usually more heavily developed.

Visitor use of the campsites is controlled by a permit system. Group size is limited to eight people. Stays in trail shelter are limited to a single night per site, but other types of campsites may be used for 7 consecutive days. Shelter visitors are restricted to the number of bunks in the facility. Permits for these sites are called into the park dispatcher and no more are issued after the shelter is at capacity. The remainder of the sites may be allowed to overflow since no attempt is made to report the number of users to a central station (this may be changed in the near future). At the present, firewood gathering is allowed everywhere in the park.

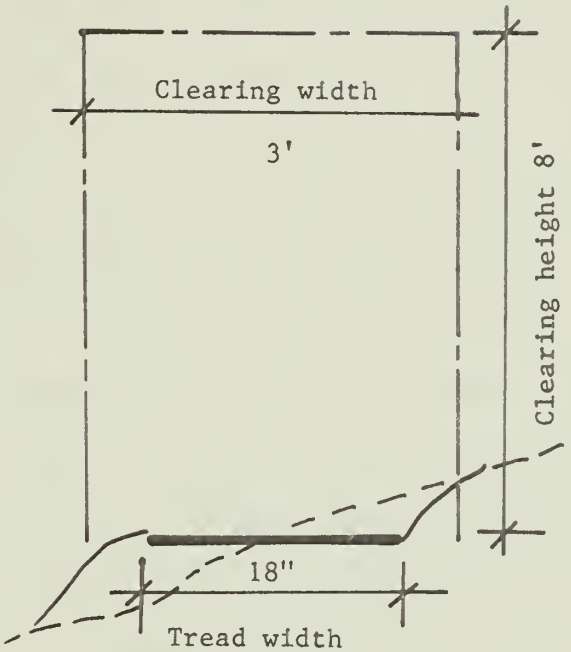
The Trail Environment

Several environmental factors are important to trail maintenance in the Great Smoky Mountains. First, the climate is moist and the

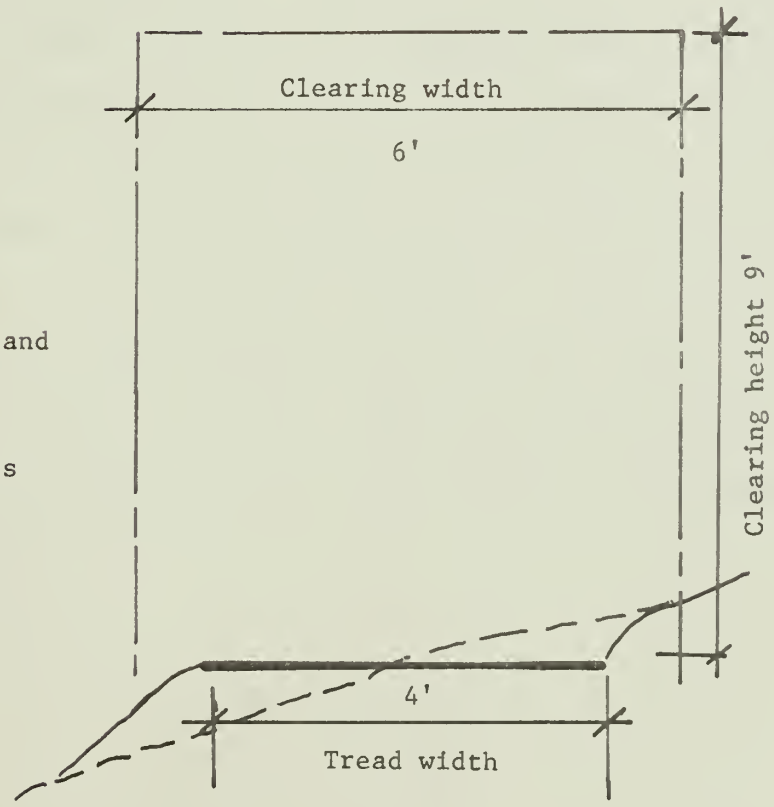
Figure 1

Trail clearing standards - 1976

Foot trails



Horse and foot trails



annual rainfall is among the highest in the eastern United States. There is more rain at the higher elevations (Gatlinburg elevation, 1460 feet, averaged 59.3 inches per year for 1947-1950 and Newfound Gap elevation, 5000 feet, averaged 87.8 inches per year for the same period [Stephens 1969]). Heavy thunderstorms are common and occasionally snow melt and/or long periods of rain may saturate the soil and cause flooding and landslides. In 1950, for instance, Mt. LeConte received about 3 inches of rain in a single thunderstorm, lasting about 1 hour. Over 40 landslides occurred as a result (Bogucki 1970). Seasonal peaks in precipitation are usually in July and November. The growing season is relatively long, for a deciduous forest area. Flowers bloom as early as late February, and a number of herbs, such as Phacelia fimbiata and Dentaria diphylla put up shoots in the fall and remain above ground during the winter. Most of the vernal herbs are present, at low elevations, by the beginning of April. Leaf fall may not be complete until the middle of November. There is no snowpack and the ground may be completely clear anytime during the winter, even at the highest elevations. Hikers using trails during the winter are frequently walking on the soil surface, which may or may not be frozen.

The topography of the Great Smoky Mountains is quite steep, and the elevations are among the highest in the eastern United States. Clingman's Dome at 6,643 feet is the highest peak in the park. Mt. LeConte rises from an elevation of about 2,500 feet at Cherokee Orchard to an elevation of 6,593 feet over 2 1/2 aerial miles. Even the lower ridges can be steep and slopes are typically 25 degrees and greater. Unlike many northern and western mountain ranges, bare rock is relatively rare and slopes of 45 degrees may be completely covered with vegetation. The topography is mature and drainage is generally quite good. A few small bogs and marshes exist, but most of them are at low elevations. The wettest areas are on the flood plains of creeks and around springs or seeps.

Little recent work has been done on the soils in the park, and they have never been mapped in detail since most of the land is not suited to agriculture. Depths are variable--from the colluvial valley bottoms where the Ramsey series may exceed a meter in depth to the high elevation ridges where the "soil" under a heath bald may be little more than a few centimeters of organic matter over bare rock (see soil surveys such as the one for Sevier County issued in 1956). Many of the soils in the park would probably be classed as in cinceptisols. Differences in the amount of organic matter and leaf litter present are related to forest type and elevation. Soils under heath balds and spruce fir forest tend to accumulate a dark moist layer of humus, for instance.

Geologic maps and surveys are available for much of the park. Most of the area is metamorphic sandstones and conglomerates, but there are several large areas of phyllites and a few small limestone areas (King et al., 1968). The Anakeesta formation noted as slate, phyllite and shist forms steep ridges in the higher parts of the park and is of special interest because of the nature of its chemical weathering. The limestones of the Knox Group are exposed in the northwest of the park in Cades Cove. The limestone soils are often shallow.

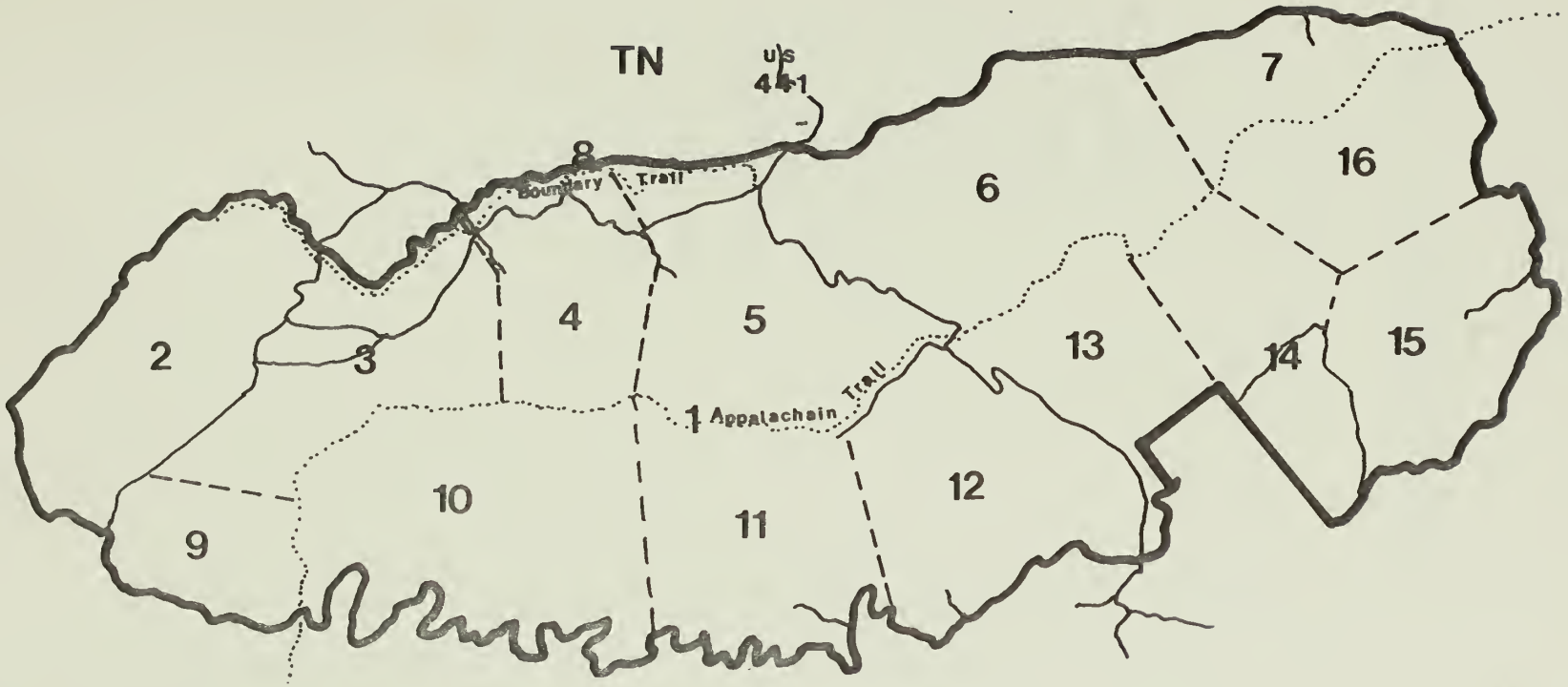
The vegetation of the park is unique and perhaps the park's most valuable resource. There are extensive stands of virgin timber particularly between Mt. LeConte and Cosby, on the slopes south of Cades Cove and in the Cataloochee area. Trees in the virgin stands may exceed 2 meters in diameter at breast height. Successional stands have a variety of histories including logging, burning, and farming. In a few places there are open treeless areas resulting from or maintained by human interference. These include burn scars (most the result of fires after logging), grassy balds (former high elevation pastures), pastures (still in use) old homesites, and clearings around buildings. The diversity of the vegetation in the park is very high, both in terms of number of species present in a stand and in terms of total number of forest types represented (see Whittaker 1956 or Golden 1974 for more complete vegetative descriptions).

The park is well-known for its wildflowers. A number of the best displays are in herbaceous forest understories, either in vernal or aestival aspect. These herb communities are composed of plants, such as lilies and ferns, which may be very sensitive to trampling and other disturbance. Certain types of forest, such as deciduous cove or gray beech and certain topographic positions such as creek flats and high elevation gaps are more likely to have these understories. Wildflower areas attract visitors, in season, as do clear areas such as grassy balds and big tree stands in virgin cove and spruce-fir forests. Forest and understory type, therefore, is not only related to the carrying capacity of an area in terms of ability to withstand trampling, but may also be related to total amount of visitor use due to the attractiveness of the area.

Methods of Data Collection

First the park was divided into 16 sections based on access. The Boundary Trail and the Appalachian Trail have both been classed as separate sections. The numbers and the names of the sections are listed in Table 1, shown in Figure 2. All the data collection points, both trail and campsite, have been recorded on 7 1/2-minute topographic maps. The computer code numbers for each 7 1/2-minute quad are shown in Table 2.

Figure 2



TRAIL SECTIONS

Table 1. Sections of the Park

1	Appalachian Trail (AT)
2	Abram's Creek (West of Cades Cove)
3	Cades Cove
4	Tremont
5	Elkmont
6	LeConte
7	Cosby
8	Boundary Trail
9	Twenty Mile
10	Hazel Creek
11	Forney Creek
12	Deep Creek
13	Smokemont
14	Heintooga
15	Cataloochee
16	Big Creek

Table 2. The 7½ Minute Topographic Maps Including Park Land.

Quad Name	Computer Code
Blockhouse	01
Bryson City	02
Bunches Bald	03
Cades Cove	04
Calderwood	05
Clingman's Dome	06
Cove Creek	07
Dellwood	08
Fontana	09
Gatlinburg	10
Hartford	11
Jones Cove	12
Kinzel Springs	13
Luftee Knob	14
Mt. Guyot	15
Mt. LeConte	16
Noland Creek	17
Richardson Cove	18
Silers	19
Smokemont	20
Tapoco	21
Thunderhead	22
Tuskeegee	23
Waterville	24
Wear Cove	25
Whittier	26

Data collection for each of the trails in the park consisted of a series of measurements for width, depth, slope, aspect, forest type, etc. The basic tools used were a Brunton pocket transit and a 30-meter or 50-meter tape.

All maintained trails were included in the survey and a few of the more heavily used manways have also been sampled. The official park trail map for 1976 is shown in Figure 3. Each trail has a number (see Figures 5 and 6) and is classified by the type of past maintenance, the type of traffic it now supports, and the presence or absence of surfacing material. These categories and their numerical coding for computerization are shown in Table 3. Each trail was then divided into sections as it was sampled. In general, the sections are about 1/3 of a mile in length. At the end of each section, a series of measurements was collected for a single point on the trail (forest type through trail depth). The total amount of erosion for that section was estimated. The trail was then given an erosion rating and an overall rating. Sampling was at regular intervals when trail conditions were consistent. After a major change in forest type or trail conditions, an attempt was made to sample the "new" or "atypical" area. Each sampling site was marked on a 7 1/2-minute topographic map.

Figures 3. and 4.

Official 1976 Great Smoky Mountains Trail Maps.

The following figures are the maps given to hikers. They show foot and horse trails and the positions of legal campsites and shelter.

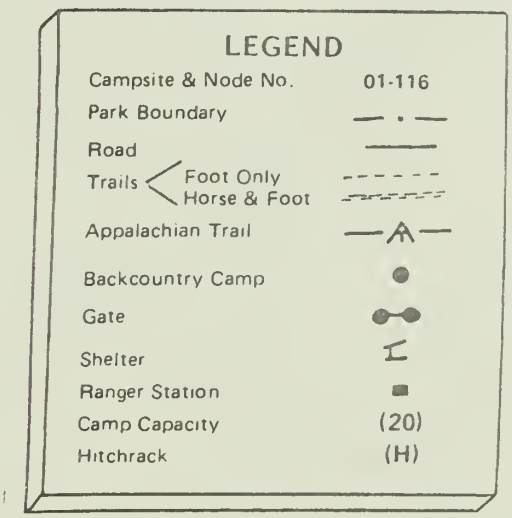


Figure 3.


TRAILS - WEST
GATLINBURG
TOWNSEND
BOUNDARY
SUGARLANDS VISITOR CENTER
ELKMONT RANGER STATION
TREMONT RANGER STATION
METCALF BOTTOMS
CHEROKEE ORCHARD
BLANKET MTN
JAKES GAP
BUCKEYE GAP
SILERS BALD
DERRICK KNOB
DOUBLE SPRING GAP
CLINGMANS DOME
MT COLLINS
THUNDERHEAD MTN
SPENCE FIELD
RUSSELL FIELD
MOLLIES RIDGE
CADES COVE
CADES COVE RANGER STATION
ABRAMS FALLS
ABRAM CREEK RANGER STATION
SCOTT GAP
LANE GAP
HATCHER MTN
RICH GAP
RICH MTN
BUNKER HILL
PARSONS BRANCH
MOORE SPRING
DOE KNOB
BIRCH SPRING GAP
WOLF RIDGE TRAIL
SHUCKSTACK
TWENTYMILE RANGER STATION
HAZEL CREEK CASCADES
HIGHROCKS
BONE VALLEY
EAGLE CREEK
FORNEY CREEK
TUNNEL
NOLAND CREEK
SUGARLANDS
ROARING FORK MOTOR NATURE TRAIL
BULLHEAD TRAIL
ROAD
MOUNTAIN
TRAIL
CREEK

TRAILS - EAST

Figure 4.

Figures 5. and 6.

Trail Numbers.

Trails are shown as dashed lines and roads are shown as solid lines. Numbers are shown for major trails. Most concession horse trails, nature trails, and manways sampled are not included.

Figure 5.

TRAIL NUMBERS – WEST

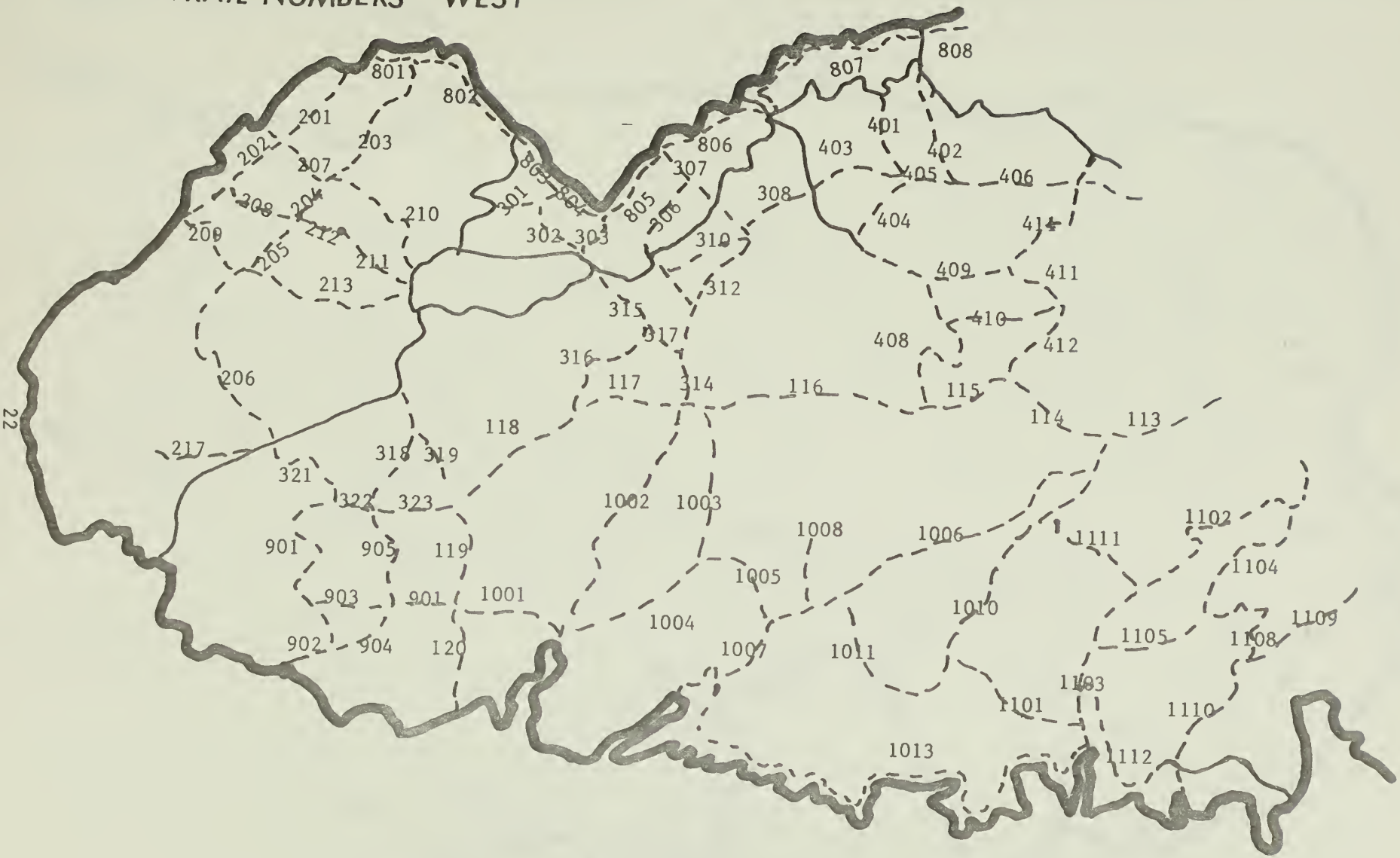


Figure 6.

TRAIL NUMBERS – EAST

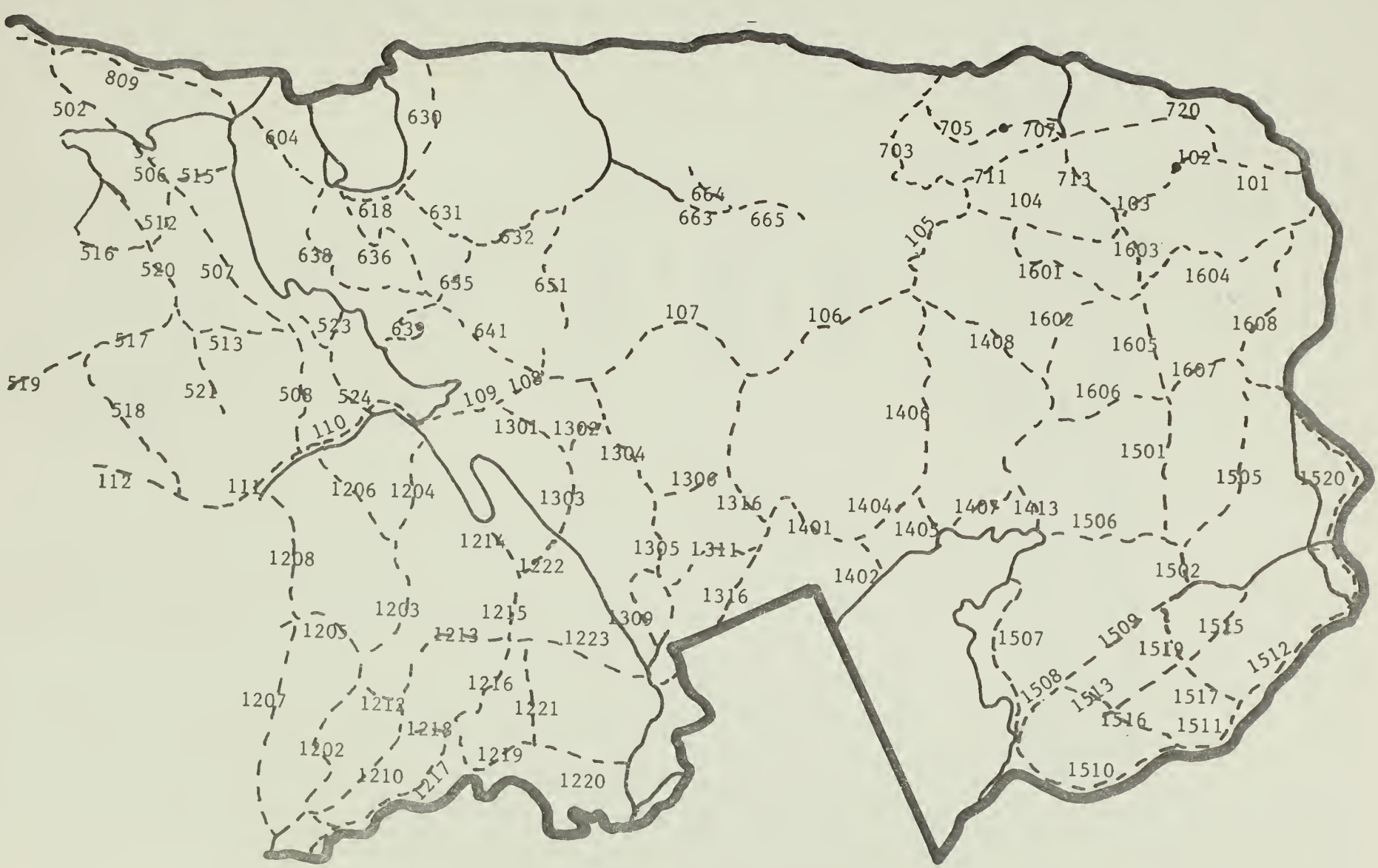


Table 3. Trail Type Codes

The following table shows the classification system and numerical codes used for the computerization of the trail sections. The first digit indicates the maintanence status of the trail, the second the type of usage which is typical or permitted, and the third the type of trail surface. A number of jeep roads in the park were closed to vehicles during 1976. These have been included with restricted roads, because of previous maintenance.

1. Abandoned jeep trails and restricted roads

    1. Foot only

        1-1-1 Surfaced
        1-1-2 Unsurfaced

    2. Foot and horse

        1-2-1 Surfaced
        1-2-2 Unsurfaced

    3. Horse only

        1-3-1 Surfaced
        1-3-2 Unsurfaced

2. Maintained trails

    1. Foot only

        2-1-1 Surfaced
        2-1-2 Unsurfaced

    2. Foot and horse

        2-2-1 Surfaced
        2-2-2 Unsurfaced

    3. Horse only

        2-3-1 Surfaced
        2-3-2 Unsurfaced

3. Unmaintained trails and roads

    3-1-2 All manways

The first columns on the data sheet (Figure 7) call for canopy and understory type. These, with their computer code numbers, are listed in Tables 4 and 5. These types were recorded specifically for the vegetation of the point where the width sample was taken, but the canopy type is usually representative of the whole preceding section of trail. The successional stage was also noted, although this is often difficult to determine without formal vegetation sampling.

The Brunton transit provided the aspect of the trail (in the downhill direction) and average slope (for the visible section), and the aspect and slope of the environment. Elevation was generally taken from 7 1/2-minute topographic maps although, in the case of some unmapped trails, an altimeter was used.

Total width of the trail was measured from the edge of the cut to the bottom of the bank (see Figure 8). In cases where the trail was on a ridge top, the total width of the disturbed area was included. In cases where the bank was slumping in on the trail, the total width includes only that portion flat enough to walk on. The width of bare soil, rock, and leaf litter are then all subsets of the total width. (In the fall and winter newly fallen leaves were not called litter; only organic material remaining from the previous

RAIL SHEET- Figure 7

rail #____ Name _____ Quad_____ Type _____

osition	Forest type	Understory type

lope, trail													
spect, trail													
lope, envir													
spect, envir													
levation													
otal width													
idth rock													
idth soil													
idth litter													
epth center													
epth sides													
xposed roots													
og rooting													
rosion bank													
rosion water													
xotic plants													

nce last position

mud													
rut													
horseplow													
foot plow													
bare rock													
exposed roots													
hog rooting													
side erosion													
Vehicle rut													
osion rating													
erall rating													
pact rating													

mments:

ate:_____ Last rain _____ Leaf fall _____ Observer _____

TRAIL SHEET TWO -- EROSION

Position	Mud holes	Eroded areas

Attractions:

Fruit plants	____	Wild flowers	____
Homesites	____	Big trees	____
Views	____	Balds	____
Waterfalls	____	Fishing	____
Poaching	____	Horse camp	____
Adjoin road	____	Major access	____
Remote	____	Near cmpgrd	____
Tower	____	Shelter	____
Other:			

Developments

Foot logs	____
Bridges	____
Water bars	____
Fords	____
Walls	____
Railing	____
Fire pits	____
Other:	

Table 4. Forest Type Codes

The following lists the canopy types recognized for this survey. The classification is based largely on Whittaker's (1956) paper and on the field experience of the investigators. A three-level computer classification was used to allow easy sorting by either successional stage, major forest type or specific forest type. All classifications are by dominance and successional status is estimated from the size of the trees and the known history of the area.

I. Successional codes

1- Virgin
2- Mature
3- Second growth
4- Early successional (usually after farming or fire)

II. Forest type codes

1. Spruce-Fir (Yellow birch)

1-1 Red Spruce - Fraser Fir (Yellow birch)
1-2 Red Spruce - Fraser Fir - Hardwood or Hemlock
1-3 Yellow Birch (mature)
1-4 Heath Bald (Rhododendron or Mountain Laurel)

2. Northern hardwoods

2-1 Beech (Gray beech gap)
2-2 Mixed northern hardwoods (Sugar maple, Beech, Yellow birch, Buckeye, Service berry)
2-3 Successional northern hardwoods (Yellow birch, Fire cherry, Red maple)

3. Mesic types

3-1 Mixed cove hardwoods (Tulip tree, Silverbell, Buckeye, Basswood, Beech, Sugar maple, White ash, Birches, Oak, Magnolia)

3-2 Hemlock - hardwood cove (same species as 3-1 with Hemlock co-dominant)

3-3 Mesic hardwood flats (Tuliptree, Sweet gum, Sycamore, Birch, Walnut)

Table 4. Forest Type Codes - Cont.

3-4 Successional cove (Tulip tree, Silverbell, Red maple, Fire cherry)

3-5 Mixed sub-mesic hardwoods (Silverbell, Black gum, Magnolia, Tulip tree, predominance of Oak)

3-6 Tulip tree (dominated by small Tulip trees with successional associates)

3-7 Hemlock cove

4. Xeric types

4-1 Mixed sub-xeric hardwoods (Red oak, Hickories, Black locust and some more mesic associates)

4-2 Mixed oak (Chestnut oak, Red oak, Black oak, White oak, Sourwood, Black gum)

4-3 White Oak

4-4 Mixed Oak - Pine (including Red maple, Pine and Sourwood-Pine, etc.)

4-5 Mixed Pines (Virginia, Pitch, Table Mountain)

4-6 White Pine

5. Balds, Burn scars, Pastures

5-1 Grassy Bald

5-2 Burn Scar (no canopy)

5-3 Pastures, old fields and artificial clearings

5-4 Early successional shrubs (Fire cherry, Serviceberry, Hawthorn, Blueberry)

5-5 Early successional heath (mostly ericads)

Table 5. Understory Codes

1. Spruce-fir and high elevation

    1-1 Bramble-sedge-herb including *Rubus* and sedge and grass mixes

    1-2 Vaccinium dominated including vaccinium herb mixes and viburnum types

    1-3 Spruce-fir seedling

    1-4 Rhododendron and mixed heaths

    1-5 High elevation herb including fern or moss dominated, *Solidago glomerata*, etc.

2. Heath balds

    2-1 Mixed heath, no trees

3. Mesic-submesic

    3-1 Mesic herbs including *Laportea*, *Cimicifuga*, ferns, etc.

    3-2 Submesic herbs including more composites, dry type sedges, New York fern, etc.

    3-3 Rhododendron, misec heaths

    3-4 Dog hobble

    3-5 Hemlock sapling or Hemlock shrub

    3-6 Deciduous shrub sapling including *Cornus* dominated

Table 5. Understory Codes-Cont.

4. Xeric-subxeric

   4-1 Vaccinium dominated including *Vaccinium* - sapling, *Vaccinium-Smilax*, etc.

   4-2 Sapling dominated including xeric shrubs like azalea

   4-3 Mountain laurel with associates

   4-4 Rhododendron-laurel

   4-5 Rhododendron with associates

   4-6 Xeric herbs

5. Early successional

   5-1 Grass - sedge

   5-2 Bramble - shrub - sapling

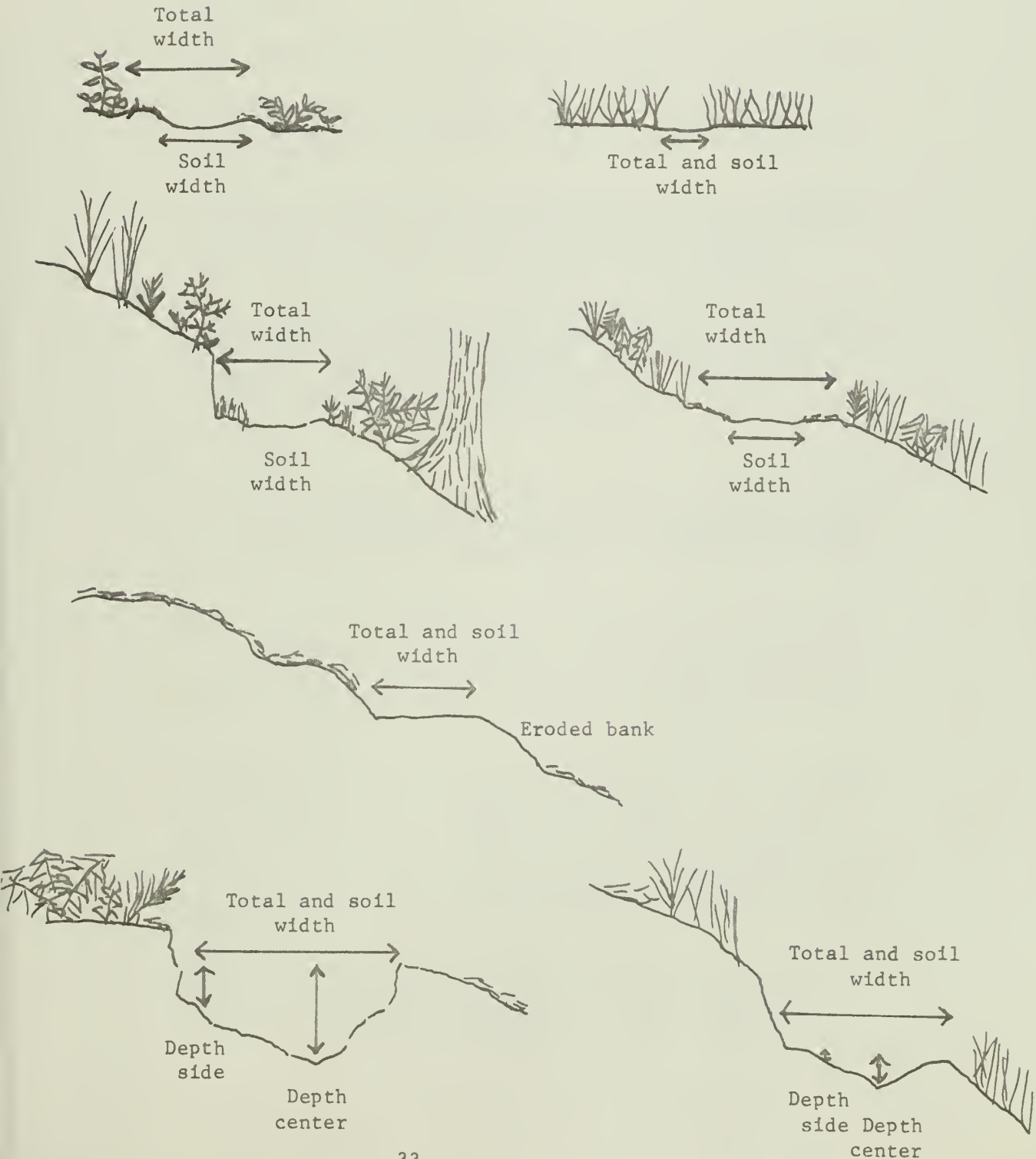
year was considered "litter.") If these three sum to less than the total width, the remainder is considered to be vegetation and undisturbed (forest floor type) leaf litter. Depth was measured at the center and at the deepest side (see Figure 8). Depth measurements are always in reference to the downhill side of the trail.

The different types of erosion listed on the data sheets were recorded in terms of estimated percentage of the trail section which was affected. This is a more subjective type of measurement than width or depth. Bank and side erosion refer to either the trail cut washing in on the trail or erosion along the edge of the trail. Water erosion is the visible movement of rock and soil downhill along the center of the trail (most trails are on too gentle a grade for rock and soil to move due to gravity). Mud is a soil surface which moves when wet (usually will retain footprints of greater than 1 centimeters depth). Foot plow and horse plow refer to a soil surface which is muddy or loose due to the impact of travelers (usually with footprints still visible). Ruts are those areas where the trail has worn at least 15 centimeters below the original bedded trail surface, either due to water erosion or use.

The criteria for the erosion and the overall rating classes are listed in Table 6. The suggested trail future is listed in Table 7.

Figure 8

Position of various width and depth measurements relative to the trail cut and trail tread



Tables 6. Standards for erosion ratings.

I. Erosion rating

1*- Very little

2 - Some, muddy spots, or tree roots, or water action evident

3 - Moderate, exposed rocks and trees or small mud holes, but little evidence of widening beyond the maintained width of the trail

4 - Extensive, rocks or tree roots exposed and roots damaged, or ruts more than 20 centimeters deep, or widening due to muddy areas, or water action consistently evident

5 - Very extensive, trail to bedrock or other substrata, or tree roots badly damaged, or some ruts more than 50 centimeters deep, or large areas (over 50 percent) of bank erosion, or mud holes so extensive that the trail is largely outside of its maintained width

II. Overall rating

1*- Excellent, surface of the trail relatively smooth, trampled area narrow (less than 80 centimeters) vegetation growing in trail cut or beside trail, easy or "forest floor" type walking

2 - Good, some small eroded areas or rough spots, vegetation near trail shows little impact, trail narraw (less than 120 centimeters on the average) with tread about 80 centimeters, or if jeep width, no ruts or areas of widening, smooth surface and little obstruction to walking

3 - Average, tread nearly as wide as the trail bed on average greater than 80 centimeters bare soil and rock or vegetation damage along the edge of the trail, or some bank erosion or some small muddy spots, or surface rough in places due to exposed rocks and roots, or water bars needed, if a jeep road, some ruts and damage at fords, stony or rough surface, or widening due to erosion

4 - Poor, trail surface very rough with many rocks or tree roots or noticeably rutted so that most of the trail is in a cut, or some large mud holes or other types of

Table 6. Standards for erosion ratings - Cont.

widening past 200 centimeters, or extensive vegetation damage due to extension of the tread area outside of the original maintained width and depth of the trail, or numerous places where hikers have gone off the trail and caused widening or if a jeep road, deep ruts and widening, extensive water erosion, poorly maintained, walking difficult

5 - Very poor, trail surface makes walking very difficult, often necessary to go around small obstacles, mud, holes, etc., most of the trail widened past 200 centimeters or rutted more than 20 centimeters deep, eroded to bed rock so that stumbling is likely, almost always necessary to look down while walking, evidence of extensive vegetation damage at the side of the trail, if a jeep road, so poorly maintained that a jeep would have difficulty traversing it, or extensive deep ruts and widened areas

---

* In both erosion ratings and the overall ratings, jeep roads were not originally allowed Class 1 ratings because their maintained width automatically causes extensive damage to tree roots and vegetation and they are, therefore, not "the best possible trail" from an erosion and damage point of view. In the field some people classified the jeep roads as Class 1, anyway. The computer program for erosion class will not allow a trail that if over 120 centimeters as Class 1, again on the basis of damage due to width.

Table 7. Suggested Trail Future.

The following categories were used on the data for suggested trail future, these were not computerized or considered in the quantitative data analysis. They were used, however, to prepare the trail descriptions and the suggested trail futures in Appendix I.

IA - An increase in foot use would help keep the trail open, and could actually aid in trail maintenance.

IH - The trail can tolerate very heavy use and a substantial increase in either horse or foot traffic is possible.

IF - The trail is in excellent or good condition and can probably tolerate a moderate increase in foot traffic.

IM - The trail presently has some trouble spots, but a small increase in foot use is possible with better or different maintenance.

IR - The trail is being damaged by horses, but if it were either repaired or horses were eliminated, more foot use would be possible.

CC - The trail is in good or average condition, and is probably at carrying capacity. The surface and conditions are such that a change in maintenance is unlikely to increase the carrying capacity unless the trail is surfaced.

DD - A decrease in foot traffic would be desirable, the trail has passed its carrying capacity, and is presently deteriorating. Maintenance is unlikely to be effective.

DM - A decrease in foot traffic and horse traffic is desirable, unless there is a change in maintenance.

DH - A decrease in horse traffic is desirable, but will not allow an increase in foot traffic.

DV - A decrease in vehicle use is desirable.

DA - The trail is very badly damaged, and most or all of the traffic should be removed to allow the area to recover, or drastic changes in maintenance are necessary. The trail is way over its possible carrying capacity, and a permanent decrease in use should be contemplated.

Table 7. Suggested Trail Future - Cont.

D? - The trail is badly damaged but may not be deteriorating further. The trail is already to bedrock or greatly widened.

These last numbers are the most subjective part of the survey and show much more variance from investigator to investigator than do the relatively standard width and depth measurements.

Campsites

Data was collected for every legal and illegal campsite found along the trails surveyed. Legal campsites as of 1976 are listed in Table 8. First the location of the site was recorded, along with its legal status, forest type, and understory type. Illegal sites are classified as: 2) emergency type, b) occasional use, c) heavy use, or d) developed illegal (with clearing or "improvements" such as benches or shelter frames). If exotic plants were present or the canopy was open, this was checked.

The site dimensions were recorded in meters (see Figure 9. Campsite Data Sheet). If there was more than one tent site or more than one disturbed area, a map was drawn on the back of the data sheet. Topography was measured with a Brunton transit. The type of water source, its distance from the camp and from privies was recorded. Attractions were checked and developments listed by the number of each (firepits being the most frequent and important of these). The standards and symbols for the different ratings are shown in Table 9. These vary somewhat according to the size and legal status of

the site. The investigator made any necessary notations of the condition or future of the site in the lower right-hand corner of the data sheet.

In order to computerize the data, a numerical coding system was developed. Some of the data has been reduced into simpler categories.

This classification is shown in Table 10. Sizes for disturbed areas are computed as if they were rectangles based on the maximum width and length measurements. Since the disturbed areas are irregular in shape and are often elipses, this probably tends to over estimate the amount of disturbance slightly.

The sampling was done between October 1975 and February 1977. An effort was made to compensate for short-term variations in condition due to season or to rainfall; but all measurements, particularly width of litter, width of vegetation, and percentage of mud, foot plow and horse plow, are subject to some seasonal variation. The pattern of illegal campsites differs seasonally, but there is no evidence there were fewer in the winter samples.

Table 8 . Legal Campsites and Shelters by Section.

Section 1 - Appalachian Trail (AT)

	Name	Carrying Capacity	Horse Use
S-1	Davenport Gap	12	H
S-2	Cosby Knob	12	H
S-3	Tricorner Knob	12	H
C-43	Mt. Chapman	10	H
S-4	Pecks Corner	12	H
S-5	Ice Water Springs	12	
S-6	Mt. Collins	12	
S-7	Double Springs	12	H
S-8	Silers Bald	12	H
S-9	Derrick Knob	12	H
S-10	Spence Field	12	H
S-11	Russell Field	14	H
S-12	Mollies Ridge	12	H
S-13	Birch Springs	12	H
	(Abandoned - False Gap)	12	

Section 2 - Abram's Creek (West of Cades Cove)

C-1	Cooper Road	10	H
C-2	Cane Creek	10	
C-3	Hesse Creek	10	H
C-11	Beard Cane	10	H
C-14	Flint Gap	8	H
C-15	Rabbit Creek	8	H
C-17	Little Bottoms	10	
S-16	Scott Gap	8	H

Section 3 - Cades Cove

6	Turkey Pen Ridge	6	H
7	(Abandoned Turkey Pen)		
9	Anthony Creek	6	H
10	Ledbetter Ridge	8	H
12	Ekaneetlee	8	
13	Sheep Pen Gap	12	H
	(Moore Spring Abandoned Shelter)	(8)	
18	West Prong	8	H

Table 8. Legal Campsites and Shelters by Section - Cont.

	Name	Carrying Capacity	Horse Use
Section 4 - Tremont			
19	Upper Henderson	8	H
20	King Branch	10	H
26	Dripping Springs Mountain	8	H
27	Lower Jakes Gap	8	H
28	Marks Cove	20	H
Section 5 - Elkmont			
21	Medicine Branch Bluff	8	H
23	Camp Rock	8	
24	Rough Creek	14	H
25	Lower Buckeye Gap	8	
30	Three Forks	12	
Section 6 - LeConte			
22	Old Sugarlands Road	12	
31	Porters Flat	15	
S-18	Mt. LeConte	12	H
Section 7 - Cosby			
29	Otter Creek	10	
33	Snakeden Mountain	10	H
34	Sugar Cove	15	
35	Gilliland Creek	15	H
(Old 33	Abandoned)		
Section 8 - Boundary Trail			
4	Kelly Gap	10	H
5	Double Mountain	8	H
7	Ace Gap	10	H
5-15	Rich Mountain	8	H
Section 9 - Twenty Mile			
92	Upper Flats	14	
93	Twenty Mile Creek	14	H
94	Long Hungry Ridge	8	
95	Wolfe Ridge	8	

Table 8 . Legal Campsites and Shelters by Section - Cont.

Section 10 - Hazel Creek

	Name	Carrying Capacity	Horse Use
80	Hazel Creek Cascades	12	
81	Proctor Creek	15	H
82	Calhoun	15	H
83	Bone Valley	20	H
84	Sugar Fork	8	H
85	Sawdust Pile	20	H
86	Proctor	20	H
87	Haw Gap	8	H
88	Pinnacle Creek	8	H
89	Lower Ekaneetlee	8	
90	Lost Cove	12	H
91	Upper Lost Cove	10	H
96	Eagle Creek Island	10	
97	Big Walnut	10	

Section 11 - Forney Creek

61	Bald Creek	12	H
62	Upper Ripskin	12	H
63	Jerry Flat	10	H
64	Mill Creek	20	H
65	Bear Pen Branch	8	H
66	Lower Noland Creek	10	
67	Goldmine Branch	10	H
68	Steel Trap	8	
69	Huggins	12	
70	Jonas Creek	12	H
71	CCC	12	H
72	Whiteoak Branch	8	H
73	Bear Creek	15	H
74	Lower Forney	12	H

Section 12 - Deep Creek

52	Newton Bald	8	H
53	Poke Patch	12	
54	Nettle Creek	8	
55	Pole Road	15	
56	Burnt Spruce	10	H

Table 8 . Legal Campsites and Shelters by Section - Cont.

	Name	Carrying Capacity	Horse Use
57	Bryson Place	20	H
58	Nicks Nest Branch	6	H
59	McCraken Branch	6	H
60	Bumgardner Branch	10	H
Section 13 - Smokemont			
S-17	Kephart	14	
48	Upper Chasteen	8	
49	Cabin Flats	20	H
50	Lower Chasteen Creek	15	H
51	Towstring	20	H
Section 14 - Heintooga			
44	McGhee Springs	12	H
46	Straight Fork	20	H
47	Enloe Creek	8	H
S-16	Laurel Gap	14	H
Section 15 - Cataloochee			
36	Cataloochee	20	H
39	Pretty Hollow	20	H
40	Big Hemlock	10	H
41	Caldwell Fork	10	H
42	Spruce Mountain	10	H
Section 16 - Big Creek			
32	Big Creek	20	H
37	Walnut Bottoms	20	H
38	Mount Sterling	20	H
Lake Trail part of Section 10 but excluded from some calculations			
75	Hicks Branch	10	
76	Kirkland Creek	12	
77	(No name)	0	
78	Chambers Creek	10	

IPSITE SHEET, Figure 8

__ Name _____ Quad _____ Coordinates _____ _____

cation _____

pe _____

rest type _____ Open canopy? _____

lerstory _____ Exotics? _____

te dimensions	1	2	Area
re rock			
l			
re soil			
lf litter			
mpled veg			
rewood clear			
ee damage			
drained			
pe erosion			
sh			
AL DIST			
damage			
rse damage			

Topography
Slope site
Aspect, site
Slope above
Slope below
Aspect envir
D below top
Convexity si
Convexity en
Moisture
Drainage
Elevation
Spring
Stream
Seep

Water
Spring#
Creek(size)
Lake
Pipe
Flow
Erosion above
Silt
Mud(area)
dis camp
pos camp
dis erosion
dis privy
pos privy
dis human
dis animal

tractions:
uit plants ____
d flowers ____
trees ____
ds ____
ws ____
terfalls ____
shing ____
aching ____
rse camp ____
ver ____
elter ____
r cmpgrd ____
r viscen ____
or access ____
r road ____
near ____
ote ____
vate ____
____
er:

Developements:
Shelter ____
Bear fence ____
Shelter frame ____
Tent space ____
Privy ____
Fireplace ____
Picnic tables ____
Bear barrels ____
Firepits ____
Hitchracks ____
Camp circle ____
Sign camp ____
Sign water ____
Sign trail ____
Other:

Rating:
Frequency use ____
Carry capacity ____
Trash level ____
Firewood level ____
Mud and dirt ____
Sanitation ____
Vegetation dam ____
Placement ____
Drainage ____
Maintenance ____

Site future, why? _____

Suggested improvements and hazard reduction:

General comments:

t rain _____
f fall _____
erver _____
e __ __ __

AMPSITE SHEET

ap of areas with more than one fire pit, or too large to describe with simple
imensions. Symbols: * = firepit, P = privy, H = hitching rack, S = spring,
= Shelter or shelter frame, F = fireplace, T = tent site
imensions should be given in meters. Show stream boundaries with wavy lines,
reas of erosion or bare soil with smooth lines, and boundaries of damaged
egetation with zigzag lines, trails as dotted lines, roads as double dotted
ines, and guffer reroutes as a line with slashes.

rails:

#	Name	Type	Signpost	Distance to Road	Distance to Next site

Table 9. Filling Out the Campsite Sheet

A. Type of site

1. Legal (indicate official capacity)

   a. Shelter
   b. Numbered backpacker site
   c. Numbered horse camp

2. Illegal

   a. Emergency type
   b. Occasional use (indicate very infrequent, infrequent, occasional)
   c. Heavy use (indicate approximate intensity and number of tent sites)
   d. Developed illegal (indicate clearing or improvements)

B. Forest type

Follows the categories in the trail section. Shelter plants should be listed if present.

C. Site dimensions

All measurements should be to the nearest meter. In general the total dispersal distance should be measured for "tree damage" and "trash" whereas the total size of the damaged area should be measured for "hog damage", "undrained", etc.

D. Topography

This section is an attempt to quantify the levelness of the site and drainage conditions.

1. Slope and aspect of the site using a Brunton

2. The slope of the hill above the site (if not on a flat or ridge top) and the slope below

3. The aspect of the whole area

4. The distance the site sits below the top of the ridge

Table 9 . Filling Out the Campsite Sheet - Continued

D. Topography - Continued

5. The average slope of the site to the sides (note if CC - concave or CV - convex)

6. Would the surrounding area (and vegetation) be considered:

VX - Very xeric
X - Xeric
M - Mesic
VM - Very mesic
H - Hydric

7. Drainage

ED - Excessively drained
WD - Well drained
MD - Moderately well drained
PD - Poorly drained
VPD - Very poorly drained
SW - Frequent standing water

8. Elevation in feet

9. Spring, stream, seep

If there is a spring, stream or seep in the midst of the campsite, indicate if it is

I - Intermittent
C -Constant

and if it has caused

M - Mud
EA - Large amounts of erosion damage
E - Erosion damage

E. Water source

1. Include the size of the stream (width in meters) or the number of springs

Table 9 . Filling Out the Campsite Sheet - Continued

E. Water source Continued

2. Include pipes or other improvements and the quality of flow (good, O.K., poor)

3. Include the distance in meters from the camp, the eroded part the camp, the privies (or likely privy sites), and human sign also the position relative to the camp and privies, including above or below and the angle

F. Attractions

These should be within easy walking distance from the site

G. Developments

Count the number of each .

H. Rating (This section should be done very carefully)

1. Frequency of use

VH - Very high, more than one group almost every night through out the season. In the case of campsites, indications that 6 or 8 tents at once is a common occurrence

H - High, the site receives almost continual use through the season .

M - Site is regularly used, but rarely supports large numbers of tents or people (more than 4 tents or 10 people)

L - Lightly used, site largely used on weekends, groups tend to be small

R - Rarely used, the site is rarely occupied, and group sizes tend to be small (1 or 2 tents, only on weekends, etc.)

MH - Site is only moderately visited, but tends to support large parties (as in the case of some horse camps)

Table 9. Filling Out the Campsite Sheet - Continued

2. Carrying capacity

IA - An increase in visitor use would help to keep the site open and maintained

IP - The site can tolerate a moderate increase in use

IH - The site can tolerate very heavy use, and an increase is possible

IM - With better or different maintenance, the site could tolerate an increase in use

CC - The site is about at its proper carrying capacity, and use should remain constant

DD - A decrease in use would be desirable, the site is showing signs of some erosion and other damage and this may worsen

DG - A decrease in large group use, or in intense weekend use is desirable, but the site can probably stand continual use by a smaller number of tents

DA - The site is very muddy or intensely eroded and should be closed for rehabilitation, or closed entirely

D? - The site is already extensively damaged, but recovery seems unlikely. With properly restricted hiker load, it will probably not deteriorate further

3. Trash levels

This concerns the general patterns around the edge of the camp

VH - Several large garbage piles in the woods. Scattered cans etc. around most of the camp

H - Scattered cans and other trash around the camp, some buried and old garbage

M - Moderate, some scattered garbage around the camp

L - Just a few pieces of foil or a couple of cans here and there

Table 9 . Filling out the Campsite Sheet - Continued

3. Trash levels - Continued

   VL - Only one or two scattered items

   0 - No trash at all

4. Firewood levels

   VH - Firewood actually present in the center of the camp, no stumps

   H - Firewood in the camp, a couple of stumps at the most

   M - Moderate, the camp area is firewood clear, but wood is available in the woods immediately around, few stumps

   L - Forest basically firewood clear in all directions, cut stumps common

   VL - Very low, forest basically firewood clear for about 100 in easy walking directions, naked forest floor and cut stumps very noticeable

5. Mud and dirt

   VH - No clean area to pitch tent or to cook

   H - Most of the campsite is dirty, preferable to sit on rocks and logs, difficult to pitch tent sensibly

   M - Moderate, clearings for tents and cooking, little grass or leaf litter to sit on, possible to put tent on litter within the confines of the site

   L - Some dirty spots where there has been cooking or camping

   VL - Leaf litter and grass on which to sit, or pitch a tent

   0 - Almost pristine forest floor conditions

Table 9. Filling out the Campsite Sheet - Continued

6. Sanitation, placement, drainage, maintenance

   E - Excellent
   VG - Very good
   G - Good
   M - Mediocre
   P - Poor
   VP - Very poor

7. Vegetation damage

   Follows scale similar to trash levels

I. Suggested improvements, site future

This section should discuss things like reducing the number of visitors, checking for contamination of the water supply, presence of dead trees and limbs, possibility of flooding, supplementing the site with another area. Site future is very important. What is likely to happen to this site under present usage in ten years? What should the National Park Service do with it?

Table 10. Computer Coding for Campsites.

1) Section and trail - follows the trail codes

2) Legality
   1 - Shelter
   2 - Legal campsite
   3 - Illegal

3) Horse use
   1 - No
   2 - Yes

4) Site number and shelter numbers are shown in Table 8. Illegal campsites are numbered consecutively by section.

5) Vegetation types follow the trail survey Table 4 and Table 5.

6) Slope position
   1 - Ridge top
   2 - Slope
   3 - Gap
   4 - Stream flat

7) Water
   0 - None
   1 - Spring(s)
   2 - Stream(s)
   3 - Lake

8) Water class (width in meters)
   1 $\leq$ ½ m
   2 $\frac{1}{2} <$ 1 m
   3 $1 <$ 2 m
   4 $2 <$ 4 m
   5 $4 <$ 5 m
   6 $5 <$ 7 m
   7 $7 <$ 9 m
   8 $9 <$ 12 m
   9 $12 <$ 15 m

9) Aspect, degree of slope, elevation, distance of camp from water, number of shelters, fire pits, etc. are listed in terms of the original numbers recorded.

Table 10. Computer Coding for Campsites. - Cont.

10) Carrying capacity
1 - 1A, way under
2 - 1H, 1M, 1P or under
3 - CC, or at
4 - DD, DG or over
5 - DH or way over

11) Frequency of use
1 - R or rare
2 - L or low
3 - M or MH or medium or moderate
4 - H or high
5 VH or very high

12) Firewood levels
1 - VH or very high
2 - H or high
3 - M or medium
4 - L or low
5 - VL or very low

13) Trash levels, mud and vegetation damage
0 - 0 or none
1 - VL or very low
2 - L or low
3 - M or medium
4 - H or high
5 - VH or very high

14) Sanitation
1 - Excellent
2 - Good
3 - Moderate
4 - Poor
5 - Very poor

15) Placement of the site
1 - VG or very good or excellent
2 - G or good
3 - M or OK or medium
4 - P or poor
5 - VP or very poor

Table 10. Computer Coding for Campsites.

16) Drainage
    1 - Good
    2 - Fair
    3 - Poor

17) Trail intersection
    1 - Yes
    2 - No

18) Open canopy
    1 - Yes
    2 - No

19) Distance from closest vehicle access (this assumes vehicle roads, boat access on Fontana Lake is not included)
    1 ≤ ½ mile
    2 ≤ 1 mile
    3 ≤ 2 miles
    4 ≤ 3 miles
    5 ≤ 4 miles
    6 ≤ 5 miles
    7 ≤ 7 miles
    8 ≤ 10 miles
    9 ≤ 12 miles

20) Carrying capacities are for legal sites only, see Table 9.

Data Analysis

The information from the data sheets was numerically coded for key-punching, and organized by numbered section. Maximum depth was used rather than both depth at the center and at the sides. Exotic plants and the recommended trail future were excluded from the computerized data matrix. Mudholes and eroded areas were listed individually according to total area.

In order to compensate for individual variations in sampling, the first program created an "objective" erosion classification and divided the trail sections into two types of width classes. The first type of width class was based on the trail standards set by the Park Superintendent in 1975. Class 1 is 80 centimeters width or less; and meets "foot trail only" standards. Class 2 is 120 centimeters wide and meets "horse trail" standards. Class 3 is jeep roads and trails; and Class 4 is all trails wider than 120 centimeters that were never maintained as jeep roads.

The second set of width class is based on a series of regular size intervals independent of park maintenance policy. If the trail cut is less than 20 centimeters and wider than the tread (rock + soil),

20 centimeters is added to the total trail width before the size class is computed (which in the case of the narrow trails this moves them up into the next larger size class).

The computer erosion classification could be redone using any variables, or combinations of variables, at any level. More classes could be defined or the list could be shortened to one or two classes. The requirements for Class 1 could be set so that few trails would meet the standards, or so that a great many would be included. The classification used here is 5-level, to match the classifications applied in the field. The cut-offs for most variables are liberal, but the program tends to produce lower values than those recorded in the field.

The size classes are:

Group 1	11	- <60 cm
Foot and horse trail	12	- >69, ≤80 cm
width	13	>80 cm - 100 cm
	14	100 cm - 120 cm
Group 2	21	120 - 160 cm
Greater widths	22	160 - 200 cm
	23	200 - 300 cm
	24	300 - 400 cm
	25	>400 cm

The "objective" or computer erosion classification sorts the reported width, depth, and percentage erosion for a trail section and assigns a value from 1 through 5 to that section. The standards set by the program are shown in Table 11.

The program does not sum up different types of erosion (many of them tend to co-occur) nor does it consider the fact that the width and depth measurements for a section may be anomalous and not representative of section. On the average, however, the computer erosion classification for a section gives some indication of the status of the trail, and allows a comparison with the subjective erosion and overall classifications done in the field. Differences between individual investigators can be compared with the use of a partially objective measure. The width classes and computer erosion classification were also punched on cards directly by the machine and included in the basic matrix.

The campsite data, as previously mentioned, was also computer coded. Note that the bare soil measurements discussed later in this report are total bare rock plus mud plus bare soil plus bank erosion.

Table 11. Computer Erosion Classes.

The computer program considers each variable separately. If any variable is not within the allowable size or percentage, the section is dropped to the next class. Note that the allowable erosion is somewhat liberal (i.e., 100 m^2 of mud is 10 2x5 m mudholes per 1/3 mile section so a section with 8 such mud holes would still fall in Class 3). Despite the liberal standards the program tends to lower ratings.

Class	Total width	Total width minus tread	Depth	% Water erosion, mud rut, horseplow, foot-plow or vehicle rut	% Exposed roots or side erosion	Total m^2 of mud or eroded areas
1	≤120 cm	≥20 cm	≥ 5 cm	≤5%	≤10%	≤10 m^2
2	≤200 cm*	≥20 cm	≥ 15 cm	≤15%	≤25%	≤30 m^2
3	≤200 cm*	-	≥ 30 cm	≤30%	≤50%	≤100 m^2
4	≤200 cm*	-	≥ 50 cm	≤50%	≤70%	≤300 m
5	All others					

* Foot and horse trails.

All of the averages, frequency tables, chi-square tables, and regressions were computed using the SAS statistical programs by Barr and Goodnight (1972).

If we were to do this survey again, we would probably change the data sheets and the sampling outline in several places including:

1. Depth sides need only be used in rare cases, maximum depth is the best measure.
2. Bank erosion on the uphill side and erosion on the downhill side need to be better discriminated. One overall estimate for each for the trail section would be better.
3. Water erosion should clearly be estimated for the whole section. It is one of the most important types of erosion and should have been better quantified.
4. The on-the-spot measures of roots, bank erosion, and hog rooting should be dropped.
5. Many people cannot recognize exotic plants, and even the good field botanists frequently forgot to check their presence; this category could be dropped.
6. Water bars and breaks probably should be recorded by trail section, as the mudholes were. The information collected on water bars was inadequate. The developments section was on

the back side of the sheet and was often forgotten. Bridges, walls, and signs were more faithfully recorded than water bars and fords.

7. Hog rooting is interesting, but only occasionally directly influences trail or campsite conditions. Hog rooting was included here partially to provide some estimate of hog range and rooting damage in the park.
8. The campsite sheet could be simplified. Bare rock and hog damage are rare. All the slope measurements are not necessary (convexity is not as useful as drainage, for instance). Field observers often neglected the water section. "Erosion above," "silt," "distance from human sign," and "distance from animal sign" could be dropped. The attractions section tends to receive variable amounts of attention. The site dimensions are by far the most important data.
9. The campsite sheets should be rewritten so that they are directly computer coded.

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