

Environmental degradation in the Hercynian and Alpine-Carpathian mountain regions of Czechoslovakia

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Abstract The different factors influencing environmental degradation in the old Hercynian and the young Alpine-Carpathian mountain zones of Czechoslovakia are identified. Phytotoxic air pollutants play an important role in the degradation occurring in the Hercynian mountain ranges where the summit areas support extensive plantations of spruce forest. The large-scale cutting of dead and dying spruce trees leads to a disruption of the natural environmental balance and provides the trigger effect in a sequence of environmental degradation (e.g. soil degradation, change in microclimate and water regime, acceleration of water erosion, etc.). The originally forest-covered mountain environment is being transformed into a meadow-shrub landscape. The Carpathian mountain ranges are affected by several slope processes accelerated by human activity (soil erosion, landslides, avalanches). The unstable flysch Carpathians are affected by accelerated soil erosion and landslides which produce rapid and permanent changes in local relief.

INTRODUCTION

Geographically, Czechoslovakia can be divided into two extensive regions; firstly, the region of the Hercynian mountain ranges and, secondly, that of the Alpine-Carpathian mountain ranges. In each region a number of factors are causing degradation of the environment.

HERCYNIAN MOUNTAINS

In the Hercynian mountain region, which is located in the northwestern and northern parts of the Czech Republic, the primary agent of degradation is the effect of phytotoxic emissions (air pollution from industrial activity located in the Czech Republic and neighbouring regions of Germany and Poland) on the coniferous forests and the mountain region as a whole. The dying trees are removed by large-scale felling and this deforestation initiates a chain of landscape processes which degrade the mountain environment. The effects of phytotoxic emissions are particularly severe in the Jesenský Mountains, the Eagle Mountains, the Giant Mountains and the Jizerské hory Mountains.

A typical example of an area with a strongly degraded environment is

provided by the Ore Mountains. This range of block mountains, underlain predominantly by crystalline rocks (gneiss, mica-schists, and phyllites) and with flat summit areas between 800 m and 1000 m a.m.s.l., was formerly covered by extensive coniferous forests (mostly spruce monocultures). In the southeast, the mountain range is bordered by a steep fault scarp (500-600 m high) dissected by numerous streams. The mean annual precipitation is 800-1000 mm, the mean annual temperature of the summit areas does not exceed 5°C and inversion conditions occur very frequently. The Ore Mountains are a significant headwater area.

The phytotoxic emissions coupled with the cool climate have caused the death of large areas of coniferous forest on the extensive summit flats and the adjacent upper slopes. The removal of the dying trees disrupts the mountain forest ecosystem. Large-scale deforestation using heavy felling equipment destroys the vegetation cover, disturbs the soil, and remodels the microrelief. Accelerated runoff occurs, leading to accelerated sheet and channel erosion. This erosion affects the middle and lower parts of the mountain slopes, frequently in a catastrophic way. The original woodland has now been transformed into mountain meadows with a new hydrological regime. Our investigations have identified the main landscape interactions and two stages in the degradation of the forest landscape of the Ore Mountains have been distinguished (cf. Fig. 1).

The degraded landscape of the Ore Mountains exerts a negative influence on the adjacent regions, particularly the Most Basin with its open-cast brown coal mining. As a result of increased flood discharges in the streams, the channels are aggrading and the reservoirs are being quickly filled with sediment. This has increased the danger of flooding of the open-cast lignite mines.

ALPINE-CARPATHIAN MOUNTAINS

Another sequence of environmental degradation can be found in the Alpine-Carpathian region of Czechoslovakia formed by the younger Carpathian mountain chains and adjacent depressions. Here, the primary negative effect on the environment is provided by anthropogenically accelerated slope processes, particularly soil erosion and landslides. The effects of avalanches and tectonic movements are of more limited significance.

An extreme example of the development of erosion and landslide processes is provided by the flysch Carpathians, where the terrain stability and slope processes are strongly affected by the highly dissected relief, the steep slopes and the unstable geology (mainly heavy claystones, marlstones and sandstones). The central Moravian Carpathians provide a classic example of an area affected by such degradation. This area is underlain by Tertiary and Quaternary sedimentary rocks with a cover of mollisols and luvisols. Within the mountain range four main ridges can be delimited. These are the Chřiby

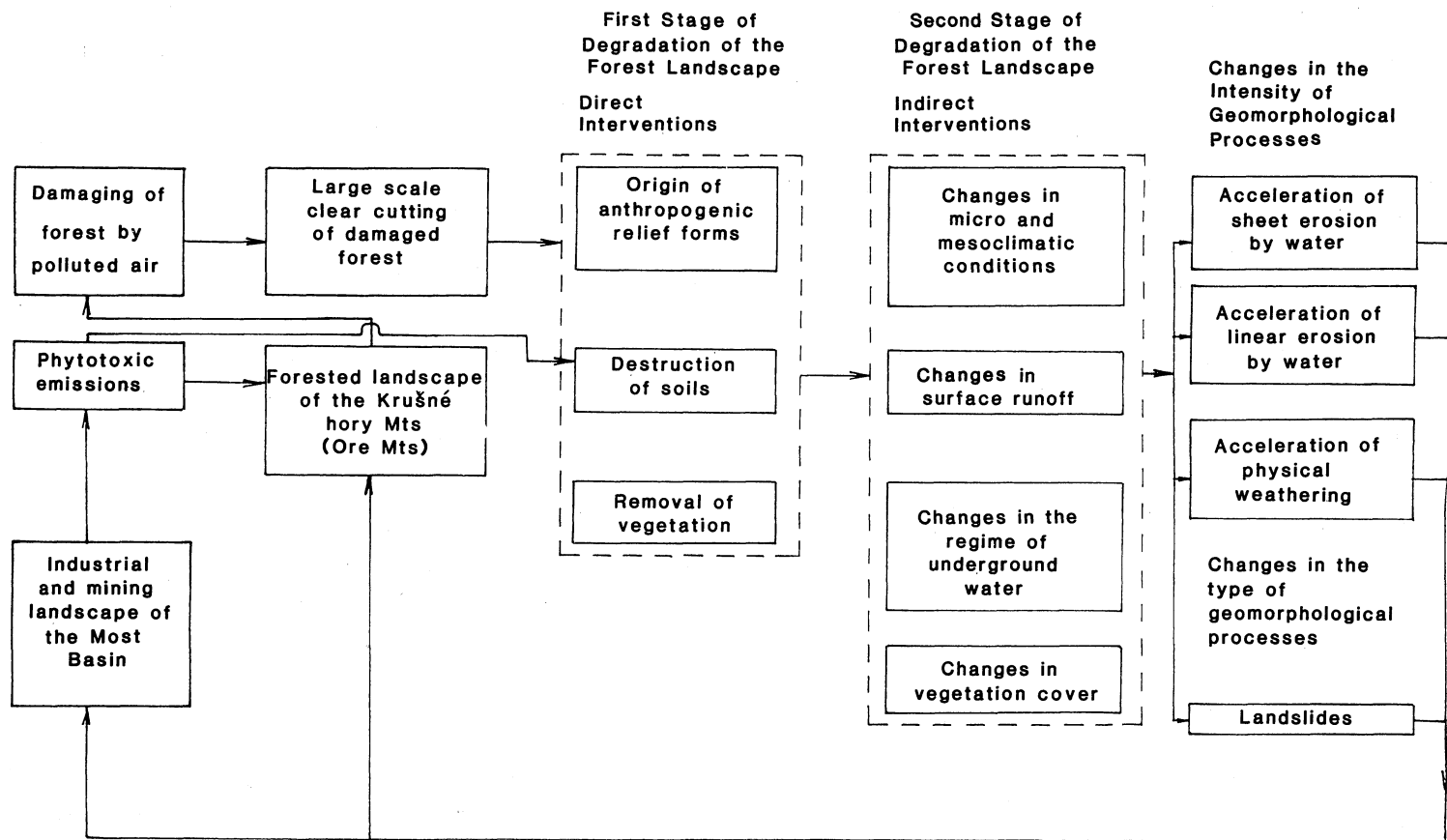


Fig. 1 The sequence of landscape interactions involved in the degradation of the forest environment of the Ore Mountains.

Mountains, the Žďánice Forest Mountains, the Litenčice Hills, and the Kyjov Hills, with altitudes between 150 and 550 m a.m.s.l. The whole area is characterized by an intricate mosaic of erosion and landslides.

The region of the central Moravian Carpathians provides a model area for the use of remote sensing to study soil erosion. The existence of the relatively homogeneous light loamy regolith and the humus mollisols and luvisols can be used to advantage. Any disturbance of the humus horizon manifests itself visually in the development of lighter areas of soil which can be readily identified on aerial photographs or satellite images. The extent of disturbance can be quantitatively assessed using computer techniques. The upper slope areas and the summit flats are the most affected by erosion. Landslides develop where the terrain and geological conditions are favourable, particularly after the deforestation and agricultural terracing of slopes. Concentrations of landslides occur along the recent incisions associated with tributary streams (average discharge $< 0.5 \text{ m}^3 \text{ s}^{-1}$) which exhibit an increasing flashy runoff regime. At the present time, approximately 10% of the territory of the central Moravian Carpathians has been severely damaged by soil (wind and water) erosion, approximately 50% by slight erosion and approximately 10% by landslides.

CONCLUSION

The different natural and anthropogenically accelerated processes currently damaging the environment of the Hercynian and Alpine-Carpathian mountain areas of the country demand different protection and improvement measures. In both the Hercynian and Carpathian regions the vegetation cover is being improved to exploit its stabilizing effect. In the Hercynian mountain regions, the original tree cover of European spruce is being replaced by coniferous and deciduous tree species from America and eastern Asia which are more resistant to polluted air. The introduction of foreign plants will, however, cause long-term irreversible changes in the natural systems of the mountains. The different situation in the flysch Carpathians of central Moravia demands the construction of a network of landscape stabilizing measures in this primarily agricultural environment. Since the 1940s a system of tree strips to protect against wind erosion has been introduced in the submountainous areas. The usual methods employed for stabilizing landslides involve reduction of the agricultural activity and the creation of a permanent herbaceous vegetation cover in those areas.