SOIL MOVEMENT IN AN ALPINE AREA

by

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SOIL MOVEMENT IN AN

ALPINE AREA

Partial Completion Report
OWRR Project A-002-COLO.

TITLE: SURFACE WATER

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ABSTRACT

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Erosion transects were established at two alpine sites in Colorado. Site variables included two aspects (north and south), two slope positions (upper and lower), and three slope classes ranging from five to sixty percent. Soil particle tagging with fluorescent dye permitted soil migration to be observed. Small micro-plots were fitted with soil collectors to catch migrating soil particles for laboratory analysis. Maximum soil particle displacement on undisturbed steep mountain slopes averaged less than one meter over a two-year period. Particle movement is highly correlated with no deposition.

Particle movement is also correlated with slope, position on slope, litter cover, rock cover, and infiltration rate. Surface soil particle, sprayed with fluorescein dye remain sufficiently visible for observation over a two-year period.

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Sub-Project Title: Surface Soil Movement Related to Site Factors in an Alpine Area.

Objectives:

1. To relate rate of surface soil movement to site factors such as slope, aspect, topographic position, soil, vegetation and others, and to develop prediction equations of surface soil movement as a function of site factors.

2. To establish long-term condition and trend studies of an alpine area.

Attainment of Objectives:

The objectives of this project as defined above, are considered to be fully met. The study of soil particle movement as related to site factors was accomplished by the establishment and observation of transects of dyed soil particles as described more fully in this report.

The first step in the study of long term conditions was accomplished by the installation of exclosures in alpine area and the first set of measurements of vegetation species composition and frequency.

Methods:

Erosion transects were established in two areas: (1) the Comanche Peak area (grazing excluded) and (2) the Crown Point area (grazed). The eight transects established on the Crown Point area were located on two aspects (north and south), two slope positions (upper and lower), and two slope classes (5 to 10 and 20 to 30 per cent). The Comanche Peak transects were similarly located on north and south slopes, on gradients ranging from 30 to 60 per cent, and on three slope positions (upper, middle, lower). Procedures varied somewhat between the two sites. On the Comanche Peak area transects were 100 feet long with half the transect consisting of soil particles tagged by spraying a water stable flourescent dye on the soil surface and the other half consisting of soil particles tagged by excavating a 1 inch by 1 inch trench, sieving the soil into size classes and dying each size class a separate, distinct color with water stable flourescent dye. The colored particles were then thoroughly mixed and replaced in the excavated trench. In the Crown Point area the eight 50-foot transects consisted of sprayed soil particles.

In addition to the erosion transects on the Crown Point area, a total of 32 micro-plots were established adjacent to the transects. These consisted of a small metal collector trough placed flush with the soil surface so that any surface runoff or water-borne soil particles moving down slope would be caught and held in a container placed below the collector trough. Flourescent dye of various colors was sprayed along transects at intervals ranging from 4 to 16 cm. upslope from the collector. Thus, soil particles caught in the collector could be identified as to origin and distance moved.

In the summer of 1968, soil particle displacement on all transects and micro-plots was determined at the beginning and end of the summer. The erosion transects were observed at night in the field using a portable black light to illuminate the dyed soil particles. The particles displaced the greatest distance from the original transect were marked and the distance recorded. On those transects with soil particles colored according to size class, the color was also recorded.

Sediment caught in the micro-plot collectors was returned to the lab, sieved into standard size classes and the colored particles in each size class were counted by color classes. This permitted an analysis of distance moved by particle sizes.

In addition to the determination of soil particle movement described above, each site was charaterized according to vegetation density and species composition, soil characteristics including infiltration rate and bulk density; and micro-relief characteristics including depressions, channels, or surface runoff areas.

Summer precipitation was measured at each site and areas of late lying snow packs were identified and classified into five snow cover categories on the basis of aerial photos of the April 1967 snow conditions.

On the assumption that wind might be an important factor in soil particle movement and help explain differences on north and south slopes, wind measurements were taken on north and south exposures during the summer of 1968. These included both total wind mileage during the observation period and wind profiles on typical days using a sensitive wave type wind meter.

During the early part of the study, two exclosures were constructed on the Comanche Peak area and vegetation measurements obtained as a basis for comparing grazed versus adjacent ungrazed areas. Since the area was subsequently withdrawn from grazing the function of the exclosures was somewhat negated and measurements were not repeated in subsequent years. However, the first year measurements should provide a set of bench mark measurements for long-term observation of vegetation structure and species compositions in undisturbed alpine tundra ecosystems.

Conclusion:

The results and conclusions of this study may be summarized as follows:

1. Normal erosion rates in alpine tundra are very low. Maximum observed soil particle displacement on essentially undisturbed steep mountain slopes averaged less than one meter over a two-year period.

2. Soil particle movement was most highly correlated with snow deposition. It appears that melt water running over a saturated soil carries particles a short distance before redepositing them downslope.

3. In addition to snow deposition particle movement was correlated with slope, position on slope, litter cover, rock cover, and infiltration rates.

4. Grazing by sheep may create substantial surface disturbance of the soil and vegetation. However, under the conditions of this study, such disturbances did not result in increased soil particle movement other than that caused directly by the sheep. This is probably due to the coarse texture of the soil, the low intensity of summer precipitation, and the fact that grazing by sheep is concentrated in the latter part of the summer when the soils are relatively dry.

5. Wind appears to be a significant factor with respect to movement of fine soil particles and plant organism residues in alpine sites. However, since soils are primarily coarse textured, wind erosion is not the major source of soil displacement.

6. Flourescent dyes constitute a simple yet effective tool for tagging soil particles and following particle movement. Particles removed from the site and returned after coating retain the dye longer than particles sprayed "in situ." However, sprayed particles are sufficiently visible for observation over a two-year period.

Publications:

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