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A study of the physical carrying capacities of natural areas for recreation on the catchment of Katarét stream

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Summary

There is no unified, established method for the study of the physical carrying capacities of natural areas for recreation. The present paper undertakes the task of defining the physical carrying capacity of a mountain range of medium height by applying Wischmeier and Smiths Universal Soil Loss Equation (USLE) and vegetation coverage.

Introduction

In the urbanized world of today the recreational potential of natural areas is increasingly appreciated. More and more people decide to spend their leisure time hiking, take week-end and holiday trips outdoors. In some cases, however, this increased interest can produce undesirable consequences. A beautiful landscape, a unique natural phenomenon draws too many visitors to its location, which can be significantly damaged. The exploitation of natural areas by outdoor activities is known in many fields. The assessment of the physical carrying capacity of these areas is a serious problem, since generally there is only a small amount of information available and there is no comprehensive method for study.

While working on the geo-ecological map of the catchment of the Katarét stream, we had the opportunity to examine this area of the Eastern-Mátra from a recreational point of view as well.

Method

The assessment of the utilization and physical carrying capacity of natural areas usually employs general ecological criteria, but these can provide mostly quantitative evaluation only. This hinders a management that focuses on environmental protection, because primarily it requires the quantitative rating of land units into classes according to their carrying capacity. F.R. Kuss and J.M. Morgen III (1986) presented a method to solve this

problem by classifying natural areas on the basis of their relative carrying capacities for recreational activities.

The theoretical background of the method is the observation that it is enough for the assessment of the physical carrying capacity to examine the soil and the density of the vegetation. This estimation is possible because the soil may be appropriate for the examination of the impact of climate, age, constituents, configurations of the terrain (slopes, depth of the water table). Also, the type and orographical situation of the soil affects the vegetational order, the biomass-product, the variety of the flora and fauna, and the degree of suitability as a biotope. The capacity of the natural area to avert the effects of recreational activities is largely attributed to these factors. The density of the vegetation is an additional factor significantly influencing the spatial extension and temporal intensity of soil erosion.

Our method is based on the Universal Soil Loss Equation introduced by Wischmeier and Smith that can be expressed as

$$A=R*K*LS*C*P$$

where A is the predicted soil loss in tonnes per hectare, R is the erosion potential of the rainfall, Ls represents the length and steepness of the slope, K is the erodibility of the soil, C is the factor representing the vegetation that covers the soil and P is the factor expressing the of erosion control practice.

A sixth factor affecting the use of the equation is T, a factor established for different soil types expressing the maximum soil loss on 1 hectare that does not impair the productivity of the given area.

If we substitute T for A in the equation, the combined value of the cover and erosion control factors

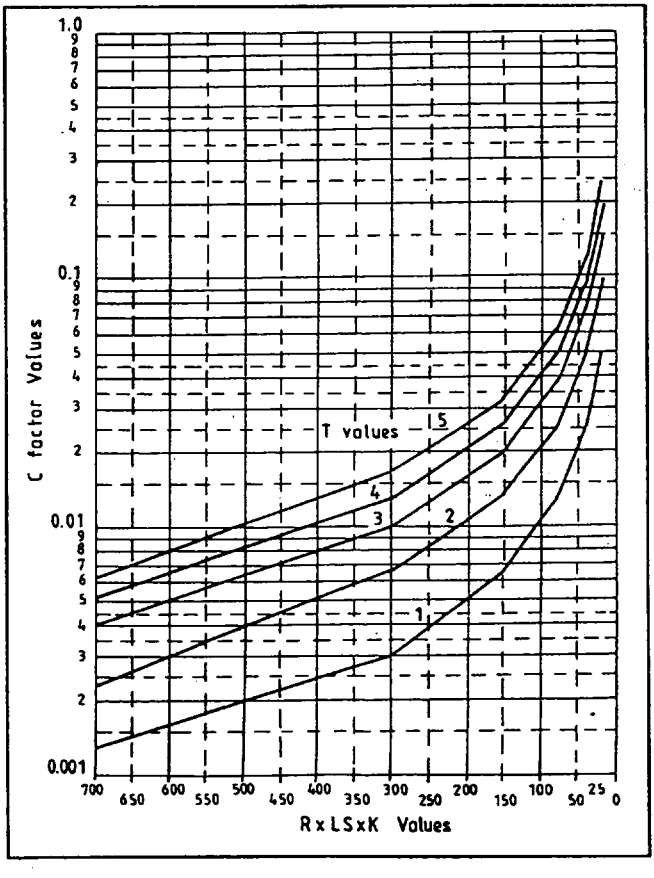

Figure 1 Graph showing the relationships of T values to C factor and Soil Loss Index values

necessary for maintaining the productivity will be $C*P=\frac{T}{R*K*Ls}$

Since in natural circumstances erosion control activities are generally not present, the value of P approaches to 1.0, therefore, when designing recreational activities, we disregard P and arrive at

$$C=\frac{T}{R*K*Ls}$$

Figure 1 serves to help to define the actual values of C.

The alternatives suggested for the estimation of the physical carrying capacity of natural areas regard the percentage values of the vegetation necessary to maintain the productivity of the soil to be the most acceptable basis for assessment. In accordance with this, the defined values of C for soil types, which indicate the impact of vegetation on soil erosion, should be converted into percentage values of vegetation coverage. Figure 2 serves to convert the values for woods and grass-covered areas.

It is necessary for the manageability of the resulting percentage values to assign them into categories. Practical considerations suggest the establishment of three categories. Areas that require 80-100% vegetation cover

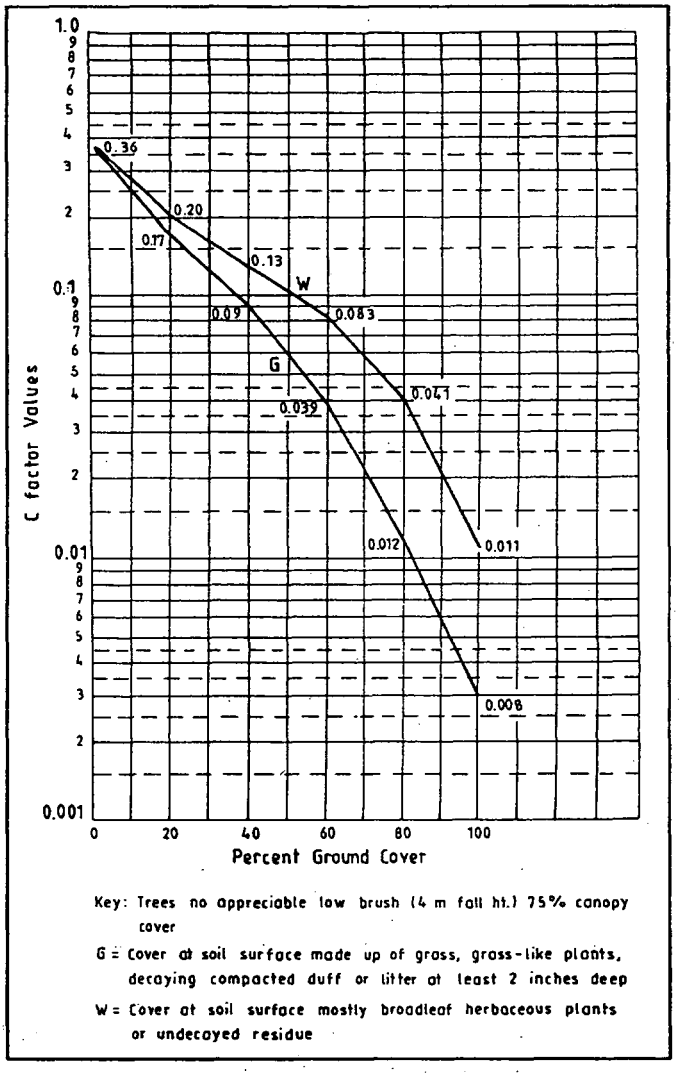

Figure 2 Graph showing the effect of two types of ground cover and variable ground cover percentages on C values

can be classified as low carrying capacity areas, those with 60-80% cover are medium, those requi-ring cover under 60% are high carrying capacity areas.

Results

The geo-ecological mapping of the drainage basin of the Katarét stream resulted in a large amount of reliable data that helped us understand the ecological and geo-ecological conditions of the area and the magnitude of the control on soil erosion processes (Mezősi et al., 1993.) We also regarded it as our important task to examine the carrying capacity of the drainage basin, where the significant proportion of protected areas and the increasing recreational utilization both called for the independent examination of these areas.

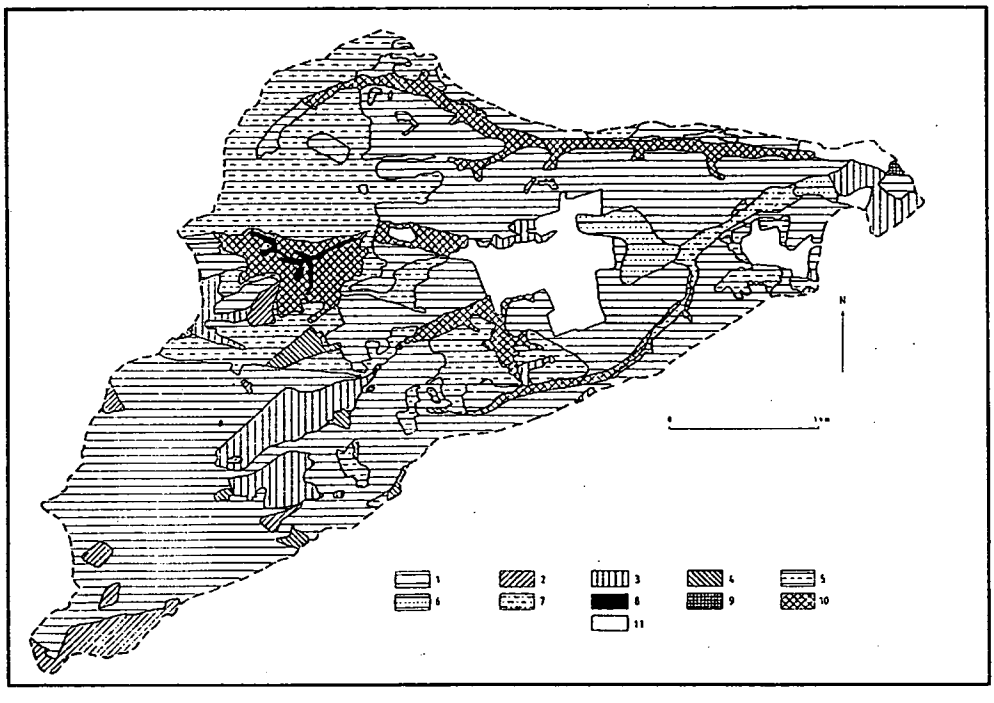

Figure 3 The soil types of the Katarét stream catchment

1 - brown forest soil with clay illuviation
2 - ranker soil
3 - Raman brown forest soil
4 - pseudogley brown forest soil
5 - ferrugineous forest soil
6 - carbonatic humic alluvial soil
7 - non carbonatic humic alluvial soil
8 - meadow soil
9 - non carbonatic stony soil
10 - colluvial soil
11 - settlement, water, mine, spoil

Our area comprised approximately 20 km² best of the NE Mátra mountains. Heights varied between 189 m and 956 m; in the formation of the major soil types the predominant factors were the andesite-rhyolite series that are the main components of the mountains and the regolith, the lacustrian deposit and fluvial formations. There are two major groups of surface forms in the area. The middle and Eastern half of the drainage basin is dominated by gently sloping riverside lines of hills, while the Northern and Western parts are characterized by ridges with steep crests and, in their foreground, similarly steep hills with narrow valleys between them. The lower areas, as well as the gently sloping, wide hillsides are intensively used for agricultural purposes. The situation, the soil types are shown in Figure 3.

We carried out the examination of the carrying capacity of natural woods and meadows on the basis of the soil units defined as part of the mapping of the soil. Thus we were able to define the values of C and the parameters explained above for the test area promptly and this way it was easy to show them in the map. The percentage values of the vegetation coverage necessary for the maintenance of the productivity of the soil are shown in Figure 4 in categorized territorial occurrence.

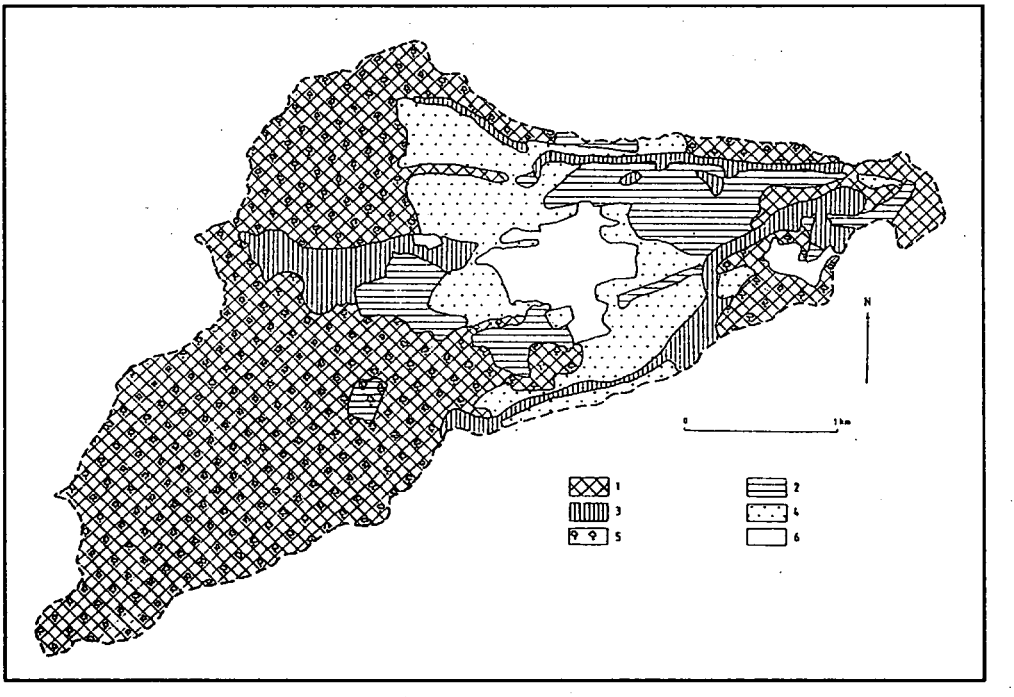

Figure 4 Physical carrying capacity of natural areas in the catchment of the Katarét stream
1 - low; 2 - medium; 3 - high; 4 - cultivated area;
5 - forest; 6 - settlement, water, mine, spoil

It is obvious from Figure 4 that the high capacity areas are located on the hills in the foregrounds of mountains and on those bordering the streams as floodplains. A common characteristic of these areas is coverage by grassy plant communities. Concerning the woods, these are primarily low capacity areas, with the rare occurrence of some medium capacity areas. The main reason for this is that the woods cover areas with the highest relief and that the thin soils formed on the andesite-rhyolite rocks have high K values. We consider it very important to emphasize the high sensitivity of wooden areas because in the privatization process large forest areas became privately owned and in many of these areas intensive logging has already started. And this, in an extreme case, can lead to the complete eradication of the soil.

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