ABSTRACT / All the maintained trails in Great Smoky Mountains National Park were surveyed for width, depth, and a variety of types of erosion. Trail erosion is related to a number of environmental variables, including vegetation type, elevation, trail slope, and section of the park. Open grass balds and spruce-fir forest are the most erosion-sensitive plant communities, and the xeric oak and pine types are the least sensitive. Trails in virgin or mature forest tend to be in poorer condition than those in successional areas. The most important physical factor is the slope of the trail.

A comparison of visitation patterns with trail condition indicates that redistribution of use would help to mitigate some erosion problems. Because trail condition is correlated to physical environmental factors, however, some sites will require intensive maintenance, even if visitation is low.

The data from this survey have already been used in environmental analysis of proposed developments within the park and can be applied to long-range planning for the park trail system as a whole.

Introduction

Like many other National Parks, the Great Smoky Mountains (GRSM) has experienced a tremendous increase in visitation over the last decade. During 1975, recreation visits were estimated at 8,541,500, and this increased to 8,991,500 during 1976. Between 1963 and 1975, total visits increased by 63%. An estimated 700,000 visitors took day hikes in 1975 and 51,400 went horseback riding. Backcountry campers spent an estimated 105,200 nights in the park.

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 1930s, at a time when enthusiastic backpackers were a rarity and the American public was not nearly as mobile as it is at present. Even though a majority of the trails built by the Civilian Conservation Corps (CCC) and the National Park Service were well designed, there are now eroded areas in most sections.

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The data presented here were originally part of an inventory of trail and campsite conditions intended for managerial use. The basic concept of erosion classes is very similar to that developed by the Soil Conservation Service to locate intensively eroded areas and evaluate erosion on a geographic basis (Soil Conservation Service 1951) or that for assessing vegetation damage developed by Braun-Blanquet (1932). Although some of the data have implications for the dynamics of trail erosion, the basic purposes of the work have been (1) to locate problem areas within the park and (2) to look at the major associations between environmental variables and the degree of trail erosion in different parts of the park.

The Trail Environment

Several characteristics of the Smokies environment are important to trail maintenance. First, the area is moist and there is more rainfall at higher elevations. Gatlinburg, elevation 445 m, averaged 150 cm precipitation annually for the period, 1947–1950, and Newfound Gap, elevation 1520 m, averaged 200 cm/year for the same period (Stephens 1969). Peak precipitation is usually in July and November. Although snow rarely remains on the ground for more than a day or two at low elevations, the snow depth on the ridge tops may exceed 2 m, and snow may remain several weeks. Snowmelt or long periods of rain may saturate the soil and cause flooding or landslides. During the summer, intense thunderstorms are common.

The topography of the park also influences trail use and maintenance. The central part of the park is one of the highest ridges in the eastern United States, with a maximum elevation of 2025 m at Clingmans Dome. Slopes are typically 25° and greater, but most of the area is covered with vegetation. The park is part of the eastern deciduous forest biome (Braun 1950), although coniferous spruce-fir forest predominates at the highest elevations. The park includes extensive stands of “virgin timber,” which have

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never been logged or farmed. Trees on the lower slopes may exceed 2 m in diameter at breast height. About 60% of the park is covered with forests regenerating on former farms or on stands logged during the early 1900s. Some open successional areas remain after large fires, grazing, or farming. The vascular species diversity is high for a deciduous forest area, and the park is well known for its wildflowers, particularly the vernal displays.

The soils in the park are predominantly inceptisols, but their structure varies greatly relative to elevation, slope, substrate, and forest type. The bedrock underlying the park is largely "pebbly, sandy, and muddy sedimentary rocks" (King and others 1968), all of which have been metamorphosed to some extent. Four small limestone windows are exposed at the western end of the park, but these are crossed by less than 10 km of trails. Most of the substrate in the central part of the park is sandstone or conglomerates with rather similar weathering properties.

Trail Maintenance

In the Great Smoky Mountains National Park, the word "trail" may mean any one 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. In a recent (1976) move by the National Park Service to reduce impacts of mechanized equipment on the back country, a substantial percentage of these roads has been closed to all vehicles, including those driven by park service personnel, except in genuine emergencies. These roads are now being maintained as hiking and horse trails (Fig. 1).

Trails not passable to jeeps have variable maintenance standards. Some horse trails have been maintained to 2-m 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 are surfaced with asphalt. The standard width for a foot and horse trail tends to be about 120 cm, or 4 ft. Newer trails and some little used trails have narrower cuts.

Not all trails have the same origin. Many of the 120-cm-wide trails were built by the CCC and were planned as part of a park trail system. Some of the trails are placed on old settler roadbeds or old railroad grades from logging days. Many are administrative roads built by the National Park Service. Some trails, especially those on ridge tops, are old manways¹ that have been opened for use with little or no engineering.

The care taken in establishing a route has varied tremendously. CCC trails are usually well graded, are 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 that has occurred 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 (Tennessee and North Carolina) of the park. Each side is further divided into subdistricts. Width of the trails, grading, and brush cutting have not always been standard from one district of the park to the other. The park standards for trail maintenance have varied somewhat over time. The standards in force at the time of this survey were a 90-cm brush clearing width and a 45-cm cut for foot trails, and a 180-cm brush clearing width and a 120-cm cut for foot and horse trails.

Methods

First the park was divided into 16 sections, based on access. Two long-distance trails, the Boundary Trail and the Appalachian Trail, were classed as separate sections (Fig. 2). All maintained trails were included in the survey (about

¹An unmaintained trail kept open by human use.