KARSTIC GEOMORPHOSITES WITH HIGH TOURISTIC VALUE IN MEHEDINȚI PLATEAU

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Abstract: In the Mehedinți Plateau area, there is a great number of karsts complexes, also named geomorphosites, created by the action of water in the massive calcareous rocks. Some of these, such as Izverna and Topolnita karsts complexes, are suitable to speleological tourism, cave diving, tourist and scientific explorations, underground and underwater photography and filming. Tourists come here from all over the world and this is a place where special camps for cave diving the fans are organized.

This study presents especially the types of geomorphosites generated by water, the touristic offer in this area and the analysis of indicators representing the global value of one of the main geomorphosites. This global value increased in particular due to their scientific, cultural and aesthetic values which makes them suitable to ecotourism. The economic value is also an important indicator for the touristic activities in Mehedinți Plateau.

Keywords: Mehedinți Plateau, water effects, karst, geomorphosites, speotourism, scientific value, cultural value, aesthetic value, economic value, ecotourism, cave diving.

Mehedinți Plateau is one of the smallest geographical area in Romania – 78.5 square kilometeres[1], situated deep in the heart of the Mehedinți County, South-West of Romania, near Serbia, between the Danube and the Motru rivers. This is one of the representative areas for the beauty and uniqueness of the karstic reliefs in Romania[2] even if limestone in its petrographic composition is less than 40%. In a percentage of 50-55%, Mehedinți Plateau is composed of metamorphic rocks (crystalline), the rest of the sedimentary rock and a very small percentage – granite.

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[1] *Apud* acad. Dan Bălteanu, *Pericarpathian Regions in Romania* IN: Romanian Academy, Institute of Geography, *Romania, Space, Society, Environment*, The Publishing House of The Romanian Academy, 2006, p. 72.

[2] M. Ielenicz, I. Săndulache, *România – podișuri și dealuri,* Bucharest, University Publishing House, 2008.

Water from precipitation and rivers has created, during in millions and thousands of years, amazing surface and underground geomorphologic forms in Mehedinți Plateau area. It is about hydrological breakdown in calcareous stratum where the processes of dissolution and precipitation are continuous. To these, in this area, there are also erosion processus, that generate numerous karstic forms[3].

There are caves, caverns, cavities, avens, whirlpools, sinkholes, uvalas, poljes[4] which were created by permanent or temporary water streams. The same happenes in the underground of the caves where the limestone dissolution creates some geological landscapes with unique shapes and colors. Stalactite and stalagmite forests, delta minerals, huge karst rooms, water depths, waterfalls, karstic lakes and all these offer spectacular images while the calcit crust covers sometimes geological, historical and cultural traces. But severe restrictions are imposed because most geomorphosites are protected by special laws. Underground wonders are complemented by those of the surface: karrenfields, gorges, natural karstic bridges, karst plateaus, permanent or temporary karstic lakes with impressive surfaces.

Karstic intermitent spring and water stream with mineral properties are also part of the entire landscape of the area situated deep in the limestone heart of the Mehedinți county.

This study underlines the link between the action of water on limestone, overground and underground karst landscapes resulting from this geomorphological action and tourism opportunities in the Mehedinți Plateau area.

Methodology

In the Mehedinți Plateau there are numerous geomorphosites resulting from the action of water on karst. It is about punctual objectives or areas (see *Table 1*). These natural attractions are more or less integrated in the tourist circuit.

I chose Izverna Cave as an exemple for geomorphosites of Mehedinți Plateau this one being one of the most famous international caves. I determined the global value of this objective using the Romanian method (Laura Comănescu, 2009; Mihai Ielenicz, Laura Comănescu, 2013)[5] concerning the assesment of the geomorphosites. So, based on four characteristics – scientific, aesthetic, cultural and economic –, subsumed under several criteria I assigned each a score between 0 and 1 (see *Table 2*). Data related to those features are included in the inventory sheet that describes these geomorphosites based on field data and a large

[3] Ion Pişota, Liliana Zaharia, Daniel Diaconu, *Hidrologie*, Bucharest, University Publishing House, 2010, pp. 195-196.

[4] Mihai Ielenicz, Alexandru Nedelea, Laura Comănescu, *Lexicon de Geomorfologie*, Bucharest, University Publishing House, 2013.

[5] Mihai Ielenicz, Laura Comănescu, *Turism, teorie și metodologie*, Bucharest, University Publishing House, 2013.

bibliography. The total average of the results obtained for each feature gave the total value of the Izverna Cave like a KAR (KARST) geomorphosite.

Table 1
The main KAR (Karst) geomorphosites from Mehedinți Plateau

No	Name	Code	Type
1.	Topolnita Complex	MHKAR1	area
2.	Topolnita Cave	MHKAR2	punctual
3.	Gaurinti Cave	MHKAR3	punctual
4.	The Aven from Prosacu Hill	MHKAR4	punctual
5.	Epuran Cave	MHKAR5	punctual
6.	Izverna Cave	MHKAR6	punctual
7.	Ponoarele Cave	MHKAR7	punctual
8.	Ponoarele Complex	MHKAR8	area
9.	Karren fields from Ponoare	MHKAR9	area
10.	The Great Zaton Lake	MHKAR10	punctual
11.	The Little Zaton Lake	MHKAR11	punctual
12.	God's Bridge	MHKAR12	punctual
13.	Băluței Gorge	MHKAR13	punctual
14.	Gramei Cave	MHKAR14	punctual
15.	Bulba Cave	MHKAR15	punctual
16.	Cerboanii Pinacle	MHKAR16	punctual
17.	Babelor Pinacle	MHKAR17	punctual
18.	Bălții Pinacle	MHKAR18	punctual
19.	Turcului Lake	MHKAR19	punctual
20.	Gornovița Lake	MHKAR20	punctual
21.	Balta Lake	MHKAR21	punctual

Fig. 1, 2. Zaton lake in different seasons (rainy season – Fig. 1, and dry season – Fig. 2).
Source: http://www.ponoare.ro/atractii/lacul-zaton.

Fig. 3. Karrenfields from Ponoare.
Source: http://cartitaplimbareata.ro/index.php/8395/podul-lui-dumnezeu-si-campul-de-lapiezuri-de-la-ponoarele-judetul-mehedinti/.

Touristic offer in the Mehedinți Plateau

For a better understanding of the analysis of these geomorphosites a brief presentation of the touristic offer in the Mehedinți Plateau is required.

Touristic offer in Mehedinți Plateau is very varied like in the entire Mehedinți County. The most common forms of tourism are the scientific tourism, eco-tourism, speotourism, balneary and cultural tourism (*See* Table 2).

Wonderful landscapes favors birdwatching and photo hunting activities. Especially in Mehedinți plateau, it is about overground and underground geological landscapes, underwater landscapes, wildlife photography and other beautiful views. All of these can be admired while hiking, on bike, from the boat or exploring the caves (with a special equipment and attendants in the flooded caves).

For a small number of tourists hunting is possible (except for full protected areas)[6]. Fishing is a leisure activity but also subject to strict protection rules but possible along The Danube river, inside Mehedinți Plateau along The Danube tributaries and in some natural lakes and also in the trout farms from Baia de Aramă (N–W of Mehedinți Plateau)[7].

Multiculturalism is specific to this county and in this area culinary tourism is the most popular. Serbian foods are well represented together with Romanian dishes. Romanian Wines and the vineyards from Mehedinți Area are also touristic attractions[8].

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[6] Mihaela Ioana Iamandei, *Turismul Cinegetic şi Turismul Piscicol în județul Mehedinți/ Cynegetic and Fishing Tourism in Mehedinți County*, Bucharest, University Publishing House, 2016.

[7] *Ibidem*.

[8] Elena Bogan, Mihaela Ioana Iamandei, *Romanian trout farms and wineries – successful touristic attractions IN International Journal of Academic Research in Environment and Geography*, 2016, vol. 3, issue 1, pp. 38-50, available at http://econpapers.repec.org/article/hurijareg/v_3a3_3ay_3a2016_3ai_3a1_3ap_3a38-50.htm.

Table 2

Touristic Offer in Mehedinți Plateau

No	Type of Tourism/ Tourism forms	Activities	Centers/Places/Sights
1.	Scientific tourism	Research activities regarding fauna, flora, geology, history, caving, etc.	in the whole area
2.	Eco-tourism	activities regarding fauna, flora, geology, history, caving, involving hiking, photohunting, birdwatching	Iron Gates Natural Park, Mehedinti Geopark Plateau[9], The Center and The North of Mehedinti Plateau
3.	Speotourism	Admiring the undergound of some caves, stalactites, stalagmites, bats, lakes, waterfalls, other specific landscapes	Topolnița Karst Complex; Izverna Cave; Ponoarele Cave; Epuran Cave
4.	Cave Diving	Exploring flooded caves	Isverna Cave
5.	Historic tourism	Visiting some historical places and their neighborhoods	Variuos historical sites regarding Romanian people Ceausescu Protocol House Ada-Kaleh viaduct (near former island)
6.	Religious tourism	Visiting some Ancient Romanian Churches	Vodița, Topolnița, St. Ana churches
7.	Cultural tourism	Visiting the tourist attractions in the largest cities, Attending festivals, various exhibitions, visiting museums, Meeting people, habits, culinary traditions	Drobeta Turnu Severin, Orșova, Baia de Aramă, Ponoare
8.	Balneary tourism	Spa, medical tourism	Bala baths (near Mehedinți Plateau, E) Herculane baths (near Mehedinți Plateau, W)
9.	Cycling	cycling touring, mountain-bike	Along the Danube border (European Road 70), on the roads among the hills and over the hills
10.	Hiking&climbing	Visits on certain routs, on the hills Climbing in some special places	South, North and in the Center of Mehedinți Plateau
11.	Culinary tourism	Tasting numerous Romanian dishes based on fish from the Danube River and also other culinary specific specialities. tasting Serbian and other international dishes	Drobeta Turnu Severin, Porțile de Fier I, Orșova, Baia de Aramă
12.	Fishing&hunting [10]	Fishing quietly or hunting with hunter's adrenaline to the maximum	On hunting funds, under the conditions required by the management of protected areas, the conditions of funds administrations and the most important the romanian laws regarding fishing and hunting and the regime of weapons and ammunitions
13.	Birdwatching, Photo hunting[11]	Surprising and Admiring landscapes - overground and underground geological landscapes, underwater landscapes, wildlife photography etc.	Along Danube River, From the Hills, in the caves, from the natural bridges (Ponoare), from different heights and different angles, near and in unique forests (Lilac Forest from Ponoare) Black Pine Forest (Borovăț forest)
14.	Nautical tourism	Kayak Canoe	Drobeta, Orșova
15.	Cruises on the Danube river	Boat trips and sailing	Orșova

[9] Monica Dumitrașcu, Dan Bălteanu, Mihaela Năstase, *Protected Areas in Romania* IN Invasive Terrestrial Plant Species in The Romanian Protected Areas, A geographical approach, EAR, 2016.

[10] Mihaela Ioana Iamandei, *Turismul Cinegetic și Turismul Piscicol în județul Mehedinți/Cynegetic and Fishing Tourism in Mehedinți County*, Bucharest, University Publishing House, 2016.

[11] *Ibidem*.

Dynamics of overnight stays in the Mehedinți Plateau area

Regarding the presence of the tourists in this area, an analysis for 2010-2015 period, based on INS data (National Institute for Statistical Data), show rich touristical flows, every year, in the summer and winter, especially in July, August, respectively December and January (Fig. 4, Fig. 5). Also, the average of data prove that Drobeta Turnu Severin, Orșova, Baia de Aramă and Bala were the most preferred locations for overnight stays. It is about four cities situated in the South (Drobeta Turnu Severin – SE, Orșova – SW), respectively in the North (Baia de Aramă and Bala – NE) of the Mehedinți County. In 2016, these tendencies were mantained. It is important to know that the tourists leave these locations for touristic destinations situated in the Heart of the Mehedinți County, in Mehedinți Plateau and also in The Iron Gates Natural Park or other natural protected areas wich are in the neighborhood of the Danube river[12].

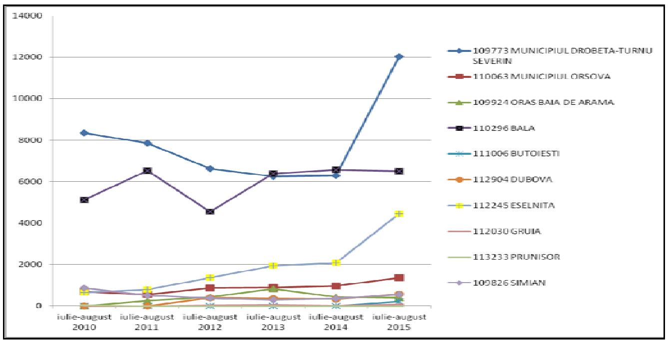

Fig. 4. Overnight stays in the summer (average, july+august) in the establishments of touristic reception with functions of touristic accomodation (Mehedinți County, 2010-2015).
Source: Personal processing based on INS data (National Institute for Statistical Data).

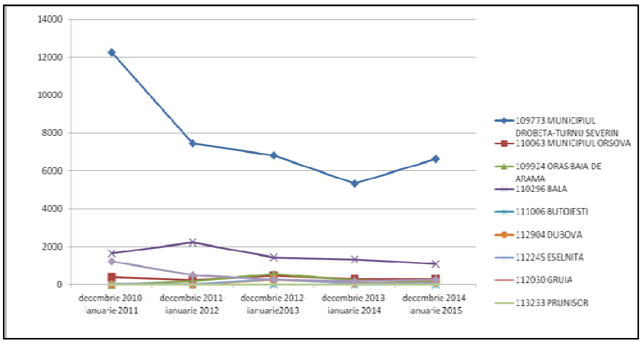

Fig. 5. Overnight stays in the winter (average, December+January) in the establishments of touristic reception with functions of touristic accomodation (Mehedinți County, 2010-2015).
Source: Personal processing based on INS data.

[12] For more information regarding touristical flows in Mehedinți County, see also Mihaela Ioana Iamandei*, op. cit.,* pp. 82-105.

STUDY CASE:

IZVERNA CAVE Geomorphosite

Izverna Cave is part of Mehedinți Plateau, a complex geomorphosite system (KAR), situated in Southwestern Romania next to Danube river. Izverna cave is located near the village Izverna, in Mehedinți Mountains at the altitude of 390 m. It is a cave of over 1.5 km long underground crossed by a stream. From underwater cave starts Izverna largest karst spring in Mehedinți county. But the cave is very difficult to explore because of drains, galleries and underground lakes.

Izverna is a speleological protected area, being one of the most famous caves in Europe for practicing underwater caving. There is very clear water from underground lakes that allows very good visibility underwater and in galleries, and makes it an ideal place for diving, underwater photography and filming.

This cave was filmed by Jacques Cousteau in the "Explorations of the twentieth century" a movie made for the Smithsonian Museum in Washington. Generally, Izverna lures with its depths, having the deepest siphons among Romanian caves, and these drains lead to many other galleries which are waiting to be discovered. At present time, Izverna has the longest network of galleries from Romania.

Izverna cave is very attractive also for treasure hunters because there are legends about their existence in its galleries[13].

Izverna cave was explored for the first time by the biospeleologist CN Ionescu till a length of 200 meters and in 1914 he published a description of this part. During the years 1964-1967, many biospeleological researches were made, and in 1973, a plan of the cave was devised and published in 1976[14].

In 1979, a team of speleologists remapped the cave, discovering new galleries, leading to the actual length of 1500 m. In the same year and next year, explorations carried out by different speleologists started and they passed through the "Green siphon" at a length of 50 meters; then they discovered "Yellow siphon", which is much shorter. Then, the passage of "Black siphon" was discovered, the largest in Romania, with over 400 m in length and a negative form of 40 m[15].

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[13] For details, see https://www.speologie.org/Izverna.

[14] T. Orghidan, Șt. Negrea, Gh. Racoviță, C. Lascu, *Peșteri din România*, Bucharest, Sport Turism Publishing, 1984, pp. 345-348.

[15] *Ibidem*.

Fig. 6. Scientists exploring Izverna Cave.
Source: http://www.skytrip.ro/pestera-izverna-din-judetul-mehedinti-ob-3039.html.

Experts say that the water coming out of the cave has some special mineral qualities that are maintained, and available for more than a year. For this reason, the Izverna river, crossing Izverna cave, is supplying drinking water to Izverna town, and now three more villages are prepared to get water from the same source.

In this cave, in summer, the average temperature is 8ºC.

At present, Izverna Cave has numerous unexplored siphons and wells being a true undergound labyrinth flooded or inactive.

It is one of the scientific objectives representative for Mehedinti Plateau, of palaeogeographical interest, helping to decipher the evolution of the whole area. Due to its very high aesthetic value, Isverna Cave has the advantage of a positive perception from both researchers and tourist speleologists. It is part of the natural heritage, and also has a cultural value due to significant traces of ancient humanization which are being discovered here. At the same time, due to esthetic value, the cave is valued in speleotourism, which is a tourism branch niche, and it can be a source of income. The economic value is high enough, though there is a small number of tourists (≤ 1000 / year). Yet, the specific costs for equipments and guiding activity are high.

Fig. 7. Bats colonies on limestone. **Fig. 8.** Bat sleeping on the cave wall (detail).
Source: http://surprising-romania.blogspot.ro/2011/01/isverna-cave.html.

Izverna Cave is integrated in a speleological and botanical reservation, with its numerous rare species, including the mottled tulip (*Fritillaria meleagris*), to which are added the horned viper (*Vipera ammodytes*), the Hermann's Tortoise (*Testudo Hermanni*) and the colonies of bats (Fig. 7, Fig. 8)[16].

Table 3
Global value of Izverna Cave as a geomorphosite

Value Type	Score 1	Score 2	Score 3	Score 4	Score 5	Score 6	Total (average-sum)
Scientific	1	0.50	0.50	0.75	0.75	1	1
Aesthetic	0.75	1	1	0.25	0.75	–	0.75
Historical-Cultural	1	1	1	0.25	1	–	0.85
Economic	0.50	0.50	0	0.50	1	–	0.5
TGV							**0.775**

The global value obtained for Izverna Cave geomorphosite is very high (*see* Table 3), above average, which is very good for a scientific and touristic objectiv. This cave has very high global value due to karst topography modelled by undergroundwater and surface water. This global value is one of a geomorphosite with a regional, national and international importance.

The highest value is the scientific value, then cultural and historical value followed by the aesthetic value and after all, economic value. Economic value is the lowest because of low accessibility. The galleries of this cave is flooded and requires special equipment, training and special permits for cave diving. This value could be increased by using better facilities to access this scientific objective and tourist attractions.

[16] Răzvan Stroe, Daniel Peptenatu, *Dicționar Geografic al Județului Mehedinți*, Craiova, Scrisul Românesc Foundation, 2011.

Conclusion

Mehedinti Plateau includes numerous geomorphosites with a high global value, each of them being of international, scientific and touristic interest. All these geomorphosites analyzed here have common geological features but are unique in the general landscape of the Mehedinți Plateau. Besides their aesthetic value, all of them, including Isverna Cave (one of the most representative) have scientifc, cultural and economic value due to their natural resources.

Using them in tourism as attractions needs special protection and conservation measures due to the increased fragility of the components, as the calcareous relief is still a perishable resource. It requires the protection of stalagmites and stalactites, and the ecosystems they grow in, for example the ones in which rare bat colonies live. Water protection is necessary even more because the villages in the area, involved in rural tourism activities, are fed by springs that pass through these geomorphosites.