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LANDCOVER CHANGE IN LIMESTONE AREAS IN THE SOUTHWESTERN PART OF THE ROMANIAN CARPATHIANS

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In the SW of the Carpathians, despite the area being fairly rich in precipitation, one may often come across degraded grounds on limestone substrate, looking very much like those encountered in the Mediterranean zones. But the maquis - type degraded bushes, unlike their Mediterranean counterpart, are not formed of sclerophile species but of deciduous ones, belonging to the shibljak group characteristic of the Balkan Peninsula. Also, because forests were heavely cut down starting from the Antiquity (but the phenomenon has been intensified over the last five centuries) and the ground was then grazed excessively, in limestone-based areas formely covered by forests strongly degraded grassland expanded, with xerophile species alternating with outcropping rock or "rock deserts" even, where the few rock species are usually hidden in the fissures or at the bottom of lapies. This situation is the result of a long-lasting anthropic activity, fluctuating these very days even. For instance extensive grazing in forest and the cutting of branches for fodder were customary from Neolithic times until the middle of the 20th century. If decisive steps against excessive grazing are taken, bushes may rapidly regenerate, so that a balanced landscape could develop and biodiversity be maintained over the time.

Key-words: xerothermophile vegetation, degraded land, SW Carpathians

As long as carbonate rocks (limestones, dolomites, calcareous marls, limestones conglomerates) are covered by a soil layer - however thin, they prove favourable to the development of vegetation. But as soon as intense anthropic pressure-induced erosion has removed it, the soil cannot easely recover its productive potential.

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In the first place, the limestone does not yield a fine-grained material capable to becoming a substratum for soil formation. Being soluble, calcium carbonate is washed away by runoff, so that only small amounts of insoluble material (other minerals found in the composition of the limestone, but in extremely low quantity) are left as residuals, which progressively accumulating, could rehabilitate the soil. In the second place, limestone fails to store the water, which infiltrates through various fissures deep down into the ground. Therefore, calcareous lands are highly vulnerable, which makes a "rock desert" landscape be a common view in high anthropic pressure zones, even where there is a fairly rich precipitation regime. Obviously, this phenomenon is enhanced in areas where rains fall irregularly.

The dynamics of such landscapes has been studied in great depth and breadth, so that there is a rich literature on the subject concerning Greece, southern Italy, southern France and the Iberian Peninsula. The phenomenon is also widespread in the former Jugoslav republics. Having been populated from ancient times, they have been suffering intense anthropic pressure, so that with the forest vegetation removed, desertification signs appeared as early as the Antiquity.

Nowadays, the problem of desertification in a Mediterranean climate is viewed in correlation with specific landuses . A comprehensive EC - sponsored study is underway to identify the ways and means for improving the situation and devising an ecological rehabilitation strategy.

In the South-West of Romania, a zone of sub-Mediterranean climate influences, desertification on limestone grounds has much in common with similar aspects in the Mediterranean region. The most affected areas are: The Mehedinți Plateau, the slopes of the Mehedinți, Cerna and Vâlcan Mountains, and some parts of Almăj, Locva and Anina Mountains (Fig. 1). The primeval vegetation in these areas was represented mostly by deciduous forests with xerothermophile elements (*Quercus pubescens* with an undergrowth of *Carpinus orientalis, Fraxinus ornus, Cotinus coggygria, Syringa vulgaris, Cornus mas, Viburnum lantana*) alternating with mesoxerophilous elements (*Quercus petraea* ssp. *polycarpa* or ssp. *dalechampi*), with some thermophilous species in the undergrowth. Some traces of such forests, now severely deformed, can still be seen at the foot of the Vâlcan, close to Tismana Monastery, in the Southern part of the Mehedinți Plateau, in the Cerna Valley at the foot of the Domogled, near Băile Herculane and in the Danube Defile.

At higher altitudes, or in places with deeper soils, the natural vegetation was represented by beech woods (mainly Fagus sylvatica ssp. moesiaca), also with some thermophile elements in the undergrowth and the herb layer. Very characteristic for this area is also *Corylus colurna*, a tree species whose dissemination area in Europe ends in the South-West of Romania, crossing the northern part of the Balkan Peninsula and reaching Anatolia and the Caucasus in the east. Fairly widespread in the past among durmast and beech forests, as well as isolated specimens on limestone cliffs, among xerothermophile bushes and pioneer rock vegetation, it exists still in some places in the Anina Mts., Almaj Mts., Cerna Mts., Mehedinți Mts. (important stands occurring at Domogled, Suscu, Piatra Closanilor and Gorganu), in the south of the Mehedinți and at the foot of the Vâlcan Massif (Motru and Tismana bassins). Another characteristic tree of the region is *Pinus nigra* ssp. *banatica*. Its present area is very fragmented, on the one hand because of its being a relict species and on the other hand, because of human activity. As Fukarek (1958) shows, the vast area covered by the Black Pine in the Tertiary was circumscribed to the Mediterranean Sea basin. Its range becoming deeply fragmented in the Pleistocene, it give rise to several subspecies and microspecies, among them *Pinus nigra* ssp. *banatica*, ende-



Fig.1. Main mountain units in the Southwestern part of the Romanian Carpathians. 1. Low-altitude mountains in which limestone roch is widely spread, 2. Depressions

mic in Romania and preserved now only in the hardly accesible places, especially on limestone rock - in the Cerna and the Mehedinti Mountains (on either side of the Cerna Valley), in Almäj Mts, very seldom in the Mehedinti Plateau and in a single place in the Vâlcan Mts., i.e. in a very rough calcareous sector of the Sohodol basin, very isolated until the mid-20 century, when they cut a major forest track along the Solodol Valley. Supposedly, many severely degraded grounds today might have sheltered Banatic Black Pine stands. In the majority of cases, forests were cleared to make room for agricultural lands (pastures, vineyards, arable land). Pine stands were also destroyed by people who, by rudimentary means, produced the tar. The effects proved to be disastrous even on the mildly dipping slopes, the thin soil layer being quickly washed away by heavy rainfall. Like in the Mediterranean regions, many such areas are covered today by xerothermophile bushes in various degrees of degradation (resembling maquis, garriga, frigana from the Mediterranean countries). The essential drawback is their being formed of deciduous bushes, similar to the Balkan Peninsula shibljak, instead of sclerophile sempervirescent ones. Their growth is also the consequence of the forest degradation in the wake of random logging, animal grazing in the forest, the cutting of branches for cattle fodder etc. Some of the Romanian researchers, who have followed this phenomenon in detailed field investigations, are Călinescu (1957), Popova (1970), Maloş (1974) etc. If grazing is not practiced in excess, then the undergrowth species of former forests (Syringa vulgaris, Fraxinus ornus, Cotinus coggygria, Cornus mas, Ligustrum vulgare, Viburnum lan-

tana) can be maintained; they even multiply among the secondary bush communities. But, with the increase of pastoral pressure, these species regress, being replaced by thorn bushes, mainly *Crataegus monogyna* and *Rosa canina*, and *Prunus spinosa* by at lower altitude. In the southern part of the degraded bush area with xerophile elements, *Carpinus orientalis* is seen to grow abundantly. The species lacking such protection organs survive only in the shelter of the thorn-bearing ones, among which some isolated specimens of strongly bush-like deformed tree species are visible, often no taller than 1 - 2 m. Some of the most frequently encountered are the elm (Ulmus glabra), the hornbeam (Carpinus betulus), Acer campestre, A. platanoides, but also Sorbus torninalis and even strongly deformed specimens of beech and durmast. Frequently, *Clematis vitalba* spreads in these communities. All in all, this bushland provides quite efficient anti-erosion protection. Even if the bushes are less degraded in some areas, their structure and floristic composition can be sensibly changed through selective felling ("clearing"). For instance some small, almost pure Fraxinus ornus stands appeared after the land was "cleared" of Crataegus monogyna and Rosa canina. Fraxinus ornus and, where it exists, Corvlus colurna have been left to develop because their leaves are used as cattle fodder.

With anthropic pressure increasing, bushland gives way to ever larger loops of degraded meadow (Fig. 2). Hence, erosion progresses and the thin soil layer covering the limestone rock, as well as the residual clays, are removed, the land continuing to deteriorate at a faster pace. The plant cover is mosaic-like, e.g. xerophile species alternate with xeromesophile and mesophile ones, according to microrelief, local shade conditions, degree of erosion etc. Large surfaces, lying on a residual clay substrate, are covered with fern (*Pteridium aquilinum*), which makes them entirely non-productive.

Although it is very difficult for a limestone-based soil to actually regain its vegetative potential, yet if anthropic pressure becomes lighter, it may in time help remake the plant cover to evolve from bushland to xerothermal karstic forest land. However, rehabilitation is usually hampered by the grazing of goats in particular, a characteristic practice on these grounds. It is well-known that goat breeding and degraded Mediterranean lands go hand to hand, and in the countries of that zone measures have been taken to stop further destruction. But in poor regions in Romania (and limestone rock areas are usually poor) the land cannot be put to other uses, except for touristic ones, which in the future may to some extent help solving this problem, but the infrastructure needed for it is still very deficient. So, there is a vicious circle - goats prevent both the plant cover and the soil itself from recovering; while the land, becoming ever more degraded, is fit but for extensive grazing.

On the steep calcareous slopes, naturally devoid of a soil layer, more or less primary xerophile shrubs occur, bushes growing inside rock clefts or on small rocky shelves. Their density at lower altitudes depends primarily on the extent of rock fissure, hence on the microrelief. If conditions are favourable, they may grow to be over 2 m tall, have a wide coverage and a variegated floristic composition. They contain especially *Syringa vulgaris, Cotinus coggygria, Fraxinus ornus,* and *Cornus mas*; here and there, various *Sorbus* species (*Sorbus dacica, S. graeca, S. aria* and in Mehedinți Mts. *S. borbasii*). Often enough, one may encounter *Cotoneaster nebro-densis, C. integerrimus, Rhamnus cathartica, Prunus spinosa* ssp. *dasyphilla*, sometimes *Prunus mahaleb*. An Alpine-Carpatho-Balkan species - *Genista radiata,* is a floristic characteristic of some Mehedinți and Cerna Mts. bushes. In Banat region and around Tismana Monastery these communities are rich in *Ruscus aculeatus,* an Atlantic-Mediterranean species. With the increase of altitude, or on rocks with few-



Fig. 2. Plant cover change on calcareous slopes in SW of Romania.

cracks, they are small-sized and have a less rich floristic composition. But *Cotinus coggygria* and lilac creep up even to higher altitudes. Dense dwarf lilac shrubs can be seen, for instance, in the Piatra Cloşanilor (Mehedinți Mts.) at heights of 1400 m. Unlike the secondary bushes emerged in the wake of forest degradation, dwarfish bush-like deformed trees are absent altogether in such situations. Isolated trees do sometimes develop in the deeper cracks, especially *Corylus colurna, Pinus nigra* ssp. *banatica, Carpinus betulus, Fraxinus excelsior*, but their shape is normal.

Often enough, despite their growing on steep slopes, these bushes, too, become degraded through grazing (goats reaching there), if they happen to lie in the vicinity of villages or sheeppens. The sun-bathed calcareous grounds are the first on which vegetation develops in spring. So, people are quick in bringing their sheep and goats to graze. In this way, the buds and the young shoots disappear even before the leaves come out (geographer I. Conea 1932, gives a very convincing description of this practice in wide use in the calcareous zones at the foot of the Vâlcan Mts.). That man had played the major role in triggering this vicious circle is indicated also by the fact that the grounds surrounding Tismana Monastery, being ecclesiastic property, suffe-

red little degradation. The fanced-in woods of Tismana Monastery were one of the oldest and largest in Romania, quoted in Medieval documents since the year 1406 (Giurescu 1975). No one could enter there to cut the trees or graze his livestock without permission from the monastery. Therefore the forest is well-preserved even on calcareous ground, with a wealth of bushes on the steep slope. On the other hand, right to the east, in the perimeter of Runcu village (the name itself standing for old deforestation actions), above the Sohodol gorges (both east and west of it), even mild slopes have been laid bare, with vast fields of lapies unearthed from under the old soil layer and residual clay layer. They look like stone deserts, indeed, similar to the most typical such forms in Greece or in Macedonia.

Likewise, in the Anina Mts., landuse is seen to have played an important part in the onset of desertification. In the surroundings of Anina town forest exploatation, together with mining sites and siderurgy date to the late 18th century. And yet, nature was not seriously affected, because felling was rational, the terrain was immediately replanted and the forest land was not used for grazing. Despite the thin soil layer superposing the limestone rock, the forest has been well preserved. The situation looks different around Caraşova village; agricultural activities holding an important share, the plant cover has turned rather xerophile.

In the years 1960s -1970s, the collectivisation of agriculture and the migration to town of the population from isolated mountain villages decreased in some places the anthropic pressure on the environment, because animal breeding was no longer a choice activity. This new situation showed up on calcareous grounds, too, as shibljak-type bushes began growing ever so thick that sometimes one could not go through them. Adequate protection measures led to a spectacular rehabilitation of the plant cover in the nature reserve "The lilac woods" at Ponoare (Mehedinți Plateau). However, these are but local achievements, the degradation of calcareous grounds being generally an ongoing process. And prospectively, the higher the prices peasants will get for their animal products, the higher the degradation of the lands.

Therefore the bush issue on calcareous grounds ought to be considered more seriously. With a view to achieving sustainable development, protection measures coupled with a reasonable pastoral pressure could have a positive outcome. Compact, well-developed bushes are a good barrier in the way of erosion, control runoff, and in time, help to the rehabilitation of the soil and of the forest vegetation, preventing thus the tendency to desertification. The bushes (if not degraded) make a fine sight - see the wonderful lilac (*Syringa vulgaris*), flourishing ash (*Fraxinus ornus*) and *Cotinus coggygria* in bloom, and the dark-red *Cotinus* leaves in autumn - which could add to the tourist attraction of many zones. Due to their rich floristic composition with impressive local variants (depending on altitude, extent of rock fissuring, floristic districts), bushes also make a significant contribution to biodiversity. Worth noting are the Balkan-Carpathian, sub-Mediterranean and Alpine-Carpathian species, some of which are rare or have their areal boundary in these places.

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ZMENA KRAJINNEJ POKRÝVKY V KRASOVÝCH OBLASTIACH JUHOZÁPADNEJ ČASTI RUMUNSKÝCH KARPÁT

Hoci sa oblasť juhozápadných Karpát zdá na prvý pohľad floristicky bohatá, častokrát tu na vápencovom substráte nachádzame degradované porasty, ktoré sa veľmi podobajú degradovaným formáciam z mediteránnej oblasti. Jenže tzv. macchie - typ degradovaných krovín - na rozdiel od mediteránnych foriem nie sú tvorené sklerofilnými, ale opadavými druhmi zo skupiny "šibljakov", ktoré sú typické pre Balkánsky polostrov. V dôsledku rozsiahleho výrubu lesov a veľmi intenzívneho spásania sa na vápencových územiach, pôvodne pokrytých lesom, rozšírili silne degradované trávnaté porasty s xerofilnými druhmi. Miestami ich striedajú skaly vystupujúce z podložia, alebo "skalné púšte", na ktorých sa vyskytuje len zopár skalných druhov, zväčša ukrytých v trhlinách.

Táto situácia je výsledkom dlhotrvajúcich antropických aktivít, ktorá sa v poslednom čase ešte stupňuje. Ak by sa však spravili rozhodné kroky, ktoré by obmedzili nadmerné spásanie, kroviny sa môžu zregenerovať a spolu s tým by sa mohla obnoviť v krajine pôvodná biodiverzita a rovnováha.

Obr. 1. Hlavné horské jednotky v SZ časti rumunských Karpát.

1. Nízke pohorie s prevážne vápencovým substrátom, 2. Depresie

Obr. 2. Zmeny vegetačného krytu na vápencových svahoch na severozápade Rumunska.