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THE LANDSCAPES DIFFERENTIATIONS IN THE PRAHOVA SECTOR OF THE BUCEGI MOUNTAINS

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Abstract

The physiognomic complexity as the main characteristics of the Bucegi Mountains landscape is the result of lithology, structure, tectonics and high altitude, which led to the vertical zoning of modelling conditions. There can be separated: the landscape of erosion outliers and the structural plateaus from the alpine area, the landscape of Prahova scarp and that of the plains at the Bucegi mountain feet. Up to about 2200 m, the landscape of erosion outliers and structural plateaus was mostly affected by human activities, mainly the tourism and uncontrolled grazing. The landscape of the Prahova scarp of the Bucegi is notable by high touristic anthropization on the slopes of the Vârful cu Dor - Furnica - Piatra Arsă mountains, neighbouring Sinaia, where there are frequent degradations of the roads and paths improperly located and maintained. The Bucegi slope northwards of Piciorul Pietrei Arse still preserves the natural landscapes in dynamic equilibrium (which possess a great tourist and alpinist potential). At the scarp foot, following the modelling of the Cretaceous flysch and sedimentation of large talus material, there resulted a relief with smooth field - plai (Plaiul Fânului,Plaiul Coştila, Munticelu, Plaiul Stânei, Plaiul Peleşului, Plaiul Furnica) - rounded interfluves with a slope below 30^0, compared to those over 30^0 (often over 50^0 within the scarp.

Keywords: *landscape differentiations, Prahova sector of the Bucegi Mountains*

Rezumat

Diferenţieri peisagistice în sectorul prahovean al MunţilorBucegi. Complexitatea fizionomică, caracteristică principală a peisajului Munţilor Bucegi, este impusă de litologie, structură, tectonică şi de marea desfăşurare altitudinală, care a determinat etajarea condiţiilor de modelare. Pot fi separate: peisajul martorilor de eroziune şi al platourilor structurale din golul alpin, al abruptului prahovean şi cel al plaiurilor, de la poalele Bucegilor. Până la aproximativ 2200 m peisajul martorilor de eroziune şi al platourilor structurale a fost în cea mai mare parte afectat de influenţa antropică prin turism şi păstorit necontrolat. Peisajul abruptului prahovean al Bucegilor se remarcă prin intensa antropizare turistică pe versanţii munţilor Vârful cu Dor- Furnica-Piatra Arsă de deasupra Sinaiei, unde apar şi degradări pe drumuri, poteci şi pârtii necorespunzător amplasate şi neîntreţinute. Versantul Bucegilor de la nord de Piciorul Pietrei Arse, conservă încă peisaje naturale în echilibru dinamic (care au un mare potenţial turistic-alpinistic). La baza abruptului, modelarea, desfăşurată pe flişul cretacic şi prin depunerea unor mari trene de grohotişuri, a generat un relief de plaiuri domoale (Plaiul Fânului, Plaiul Coştila, Plaiul Munticelu, Plaiul Stânei, Plaiul Peleşului, Plaiul Furnica etc.) - interfluvii rotunjite, cu o pantă sub 30^0, faţă de cele de peste 30^0 (frecvent peste 50^0) din cadrul abruptului.

Cuvinte-cheie: *diferenţieri peisagistice, sectorul prahovean al Munţilor Bucegi*

INTRODUCTION

This paper is based on several specialty works, which have been included in the Reference section. In addition, the interpretation of topographic maps of scales 1:25,000 and 1:50,000, satellite images, geological maps of scales 1:50,000 and 1:200,000 and soil maps at scale 1:200,000 has provided useful information. In order to reach the objectives, an important volume of data has been processed and interpreted in a correlative manner: the National Administration of Meteorology, the Forest Research and Management Institute, which has supplied data regarding the coppice of the Azuga and Sinaia Forest Services, the Directorate of Statistics and Ploiesti Environmental Protection Agency. During the field trips, observations have been made, as well as soil and geomorphic mapping (especially concerning the present processes) has been undertaken, focusing on the upper forest limit, areas covered by juniper tree associations. Access roads and touristic paths have also been mapped and their actual state has been assessed. Likewise, sheepfolds and chalets have been taken into account for their impact on the surrounding areas.

We consider that there are various ways for conceiving the landscape and to analyse it. Many definitions bring a lot of subjectivity to the geographical landscape. According to these, the geographical landscape would represent the visual projection of some rather psychological relationships between man and the territory in which he lives (Drăguţ, 2000). However, most definitions refer to

the objective landscape, consisting of concrete elements strongly linked by a set of relations. This type of approach assimilates the geographical landscape to other concepts used in geography, such as the geographical environment and the geosystem.

Between environment, landscape and geosystem there is a mutual interaction. Therefore, no landscape or geosystem can exist without exhibiting a certain type of environment, as there is no type of geographical environment to possess life conditions outside the landscape or its geosystemic functionality (Roşu, 1987). Consequently, the environment represents the entire terrestrial organism, while the geosystem stands for its functional part, whereas the landscape offers the most specific stable material expression that every environment type and geosystem put on (Posea, 1978).

The western limit of the analysed area follows the watershed between the Prahova and Ialomita rivers up to Omu peak (2505 m). From here, the northwestern, northern and northeastern limits separate the Prahova's mountain basin from the Ghimbav, the Timis and the Garcin basins. As far as the eastern boundary is concerned, this is embodied by the Prahova Valley.

RESULTS AND DISCUSSIONS

The main feature of the Bucegi Mountains is given by the complex physiognomy of the landscape. This is primarily imposed by lithology, structure, tectonics and the great altitudinal development, which explain the zoning of physical-geographical characteristics. Therefore, several types of landscapes can be distinguished in this area, namely the landscape of the outliers and structural plateaus of the alpine area, the landscape of the Bucegi escarpment to the Prahova Valley and the landscape of the flat ridges at the foot of the Bucegi Mountains.

The landscape of the outliers and structural plateaus of the alpine area. In the upper part of the Bucegi Mts., the headward erosion carried out from the Prahova level towards the highest altitudes in the Bucegi and the evolution between the Prahova – the Ghimbav in the north-eastern part of the Bucegi, led to the appearance of the following peaks: Bucsoiu, Omu, Bucura Dumbrava, Gavanele, Coltii Obarsiei, Costila, Caraiman, Jepii Mici, Jepii Mari, Piatra Arsa, Furnica, Varful cu Dor, Vanturis, etc.

Westwards from the above-mentioned peaks, there is an area with smooth and moderate slopes (almost all of them having less than 15^{o}) known as the Bucegi plateau (Vâlsan, 1939), which is drained almost entirely by the upper reaches of the Jepilor and Izvorul Dorului streams. It streaches to the sequence of Baba Mare 2292 m, Cocora 2191 m, Laptici 1877 m, Blana 1877 m, Nucet 1860 m peaks and several saddles that form the present watershed (separating the Prahova basin from that of the Ialomita).

This plateau preserves an upper erosion level, which can be seen on the eastern edge of the Bucegi Mts., at elevations of 1800 – 2500 m (Omu, Costila, Caraiman, Jepii Mici, Ciocarlia, Jepii Mari, Piatra Arsa, Furnica, Varful cu Dor, Vanturisul peaks etc.), as well as on the western watershed of the Izvorul Dorului (Nucet – Cocora), where it is represented by structural outliers, most of them with asymmetrical appearance (cuestas), which tower over structural surfaces.

The age of this erosion level is disputable, being generally considered equivalent to the Borascu level (Orghidan 1931, Valsan 1939, Valeria Michalevich Velcea 1961, Posea 1998). The microforms developing on the Bucegi plateau are the rock pedestals, mushroom rocks and sphinx-like rocks (Babele, Baba din Vanturis, Sfinxul), the genesis of which is linked to cryoclastism, gullying and corrasion, which operate differently on sandstones and conglomerates.

Up to approximately 2200 m (in the upper basin of the Izvorul Dorului), the landscape of the outliers and structural plateaus with subalpine elements has been almost entirely affected by anthropogenic influence (Fig. 1), consisting of touristic activities (a dense and chaotic network of paths) and uncontrolled shepherding. Where juniper trees have been cleared and where the debris from the existing buildings has been thrown away, one can notice serious ecological disequilibria. Beside the destruction of natural vegetation and its replacement by *Nardus stricta* and other ruderal species, anthropogenic actions have also led to soil cover removal on large areas and to the formation of a gully network along the numerous roads and paths.

The landscape of structural plateaus has been affected for the most part by anthropogenic influence consisting in touristic activities and overgrazing. Serious problems arise where juniper trees that once covered the entire plateau of the Bucegi Mts., at least as high as 2200 m altitude, have been cleared and in the areas where various constructions have been accomplished. Beside vegetation destruction, human actions have also contributed in a negative manner to the removing of soil cover from the oversized network of roads and paths.

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Fig. 1 The landscape of structural plateaus Bucegi Mts

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The boundary between the alpine and subalpine zones is easy to establish on the Bucegi plateau, because *Nardus stricta* disappearance is obviously preceded by its nestling on the bottom of microdepressions. Above 2200 – 2300 m, the landscape of the outliers and structural plateaus with alpine elements (low grass and plant associations that form small cushions) is better preserved than the previous one, even though here can be noticed several ecological disequilibria around the Costila relay and the Omu Peak chalet and weather station.

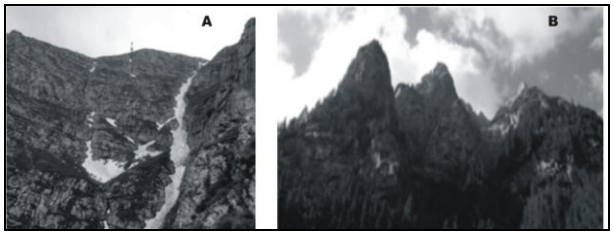

Fig. 2 Escarpment valleys with temporary flow, which also act as rock streams and avalanche chutes (A). Haystack-shaped outliers in the Jepii Mts (B).

The landscape of the Bucegi escarpment to the Prahova Valley. The Bucegi plateau has an impressive cuesta front, 15 km in a straight line, but very winding in the field, which towers over the Prahova Valley. The appearance of the Bucegi escarpment to the Prahova Valley, where the maximum declivities are generally specific for the slopes developing between 1550 – 1600 m and 1950 – 2000 m, is very diverse. The lithology, consisting of conglomerates, sandstones and limestones in the upper part of the Bucegi Mts. and Cretaceous flysch at the base, as well as monoclinal structure and tectonics (horsts and grabbens) have produced a great variety of microforms and mesoforms.

Headward erosion of the Prahova's tributaries (triggered by the neotectonic uplift of the mountains) and periglacial processes led to the formation of intersection crests (residual periglacial relief) from the general line of escarpment and large screes at the base of the slopes, where there can be seen 2 – 3 generations of talus cones (the oldest are stabilized by soil and woods, while the newest are still exerting their pressure on the forest).

The undercutting of the Bucegi conglomerates and the transportation of materials along the steep incipient thalwegs, frequently conditioned by tectonics, have produced impressive escarpment valleys (Fig. 2 A) separated by ridges, which show a temporary flowing regime. Many of these are mere rock streams or avalanche chutes. Avalanche chutes are fed with snow coming from the cirques and nival niches that are found on the escarpment edge of the Costila Mt.: Blidul Uriasilor (on the southern slope), which supplies a steep thalweg stream developing under Costila relay, and the nival cirques lying at the headwaters of the Costila, Malin and Pripon valleys. If Costila valley develops on the eastern slope, the last two are found on the northern one. The ridges have different physiognomies. The most spread are the indented ones (Creasta Morarului and Balaurul within Bucsoiu Mic), but there are also ridges made up of haystack-like outliers (Fig. 2 B), as it is the case of the Jepii Mici – Claia Mare (1863 m) and Claita (1853 m), separated by the Valea Seaca a Clailor.

Fig. 3 Brâna Mare a Coştilei – a bench lying on the northern slope of the Coştila Mt.

The escarpment microrelief is very complex. The sandstones (especially quartzitic ones, which are harder and less permeable) and conglomerate intercalations favouring the development of structural benches (Fig. 3), overhanging rocks and lithological levels that look like big steps (Valeria Michalevich Velcea, 1961). The microtectonics has further led to rock-walls fragmentation by horns, fissures (the most impressive being the Fisura Albastra from the southern wall of the Costila Mt.), hollows under overhanging rocks, wind potholes and escarpment valleys.

The Pleistocene induced some changes in the landscape of the northeastern scarp through the appearance of small glaciers at the headwaters of the Cerbul (Fig. 4) and Morarul valleys. These two valleys are now separated by the Morarul Ridge, with triangular profile, which once acted as an arête. Before the glacial period, the catchment areas of the valleys stretched as far as the foot of the Omu peak, while the thalwegs had been very steep in the long profile.

Fig. 4 Glacial-nival cirques on the Valea Cerbului headwaters. The influence of structure is obvious

The amount of ice being rather low, glacial erosion was restricted to the catchment areas lying at the valley headwaters, between 2100 m and 2450 m altitude, where cirques with diameters ranging from 1 to 1.5 km came into existence. The troughs may owe their U – shaped profile to the present geomorphologic processes as well, of which the most important is the accumulation of avalanche snow on some structural steps. At the base of the cirques, the debris covers the rocks that look like they have been polished by glaciers. As far as the moraines are concerned, these have been moved to lower sites by waters and avalanches. The valleys make up a dense and intricate network. Some have a V – shaped cross-section profile in the escarpment area, which certifies their younger age. Others (as the Caraiman and the Peles) widen out at the headwaters or exhibit a more rounded profile, sometimes resembling a trough (the Cerbul, Morarul and Malinul valleys), a feature that is often the result of nival cirques development. The long profile of obsequent valleys (the Costila, Jepi, Urlatoarele, Babei, Peles and Zgarbura valleys etc.) is steep until approximately 1400 – 1600 m and becomes less inclined at lower altitudes, in the flysch domain.

The breaks of slopes that can be seen in the thalwegs owe their existence to the geological structure and rock hardness. Sometimes they are highlighted by the presence of waterfalls, as it is the case with those developing on the Caraiman, Valcelul Inspumat, Urlatoarele, Peles and Zgarbura valleys. The headward erosion exerted on the plateau area has led to stream piracy phenomena. Thus, the Valea Jepilor has captured the upper stretch of the Valea Izvorul Dorului, whereas the stream developing in the escarpment area, at present the obsequent stretch of the Izvorul Dorului valley has captured the subsequent reach of the aforementioned river, which drained the plateau.

The Cerbul and Morarul valleys, with headwaters in the glacial or glacial – nival level, show complex long profiles, with important knick-points at the contact with the periglacial zone (2100 – 2200 m altitude), and present accumulations of big rocks. Further down, in the flysch domain, the profile becomes less inclined. Likewise, the Izvorul Dorului Valley dips gently on the plateau, then, down the escarpment, it has the same features as the other obsequent valleys in the area (high breaks of slopes, waterfalls and blocks), getting in the end a less inclined profile when crossing the flysch domain. Seen from the Baiul Mts., the Bucegi escarpment to the Prahova Valley appears higher to the north and lower to the south. The sector between Bucsoiu and Piciorul Pietrei Arse is the most impressive and the most fragmented (Fig. 5 A, B), due to the recent uplifts (Neogene and Quaternary), which have led to a significant deepening of the Prahova and the Ghimbav base levels.

From the general scarp line, the erosion has detached trapezoidal sides (the Costila Mts., Caraiman, Jepii Mici, Jepii Mari, Piatra Arsa etc.), triangular facets (the Morarului Mts. and the Bucsoiu Mic), as well as ridges, either indented or made up of haystack-like peaks. South of the Piciorul Pietrei Arse, the scarp looks more compact, due to the higher base level and the presence of calcareous rocks (represented by klippes). The landscape of the Bucegi escarpment to the Prahova Valley has suffered an intense touristic anthropization, especially on the slopes of Varful cu Dor, Furnica and Piatra Arsa summits, which rise above Sinaia town. These areas are full of degradation phenomena that affect roads, paths, as well as the bad located and ill-maintained tracks.

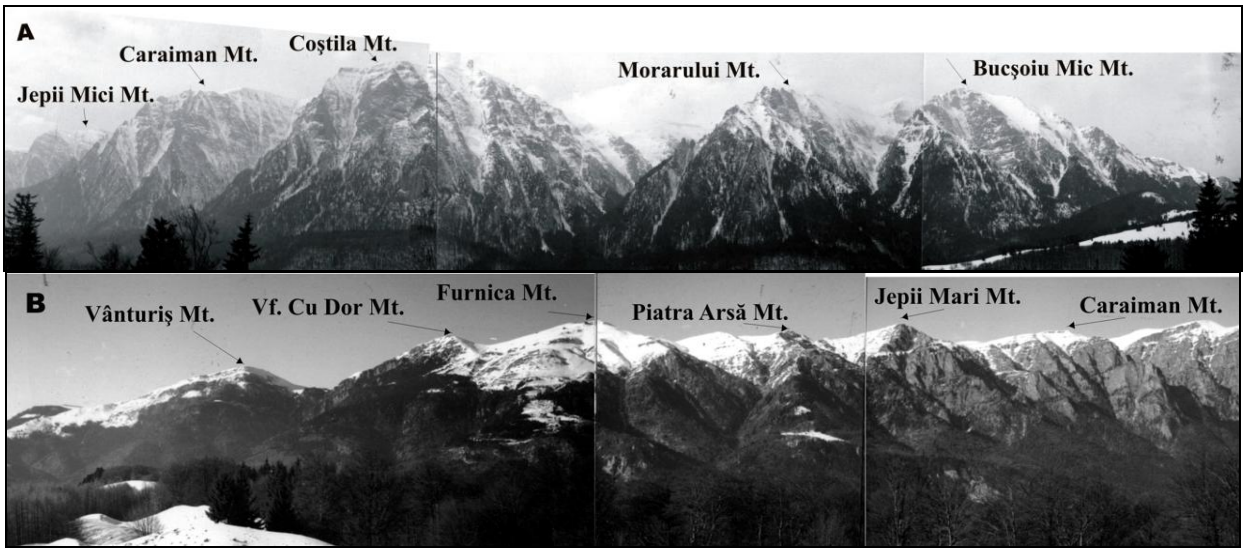

Fig. 5 The landscape of the Bucegi escarpment to the Prahova Valley can be divided into two sectors: the sector lying north of the Piciorul Pietrei Arse, more impressive and more fragmented (A) and the sector lying south of the above-mentioned ridge, which is more compact (B).

The Bucegi slope lying north of the Piciorul Pietrei Arse still preserves natural landscapes found in a dynamic equilibrium, which have a great potential for tourism and climbing. The rare forests (spruce fir, larch tree and occasionally Swiss pine), which develop near the upper tree line, are another representative feature of the eastern escarpment of the Bucegi Mts. They account for 3 per cent of the total forested area of the Prahova mountain catchment and are found either on the steep slopes, where they advance as high as 1800 m altitude or even more, or on the scree fields lying beneath. These forests are fragmented and their consistency is low. Likewise, the trees are rather short, showing specific physiognomies (flag or crawling creatures) and low vitality.

The landscape of the flat ridges at the foot of the Bucegi Mts. At the base of the scarp, the shaping processes that affected the Cretaceous flysch and contributed to the accumulation of scree have generated a relief made up of flat ridges and rounded interfluves (Fig. 6). Here, the gradients are lower than 30^0, unlike the scarp area, where slopes frequently exceed 30^0 or even 50^0. From north to south, the main flat ridges are Plaiul Fanului, Plaiul Costila, Plaiul Munticelu, Plaiul Vaii Seci, Plaiul Bolovanului, Plaiul Stanei, Plaiul Stana Veche, Plaiul Paltinului, Plaiul Secului, Plaiul Piatra Arsa, Plaiul Pelesului, Plaiul Furnica, Plaiul Zgarburei and Plaiul Coltii lui Barbes. Here and there, ridge profiles show flat sectors that preserve erosion levels, such as those found at ± 1500 m and ± 1100 m (possibly being the same age as the Clabucetele and Predealul levels).

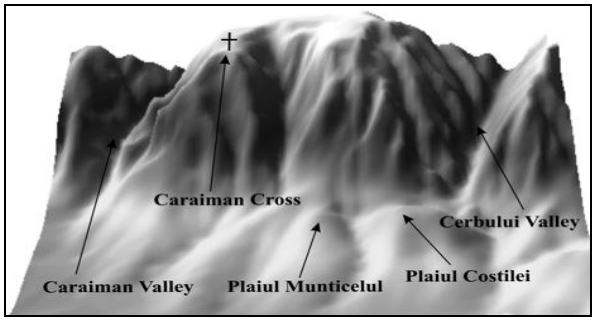

Fig. 6 At the base of the Bucegi escarpment to the Prahova Valley, the shaping of Cretaceous flysch rocks and the accumulation of scree have generated a relief of flat ridges.

Their presence is put on the account of harder rock formations, as it happens with the Sfanta Ana calcareous rocks, or with those found at Poiana Stanei or in the Piatra Arsa area, etc. In comparison with the escarpment sector, the lower reach of the valleys develops on flysch. Consequently, the valleys are larger and deeper, showing less inclined long profiles and narrow floodplains bordered by small glacises. For the most part, the flat ridges are covered with coppices that preserve their natural state, which is also the case of those growing on the Bucegi escarpment to the Prahova Valley. However, there are certain areas where the land is covered by secondary meadows. Here and there, the intense human pressure has contributed to the degradation of this landscape type, the best example in this respect being the Plaiul Furnicii with its complex touristic improvements.

CONCLUSION

Where anthropogenic activity is intense (road construction, forest harvesting, clearings, overgrazing, development of touristic infrastructure, especially for winter sports etc.), the relationships between the systems' elements are disturbed, generating to a greater or lesser extent other geodynamic and ecologic relationships that are mirrored by the system. The anthropogenic factor influences all the elements of the landscape, leading to their artificialization in various proportions. At present, one can hardly spot purely natural landscapes. This is why anthropogenic activities have turned into a criterion for separating the various landscape categories, based on their anthropization degree. According to the classification proposed by Cristina Muica (Geografia Romaniei, vol I, 1983), in the study area, there can be distinguished slightly and moderately anthropized landscapes. The slightly anthropized landscapes show a high degree of naturality. For this type of landscape, the natural elements prevail, while the human intervention is almost absent. This means the changes of structure and the alterations of natural floristic composition are minor, whereas human habitats are poorly developed. In this category we can include the sector of the eastern escarpment of the Bucegi Mts. lying north of the Piciorul Pietrei Arse; the alpine meadows; the forests the natural character of which has not been altered dramatically by plantations of resinous species; the subalpine meadows, both primary and secondary ones, which have a low degree of degradation; and, partly, the secondary meadows from the spruce fir zone, which in their turn are less degraded. The moderately anthropized landscapes are characterized by a strong fragmentation of the forest area, alterations of structure and floristic composition, and the presence of degraded meadows. We include here the sector of the eastern escarpment of the Bucegi Mts. lying north of the Piciorul Pietrei Arse (clearings, degraded secondary meadows, touristic improvements) and the primary and secondary meadows of the subalpine zone degraded through the spreading of invasive species (most often *Nardus stricta)*.

REFERENCES

Bertrand G., (1968), *Paysage et géographie physique globale*, Rev. géogr. des Pirénées et du sud-ouest, t. 39.

Buza M., (1979), *Structura geosistemului din Munţii Cândrel,* St. cerc. G.G.G., Geografie, XXVI, Bucureşti.

Deploux M., (1972), *Ecosisteme et paysage,* Rev. geogr. de Pyrenées et des sud-ouest, t. 43, Paris.

Drăguţ L., (2000), *Geografia peisajului*, Edit. Presa Univ. Clujeană.

Goudie A., (1984), *The Nature of the Environment. An Advanced Physical Geography,* Basil Blackwell Ltd. Oxford.

Grigore M., (1981), *Munţii Semenic. Potenţialul reliefului,* Edit. Academiei, Bucureşti.

Ielenicz M., (1996), *Contribuţii la teoria peisajului,* Rev. Terra 1994-1995, Bucureşti.

Ielenicz M., (1997), *Mediu-Ştiinţa mediului-Geografie,* An. Univ. Bucureşti, Geografie, Bucureşti.

Ielenicz M., (2000), *Geografie generală. Geografie fizică,* Edit. Fundaţiei "România de Mâine", Bucureşti.

Mac. I., (1990), *Peisajul geografic, conţinut şi semnificaţie ştiinţifică,* Rev. Terra, 1 – 4, Bucureşti.

Mehedinţi S., (1934), *Terra. Introducere în Geografie ca ştiinţă, vol.* I şi II, Bucureşti.

Micalevich-Velcea Valeria, (1961), *Masivul Bucegi-studiu geomorfologic*, Edit. Academiei, Bucureşti.

Mureşan Alina, (1995), *Passé et présent dans la recherche géographique du paysage*, Studia Univ. Babeş-Bolyai, Geogr., XL, 1-2.

Niculescu Gh., (1972), *Diferenţieri în peisajul geografic al Carpaţilor Meridionali,* Lucr. Simp. de geogr. fiz. a Carpaţilor, (sept. 1970), Inst. de Geogr., Bucureşti.

Oprea R., (2005), *Bazinul montan al Prahovei. Studiul potenţialului natural şi al impactului antropic asupra peisajului.*, Edit. Universitară, Bucureşti.

Oprea R., (2005), *Dinamica şi evaluarea peisajului în culoarul montan al Prahovei*, în volumul Lucrari şi rapoarte de cercetare, vol. I, Editura Universităţii din Bucureşti.

Oprea R, Oprea Monica, (2000), *Aspecte ale impactului antropic în bazinul Izvorul Dorului*, Comunicări de Geografie, volumul IV, Editura Universităţii din Bucureşti.

Orghidan N., (1931), *Observaţii geomorfologice în Bucegi,* Lucr. Inst. de Geogr. al Univ. din Cluj, (1931-1932).

Patrulius D., (1969), *Geologia Masivului Bucegi şi a Culoarului Dambovicioara,* Edit. Academiei, Bucureşti.

Posea Gr., (1998), *Suprafeţele de nivelare din Munţii Piatra Craiului-Baiu (Carpaţii de Curbură),* Anal. Univ. "Spiru Haret", Geografie, 1, Bucureşti.

Roşu Al., (1987), *Terra – geosistemul vieţii,* Edit. Ştiinţifică şi Enciclopedică, Bucureşti.

Stoenescu Şt., (1951), *Clima Bucegilor,* Edit. Tehnică, Bucureşti.

Tudoran P., (1976), *Peisajul geografic-sinteză a mediului înconjurător,* Bul. Soc. de Ştiinţe Geogr. din România, vol. IV (LXXIV), Bucureşti.

Vâlsan G., (1939), *Morfologia văii superioare a Prahovei şi a regiunilor vecine,* Bul. Soc. Regale Române de Geogr., t. LVIII, Bucureşti.

***(1969), *Solurile Munţilor Bucegi,* Edit. Academiei, Bucureşti.

*** (1983), *Geografia României, vol.* I, *Geografia fizică,* Edit. Academiei, Inst. geogr., Bucureşti.

*** (1990), *Amenajamentul O.S. Sinaia, Studiu general,* Şef proiect ing. Popescu I., Regia Autonomă a Pădurilor ROMSILVA R.A. I.C.A.S, Bucureşti.

*** (1999), *Amenajamentul O.S. Azuga Studiu general,* Şef proiect ing. Bălan N.Regia Naţională a Pădurilor, I.C.A.S, Bucureşti.