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## GEOECOLOGICAL EVALUATION OF THE ORLOVAČA CAVE

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### ABSTRACT

Speleological tourism in the world has a long tradition. The environment of the karst underground has long attracted nature lovers, various researchers and tourists. Orlovača cave is one of the largest and most beautiful cave systems in Bosnia and Herzegovina and Republic of Srpska. Accordingly, in order to evaluate the tourist values of this locality, geoeological evaluation is applied by method of recreational potential and appraisal. The results should indicate the importance of cave tourism on the domestic and international markets, as well as preserving the environment in locality.

Keywords: *geoeological evaluation, Orlovača cave, tourism, environment*

### INTRODUCTION

Orlovača cave (948m) is situated on the hill (1.056m) in the western part of the Romanija mountain in the basin Mokranjska Miljacka river, respectively, in the valley of its right tributary of Sinjava. It is located in the eastern part of the Republic of Srpska along the main road Sarajevo-Pale-Sokolac and it is easily accessible. The nearest urban centers are Sarajevo and Pale (15km and 10km), which characterize the cave as zone of recreational trips these urban centers. Favorable geographical location of the cave is determined by the proximity of the famous mountain resort called Jahorina. The cave location is defined by spatial relationship to dispersive zones, other tourist values in close environment and relationship to the existing transportation infrastructure, so we can conclude that this is a very favorable tourist position. Favorable geographical location of the cave is determined by the proximity of the famous mountain resort called Jahorina.

Geological structure of the wide area of Orlovača cave belongs to the structural facial unit of Romania-Pracha-Jahorina with different composition and age of rocks. Within the limestone mass of the cave prevail massive and bedded, sailing and compact, light gray and gray, sometimes ruddy cleavage limestone. This area has two morphological units, which are essentially determined morphogenetic characteristics of the cave. They are Orlovača hill with developed speleological facility and Sinjava stream, which flows at the foot of the hill [1,2,3].

Hydrologic framework of exploring area is Sinjava river. There are two strong springs bringing water into Sinjava river. They stand out from the stone passages below the opening of a small cave and from the entrance of the first researchers ie. from the southwestern part of the Orlovača hill on the right side

of the valley. Water regime of the Sinjava hydrological system is characterized by high amplitude between the minimum and maximum water level, which is the main characteristic of karst streams [4].

The convenience of this area is reflected in the fact, that climate of this area is taken as a stimulating factor for the development of tourism. Minimum monthly average air temperature in the study area occur in January (-4.2°C). They are negative in February and December, while the two hottest months July and August (16.4°C). Stable microclimate inside the cave allow comfortable tour during the year.

Air temperature and humidity are measured in different parts of the cave by digital device Huger on 2 meters high. It was determined that in deeper part of the cave, values of temperature and humidity are almost uniform. Air temperature is 8.8°C and relative humidity is 90% [4], Table 1.

Table 1 The values of air temperature (°C) and relative humidity of air (%) in the cave

Place of measurement	t°C	f%
The entrance hall	20,3	42
Hermitage	10,6	72
Elephant hall	9,2	80
Thermopylae pass	9,1	88
Romanija	8,8	90
amplitude	11,5	48

Source: (Pecelj M, and group of authors, 2006, 34).

The microclimate of the cave is characterized by a small range of air temperature and relative humidity. The main characteristic of uniformity of climatic elements is branched and complex cave systems, where sufficient depth is achieved and there is no outside influences.

## BIOSPELEOLOGICAL CHARACTERISTICS

Biospeleological features of the cave system is characterized by a variety of different groundwater biotope diversity and living community that inhabit them. The cave is home to a large number of endemic species of cave fauna, which are known as troglobiont fauna. Orlovaca cave, as well as other caves of the Dinaric Alps, is characterized by a number groups of insects from the order *Coleoptera* (beetles). The most represented families are *Carabidae* and *Cholevidae*, red *Colembolla* (wingless) and order *Diptera* (flies).

Biospeleological explorations, [5,6] found more species of living organisms, which were analyzed at the Faculty of Biology in Belgrade, where he made redescription species *Charonites orlovacensis Reitter* and brought forward new information on taxonomic and ecological characteristics of this taxon that has been scientifically verified as currently troglobiont most significant caves, which is by far the largest contribution to the scientific knowledge of new species of subterranean fauna Orlovaca [4]. After in-depth research and detailed laboratory analyzes that were conducted in the Faculty of Biology, just nine years later, they finally found the relevant individuals, so the 2012th years, defined a new species and a new genus *Puncto Charonites orlovancesis*, which is for now, the most important species are considered endemic species known cave Orlovača [6] . Besides insect fauna of the cave and make a spider (*Chelicerata*), millipedes (*Uniramia*), as a special group *Arthropoda* (at various locations in the cave, about 100 meters from the entrance, and usually on the walls of the cave and jewelry), there is a very unusual type of centipede, which is considered to be perhaps a new species, according to which the caves represent a unique site). This caving facility is endangered habitat groups of mammals in Europe, which is endemic entemofauni-Blind (microc hipoptrea), and tourist visits to the cave should be carefully arranged.

Morphological characteristics of the cave system is a complex combination of branched channels in multiple levels that reflect different stages of development. According to Pecelj, inside cave system is

allocated more levels with the following sub-units: the entrance and the main channel (consisting of an entrance hall, dragon's lair, Hermitage Hall, lighthouse channel, Elephant eye hall, and pass of Thermopylae and Romanija), Gallery hall, channels of the lower level with an underground Sinjava river, Sinjava river source and Small cave [4]. The cave has a rich and varied cave ornaments: stalactites, stalagmites, halaktitima, cave pillars, draperies.

The cave is decorated for tourists to a depth of about 650 m. From the entrance several hall are arranged: Entrance hall; Dragon's lair; Crocodile hall; Hermitage hall (at the end of this hall, there is a group of the most beautiful decorations in the cave-the cave gallery columns); Lighthouse passage, Elephant hall (one of the most important decorations of this hall is symbol of the Orlovača cave, the Olympic Flame-shows the inverted form of the Olympic torch that symbolizes the eternal flame); pass of Thermopylae (which is the most beautiful waterfall of the Orlovača cave - Niagara Falls) Romanija hall (the central hall of the cave, which gives the appearance of a beautiful stone theater) and Gallery hall.

### GEOECOLOGICAL EVALUATION

To make geoecological evaluation of the Orlovača cave, two methods were used: recreation potential index and appraisal method. Method of recreational potential index is based on geological, geomorphological, hydrological and hydro-geological data, collected during the years of speleological exploration. The purpose is determining cave benefits for tourism purposes. Based on Buzjakov criteria for geoecological evaluation caves for tourism, the scoring of the Orlovača cave is committed [7], Table 2. With 135 points and score 10, Orlovača cave belongs to one of the most valuable part of the landscape.

Table 2 Evaluation results of the cave

starting points 100			appraisal category
physical characteristics	length	10	
	morphology	10	
aesthetic, scientific and educational value	size	0	
	other	5	
tolerable capacity		0	
patency		10	
availability	distance from the road	-10	
	slope	5	
	access	5	
final score 135			

Appraisal method is determined by the evaluation of the physical characteristics, aesthetic, scientific and educational value, carrying capacity, mobility and availability. Orlovača cave has appraisal category values of 135 points and its considered as the most valuable parts of the relief. According to the physical benefits, the cave branched and tier. Based on the visitors survey and impressions they left, there are some aesthetic value. As a general measure of aesthetic value is selected travertine wealth.

The aesthetic value is complement with other interesting phenomena such as microrelief forms, sediments, rocks, paleontological findings, fossils, biodiversity, and archaeological artifact. Tolerable capacity of the cave is determined by the model of cave division on the energy levels. Orlovača is a medium energy level. When it comes to evaluating mobility, it is easy to walkable. When it comes to evaluating the availability, it could be regarded as very accessible cave whose slope is less than 5%. Based on the applied evaluation, it could be concluded that the Orlovača cave is suitable for classic and adventure speleological tourism, as well as for recreational speleology.

### THE AESTHETIC VALUE OF THE ORLOVAČA CAVE

Orlovača cave is a natural monument, a gem located in the hamlet of Lower Sinjevo near Sumbulovac in Pale Municipality, the eastern part of the Republic of Srpska, Figure 1. The ambiance of the surrounding landscape of the cave, the process of its creation, and the wealth of the cave ornaments and in many ways unique beauty, are her special aesthetic characteristics, and therefore interesting target of tourist interest. Landscape and environmental values of the cave is highly ranked, despite the subjectivity of experience, leave reviews of beauty of nature.

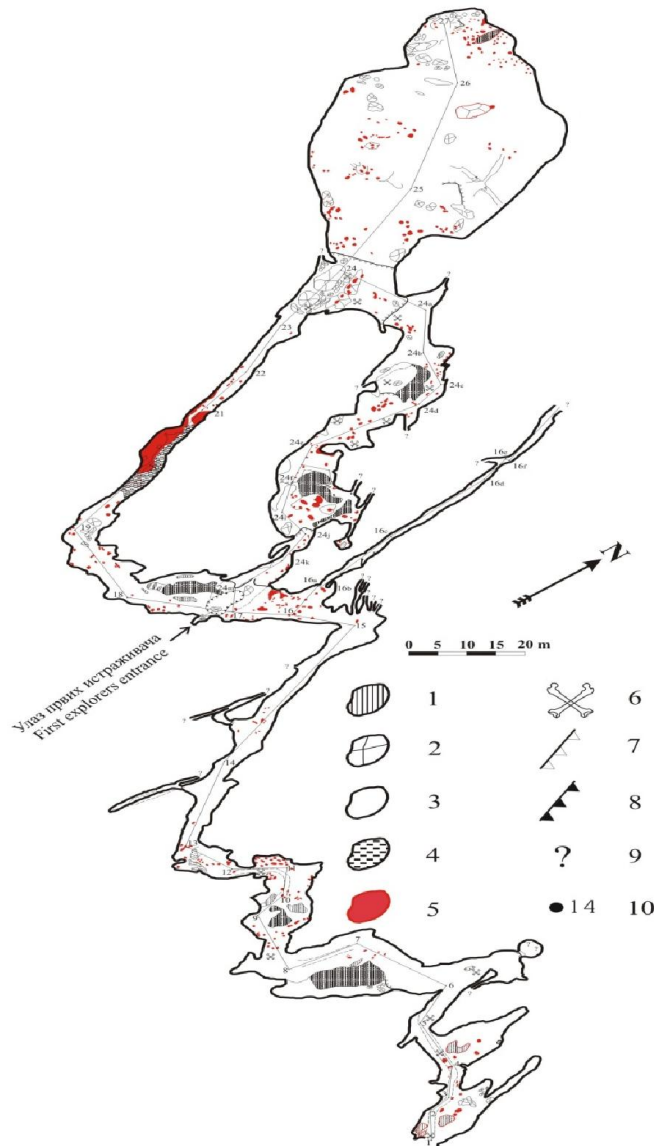
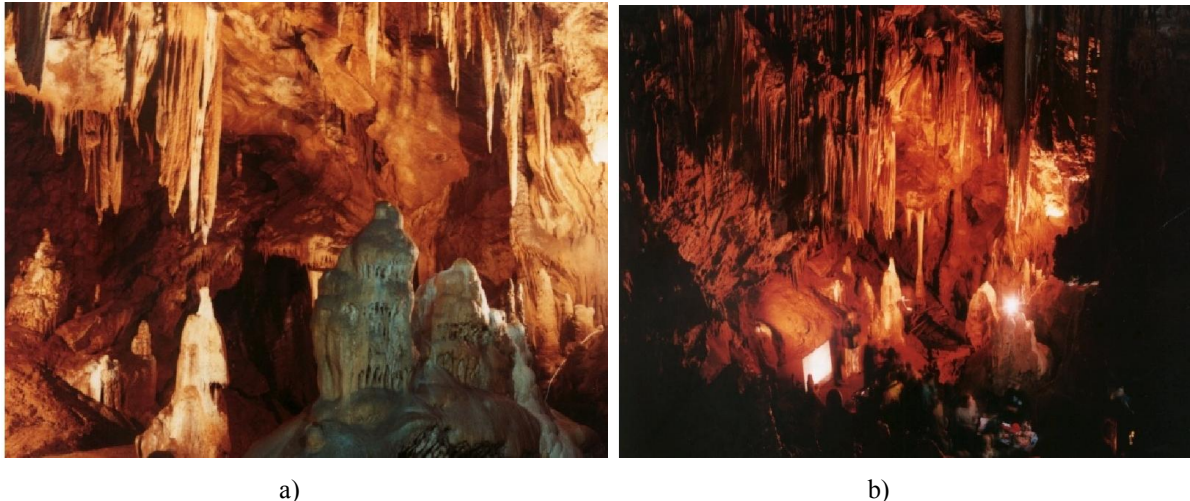


Figure 1 Detailed sketch of touristic part of the Orlovača cave - Source: Pecelj M, and group of authors, 2006  
 1. rock, 2. blocks, 3. permanent pond, 4. ephemeral pond, 5. speleothems, 6. paleothological findings, 7. bluff, 8. bluff possible climb only with speleological equipment, 9. uninvestigated parts, 10. measurement points

These values are based on the exceptional landscape diversity and, for now, undisturbed landscape character effects of economic activity [8]. The cave ornaments represent extraordinary wealth that has been created for millions of years. It is a unique piece of cave ornaments, natural beauty, where the stalagmites and stalactites interspersed with fragments of coral and aragonite ornaments and unique cave columns, reminiscent of antique and Renaissance castles and monuments of different colors, Figure 2.



a) b)  
Figure 2 The interior of the cave Orlovaca - Source: Pecelj M, and group of authors, 2006  
a) speleothems in Romanija chamber, b) Galerija and Romanija chambers

The aesthetic value of this object enhancing and enriching beautiful draperies provide the perfect ambience design. Basins of different sizes filled with water, provide a complete inventory of the cave ornaments. In addition to the cave ornaments, special tourist motive in caves are underground streams, rivers, lakes, rare forms of cave flora. For these reasons, Orlovača cave is one of the largest and most beautiful cave system in Bosnia and Herzegovina and Republic of Srpska.

#### ADVANTAGES AND DISADVANTAGES ORLOVAČA CAVES AND ITS IMPACT ON TOURISM DEVELOPMENT AND ENVIRONMENT PROTECTION

Advantage of geographical position of the cave lies in the fact that in its immediate vicinity has two important emissive centers, Sarajevo and Pale, Jahorina resort and Romanija mountain are natural resources, which are characterized by the beauty of nature. Romania as an area with a variety of animal species is interesting for hunting, with excellent hunting places related with regional and forest roads and hunting lodges. It is suitable for paragliding and more peaceful forms of recreation. The beauty of the environment, clean air and proximity to ski slopes of the Jahorina resort is natural predisposition for creating an integrated tourist offer. Orlovača cave was declared as a natural monument of 2011. Based on the inventory of the geological heritage of Serbian property, Orlovača cave is objektat of geological heritage important for Balkan and it was nominated for the verification of the European Association for the Conservation of Geocological Heritage-ProGEO [1,9,10]. Orlovača environment has relatively small area of surrounding caves that offers a possibility of its unification interesting as tourist spots.

For tourists, the most interesting would be to connect Orlovaca cave with a cave at the source of Mokranjska Miljacka, which was officially declared as the longest cave in the Republic of Srpska. The cave at the source Mokranjska Miljacka provides opportunities for development of extreme adventure tourism, while Orlovača cave offers unique cave inventory. Other caves that offer connectivity to Orlovača cave are also Small caves, such as Vasa's cave and Round cave.

Cultural and historical heritage of this area contains a wide range of both religious and traditional folk motifs. Those are Monastery of St. George on Ravna Romanija and Monastery Knežina. As a key element and necessary measures of development, it implies touristic development and promotion of tradition and authenticity of the cave and surrounding rural and mountainous region. Also, providing conditions for development and training for existing and potential participants in the tourism development of this area. The main limiting factor of a more organized tourism development and visiting is total accommodation capacity in the municipality of Pale, about 3,500 beds, which is considered insufficient for massive tourism development in the region and providing quality and

adequate tourism services. Also, unstable geopolitical situation in the European touristic market - refers primarily to the bad image created as a result of the war in this region during 90's, as well as the economic crisis.

Better and more aggressive marketing activities and good personnel resources could improve position of the site on tourist map of the Republic of Srpska and contribute to the development of the speleological tourism in this area. A new wooden houses and mills, as well as the seat of location points and guiding services will contribute increase of tourist traffic to this site, which is currently based mainly on an organized excursion tourism (students excursions).

## CONCLUSIONS

Orlovača cave is declared as an unusual speleological site recorded as natural landmark in 2011. This cave offer unique experience and recommended for everyone. According to geoecological evaluation of Orlovača cave, it has been found that is the site of the most valuable parts of the landscape. Therefore, it should be properly agree on goals of this study with possibilities that cave offers. Taking into account the importance of environmental protecting and its proper use for tourism purposes, it could be achieved multiple positive effects, and general well-being, primarily for the local population, and than for the country. Orlovača cave is actually a very important natural resources still insufficiently exploited for tourism.

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