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CONTRIBUTIONS TO INVENTORY AND ASSESSMENT OF THE GEOMORPHOSITES FROM CALIMANI NATIONAL PARK. CASE STUDY: BISTRICIOR MASSIF

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Abstract: Călimani National Park belongs to Călimani Mountains, extends on a surface of 24,041 ha and superposes over the districts of Suceava, Harghita, Mureş and Bistriţa-Năsăud. It conserves elements of flora, fauna and relief that stand out through a very high attractive potential, a fact which determines massive flows of tourists and enables diversified leisure activities. An important role in administrating this protected area, as well as in capitalizing its attractive resources, is given to the process of inventory and assessment of the relief forms with a scientific, aesthetic, cultural, ecologic and economic relevance, and that of the geomorphosites. Henceforth, the present work is meant to assess from this point of view a potential geomorphosite within the Călimani National Park, namely the Bistricior Massif. As such, an assessment methodology used on an international scale has been applied, and the obtained results plead for granting the status of geomorphosite to the Bistricior massif. This fact is particularly relevant not only for the future touristy development and capitalization strategies, but also for the activities of management and conservation of the natural resources within the above mentioned National Park.

Key words: geosites, geomorphosites, assessment criteria, Cusma site, Colibita Depression, Bistricior Massif, Calimani Mountains, Calimani National Park

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FOREWORD

Within the latest two decades, along with the intensified preoccupation for environmental protection and conservation, a new research direction took shape in geomorphology as well, meant to point out the valences of the relief as an element of natural inheritance, which has to be given the same attention as for the biotic components (Panizza and Piacente, 1993; Panizza, 2001; Reynard, 2005; Reynard and Panizza, 2005; Panizza and Piacente, 2008; Ilieş and Josan, 2009a, 2009b; Reynard and Regolini-Bissig, 2009). Thus there were formulated such concepts as geodiversity, geosite, geolandscape, geotop and geomorphosite, there was established a methodology of research for geodiversity and geomorphosites and there were also elaborated numerous works concerning the inventory, assessment and capitalization of the geomorphosites in different regions of the world, including the Romanian Carpathian mountains.

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In this context, the present work is meant to continue these preoccupations by bringing into debate the Bistricior Massif from the Călimani Mountains, within the Călimani National Park, as a potential geomorphosite (www.calimani.ro). This massif, as a "stand alone" geomorphologic entity, is little known in the specialized literature but is mentioned in different works related to Călimani Mountains (Cosma et al., 1963; Naum, 1969; 1974; 1989), and Colibița Depression (Bâca and Șteff, 2010) or on the occasion of some studies concerning the glaciation within the Oriental Carpathians (Athanasiu, 1899; Savicki, 1912; Krautner, 1930; Someşan, 1932; Sârcu, 1964; Naum, 1970; Mândrescu, 2001).

On the other hand, from a touristy point of view, the Bistricior massif is a well-known and visited location especially by those fond of mountain climbing, the access toward this objective being made from the valleys of Mureş, Dorna and Bistrița Ardeleana. This area also has a status of complex reservation (category IV according to IUCN) within the Călimani National Park and the website "Natura 2000 Cuşma" (www.usamv.ro/cusma), conserving forms periglacial relief and items of sub-alpine flora and fauna. By its geomorphofunctional position and its natural valences, we consider that the Bistricior massif meets the major criteria to be included in the category of geomorphosites, a fact also emphasized by the results obtained thorough the assessment in the present study.

WORK METHODOLOGY

The research activity for Bistricior massif took place within the period of 1995-2010, when observations were made on the periglacial relief, the up-to-date morphogenetic processes and tourist practices from this area. In this respect the specialized bibliography referring to certain geologic, geographic and touristy problems was looked into, there were consulted cartographic and photographic materials, archived documents regarding area humanizing, forestry exploitation and specific development, as well as thorough observations on different morphogenetic and geomorphodynamic aspects (relief as a whole, detailed relief, slope processes, anthropogenic impact, etc.). A distinct attention was given to touristy circulation, monitored with the support of the Salvamont formation in charge with the area. A part of the research results were turned to account in the work *"Colibița-dimensiuni turistice"* (Bâca and Șteff, 2010), and others are to be published in the future period. Relying on the great volume of materials gathered and sorted within this period, the next logical step is to get to the evaluation stage of the massif, with the purpose of it being accredited as a geomorphosite.

To this end there were consulted numerous specialized works from the latest two decades, dealing with the problem of geomorphosites and their inventory and assessment (Panizza and Piacente, 1993; Pralong, 2005; Pralong and Reynard, 2005; Reynard, 2005; Reynard and Panizza, 2005; Reynard, 2006; Reynard et. al., 2007a; Reynard et. al., 2007b; Pereira et al., 2007; Ilieș and Josan, 2007; Panizza and Piacente, 2008; Reynard et al., 2009; Ilieș et al. 2009; Comănescu et al., 2009; Comănescu and Nedelea, 2010 etc.) so as to adapt information according to international standards.

As a result, given the specificities of Bistricior Massif in what concerns extension, geospatial relations, genesis, geomorphometry and touristy exploitation, preference was given to the assessment criteria proposed by Reynard (2006).

STUDY AREA

Bistricior massif is situated in the north-western part of the Călimani Mountains (figure 1), at the contact with the area of Bârgău Mountains, between Șaua Terha (1470 m) at N, Valea Dornei at NE and E, Șaua Struniorului (1760 m) at SW, Pârâul Mijlociu at S, Șaua Scurtu (1350 m) at SW and the sources of Bistrița Ardeleana (Colbu and Tirimiul de Sus) at NE.

From an orographic point of view, the Bistricior Massif is part of the Priporul Roşu-Buba-Terha-Bistricior-Scurtu ridge, which borders Colibița Depression at E and SE, being linked to the high central area of the Călimani Mountains through the Strunior-Ciunget-Pietrosu ridge (figure 2).

The massif's individualization took place after the ceasing of eruptions in Călimani (superior pontian), through the fragmentation of a lava plateau from the western part of the central cone, under the action of fluvial erosion manifested in this sector by the valleys of Dorna, Bistrița Ardeleană and Răstolița.

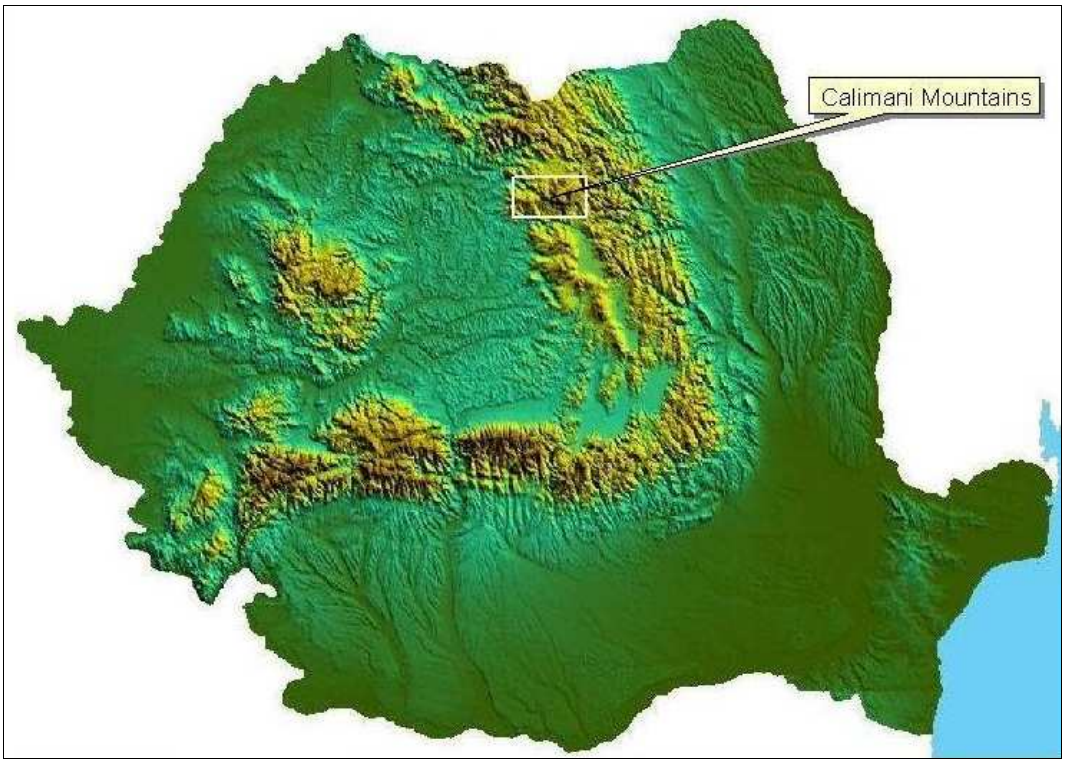

Figure 1. Geographic position of the Calimani Mountains in Romania

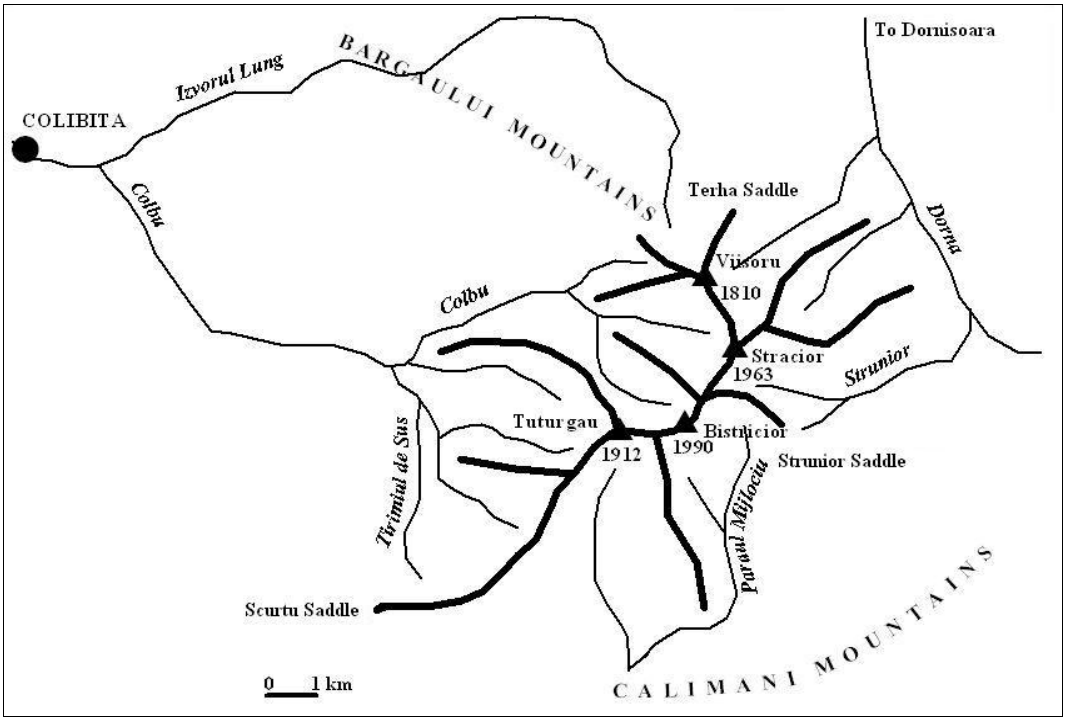

Figure 2. Geographic location of Bistricior massif within the Călimani Mountains

Detached from the mountain mass of the Călimani, the Bistricior Massif overlooks towards east and north-east the valley of Dorna (1050-1300 m), towards north-west the knolls of southern Bârgău (Căsaru, 1591 m; Măgurița, 1581 m; Dl. Ariilor, 1546 m; Cornu, 1510 m), towards west the Colibița Depression (800-1000 m), and towards south-west the ridge Piciorul Scurt-Chicera lui Pasăre-Țiganca (1300-1500 m) from the Călimani Plateau.

The massif's flanks stand out through geomorphometric parameters of high values and bear the imprint of periglacial moulding within the Pleistocene. Thus there can be noticed semi-funnels and cryonival corridors, nival niches, residual ridges, rocky formations and detritus fields (figure 3).

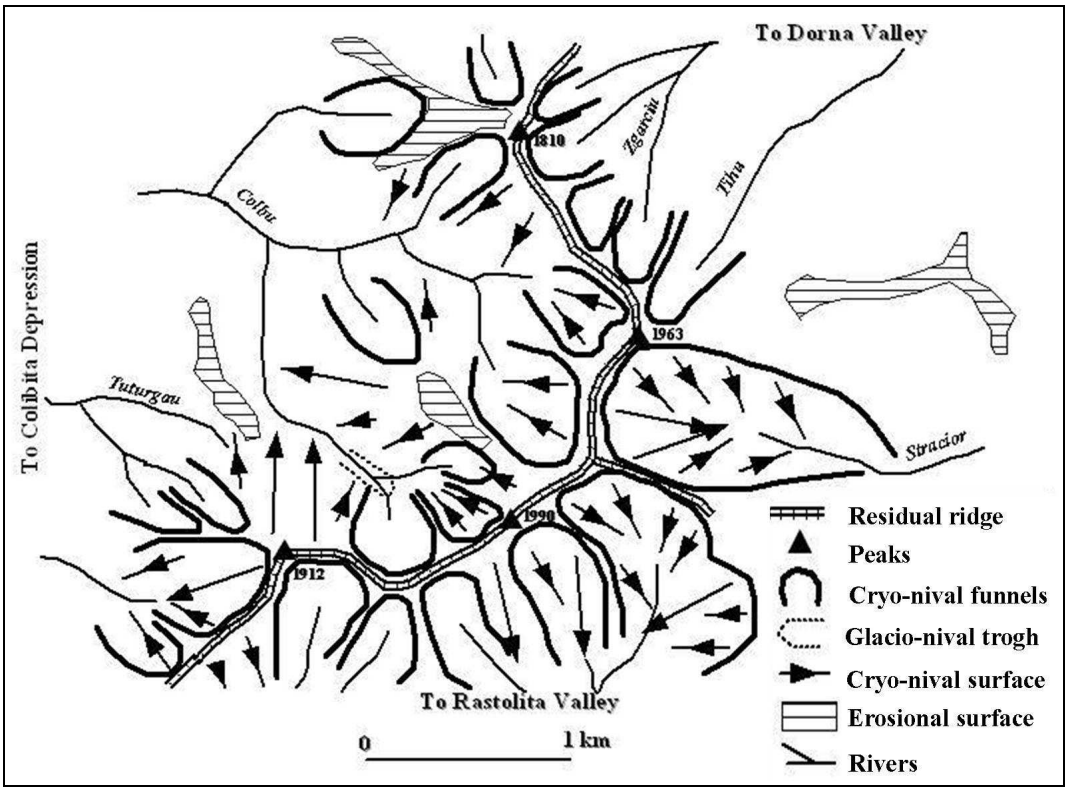

Figure 3. Periglacial complex from Bistricior massif

The main ridge of the massif has a sinuous shape, from North-East versus South-West, as function of the intensity of erosive processes reported to the limitary erosion bases. There stand out three peaks over 1900 m, namely Străcior (1963 m), Bistricior (1990 m) and Țuțurgău (1912 m). As for the ridge's configuration as a whole, three distinct sectors can be delimited, as follows:

- the Viișoru-Străcior sector, flatly shaped, dominated on the terminal side, towards Șaua Terha, by residual rocky formations covered by junipers, out of which there stands out the peak Viișoru (1810 m);

- the Străcior-Bistricior sector, narrow and slightly unleveled, marked on the southern side by numerous nival niches;

- the Bistricior-Țuțurgău sector, steep, unleveled and narrow, marked by residual peaks, deep ensaddlements, rocky formations and detritus fields.

Preoccupations regarding the research of glacio-nival relief in Călimani Mountains are to be foreseen in the works of Athanasiu (1899), Savicki (1912), Krautner (1930), Someșan (1932), Sârcu (1964) and Naum (1970). Strictly referring to the Bistricior massif, Savicki (1912) mentions

"glacial traces on its northern slope", whereas Sârcu (1964) asserts that the two valleys on the north-western slope of the massif, namely Colbu and Gura Plaiului, are not of a glacial origin, and Naum (1970) considers that "in the western part of the massif, under Bistriciorul Peak (1990 m), there appear two nivation troghs at the altitude of 1800-1850 m" and that "in Bistricior there may have existed embryonic or nival glacial troghs".

Recently, Mândrescu (2001) confirms the nival origin of the troghs under Bistriciorul Peak, correlating them as altitude with the inferior alpine troghs from the glacial basin of Lala or the troghs Cobăşel, Gropile and Pietroasa (Rodnei Mountains).

RESULTS AND DISCUSSIONS

Bistricior massif is situated in the western part of the Călimani Mountains National Park, lies on a surface of 25 km² and administratively superposes the districts of Bistrița-Năsăud (north-western flank), Suceava (eastern and north-eastern flank) and Mureș (southern and south-western flank) (figure 4).

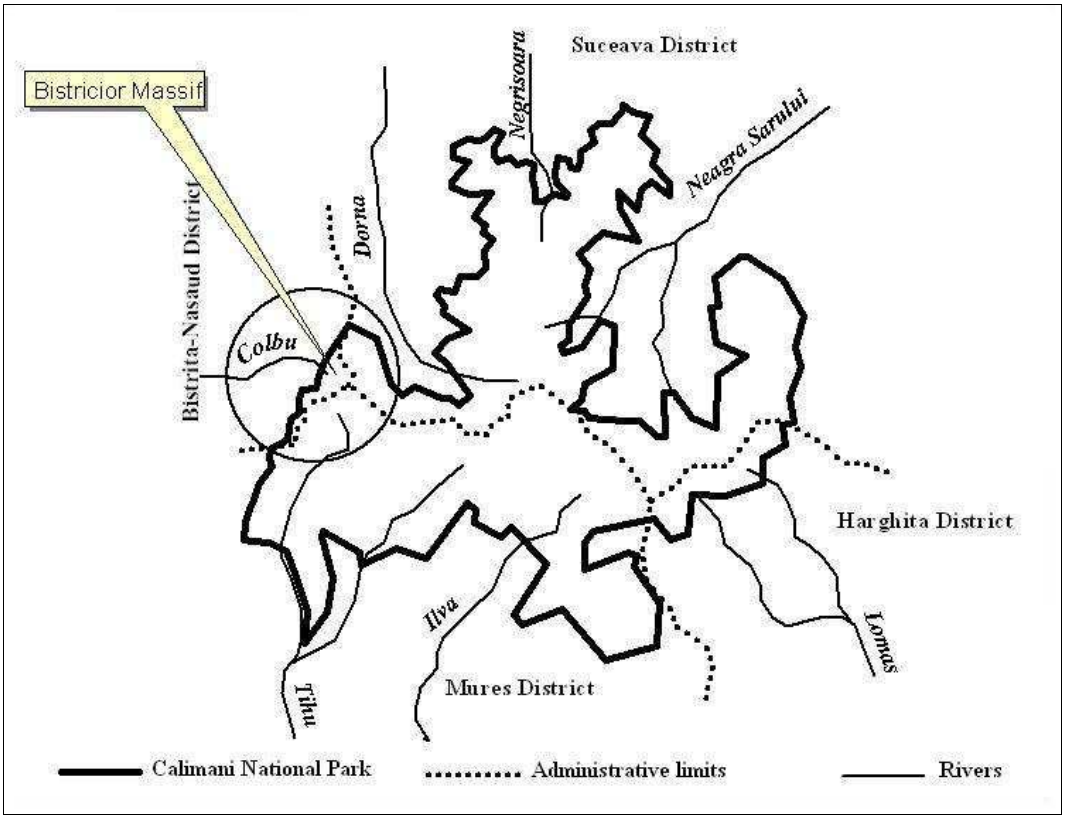

Figure 4. Calimani National Park and Bistricior Massif

Among other geomorphologic landmarks such as 12 Apostoli, Pietrele Roșii, Pietrosu or Reținș, Bistricior can embody a potential geomorphosite within the National Park. It distinguishes through representative altitudes and through a certain degree of isolation within the Călimani Mountains, a fact that confers it a spectacular position from a geomorphologic and touristy point of view. Likewise, the Bistricior massif holds the status of complex reservation within the site Natura 2000-Cușma, managed by the Local Council of Bistrița-Bârgăului, preserving forms of periglacial relief (residual ridges and peaks, semi-funnels and cryonival corridors, narrow valleys, steep slopes, rocky formations and gelifraction fields) along with

elements of sub-alpine vegetation such as the juniper on the two flanks. Its surface, drastically reduced in the past in order to achieve more pastures, is currently rehabilitated, which proves beneficial for both biodiversity and the softening of the morphodynamic processes.

Henceforth, paying respect to the fact that the geomorphosite represents a form of relief with scientific, aesthetic, cultural, ecologic and economic valences (Panizza, 2001), it was opted, in the assessment process of the massif, for the analysis of these dimensions, taking into account the criteria and the marking scheme advanced by Pralong (2005), Reynard (2006) and Pereira (2007).

The results of this assessment are presented in the tables 1-6 and reflect, as objectively as it gets, the personality of the Bistricior massif, showing the place held by this one within the mountainous geosystem it belongs to, as well as reported to the whole National Park of Călimani.

The criteria applied for the quantification of each value (scientific, aesthetic, cultural, ecologic, economic), are relevant for the analyzed geomorphostructure, and the score (0-1p) was supported by certain arguments revealing brief and concrete information on the geomorphofunctional and environmental situation from the massif.

Table 1. Scientific value of the Bistricior geomorphosite (after Reynard, 2006, modified)

Criteria	Assessment	Score
Uniqueness within the area	The massif is one of the most important subunits within Călimani Mountains, shaped on compact volcanic rocks, along with the central caldera and the ridge Pietrosu-Răţiţiş-Strunior	0.80
Integrity	The massif underwent anthropic and natural altering (pasturing, forestry exploitation, mining prospects), and yet it preserves its geomorphofunctional features	0.80
Representativeness of the geomorphologic processes and didactic value	The massif is a good example for the past and present periglacial geomorphologic processes of the sub-alpine level (gelifraction, nivation, geliflux, suffusion, detritus movement)	0.80
Paleogeographic value	The geomorphosite individualized itself through the dissection of a lava plateau situated on the western flank of the central cone in Călimani Mountains	1.00
Number of relevant geomorphologic features	Over 3 (massiveness, geomorphometric parameters of high values, periglacial, glacionival and fluvial relief, etc.	1.00
Geologic features with impact on relief	The volcanic processes generated complex minerals, and their prospecting along the superior course of Colbu valley generated certain forms of anthropic relief (sterol dumps, roads, ditches, etc.)	0.50
Cognition degree in specialized publications	Medium (articles on national scale, tourism works)	0.20
Scientific value	The geomorphosite is representative for the evolution of volcanic relief and for periglacial shaping	0.72

Table 2. Ecologic value of the Bistricior geomorphosite (after Reynard, 2006, modified)

Criteria	Assessment	Score
	Through its features, the geomorphosite	

Ecologic influence	sustains the development of forestry and sub-alpine ecosystems	1.00
Protected sites	The massif is a protected area within the site Natura 2000-Cuşma and preserves forestry and sub-alpine ecosystems that develop in close connection with the geomorphometric conditionings	1.00
Ecologic value	The geomorphosite is representative for the development of sub-alpine ecosystems	1.00

Table 3. Aesthetic value of the Bistricior geomorphosite (after Reynard, 2006, modified)

Criteria	Assessment	Score
Visibility	By its altitude, the massif ensures a great visibility over the landscape, and its aesthetic image is emphasized by the proximity of geomorphologic elements that define it	1.00
Contrast, vertical development and space distribution	The geomorphosite dominates Dorna valley, Colibița depression, Călimani plateau and the tops of southern Bârgău	1.00
Chromatic diversity	Rocky formations, stone flows, sub-alpine pastures, conifer forests	0.50
Aesthetic value	Owing to its imposing physiognomy, the Bistricior geomorphosite is characterized by a high aesthetic level	0.83

Table 4. Cultural value of the Bistricior geomorphosite (after Reynard, 2006, modified)

Criteria	Assessment	Score
Religious and symbolic importance	It does not support religious activities	0.00
Historic importance	On the main ridge, between the peaks Străcior and Bistricior there are preserved defensive ditches and firing emplacements from the 1st World War	0.50
Literary-artistic importance	It does not support literary-artistic activities	0.00
Cultural value	The cultural dimensions of Bistricior geomorphosite are scarce	0.16

Table 5. Economic value of the Bistricior geomorphosite (after Reynard, 2006, modified)

Criteria	Assessment	Score
Accessibility	The access to the massif is made on forestry roads with terrain vehicles and on foot, as well as on pastoral paths and touristy marked tracks	0.50
Present capitalization and geomorphologic interest	The massif is promoted and capitalized for its geomorphologic features in activities of mountainous and scientific tourism and extreme sports	0.80
Capitalization of other natural elements	The Bistricior massif is promoted and capitalized as protected area with sub-alpine and forestry vegetation within the Călimani National Park and the site Natura 2000-Cuşma	0.80

Legal protection and capitalization restrictions	Protected area, with limited exploitation restrictions	0.50
Equipments and services	The touristy accommodation facilities are placed over 10 km away, in Colibița depression. Under the main ridge in Poiana Gura Plaiului there is a Salvamont refuge offering shelter to the tourists	0.20
Economic value	Through its features, Bistricior geomorphosite represents an important touristy objective, alas with a rather modest capitalization due to the access difficulties and lack of accommodation facilities	0.56

Table 6. Protective value of the Bistricior geomorphosite (after Reynard, 2006, modified)

Criteria	Assessment	Score
Integrity	The anthropically induced changings do not affect the essential geomorphologic features of the relief	0.80
Vulnerability	The geomorphologic and biogeographic elements may be anthropically altered	0.80
Protective value	The situation of Bistricior geomorphosite is relatively stable, but the legal protection and conservation code is not yet clearly defined	0.8

CONCLUSIONS

By processing the data from tables 1-6 there have been obtained global values related to the scientific, aesthetic, cultural, ecologic, economic and protective dimensions of the Bistricior massif, and its global value is 0.685 (table 7), one that exceeds, for instance, the values obtained for other geomorphosites in the Romanian Carpathians such as: Ocolaşul Mare from Ceahlău National Park (0.55), Babele or Sfinxul from Bucegi Mountains (0.62) (Comănescu and Dobre, 2009; Comănescu et al. 2009; Comănescu and Nedelea, 2010).

Likewise, the global values on categories of criteria are comparable with those established by the above mentioned authors for the assessed geomorphosites (table 8):

Table 7. Global value of the Bistricior geomorphosite

Scientific value	Additional value (C+Sce+Eco)	Economic value	Protective value	Global value
0.72	0.66	0.56	0.8	0.685

Table 8. Compared global values

Geomorphosite	Scientific value	Aesthetic value	Cultural value	Economic value
Caraiman plateau	0.47	0.6	0.6	0.9
Ocolaşu Mare	0.66	0.75	0.5	0.3
Bistricior	0.72	0.83	0.16	0.56

In the case of the Bistricior Massif, one can notice that the highest scores are recorded by the scientific, additional and protective values, a fact that emphasizes the massif's importance on a touristy and environmental scale. Therefore, the future actions of touristy development and capitalization initiated by the administrative authorities of Călimani National Park and Natura 2000 Cuşma site must be oriented

towards the protection and conservation of the attractive patrimony and towards promoting some touristy practices with a very diminished impact on the landscape.

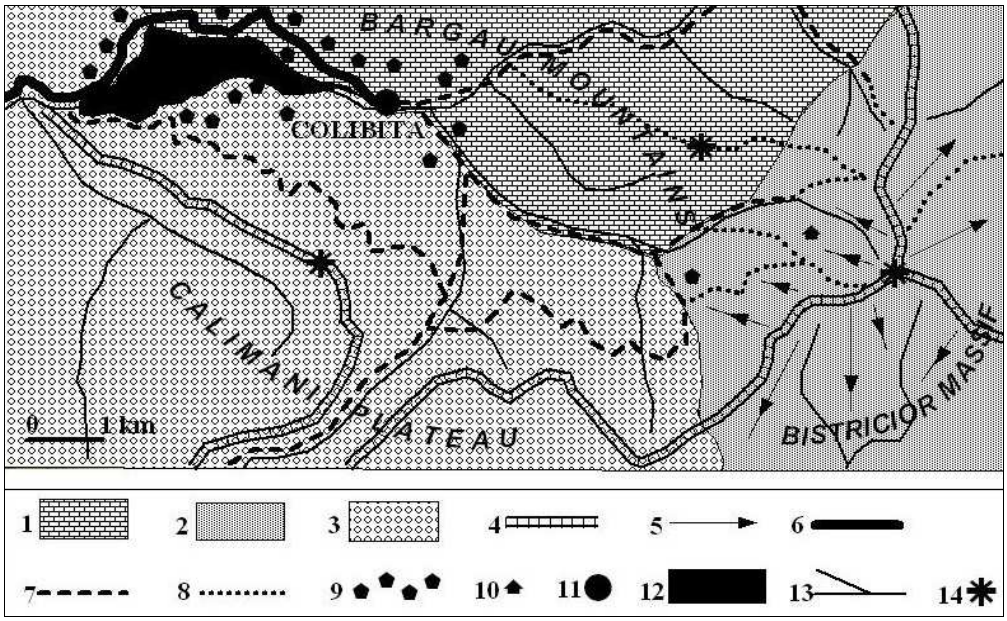

Figure 5. Geotourist map of the Bistricior geomorphosite and Colibita Depression
1.Landforms carved on sedimentary rocks 2.Landforms carved on andesitic rocks 3.Landforms carved on volcanic conglomerates 4.Residual ridge 5.Residual slopes with avalanches and rock falls hazard 6.Main road 7.Forest roads 8.Tourist path 9.Agritourist pensions 10.Shelter 11.Rural settlement 12.Reservoir 13.Rivers 14.Scenic overlook

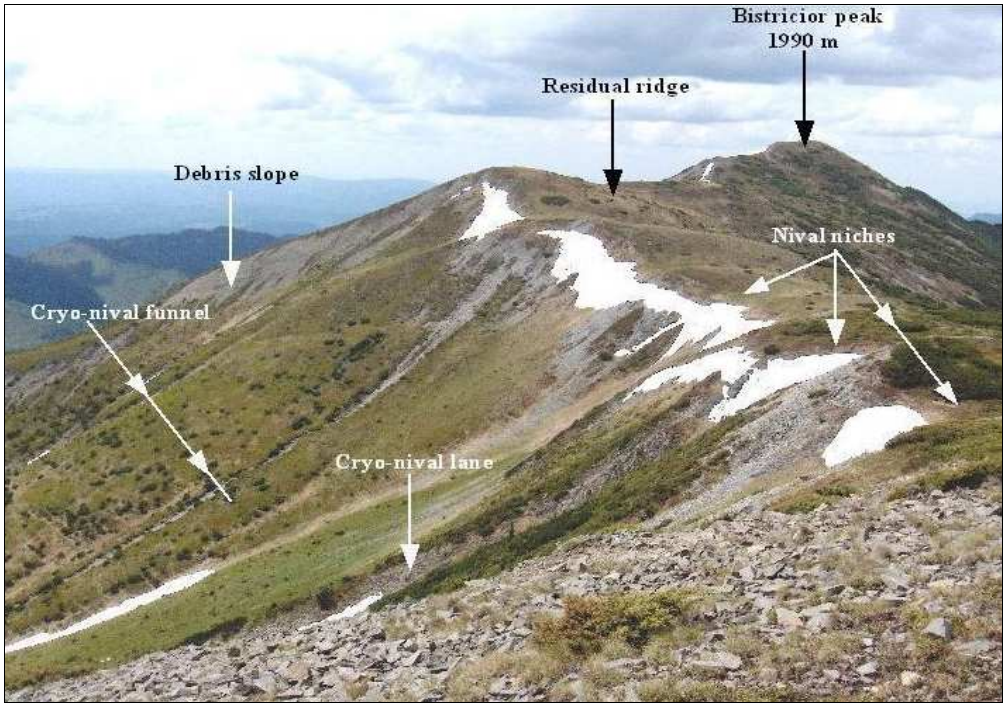

Figure 6. Overview on Străcior-Bistricior ridge revealing the relief's scientific and aesthetic dimensions

As a result, of this assessment there can be stated that the Bistricior Massif from Călimani Mountains and Călimani National Park meets the minimal conditions to acquire the status of geomorphosite. By location, altitude, cultural-historic implications, as well as geomorphologic and biogeographic features, this one represents an important touristy landmark within this Carpathian sector (figure 5, figure 6) and a noticeable protected area within the site Natura 2000 Cuşma.

Another advantage in capitalizing its attractive potential is the proximity from Colibița depression, which is the main access "gate" towards the massif, registering over 300 touristy facilities and having, yet unofficially, the status of climacteric resort (Bâca, 2009).

In the Gura Plaiului clearing, under the Bistricior peak, there is a Salvamont refuge, where mountaineers can find shelter. One need mention here as well the proximity of Dorna and Răstolița valleys, absorbing tourist fluxes from Dorna depression and Mureș valley, which is facilitated by the presence of certain access routes (forestry roads), as well as some marked touristy tracks.

Aknowledgements

The present work represents a part of the research results processed in order to elaborate the visiting strategy for the site Natura 2000 Cuşma, from the management plan of this site, initiated by the City Council of Bistrița Bârgăului, as well as a part from the reference material prepared for the project "Federation for the development of Bârgău-Călimani rural area", proposed by the Chamber of Agriculture of Bistrița-Năsăud District and advanced for financing to the Agricultural and Rural Development Direction of Bistrița-Năsăud District, on the axis 4 LEADER. The authors acknowledge to anonymous reviewer for their thoughtful suggestions and comments.

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