

## THE PROTECTION OF THE GEOMORPHOSITES WITHIN THE MĂCIN MOUNTAINS NATIONAL PARK (ROMANIA) AND THEIR TOURISTIC IMPORTANCE

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### Abstract

*The Măcin Mountains represent the oldest orogen unit on Romanian territory and one of the oldest in Europe. The geomorphosites of Culmea Pricopanului are the most spectacular and they "hide" a great touristic potential. The poor infrastructure makes the number of tourists in the region extremely low. Nevertheless, there is a didactic, specialised tourism. The geomorphosites of the Măcin Mountains are conserved very well, because they are situated within the National Park. Unfortunately, the new quarries opened in the vicinity and their potential extension may affect the touristic potential of the area.*

**Keywords:** *conservation; geomorphology; environment; touristic potential; protection*

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### Introduction

The Măcin Mountains National Park (PNMM) was constituted through the provisions of Law 5/2000 on the approval for national planning of the national territory – Section III: *Natural areas protected by national interest*, in agreement with the procedure approved by the MO [Ministerial Order] no. 850/ 2003 and based on the provisions of the GEO [Government Emergency Ordinance] no. 57/2007. The PNMM changed its administration, according to the Agreement no. 742/22.05.2004, closed between the Ministry of Environment and Waters Management and RNP ROMSILVA. According to the MO no. 850/27.10.2003, the procedure of delegating the custody of natural protected areas fall under the administration of the PNMM, according to the agreement no. 742/MMGA/22.05.2004, closed between RNP - Romsilva and the Ministry of Environment and Waters Management.

The Măcin Mountains National Park is included in the category of national parks, with the purpose of protecting and conserving representative samples for the national geographic park. The samples comprise natural elements with a special value, from a floristic, faunistic, hydrological, geologic, paleontological or other type of perspective, thus providing the possibility of scientific, educational, recreational and touristic visits. The PNMM corresponds to the second IUCN category– *“National park: protected area mainly administered for the protection of ecosystems and for recreational purpose.”*

The most important touristic patrimony of the Măcin Mountains National Park is represented by the geomorphosites, which are unique in Romania and maybe even in Europe. The geomorphosites represent landforms, or geomorphologic processes with specific or unique

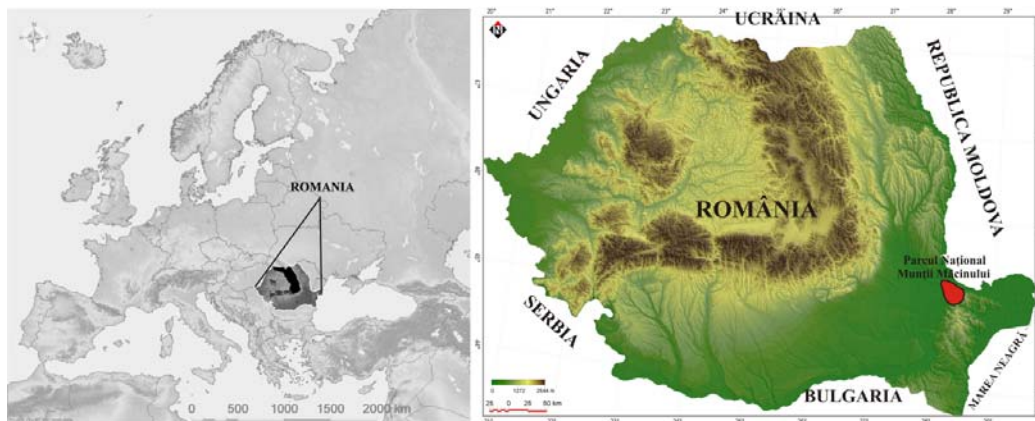
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value. A geomorphosite may be a landform with a special importance in the genetic deciphering of the planet. It may have a scientific or additional value (aesthetic, cultural, ecologic and economic) [1-6].

**Geographical Location**

The Măcin Mountains are situated in the southeast of Romania; more precisely, in the northwest of Dobrudja, in the Tulcea County, between the Danube Valley, Valea Luncaviței, and the Cerna–Horia saddle, between 28°07' and 28°27' long. E, and 45°01' and 45°21' lat. N, respectively (Fig. 1). The Măcin Mountains National Park encompasses most of the mountainous area bearing the same name (Fig. 2).



**Fig. 1.** Localization of the Măcin Mountains and of the influence area in Romania (A) and in the Tulcea County (B)



**Fig. 2.** Repartition of the main geomorphosites within the Măcin Mountains National Park

## Methodology

For the current research stage we used the method of bibliographic study and the study of specific documents – which involved a systematic analysis of the scientific publications and of the various official reports and documents - in order to understand the concepts listed below:

- sustainable use of resources;
- biodiversity preservation;
- increase in the number of tourists in the area;
- drawing up basic studies for biodiversity researches;
- elaborating detailed studies (with maps) on the current state, the distribution and the evolution in space and time of the priority and endangered species and of the park habitats;
- creating a database and a simple, long-term, monitoring program for the key-species, for their habitats and regarding potential threats, in order to support an effective preservation.

The information presented in this paper originates in national and international specialized publications, in online library articles and in reports of international organizations or institutions (European Commission, Global Environment Fund, and United Nations Development Programme). Forest and topographic maps, along with maps for the forested areas and satellite images have been used. The maps printed for the PNMM (Table 1) helped us build the GIS system (GEF Project-2010/Global Environment Fund UNDP/United Nations Development Programme).

**Table 1.** Cartographic resources for the Măcin Mountains National Park

No	Cartographic resources	Scale/resolution
1	General forest map	1 : 100,000
2	Forest maps for production units	1 : 20,000
3	Basic map for the forested areas of the Măcin Mountains	1 : 5,000
4	Topographic maps	1 : 25,000
5	Satellite images	12 m resolution
6	Orthophotoplans	5 m resolution
7	GIS system	in progress

## Results and Discussions

Within the Măcin Mountains National Park we identified 15 types of landforms and processes that may be included in the category of geomorphosites. The geomorphosites were assessed based on a model already accepted in other specialised publications [7]. The touristic value of the geomorphologic forms and processes fall into four categories, to which other criteria have been added: scenic/aesthetic [8-11]; scientific (which includes the ecologic value) [12]; cultural [13]; economic [13-15] value.

Concerning the landforms within the Măcin Mountains National Park, the following criteria have been used for the touristic value of the geomorphosites:

- scientific value: palaeogeographical interest, representativeness, surface (%), uniqueness, integrity, ecologic interest (Table 2);

**Table 2.** Specific criteria for assessing the scientific value

Criterion	0	0.25	0.50	0.75	1
Palaeogeographical interest (St <sub>1</sub> )	0	Low	Moderate	High	Very high
Representativeness (St <sub>2</sub> )	0	Weak	Moderate	High	Very high
Surface (%) (St <sub>3</sub> )	0	<25	25-50	50-75	>75
Uniqueness (St <sub>4</sub> )	>7	5-7	3-4	1-2	1
Integrity (St <sub>5</sub> )	Destroyed	Highly damaged	Averagely damaged	Slightly damaged	Intact
Ecologic interest (St <sub>6</sub> )	Null	Weak	Moderate	High	Very high

- o scenic/aesthetic value: the number of points with maximal visibility, the average distance to the belvedere points, surface (km<sup>2</sup>), difference in the level, chromatic contrast (Table 3);

**Table 3.** Specific criteria for assessing the scenic value

<b>Criterion</b>	<b>0</b>	<b>0.25</b>	<b>0.50</b>	<b>0.75</b>	<b>1</b>
Number of belvedere points on the geomorphosite (Sce <sub>1</sub> )	0	1	2-3	4-6	>6
Average distance to the belvedere points (m) (Sce <sub>2</sub> )	0	<50	50-200	200-500	>500
Surface (km <sup>2</sup> ) (Sce <sub>3</sub> )	0	Small	Moderate	Large	Very large
Difference in the level (m) (Sce <sub>4</sub> )	0	0-200	200-500	500-1000	>1000
Chromatic contrast (Sce <sub>5</sub> )	Identical colours	-	Complementary colours	-	Opposite colours

- o cultural value: cultural and historical characteristics, iconographic representations, historical and archaeological relevance, religious relevance, artistic and cultural events (Table 4);

**Table 4.** Specific criteria for assessing the cultural value

<b>Criterion</b>	<b>0</b>	<b>0.25</b>	<b>0.50</b>	<b>0.75</b>	<b>1</b>
Cultural and historical characteristics (Cult <sub>1</sub> )	Not connected	Weak connection	Moderate connection	Strong connection	Very strong connection
Iconographic representations (Cult <sub>2</sub> )	Never	1-5	5-10	20-50	>50
Historical and archaeological relevance (Cult <sub>3</sub> )	No relevance	Weak relevance	Moderate relevance	High relevance	Very high relevance
Religious relevance (Cult <sub>4</sub> )	No relevance	Weak relevance	Moderate relevance	High relevance	Very high relevance
Art and culture events (Cult <sub>5</sub> )	Never	By hazard: once	Periodically 3-7 years	Between 1 and 3 years	Every year

- o economic value: accessibility, presence of risks, number of visitors, official level of protection, attraction (Table 5).

**Table 5.** Specific criteria for assessing the economic value

<b>Criterion</b>	<b>0</b>	<b>0.25</b>	<b>0.50</b>	<b>0.75</b>	<b>1</b>
Accessibility (Eco <sub>1</sub> )	>1 km from a modernized road	<1 km from a modernized road	Local road	Regional road	National road
Presence of risks (Eco <sub>2</sub> )	Uncontrollable	Uncontrolled	Weakly controlled	Highly controlled	Risk-free
Number of visitors (Eco <sub>3</sub> )	<500	500-2000	2000-10000	10000-100000	>100000
Official level of protection (Eco <sub>4</sub> )	None	-	Limited	-	Total
Attraction (Eco <sub>5</sub> )	-	Local	Regional	National	International

The criteria were noted based on the values scale ranging between 0 and 1, and then four basic components for the touristic value were calculated [7, 6]:

1. Scientific value:  $V_{sci} = \frac{(St_1 + St_2 + 0.5xSt_3 + 0.5xSt_4 + St_5 + St_6)}{6}$ , where  $St_1, St_2, St_3, St_4, St_5$  and  $St_6$  correspond to the 6 criteria specific to this value. A weighing was introduced for  $St_3$  and  $St_4$ ; both of them assess rarity in comparison to the  $Sce_3$ .

2. Scenic value:  $V_{sce} = \frac{(Sce_1 + Sce_2 + Sce_3 + Sce_4 + Sce_5)}{5}$ , where  $Sce_1, Sce_2, Sce_3, Sce_4$  and  $Sce_5$  correspond to the 5 criteria specific to this value. The criteria are equal.

3. Cultural value:  $V_{cult} = \frac{(Cult_1 + Cult_2 + Cult_3 + Cult_4 + Cult_5)}{5}$ , where  $Cult_1, Cult_2, Cult_3, Cult_4$  and  $Cult_5$  correspond to the 5 criteria specific to this value.  $Cult_2$  may also assess the number of literary references, which are proportional to any iconographic material.

4. Economic value:  $V_{eco} = \frac{(Eco_1 + Eco_2 + Eco_3 + Eco_4 + Eco_5)}{5}$ , where  $Eco_1, Eco_2, Eco_3, Eco_4$  and  $Eco_5$  correspond to the 5 criteria specific to this value. The criteria are equal.

The touristic value represents the arithmetic mean of the values obtained by the four components:  $V_{tour} = \frac{(V_{sce} + V_{sci} + V_{cult} + V_{eco})}{4}$ , where:  $V_{tour}$  = touristic value,  $V_{sce}$  = scenic/aesthetic value,  $V_{sci}$  = scientific value,  $V_{cult}$  = cultural value,  $V_{eco}$  = economic value.

According to the genetic criterion, the geomorphosites of the Măcin Mountains have a geomorphologic nature. For each geomorphosite, a code comprising the letters TL (location of the geomorphosite within the administrative unit, meaning the Tulcea County), a geomorphic (geomorphologic) code and figures (which indicate the position on the map) (TLgeomorf1) were set (Fig. 3; Table 6).

**Table 6.** The main geomorphosites within the Măcin Mountains National Park (Măcin Mountains)

No	The geomorphosite	Code	Type
1	Măcin Mountains	TLgeomorf1	areal
2	Weathering	TLgeomorf2	areal
3	Granitic arena	TLgeomorf3	areal
4	Granite exfoliation	TLgeomorf4	areal
5	Stone blocks (granite)	TLgeomorf5	areal
6	Tor	TLgeomorf6	areal
7	Erratic block	TLgeomorf7	areal
8	Tafoni	TLgeomorf8	punctual
9	Inselberg	TLgeomorf9	punctual
10	Domed inselberg	TLgeomorf10	punctual
11	Pedimentation level	TLgeomorf11	punctual
12	Differential erosion	TLgeomorf12	areal
13	Papucul Doamnei	TLgeomorf13	punctual
14	Tor and agglomeration of stone blocks	TLgeomorf14	punctual
15	Erratic block with cleft	TLgeomorf15	punctual



**Fig. 3.** The crest of the Măcin Mountains, the oldest mountainous landform on the Romanian territory



**Fig. 4.** Granitic rocks of the Măcin Mountains:  
 a – Weathering, b - Constitution of the granitic arena, c - The exfoliation phenomenon

All the 15 geomorphosites have been assessed in order to determine their touristic potential (Figs. 5-10; Tables 7-11). All the geomorphosites are located on the territory of the Măcin Mountains National Park. It is worth mentioning that the entire Măcin massif is, in fact, a geomorphosite. Its fragmentation and the high landscape interest led to the distinction between several highly important geomorphosites from the touristic perspective.

**Table 7.** Assessment of the scientific value for the geomorphosites within the Măcin Mountains National Park

No	Geomorphosite	Scientific value						Total
		St <sub>1</sub>	St <sub>2</sub>	St <sub>3</sub>	St <sub>4</sub>	St <sub>5</sub>	St <sub>6</sub>	
1	Măcin Mountains	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	Weathering	0.75	0.75	0.50	0.50	1.00	0.50	0.66
3	Granitic arena	0.75	0.75	0.50	0.50	1.00	0.50	0.66
4	Granite exfoliation	1.00	1.00	0.50	1.00	1.00	1.00	0.92
5	Stone blocks (granite)	0.50	0.50	0.50	0.50	0.75	0.75	0.58
6	Tor	0.50	0.25	0.50	0.50	0.75	0.75	0.54
7	Erratic block	0.75	0.75	0.50	0.50	0.50	0.50	0.58
8	Tafoni	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	Inselberg	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	Domed inselberg	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	Pedimentation level	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	Differential erosion	0.50	0.50	0.50	0.50	1.00	0.75	0.62
13	Papucul Doamnei	1.00	0.25	1.00	1.00	1.00	1.00	0.88
14	Tor and agglomeration of stone blocks	0.50	0.25	0.50	0.50	0.75	0.75	0.54
15	Erratic block with cleft	0.50	0.50	0.50	0.50	0.75	0.75	0.58





Fig. 5. Stone blocks (granite) on the western slope of the Măcin Mountains

Table 8. Assessment of the scenic value for the geomorphosites within the Măcin Mountains National Park

No	Geomorphosite	Scenic value					Total
		Sce1	Sce2	Sce3	Sce4	Sce5	
1	Măcin Mountains	1.00	1.00	1.00	0.50	1.00	0.90
2	Weathering	0.00	0.25	0.25	0.00	1.00	0.30
3	Granitic arena	0.00	0.25	0.25	0.00	1.00	0.30
4	Granite exfoliation	0.50	0.50	0.25	0.25	1.00	0.50
5	Stone blocks (granite)	0.50	0.50	0.25	0.25	0.00	0.30
6	Tor	0.50	0.50	0.25	0.25	1.00	0.50
7	Erratic block	0.50	0.50	0.25	0.25	1.00	0.50
8	Tafoni	0.50	0.50	0.25	0.25	1.00	0.50
9	Inselberg	1.00	1.00	0.50	0.25	1.00	0.75
10	Domed inselberg	1.00	1.00	0.50	0.25	1.00	0.75
11	Pedimentation level	0.75	1.00	0.50	0.25	0.00	0.50
12	Differential erosion	0.50	0.50	0.25	0.25	0.00	0.30
13	Papucul Doamnei	0.50	0.50	0.25	0.25	1.00	0.50
14	Tor and agglomeration of stone blocks	0.50	0.50	0.25	0.25	0.00	0.30
15	Erratic block with cleft	0.50	0.50	0.25	0.25	0.00	0.30

Table 9. Assessment of the cultural values for the geomorphosites within the Măcin Mountains National Park

No	Geomorphosite	Cultural value					Total
		Cult1	Cult2	Cult3	Cult4	Cult5	
1	Măcin Mountains	1.00	0.00	1.00	0.75	1.00	0.75
2	Weathering	0.00	0.00	0.00	0.00	0.00	0.00
3	Granitic arena	0.00	0.00	0.00	0.00	0.00	0.00
4	Granite exfoliation	0.00	0.00	0.00	0.00	0.00	0.00
5	Stone blocks (granite)	0.00	0.00	0.00	0.00	0.00	0.00
6	Tor	0.00	0.00	0.00	0.00	0.00	0.00
7	Erratic block	0.00	0.00	0.00	0.00	0.00	0.00
8	Tafoni	0.00	0.00	0.00	0.00	0.00	0.00
9	Inselberg	0.00	0.00	0.00	0.00	0.00	0.00
10	Domed inselberg	0.00	0.00	0.00	0.00	0.00	0.00
11	Pedimentation level	0.00	0.00	0.00	0.00	0.00	0.00
12	Differential erosion	0.00	0.00	0.00	0.00	0.00	0.00
13	Papucul Doamnei	0.00	0.00	0.00	0.00	0.00	0.00
14	Tor and agglomeration of stone blocks	0.00	0.00	0.00	0.00	0.00	0.00
15	Erratic block with cleft	0.00	0.00	0.00	0.00	0.00	0.00



**Fig. 6.** The granite from the Măcin Mountains:  
 a - Tor on the Pricopanu crest, b - Erratic block or incipient *tafoni*, c - Constitution of *tafoni*



**Fig. 7.** Inselberg with pediment on Culmea Pricopanului and Domed inselberg on the Măcin Mountains

**Table 10.** Assessment of the economic value for the geomorphosites within the Măcin Mountains National Park

No	Geomorphosite	Economic value					Total
		Eco1	Eco2	Eco3	Eco4	Eco5	
1	Măcin Mountains	1.00	1.00	0.50	1.00	1.00	0.90
2	Weathering	0.00	0.25	0.25	1.00	0.75	0.45
3	Granitic arena	0.00	0.25	0.25	1.00	0.75	0.45
4	Granite exfoliation	0.00	0.25	0.25	1.00	0.75	0.45
5	Stone blocks (granite)	0.00	0.25	0.25	1.00	0.75	0.45
6	Tor	0.00	0.25	0.25	1.00	0.75	0.45
7	Erratic block	0.00	0.25	0.25	1.00	0.75	0.45
8	Tafoni	0.00	0.25	0.25	1.00	0.75	0.45
9	Inselberg	0.00	0.25	0.25	1.00	0.75	0.45
10	Domed inselberg	0.00	0.25	0.25	1.00	0.75	0.45
11	Pedimentation level	0.00	0.25	0.25	1.00	0.75	0.45
12	Differential erosion	0.00	0.25	0.25	1.00	0.75	0.45
13	Papucul Doamnei	0.00	0.25	0.25	1.00	0.75	0.45
14	Tor and agglomeration of stone blocks	0.00	0.25	0.25	1.00	0.75	0.45
15	Erratic block with cleft	0.00	0.25	0.25	1.00	0.75	0.45





Fig. 8. Pedimentation levels on the western slope of Culmea Pricopanului and differential erosion in the Măcin Mountains

Table 11. Assessment of the touristic value for the geomorphosites within the Măcin Mountains National Park

No	Geomorphosite	Scientific value	Scenic value	Cultural value	Economic value	Touristic value
1	Măcin Mountains	1.00	0.90	0.75	0.90	<b>0.89</b>
2	Weathering	0.66	0.30	0.00	0.45	0.35
3	Granitic arena	0.66	0.30	0.00	0.45	0.35
4	Granite exfoliation	0.92	0.50	0.00	0.45	<b>0.47</b>
5	Stone blocks (granite)	0.58	0.30	0.00	0.45	0.33
6	Tor	0.54	0.50	0.00	0.45	0.37
7	Erratic block	0.58	0.50	0.00	0.45	0.38
8	Tafoni	1.00	0.50	0.00	0.45	<b>0.49</b>
9	Inselberg	1.00	0.75	0.00	0.45	<b>0.55</b>
10	Domed inselberg	1.00	0.75	0.00	0.45	<b>0.55</b>
11	Pedimentation level	1.00	0.50	0.00	0.45	<b>0.49</b>
12	Differential erosion	0.62	0.30	0.00	0.45	0.34
13	Papucul Doamnei	0.88	0.50	0.00	0.45	0.46
14	Tor and gglomeration of stone blocks	0.54	0.30	0.00	0.45	0.32
15	Erratic block with cleft	0.58	0.30	0.00	0.45	0.33



Fig. 9. “Papucul Doamnei” as landform of the type “Babe” and Tor and agglomeration of stone blocks on the Măcin Mountains

It is worth mentioning that the distinct geomorphosite represented by the Măcin Mountains rated .89. This value – close to the ideal – makes the Măcin Mountains a highly important touristic attraction on the Romanian map. Unfortunately, its touristic promotion is very low and there are practically no touristic facilities. This is the oldest mountainous unit on the Romanian territory and the geomorphologic processes that occur on the surface create

unique landforms. The scientific value of the geomorphosite is maximal. In this location, the students of the geology and geography faculties perform their practical field training.

Among the inventoried geomorphosites worth mentioning are, the Granitic exfoliation area (0.47), the *Tafoni* (0.49), Inselbergs (0.55), Domed inselbergs (0.55) and the Pedimentation level (0.49). These are unique landforms on the Romanian territory and among the rarest in Europe. They can become the target of tourism for educated people.



Fig. 10. Erratic block with cleft on the Măcin Mountains

## Conclusions

The geomorphosites of the Măcin Mountains are among the most important on the national and on European level. The level of protection is high because they are located inside the Măcin Mountains National Park. The number of tourists is low because of the poor infrastructure. Perhaps this is precisely why they have been preserved so well.

They present a high scientific interest. For that reason, a significant number of students from the faculties of geology, geography, silviculture, biology, etc visit them annually. In the future, some geomorphosites may be affected by the nearby quarry exploitations (industrial or artisanal).

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