Environment Threats in Romanian Karst

Pompei COCEAN
Department of Geography, University of Cluj, Clinicilor 5, 3400 Cluj, Romania

Abstract

Human impact on Romanian karst generated numerous environment threats, among which we mention habitation, agriculture, forestry, industry and tourism - induced threats.

Human presence and households in karst areas determine habitation threats. The construction of households and annexes, access roads, fences is based on the quarrying of limestones. Habitats also involve karst water pollution with domestic runoff and residual waste.

Agriculture and pastoral threats are manifested on soils karst microlandscapes, which are modified or destroyed by plant cultures or pastures.

Forestry threats derive from forest exploitation and modification of their componence and of local topoclimates, with chain effects on landscape dynamics.

Industrial risks are caused by quarrying of limestones, fire clays and bauxites. They determine landscape modifications, including the disappearance of various landscapes (gorges, caves).

Touristic threats consist of erosion acceleration, endangering of rare plant and animal species, speleothem breaking, graphic pollution of the cave walls, karst water pollution, etc.

Karst landscape occupies in Romania cca 4.600 km^2, which represent only 1,94 % from the total surface of the country. Besides its restricted territorial extension, karst areas are extremely fragmented (Fig. 1). Even if the extent of karstified areas is limited and they are highly dissipated, their karstification index is high. The Romanian karst inscribes, by its number of forms, variety and by the amplitude of exo- and endokarstic forms, in the category of karst typical for the temperate areas (Cocean, 2000). It suffices to mention the abundance of closed basins (dolines, uvalas, karst catchment depressions), but especially of the approximately 12.000 caves and potholes (cca 2.8 caves/km^2) frequently disposed in multi-leveled systems (with 2 or 3 levels). Exploration activities continue, especially in the flooded endokarst networks.

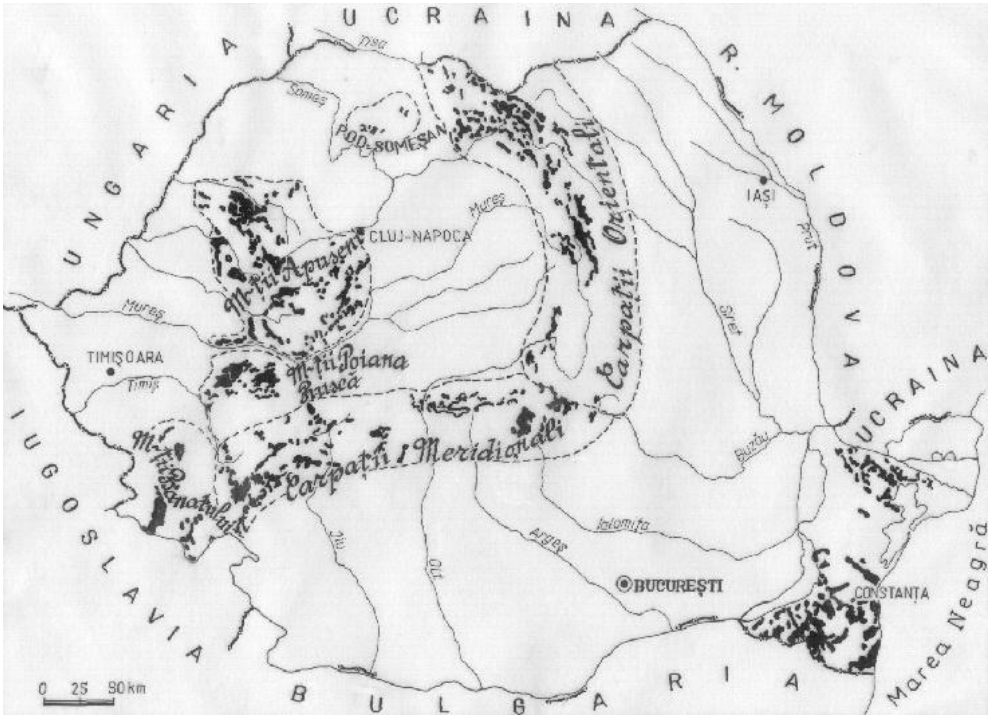

Fig. 1. Karst areas of Romania (from Bleahu M. et al., 1976)

Human impact on karst has a long history and a varied action which, corroborated with its complex natural evolution, have shown a series of ecologic risks, frequently succeeding in perturbing the dynamics of the karst systems and their natural feedback. Such risks are determined by human habitation, agriculture, forestry, industry and tourism.

1. Risks determined by human habitation appear from the degree of habitation of areas with limestones, respectively of constitution of settlements and groups of permanent households. The relatively low altitude of Romanian karst (250 m in South Dobrogea Plateau – 1400 m in Padis area, Apuseni Mountains), together with its preponderant disposition as large plateaus, intensely flattened - veritable karstoplenes - determined an early and very intense settling. There should be mentioned the footprint discoveries from Ciur-Izbuc Cave, Vîrtop Glacier Cave, as well as of the prehistoric paintings from Cuciulat Cave, whose age was estimated at over .000 years.

Karst plateaus from Apuseni Mountains (fig. 2), Banat Mountains, Poiana Ruscã Mountains, Mehedinţi Plateau, South Dobrogea Plateau, Someşan Plateau, are densely populated, with small and medium, villages, spread or concentrated especially along plateau valley passages (Ponoare, Mniera, Ocoale) or on the smooth water divide between them. The construction of households, annexes and fences is frequently based on using the calcareous rock in masonry. Limestones are quarried from the abrupt sectors of the slopes or from karren (Poieni Plateau). These have as result changes in the mechanic equilibrium of rock beds, of the topographic angles of the slope surfaces, generating landslides and erosional processes. When houses are built on inclined slopes, there are leveled platforms, which induce the same phenomena.

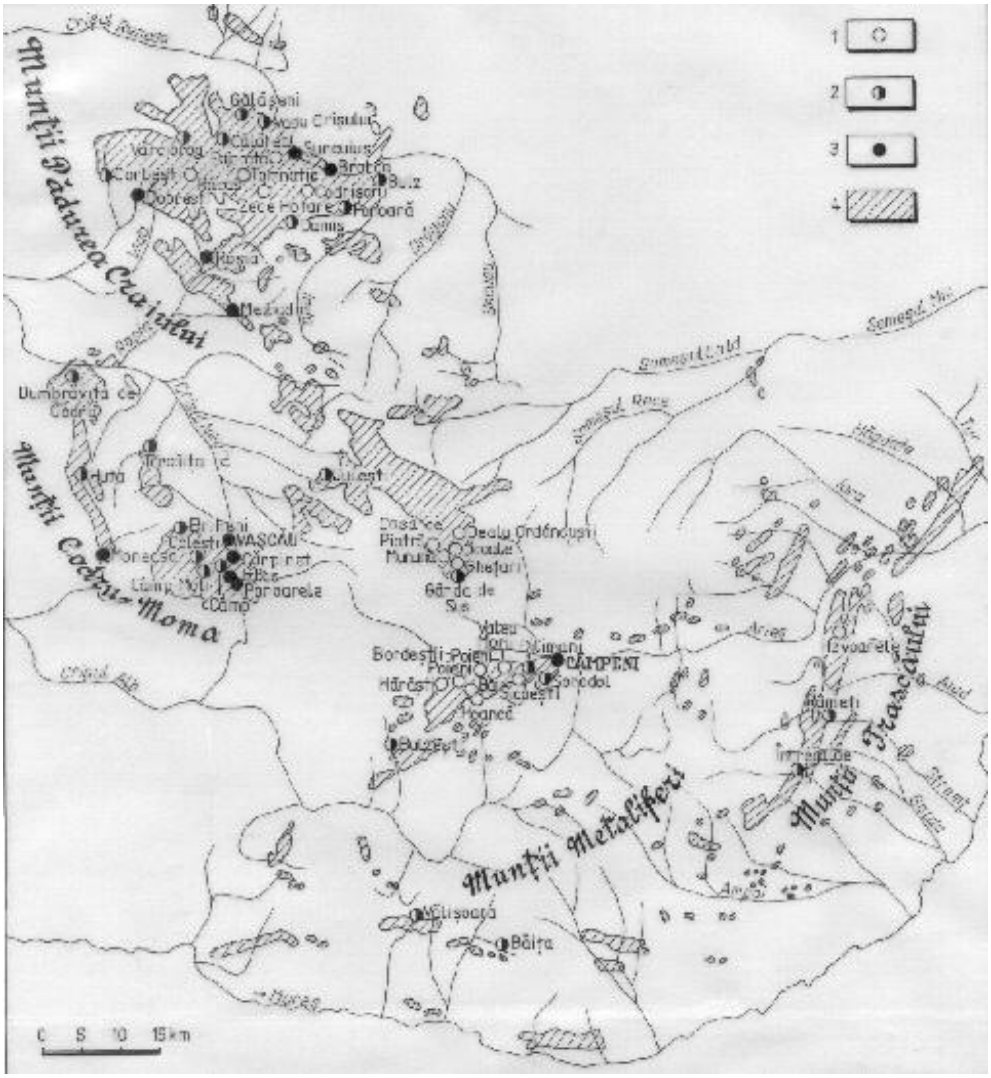

Fig. 2. Settlements in the karst of Apuseni Mountains. 1.Scattered settlements; 2.Spreaded settlements; 3.Gathered settlements;4.Karstic zones.

On the other hand, habitats generate a diverse contribution of residual products (domestic and animal waste) which are frequently discarded in karst waters or deposited in negative landscapes (especially dolines and potholes), affecting chemical composition or generating local pollution. The archaic habit of disposing dead animal in ponors or potholes may have ill-fated sanitary repercussions, in the context of polluting groundwater with an unknown direction, whose outlets serve as water source for other inhabited areas.

Inhabited areas, directly linked with their extent and degree of development, presume a technical territorial infrastructure necessary for an optimal functionality. This includes access roads, power lines, water pipes etc. The material support of the elements mentioned is karst landscape, more or less affected. Road construction implies the most consistent impact, especially on slopes, where landscape modifications are most visible (blasting, terrace construction, leveling, excavations). These can be seen along gorge sectors, such as those of Ordâncuşa, Vida, Gârdişoara, Olteţ, Galbena, Bicaz rivers, but also on karst plateaus from Anina, Pădurea Craiului, Codru-Moma Mountains, Mehedinţi Plateau, etc.

2. *Agriculture and pastoral risks* derive from agricultural exploitation of karst areas. The increased pressure over soil levels has as consequences the degradation of soil horizons, their compaction or removal through erosion stimulated by uncontrolled use. The economic profile of most inhabited areas in Romanian karst is agricultural or agriculture and forestry-based, so the pressure over the lands progressively increased with population growth. The maximum value was reached in the 6^{th} –7^{th} decades of the XXth century, when the Romanian rural demographic boom was at its peak. Since then, rural population migration towards cities, in the period of forced communist industrialization, respectively the drastic fall of the demographic growth from after 1990, led to a decrease of the agricultural impact on karst, where depopulation has reached alarming levels for the existence of many inhabited areas.

The forms of manifestation of the agro-pastoral threats include the replacements of natural, spontaneous vegetation, with cultures; the threat of the phytogeographic stock through intensive pasture; erosion acceleration and the increase of the rock outcrop surfaces (especially in the areas with preexistent karren fields). Such phenomena can be seen in plateau areas from Padurea Craiului, Codru Moma, Bihor, and Aninei Mountains, and Mehedinti Plateau. In South Dobrogea Plateau, the incipiently karstified Sarmatian limestones are covered with a thick layer of loess, which provoked intense solification; the limestones are less affected from this point of view.

Locally, groundwater is polluted with animal runoff. Springs and wells used as water sources are centers for such phenomena. The neighboring areas are strongly affected by erosion due to the destruction of the vegetal layer resulted from animal movements.

3. *Risks induced by forest exploitation* in karst areas concern strong landscape modifications determined by total deforestation. They involve changes of floristic composition, or definitive removal of vegetation on slopes with high declivity. After the removal of tree cover, erosional processes are installed, determining the wash-away of soils and therefore the removal of the germinal substratum necessary for plant growth.

The most frequent aspects in the studied karst areas are those linked to the development of derivative vegetation in areas where deforestation was not immediately followed by immediate replanting. This derivative vegetation consists of varios bush species with low economic value. Their only function is the one of fixation of the soil cover. Typical examples of these are Bedeleu slopes or karst areas of Metaliferi and Aninei Mountains, but also extended plateau surfaces (Vascau, Racas, Poieni).

Forest exploitations presume constructions of access roads that frequent are randomly traced at, without an adequate landscape protection. These access roads are the starting points for intense and profound streaming and ravination of slope that become unbalanced due to landslides and crumbling. In turn these phenomenon is affecting gorges, defiles, abrupt slopes or even slope caves (Vida, Gârdisoara, Ribicioara, Oltet, Galbena Gorges etc).

The changes of the natural vegetal composition determine cumulative modifications of solar radiation and in turn, of local topoclimates, reflected in more pronounced drought, accelerated surface flow and the increase of the hydric deficit in soils. As a consequence, there appear the conditions for the extension of the uncovered karst, together with the gradual removal of the soil cover previously protected by forest vegetal associations. In the same time there appears the migration and disappearance of the specific fauna; the brown bears, once frequent in the forests from Apuseni Mountains are now rarely present and only in areas unaffected by strong deforestation.

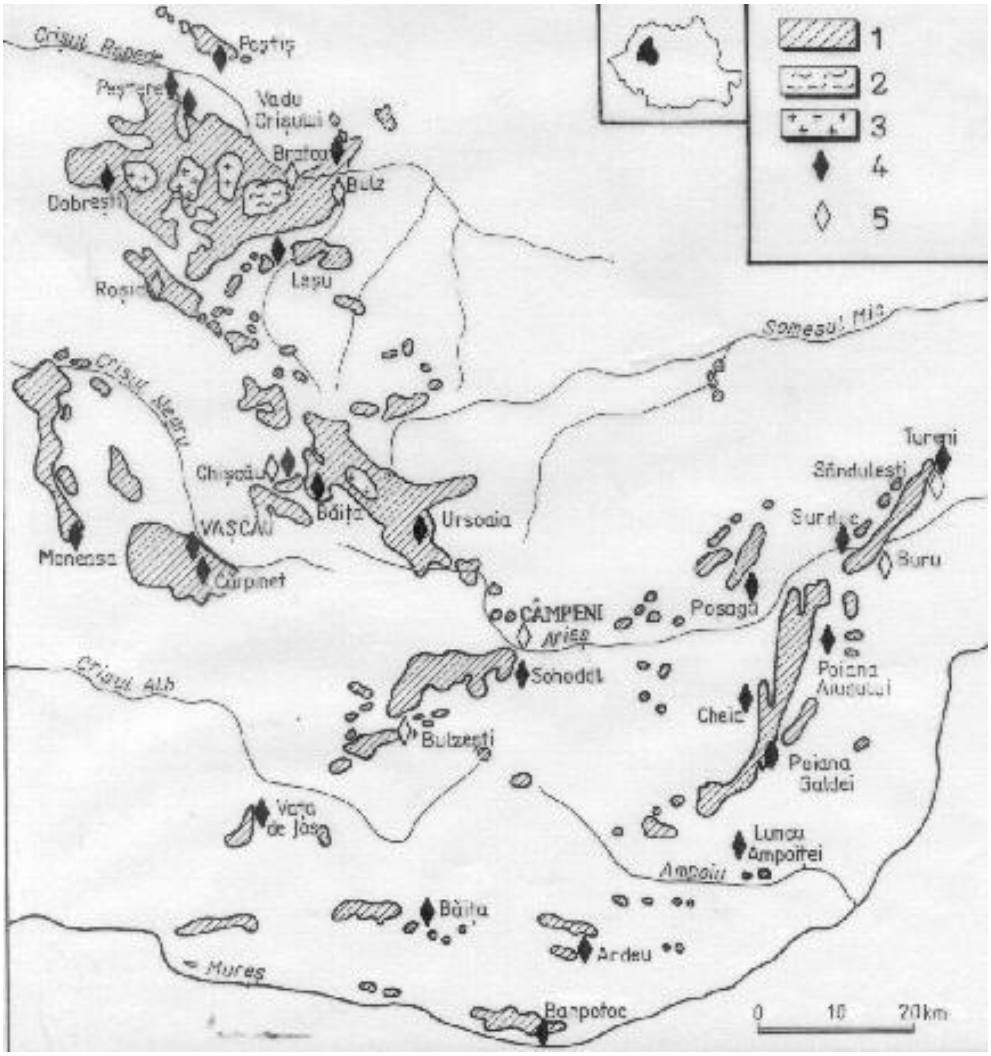

Fig. 3. Forms of industrial exploitation of karst from Apuseni Mountains. 1.Karstic zones; 2.Fire-clay exploitations; 3.Bauxite exploitations; 4.Biuld materials exploitations; 5.Abandoned quarries.

4. *Industrial threats* are the most numerous and the most important, frequently affecting the structure of the dissolution landscape. They are derived from quarrying or mining of limestones and marbles, fireclays, and bauxites.

Limestone exploitation as construction rock (including crystalline limestones, quarried for monuments and works of art), but also for lime, is extremely old on Romanian territory. It was primarily attested by archeological discoveries; the Roman city of Ulpia Traiana Sarmisegetuza, built in the centuries II-III A.C., is mainly constructed with marble extracted from the Poiana Ruscã Mountains. Limestone exploitation did not stop, on contrary it was intensified nowadays. The presence of high-efficiency cement factories intensified the exploitation of this raw material, the quarries visibly affecting the slopes of most calcareous massifs. Limestones are also used in other industrial processes (steel industry, chemical industry), and by rural population to build foundations, fences, roads etc. Fig. 3 illustrates the main limestone quarries from Apuseni Mountains, where the exploitation has reached its peak.

The limestone quarrying effects over the environment are numerous: destruction or threatening of the structure and aspect of some landscapes (gorges, caves, cliffs, klippes or olistoliths); changes in slope declivity and creation of new landscapes with unstable equilibrium – quarry terraces and steps, gradients, overhangs resulted through explosion, waste rock; the removal of the neighboring vegetation; migration of the terrestrial and subterranean fauna from the threatened area etc. The remodeling of the relief so created needs rapid and consistent interventions, which was not realized in the Romanian karst.

Exploitation of Hettangian fireclays from Padurea Craiului Mountains was done in shallow mine galleries in the Suncuius-Balnaca area. Acces roads to the galleries, raw material charge and discharge stations, cable ways, have a negative impact over the landscape whose components (soil, vegetation) are threatened.

The Neocomian bauxites exploitations started in 1914 and reached a high intensity in Padurea Craiului and Bihor Mountains (where are the biggest reserves in Romania). Their accumulation mode, in the Lower Cretaceous paleokarst features (mainly dolines), determined the formation of lens-like bodies. Exploiting such bodies caused the landscape to be come completely modified. Alongside landscape inversions created by lenses excavation these also resulted in intense minor fragmentation with excavation holes, waste rock disposals, access roads to each particular lens, etc. On a minor scale, karst landscape of Racas, Zece Hotare, Padis plateaus was unstructured, its natural evolution being completely modified through the destruction of karren, dolines, uvalas, filling of ponors, caves and potholes with material belonging to uncoverings. Evidently, the vegetation in the respective areas is completely removed, the erosion installing rapidly through sillon and ravines.

5. *Touristically derived threats* are, in their turn, extremely varied. The attractions of karst areas, trough their variety and consistency, make them more interesting than other landscapes. Therefore touristic impacts have a large development and various intensities.

A first form derives from unorganized tourism. Gorges and caves are primarily affected, as they are standards for most karst areas. The choice of accessing paths and campsites, collecting endemic or relict plants within biotopes located in the ecologic niches from gorges, destruction of speleothems, pollution of the underground landscape, waste disposal etc., are only a few of the numerous negative impacts conditioned by the uncontrolled groups of tourists in karst areas.

Possible threats may be induced by the actions of arrangement and tourist exploitation of karst attractions. We include here especially ice caves (such as Scarisoara Glacier Cave) where tourist access on the surface of the ice block has a strong influence over the caloric balance of the cave, with negative influences on the conservation of the fossil glacier. In such cases, show cave arrangements must be realized only after rigorous studies, and the intensity of tourist exploitation must be correlated with the conservation capacity of the tourist resource.

Circumstantial show cave arrangements such as the ones in Vadu Crisului, Meziad, Huda lui Papara caves etc, where the absence of electricity and of some construction works determined the degradation of the underground landscape in some sectors, not to mention the doubty safety and easiness of the access.

References

Bleahu, M., Decu, V., Negrea, St., Pleşa, C., Povara, I., Viehmann, I. *Peşteri din Romania*, Edit. Stiintifica si Enciclopedica, Bucuresti, 1976.

Cocean P. *Les resources economiques de karst des Monts Pãdurea Craiului et leur valorisation,* Studia UBB, XXXIV, 3, 1988

Cocean, P. *Muntii Apuseni. Procese şi forme carstice*, Edit. Academiei, Bucuresti, 2000.

Cocean, P., Onac, P., *Impact antrophiques sur le karst des Monts Apuseni (Roumanie),* Studia UBB, XLI, 1-2, 1996.

Cocean, P. Silvestru, E. *Re-balancing of karst landscapes affected by mining activities*, Geographical International Seminars, 1, Bucureşti, 1993.

Papiu-Corvin, V., *Litologia calcarelor mezozoice asociate bauxitelor din Masivul Pãdurea Craiului,* D.S. Inst. Geol. IV, 1, 1970.

Protescu, O. *Problema bauxitului în Romania*, Bul. Acad. de St. din România, 10, Bucuresti, 1942.