USDA Forest Service Research Note SE-153 February 1971

SOIL MOVEMENT IN ESTABLISHED GULLIES AFTER A SINGLE PRESCRIBED BURN IN THE SOUTH CAROLINA PIEDMONT

Abstract.--The effect of prescribed burning on soil movement in 25 established gullies was studied on Sumter National Forest, South Carolina. One moderately intense backfire in Piedmont pine communities did not have a measurable effect on soil movement in these gullies. Studies involving the effects of burning on factors other than soil movement are recommended.

Brender and Cooper[1] and Goebel et al.[2] demonstrated that one or two prescribed burns in loblolly pine (Pinus taeda L.) stands in the lower Piedmont of Georgia and South Carolina did not increase soil movement under the pine canopy. On clearcut areas, however, soil movement was detected on steeper slopes, logging roads, and in scarified clearings. They concluded that degree of slope, disturbance of ground surface fuel, amount of protection rendered by overstory canopies, and litter composition were the key factors in erosion of forest soils under Piedmont pine communities.

Our study, also conducted in loblolly pine stands of the South Carolina Piedmont, was designed to determine the effect of one spring or summer burn on soil movement in established gullies. Established gullies were selected as sample areas because drainage is concentrated there. Consequently, they are highly vulnerable to erosion, and changes in soil movement within these gullies should reflect the changes in the forest floor when the litter is reduced by burning.

On the Sumter National Forest near Greenwood, South Carolina, nine 28- to 107-acre areas dominated by loblolly pine over 40 years old were randomly selected. Basal area of pines averaged 91.4 square feet per acre, and there were no records of wildfires in existing stands nor of operations for timber stand improvement during the last 4 years. Slope averaged 6.7 percent. Three of the areas were randomly selected to be burned during the spring of 1965, three during the summer of 1965, and the remaining three served as controls and were not burned.

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[1] Brender, E. V., and Cooper, R. W. Prescribed burning in Georgia's Piedmont loblolly pine stands. J. Forest. 66: 31-36. 1968.

[2] Goebel, N. B., Brender, E. V., and Cooper, R. W. Prescribed burning of pine-hardwood stands in the Upper Piedmont of South Carolina. Clemson Univ., S. C. Agr. Exp. Sta., Forest. Res. Ser. 16, 22 pp. 1967.

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Nine gullies were located in the areas to be burned in spring, eight in the areas to be burned in summer, and eight in the unburned control areas. These gullies varied in size within and between each area, ranging from 18 inches deep and 36 inches wide to 12 by 50 feet. Soils in most of the gullies were stabilized except on the small water courses in the centers. In the larger gullies, some vegetation was established on the sides, and the ground was covered with an accumulation of litter except in the water courses.

Three permanent erosion stations were established in each of the 25[3] gullies. Within a gully, the first station was installed approximately 20 feet down from the gully's origin. The other two stations were located further down the gully wherever mineral soil was exposed. Each erosion station was marked by two metal stakes 3 feet long; these were driven into the ground approximately $2\frac{1}{2}$ feet and leveled. The distance from a metal crossbar between the stakes to mineral soil was measured at 10 points 2 inches on center along the crossbar (fig. 1). At each station, these distances were measured during the winter of 1964-65, before the burns, and again in December 1966, 1 year after the burns.

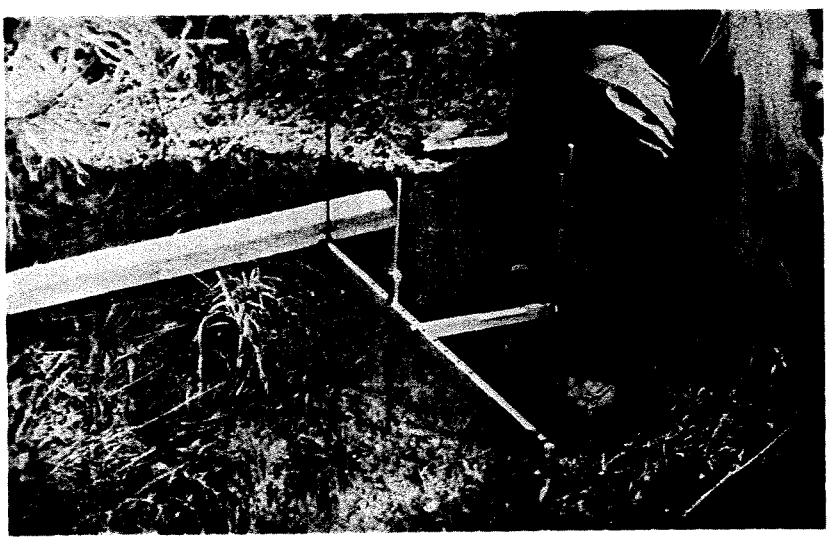

Figure 1.--Measuring the distance from the metal crossbar to mineral soil at one of the 74 erosion stations.

Spring burns were conducted on April 6 and 9 and on May 5, 1965; summer burns were conducted on July 26 and on August 17 and 18. All six burns were backfires; they were considered "cool" burns because about half of the ground fuel was consumed. In the few areas where mineral soil was exposed, such as in several piles of old slash, no sheet

[3] One station was destroyed in a gully on an area burned during the summer, resulting in a total of 74 erosion stations.

erosion was evident. One of the most striking changes after burning was the almost complete kill of redcedar (Juniperus virginiana L.). All cedars in or near the fire were killed.

All soil movements, whether they increased or decreased the distance from the crossbar to the ground, were recorded. An analysis of variance of the total change in the surface soil revealed that no significant changes could be attributed to the treatments.

Soil movement occurred in gullies on the burned areas, but just as much erosion took place in gullies on the control areas. As expected, the surface horizon of some gullies within a treatment changed more than others ("f" value of 2.15 significant at the 95-percent level of probability). This difference was expected because no attempt was made to duplicate gully dimensions within or between treatments.

It should be noted that soil movement in plowed firelines can be a serious problem with prescribed burning in the Piedmont (fig. 2). We observed much more erosion in firelines than in the burned areas. Whenever possible, firelines should be located on gentle slopes along a contour.

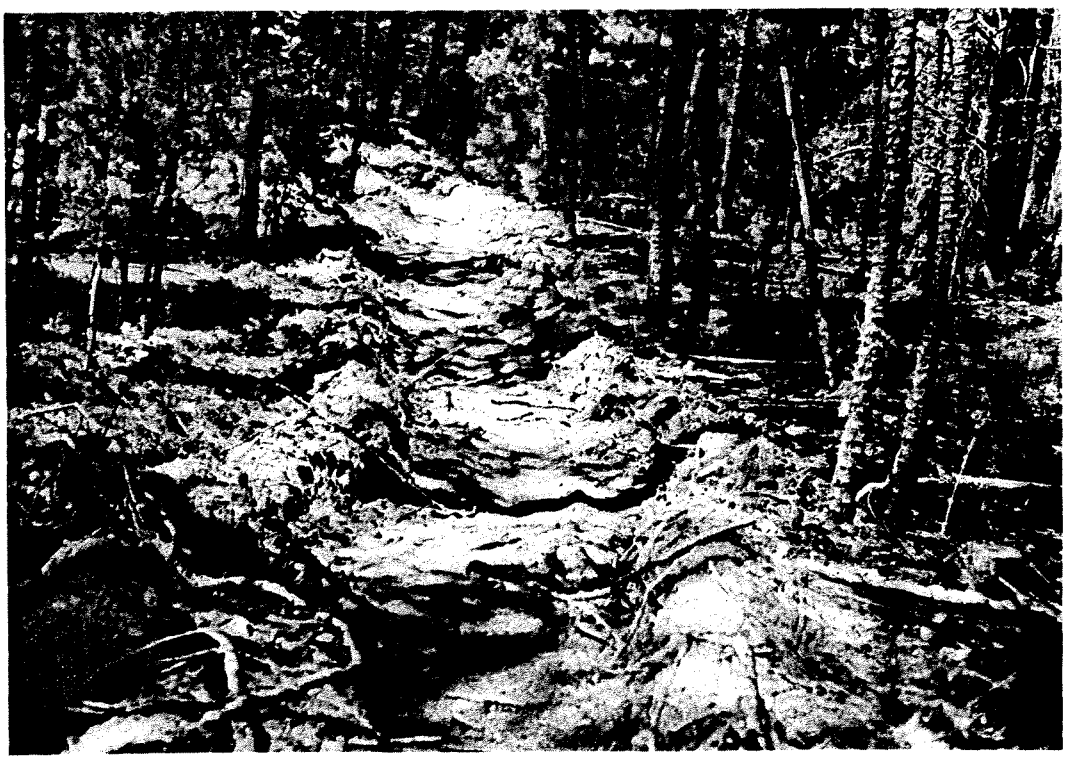

Figure 2.--A fireline which will erode because it is plowed perpendicular to the slope.

CONCLUSIONS

One moderately intense backfire in Piedmont pine communities did not have a measurable effect on soil movement in established gullies. Movement occurred in gullies on the control areas as well as in those on the burned areas. These findings support those of Brender and Cooper in Georgia (see footnote 1). However, the effects of prescribed burning on soil factors other than movement must be determined before we can recommend such burns as a tool for widespread management of Piedmont pine forests. For example, we need to know the effects of burning on nutrients in the soil and on vertical and horizontal water movement. Attention must also be given to effects of burning on the atmosphere.

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