

Conservation of Geomorphological Heritage in the Homolje Area (Eastern Serbia) - Current State and Perspectives

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Abstract

Homolje is one of the most developed geomorphological areas in Eastern Serbia. Shallow karsts prevail across this region with cover vegetation and soil, with developed surfaces, and underground karst landforms. This type of terrain leads to the occurrence of different geomorphological landforms that stand out from the rest, primarily for their scientific, aesthetic and ecological value, uses, and tourism potential. Gorges can be singled out as the largest geosites, then uvalas, caves, karst bridges, and tufa accumulations. Two are on the National list of geoheritage of Serbia as protected natural monuments. As geoheritage protects only authentic and representative landforms, the main task of this paper is to point out the most significant measures to improve the unsatisfactory current state of geomorphosites of the Homolje area and possible solutions for their conservation, adequate use and better tourism promotion. This paper presents a review of geomorphological heritage in this region of Serbia with a focus on its conservation.

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Introduction

Relief can represent the scientific and cultural heritage of territory, the same significance as a famous historical monument or work of art (Ilieş & Josan 2009). Relief can emphasize the historical, cultural, or spiritual value of a site. Sometimes, not so spectacular landscapes can be a very attractive and integral part of the historical or cultural heritage, such as carved figures of kings in the rock (the face of Decebalus the king of Dacia on the Romanian side of the Đerdap gorge) or religious buildings lo-

cated high in the rock (the Monastery of Ostrog in Montenegro) or fortresses in river valleys (fortress of Ramesses II in the Nile River valley) (Miljković 2018). These examples, and many others, are a symbol of longevity, indestructibility and tenacity, precisely because of the material from which or in which they are built, such as the position, which has withstood the test of time.

In Serbia, objects of geomorphological heritage (geomorphosites) have been developed in all tectonic units, mostly in karst areas. The Institute for Nature Conservation of Serbia has so far protected around 80 geosites; of these, 53 geosites of geomorphological character (Miljković 2018).

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Although Homolje represents the area of very attractive hydrological values, including unpolluted watercourses, waterfalls, thermal springs, karsts and intermittent springs, the main focus of this study are geomorphosites. This relatively small area is characterized by mostly karst landscapes, with mountain ranges, gorges, basins, uvalas, karst bridges, caves and tufa accumulations (Miljković 2018). These landforms with high scientific and aesthetic values are not rationally used and have not been sufficiently recognized in Serbia (Miljković 2018). Some of them are very vulnerable, exposed to natural and anthropogenic influences, which is why their adequate conservation and preservation should not only be the concern of individuals but of the entire country. 'Well managed and accessible geomorphosites are important to both science and society, for research, education, and, in some cases, for recreation' (Prosser *et al.* 2011, 337). This arti-

cle presents a review of prominent geomorphosites in this region of Serbia with a focus on its current states, problems, and perspectives for potential conservation.

Description of the Study Area

The Homolje area is located in Eastern Serbia and is bounded by mountain ranges, the Homoljske Mountains (940 m) to the north, Beljanica Mountain (1,339 m) to the south, Crni Vrh Mountain (1,043 m) to the east, and the Gornjačke Mountains (825 m) to the west (Fig. 1). The surface of the Homolje area is 760 km² and has the appearance of an irregular rectangle in an E-SE – W-NW direction, approximately 35 km in length and maximum width is 26 km (Miljković 1992).

The Homolje area is characterized by geological units from the oldest Precambrian to the youngest

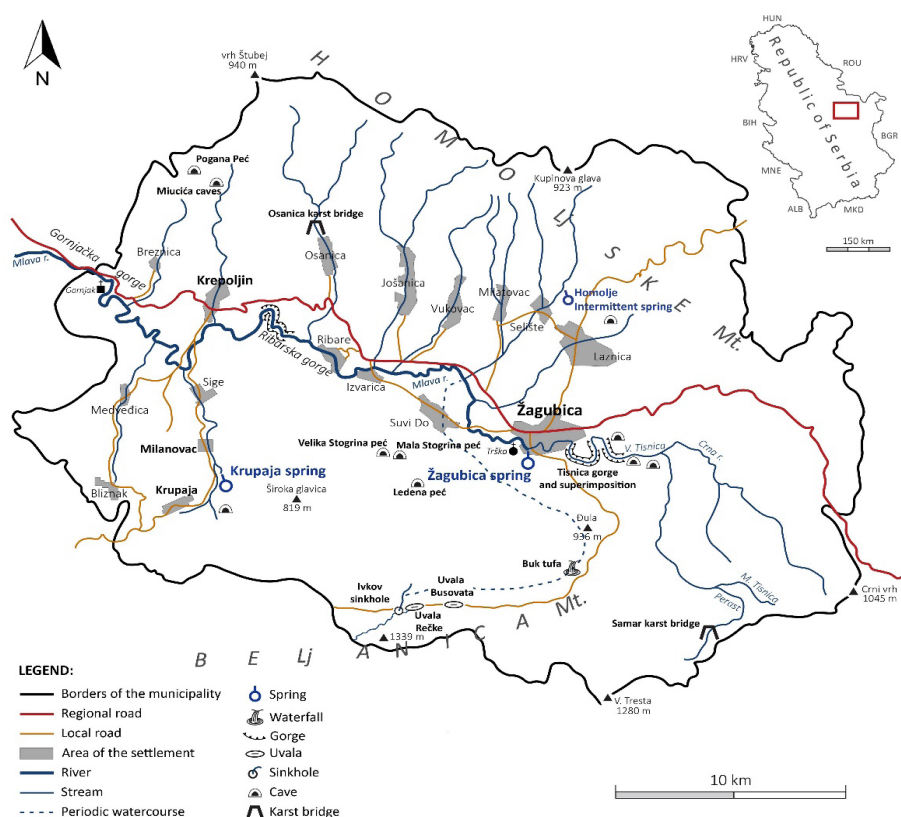


Figure 1. Location of the main geoheritage sites in the Homolje area (Eastern Serbia), following Miljković *et al.* (2018)

Quaternary, but geological formations of Mesozoic age cover the largest area (Antonijević *et al.* 1970; Miljković 1992). The oldest rocks are crystalline schists, gneisses, and gabbros (Antonijević *et al.* 1970; Miljković 1992). Younger Palaeozoic rocks of the Homolje area include granitic rocks and Permian red sandstones. The Beljanica Mountain structure is dominated by Cretaceous and Jurassic rocks where Gornjačke Mountains Triassic and Jurassic formations prevail, while in the Homoljske Mountains minor groups of Jurassic and Cretaceous sediments are also present (Antonijević *et al.* 1970; Miljković 1992). Paleogene igneous rocks (dacite-andesite rocks, volcanites) and Neogene sediments (sandstones, sands, claystones, marlstones, breccias, conglomerates, gravels, and coal deposits) have large distributions across the Homolje area (Antonijević *et al.* 1970; Miljković 1992). Quaternary sediments occur in the form of alluvial deposits and tuffs (Antonijević *et al.* 1970; Miljković 1992).

Landforms formed by fluvial and karst processes are the most development in the Homolje area. The most impressive landforms of fluvial relief are gorges, which in some places have the character of

canyons, such as Gornjačka Gorge, Ribarska Gorge, Tisnica River Gorge, Do River Gorge, Osanička River Gorge, and others. These are mainly epigenetic in origin (Miljković 1992; Miljković 2018). Surface karst landforms are represented by limestone pavements (clints and grikes), sinkholes, uvalas, and karst valleys. The most common and well-developed underground karst landforms occur on Beljanica Mountain. The second area where a large number of caves were discovered is in the southern slopes of the Homoljske Mountains (Miljković 2018).

Geomorphosites of the Study Area

The objects of this paper are ten geomorphosites within the Homolje area, two of which are on the National List of the geoheritage of Serbia, the Osanička River Gorge with karst bridge and the Samar Karst Bridge (Table 1). The remaining 8 geosites have priority in the future protection of the Homolje area's geoheritage (Table 2). Gorges can be singled out as the largest geomorphological phenomena, followed by uvalas, caves, karst bridges, and tufa accumulation as the smallest ones.

Table 1. List of protected geomorphosites in the Homolje area

Mark	Protected geomorphosites	Description
GS ₁	The Osanička River Gorge with karst bridge	The gorge represents a landform formed by fluvial and karst processes. It extends generally in a N-NW – S-SE direction for approximately 1.5 km and it is epigenetic in origin. This is a habitat for 166 plant species (Miljković 2018). A karst bridge (18 m long) is located in the narrowest part of the Osanička River Gorge (Fig. 1). The height of the stone arch measured from the bottom of the river bed varies between 0.9 m and 3 m. It has a height of 2.8 m at the entrance of the karst bridge, 3 m at the exit, and 0.9 m in the central part (Miljković 1984). This geosite is protected since 1979 as a Nature Monument and has an area of 30.44 ha (Miljković 1984; Miljković 2018).
GS ₂	Samar Karst Bridge	Located in the southeastern part of the Homolje area, on the Perast River, which flows into the Mala Tisnica River (Fig. 1). Represents an impressive natural stone bridge in Jurassic limestones that can be reached with difficulties, through numerous smaller waterfalls, steep sections and sinking streams (Fig. 3B). According to recent measurements, the Samar Karst Bridge has a length of 6 m, an opening height of 15 m, and a width of 12 m (Petrović & Carević 2015). The total height of the stone bridge is 24 m because the arch itself is 5-10 m high (Petrović & Carević 2015; Miljković 2018). Samar Karst Bridge is a protected Geomorphological Nature Monument since 1979, on an area of 40.20 ha (Miljković 2018).

Gorges here are epigenetic, with very steep slopes in some sections. They have not yet been fully researched, only a few authors had investigated it (Dragašević 1876; Karić 1887; Cvijić 1889; Paunković 1935; Lutovac 1954; Milić 1977; Miljković 1983, 1984, 1985, 1992; Miljković 2018). There are four uvalas in the Homolje area, and for the protection are proposed two of them. In the highest parts

of Beljanica Mountain are the Uvala Rečke and the Uvala Busovata (Fig. 1). Special attention was dedicated to the uvalas in the karst terrain of Beljanica Mountain by several scientists (Cvijić 1893; Lazić 1929, 1948; Petrović 1954b, 1974; Gavrilović 1965, 1976), who considered them as geomorphological and hydrological curiosities.

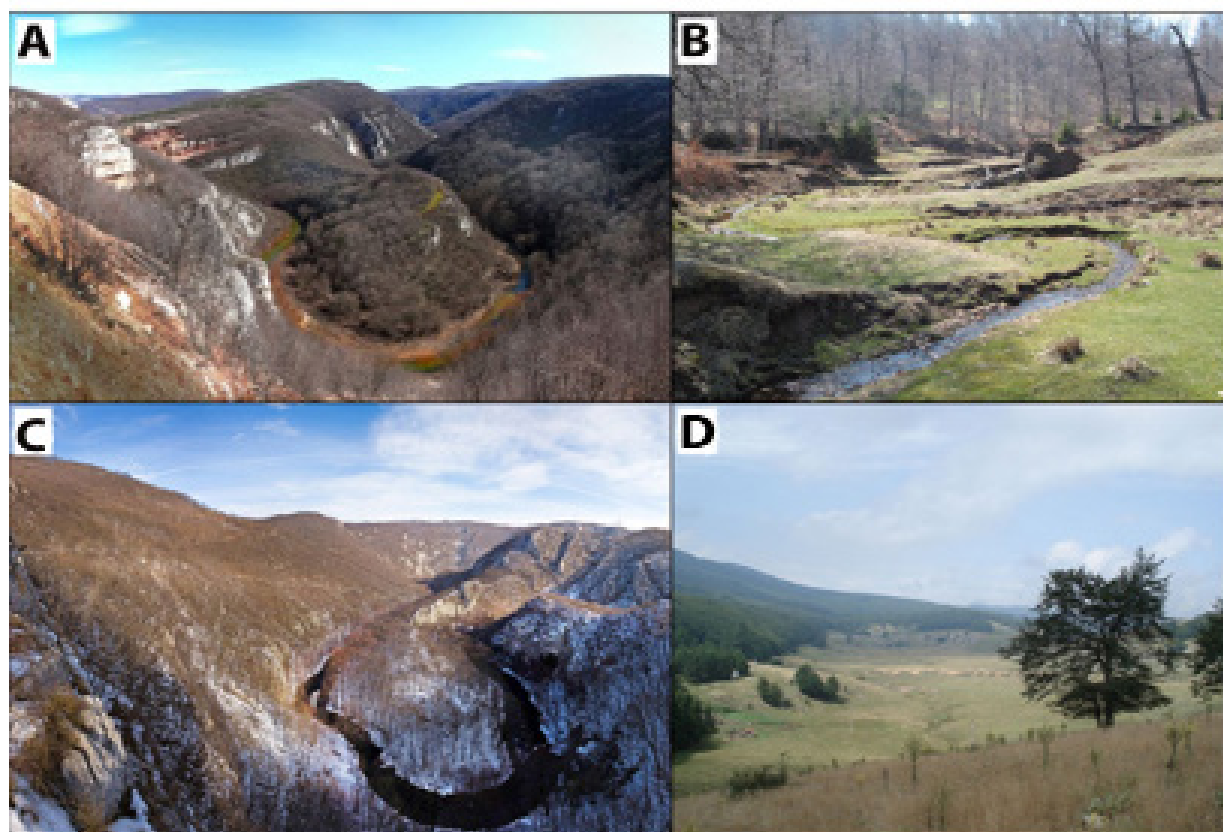


Figure 2. Gorges and uvalas of the Homolje area: A) Pronounced meander of the Tisnica River Gorge, B) The sinking stream in the Uvala Rečke, C) Pronounced meander of the Ribarska Gorge, D) Landscape of the Uvala Busovata

Caves are represented in the limestone terrain of the Homolje area in large numbers, from those with simple gallery to highly developed cave systems. Over 50 caves have been fully or partially explored, many of which have great tourist potential but still without necessary recognition in Serbia (Pogana Peć Cave, Velika and Mala Stogrina Peć Cave, Ledena Peć Cave and others).

Karst bridges or natural arches represent true nat-

ural rarities in relief and usually are protected as geoheritage, formed by fluvial and karst erosion (Gavrilović 1998; Petrović & Carević 2015). In Serbia, a few karst bridges are known and explored, and even two are located in the Homolje area. Tufa accumulations are the significant indicator of paleogeography, vegetation cover and geomorphological process in the past. Tufa deposits in the Homolje area are mostly Holocene ages (Gavrilović 1992).

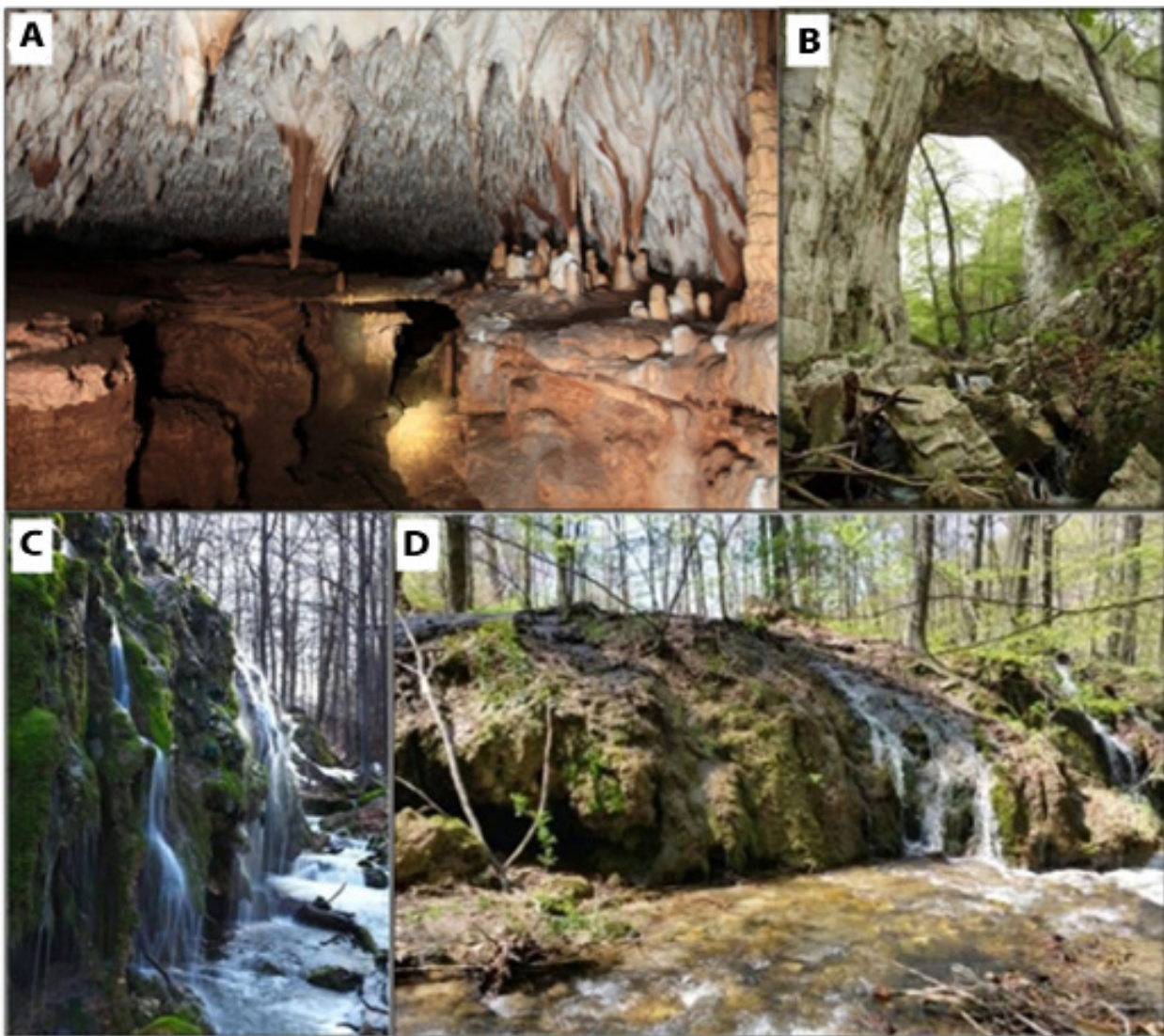


Figure 3. Cave, karst bridge and tufa accumulations of the Homolje area: A) Cave formations of the Pogana Peć Cave, B) Samar Karst Bridge, C) Upper tufa accumulation by the Buk spring, D) Lower tufa accumulation by the Perast River

Since geoheritage protects only authentic and representative landforms, the main task of this paper is to point out the most significant measures to improve the unsatisfactory current state of geomorphosites of the Homolje area and possible solutions for their conservation, adequate use and better tourism promotion.

Conservation of the Geomorphosites of the Homolje Area

As mentioned, only two geomorphosites of the Homolje area, the Osanička River Gorge with karst bridge and the Samar Karst Bridge, are under pro-

tection. According to the Nature Conservation Act (“Official Gazette of the Republic of Serbia”, No. 36/2009, 88/2010, 14/2016 and 95/2018), they belong to III category of protection, as a natural monument, which means an area of international, national and exceptional importance.

Each protected area also has a regime of protection (I degree, II degree and/or III degree). The regime of protection is established in dependence on the natural values of the geosites, and following the appropriate measures are regulated for given space, indicating which activities are allowed in the area,

Table 2. List of proposed geomorphosites for protection of the Homolje area

Mark	Geomorphosites proposed for protection	Description
GS ₃	Gornjačka Gorge	Located in the western part of the Homolje area (Fig. 1). The Mlava River carved through the Mesozoic limestones of the Gornjačke Mountains over a total length of 16 km, forming four pronounced meanders (hooks) (Miljković 1992). The gorge is epigenetic, tectonically predisposed along a major fault that extends to the southern side of the Žagubica Basin, continuing westward through the Ribarska Gorge and the central part of the Krepoljin-Krupaja Basin, determining the direction of the Gornjačka Gorge (Miljković 1992; Miljković 2018). In the gorge are numerous remains of old fortifications from the Roman period, hermitages and churches from the Middle Ages of Serbia, unexplored caves and the Gornjak Monastery from the 14th century.
GS ₄	Tisnica River Gorge	Located in the eastern part of the Žagubica Basin, near Žagubica settlement (Fig.1). This gorge-canyon is almost unexplored (Fig. 2A). The Tisnica River carved through the limestones of eastern Beljanica Mountain (Miljković 2018). The gorge has a large number of caves on both sides of the valley. It is assumed that the springs in the canyon valley of the Tisnica River are connected underground with the Žagubica spring (Petrović 1954a).
GS ₅	Ribarska Gorge	Represents the natural boundary between the Krepoljin-Krupaja Basin in the west and the Žagubica Basin in the east (Fig. 1). The Mlava River carved the valley approximately 9.5 km long, forming three pronounced meanders (Fig. 2C) (Miljković 1992). The massive limestones of the Upper Jurassic are the main rock mass in which the Ribarska Gorge is cut (Antonijević <i>et al.</i> 1970; Miljković 2018). As well as in the Gornjačka Gorge, the Ribarska Gorge contains numerous ruins of Roman fortifications, the remains of tools and objects from that period.
GS ₆	Uvala Rečke and Ivkova pit cave	Situated approximately 2.5 km northeast of the highest peak of Beljanica Mountain (1,339 m) (Fig. 1). It extends from 1,500 m to 2,000 m in length, with a maximum width of up to 500 m (Miljković 2011, 2018). The rim of the Uvala Rečke is built of Cretaceous limestones, while the bottom lies on green crystalline schists covered with thick clay and gravel deposits (Antonijević <i>et al.</i> 1970). At the bottom of the Uvala Rečke, periglacial forms occur - grass hummocks (Fig. 2B), which are rare landforms in Serbia (Miljković 2011, 2018). In the southwestern part of the uvala is located Ivkova pit cave (the opening height of 20 m and the width of 12 m), explored to a depth of 280 m (Miljković 2011, 2018).
GS ₇	Uvala Busovata	Located in the central part of Beljanica Mountain, 3 km east from the Uvala Rečke (Fig. 1). It extends along approximately 1 km, with a maximum width of 500 m (Miljković 2011, 2018). It is surrounded by Jurassic limestones, except on the east where its rim is built of crystalline schists (Antonijević <i>et al.</i> 1970). Numerous sinkholes appear at the rim of the uvala, such as the pit caves (Miljković 2018). At the bottom of the uvala, grass hummocks also occur. The uvala has been protected since 1975 as a Strict Nature Reserve, on the area of 15.86 ha (Miljković 2018).
GS ₈	Pogana Peć Cave	Located on the northern slopes of the Gornjačke Mountains, below the southern slopes of the Homolje Mountains, at an altitude of 490 m (Fig. 1). More than 2,000 m of the cave system was explored (Miljković 1988). The geological composition of the cave area is characterized by the Permian red sandstones, carbonate rocks and sandstones of Triassic, Jurassic and Cretaceous ages, and Neogene sediments as the youngest formations (Antonijević <i>et al.</i> 1970; Miljković 2018). A special value of the cave is the Prehistory Canal, with a large amount of well-preserved paleontological remains of Quaternary fauna (Miljković 1988; Miljković 2018). The end of this cave is Miucića Cave, from which the Komnensko spring flows.
GS ₉	Tufa accumulations by the Buk spring	Formed in two accumulation levels (the higher and the lower accumulation), on the right side of the Do River Gorge, in the eastern part of Beljanica Mountain (Fig. 1). Tufa deposits were formed by the periodical spring (740 m) that built up the higher accumulation level (Fig. 3C), and the permanent karst spring (693 m) that built up lower accumulation (Miljković 2011, 2018). Both tufa accumulations cover an area of 22,500 m ² (Gavrilović 1992).
GS ₁₀	Tufa accumulations by the Perast River	Located in the eastern part of Beljanica Mountain, almost unknown and unexplored (Miljković 2018). The upper tufa accumulation is located at an altitude of 847 m (5 m in height) and the lower tufa accumulation is at an altitude of 834 m and has the appearance of a fan, 21 m in height (Fig. 3D) (Gavrilović 1992; Miljković 2011). Tufa accumulations cover an area of 23,100 m ² (Gavrilović 1992).

and which not (Simić 2011). These two protected geomorphosites belong to the third degree of a protection regime. According to the Nature Conservation Act (“Official Gazette of the Republic of Serbia”, No. 36/2009, 88/2010, 14/2016 and 95/2018), this implies proactive protection implemented in a protected area with partially modified or modified ecosystems, areas and sites of geoheritage with scientific and practical importance. This also means that this protection regime allows interventions for restoration, revitalization and improvement of the protected area, the building of tourist facilities, catering, tourist infrastructure and the construction of smaller facilities for the presentation of natural values or objects in a traditional style that are in accordance with the needs of cultural, rural and ecotourism (clause 35).

The third protection regime prohibits the construction of oil refineries and chemical industry facilities, metallurgical and thermal facilities, petroleum/natural gas storage facilities and waste products. Also, this regime limits the construction of industrial and energy facilities, asphalt bases, accommodation facilities and ski resorts, infrastructural facilities, industrial goods and building materials warehouses, cottages, exploitation and processing of mineral resources, education of waste management facilities, construction of settlements and expansion of their construction areas, hunting and fishing, the formation of forest and agricultural monocultures, application of chemical agents and other works and activities that may have a significant adverse effect on the natural and other values of the protected area (clause 35).

The remaining 8 geosites with high priority in the future protection of the Homolje area’s geoheritage have no necessary local and national recognition. The main aim of conservation of geosites was pointed out by Hose (2012) as “protecting from damage, deterioration or loss through the implementation of protection and management measures” (Hose 2012, 16). Some of the geomorphosites of the Homolje area are exposed to weather or anthropogenic influ-

ences or they are neglected and inaccessible (e.g. Ribarska Gorge, Pogana Peć Cave, Tufa accumulations by the Perast River). Also, the local inhabitants are not educated about the importance of the geosites that surround them, and some of them are even unknown to them (Pogana Peć Cave, Tufa accumulations by the Perast River). One of the main aims of this paper is to point out the unsatisfactory current state and necessary for protecting the geomorphosites of the study area because conservation is significant for nature and an important contemporary issue for society (Vasiljević *et al.* 2014).

Current State and Problems of the Geomorphosites of Homolje Area

The aesthetic value of the Osanička River Gorge with karst bridge is a combination of a canyon-gorge type of landform and natural bridge, as morphological units that represent natural curiosities in the karst relief. This gorge stands out with its height and vertical cliffs, stone columns, unpolluted watercourses, as well as diverse vegetation (habitat of 166 plant species) and specific fauna (Miljković 2018). The gorge and the karst bridge are taken care of by the local population as a symbol of the countryside and a natural gift. However, the masonry dam that was erected at the exit from the gorge caused the accumulation of the sediments from the upper drainage basin, which buried part of the riverbed below the karst bridge (Miljković 2018). This changed its former natural appearance. If the sediment deposits were removed, the Osanička River would become a lake upstream of the dam, which would make the karst bridge passable. Nevertheless, the masonry dam with the overflowing waterfall makes the entrance to the gorge (from the direction of the countryside) very picturesque (Fig. 4A).

Although the Gornjačka Gorge represents the least explored gorge, it is the most famous geomorphosite of the Homolje area. Human interventions have significantly endangered the essential ecological values of this geosite. By declaring one spring curative, downstream from the Gornjak Monastery, the traffic of motor vehicles to the spring and the bank

of the Mlava River is uncontrolled. Garbage and waste of various types that are disposed of, pollute not only the spring but also the Mlava River. Also, limestone exploitation activities in the quarry at the exit from the Gornjačka Gorge have destroyed the local environment and greatly endangers the biodiversity of the most beautiful part of this geosite (Miljković 2018).

Not far from Žagubica settlement, at the end of the most beautiful part of the Tisnica River Gorge, there is a quarry that has not been operating for years. However, the gorge suffered consequences from mining and exploitation of metamorphosed limestone, which was marketed as a quality building material known as marble (Miljković 2018).

Unlike the Gornjačka Gorge, which is heavily visited during the summer period, the Ribarska Gorge is

known only to sport fishermen, although it is not far behind the three previous gorges in its picturesque landscape and untouched nature. Since no roads through the Ribarska Gorge, it is the least threatened gorge in the study area. However, the artificial dam built in 2019 (Fig. 4B, C), at the exit of the Mlava River from the gorge (in the last pronounced meander), will have a very negative impact on the environment. In the first place, it will affect the fauna and flora in the Mlava River, the change of the microclimate in the gorge, the regime of the Mlava River, as well as the vegetation in the near area (Miljković 2018).

Uvala Rečke is one of the most picturesque parts of Beljanica Mountain and one of the most preserved areas. The southern and eastern sides of the uvala are surrounded by old beech forests, while the north side is covered by grasslands. The Uvala Busova-

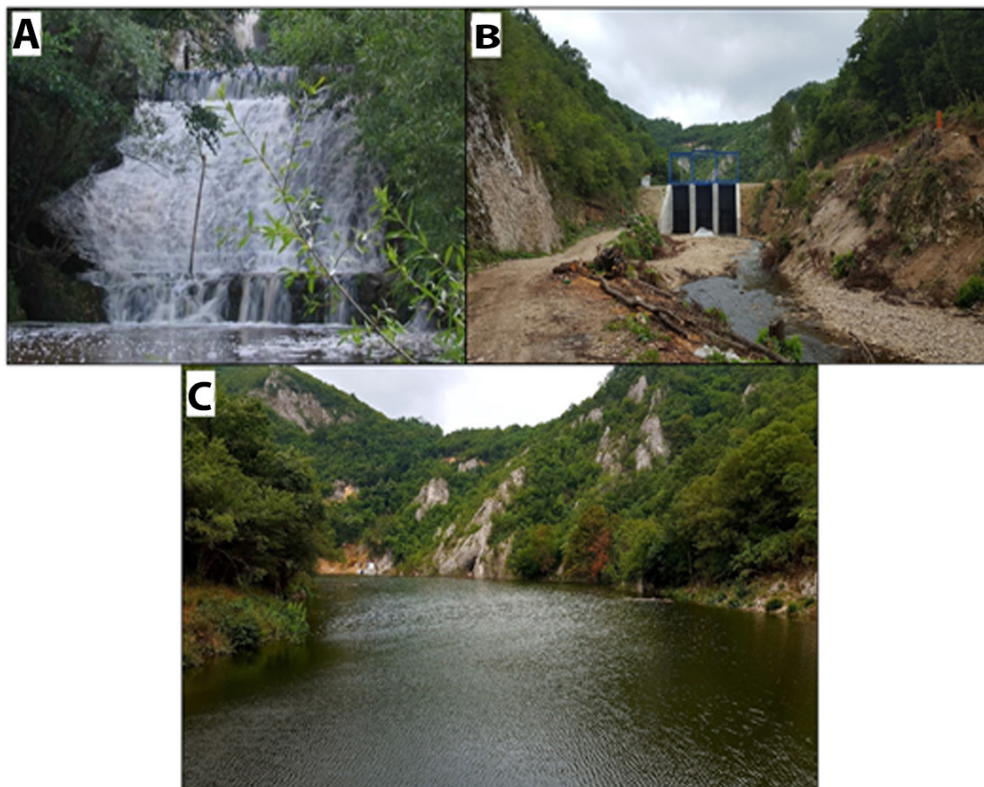


Figure 4. The human interventions in gorges of the Homolje area: A) The masonry dam with the overflowing waterfall in the Osanička River Gorge, B) The artificial dam in the Ribarska Gorge – view in front of the dam, C) View behind the dam in the Ribarska Gorge

ta on the other side is threatened. Namely, suitable topography and overambitious wishes that are far above the real natural conditions encouraged the highest state authorities to build a ski centre in the area of the uvala with functional and tourism facilities (Miljković 2018). For years, various interventions have been carried out in the first phase of the realization of ski resorts without professional supervision.

The Pogana Peć Cave stands out as a priority geosite for the protection of geoheritage and is the one best researched so far (Miljković 2018). The aesthetic value is high, both in terms of the variety of cave formations and its preservation. There is a large concentration of stalactites, stalagmites, draperies and other cave formations preserved and intact. Some are a real rarity in the karst of this area. Since the cave is not nationally protected, it is exposed to various negative influences that can permanently damage it.

Although difficult accessibility has a positive effect on the preservation of the Samar Karst Bridge, the ecological preservation of the geosite is threatened by disturbance, because there is no direct control of protection, even though it is a Natural monument and one of 80 protected geosites in Serbia (Miljković 2018). Therefore, discarded machine parts and tires, fuel and lubricant packaging can be found here.

Unlike other rocks, tufa can be rapidly transformed due to natural and anthropogenic disturbances, and the vulnerability of such natural phenomenon is pronounced and protection is necessary. Since the tufa accumulations by the Perast River is difficult to access and almost unknown, it is well preserved. However, the insufficient care of the tufa accumulations by the Buk spring has left visible consequences. The ecological value and local climate conditions are disturbed by the road Žagubica - Busovata which cuts the tufa accumulations to higher and lower levels. This is specially referred to the lower accumulation, where tufa is deposited more inten-

sively than in the upper one (Miljković 2018).

One of the main problems of the absence of conservation in the Homolje area is the incomplete inventory of geomorphosites in the first place. Inventory and assessment play a crucial role in the implementation of subsequent basic conservation, valuing, and monitoring of the geoheritage (Henriques *et al.* 2011). The prominent geomorphosites presented in this review study, selected according to quantitative assessment methods (Miljković 2018), have the priority and should be protected by geoconservation and land-use planning policies.

Future Directions for Improvement of the Current State of the Geomorphosites of Homolje area

The aim of this study is to point out the current state of the geomorphosites of the Homolje area, the necessity for protection and implementation of appropriate measures and the adequate use of protected geosites. Only after the implementation of these measures, development perspectives should be directed towards valorization, infrastructure development, an arrangement of geosites for public use (tourist visits), promotion, education of the local population, etc. This process of protection and conservation requires a certain amount of time and financial investment, which is important to determine the priorities among the natural potentials of the geosites of this area over which the mentioned measures would be implemented.

Gray (2005) pointed out that geodiversity, respectively geoheritage as one of its elements, should be protected and conserved for two reasons. "First, geodiversity is valuable and valued in a large number of ways, and second, it is threatened by a huge variety of human activities" (Gray 2005, 6). According to Miljković (2018), the priorities of protection and conservation are geosites that are best valued and most visited (threatened). According to the total values and the final ranking by Pereira *et al.* model (2007), Gornjačka Gorge is the most valuable geomorphosite of the Homolje area, with the highest Additional, Geomorphological and Management

values (Miljković 2018). The following are Tisnica River Gorge, Uvala Busovata, Samar karst bridge and Uvala Rečke. The least valued is the Pogana Peć Cave (Miljković 2018).

The Gornjačka Gorge as the most visited geosite is also the most threatened. The recent commissioning of a renovated motel (2018) located on the right side of the Mlava River (opposite the Gornjak Monastery), should follow strict measures to prohibit uncontrolled disposal of waste and fecal water from this facility in the Mlava River, as well as to prohibit traffic and parking in front of the monastery. Both gorges Gornačka Gorge and Tisnica River Gorge suffered consequences from mining and exploitation limestone. To improve the damaged natural states in one of the most beautiful parts of the Homolje area, it is necessary to carry out a thorough rehabilitation and revitalization (Miljković 2018).

Due to the stated and future failures, the Uvala Busovata should be conserved, and valorization plans should be left to the experts in the relevant fields. Urgent protection measures must be carried out in the narrow zone of the sinking stream that flows in the Resava River basin (southern border of the Homolje area) (Miljković 2018). The Uvala Busovata and Rečke, as the area of the Pogana Peć Cave, are suitable locations for the cycling park, which would improve the tourist offer of the Beljanica Mountain, Gornjačke Mountains and Homoljske Mountains.

Future directions for improvement and promotion (geotourism) should be directed on the Pogana Peć Cave which has a favourable position for tourists because it is located between the well-known Ceremošnja Cave and Ravništarka Cave approximately 10 km in the north, and Resavska Cave approximately 40 km in the south. Conservation of this geosite would prevent pollution of watercourses and springs on its area, insertion of toxic substances to the cave, as a waste, dead animals, etc. Also, the destruction and theft of cave formations, fossil remains, cave flora and fauna would be prevented. An untouched area of this geosite is not accompa-

nied by adequate protection. Namely, from the exit of the cave, known as the Miucića Cave, flows the Komnensko spring which is captured for the needs of the water supply of Krepoljin settlement (Miljković 1988). Therefore, it is necessary to protect the wider zone of the spring, as well as the entrance to the Miucića Cave (Miljković 2018).

Since the tufa accumulations can be rapidly transformed due to natural and anthropogenic disturbances, the anthropogenic factor must be strictly controlled in various ways. It is necessary to strictly prohibit logging of beech forests, to control excursion (sightseeing) areas, to prohibit the exploitation of tufa for building and other purposes, to prohibit motor vehicles in the waterfall zone, etc. (Miljković 2018). By protecting and determining the guardian of both tufa accumulations, it would prevent further disruption of the phenomena and preserved grasslands and beech vegetation in its surroundings. Therefore, it is necessary to set up the boards with restrictions on the movement of visitors and motor vehicles, mark the paths of permitted movement, mark the viewpoints, as well as regular monitoring of the implementation of site protection measures (Miljković 2018).

That applications of geoconservation could be 'identified through the production of materials, methods and/or scientific services useful to society, namely geoeducation', Henriques *et al.* (2011, 117) pointed out. One of the ways to improve the current state is the promotion of scientific education of geomorphosites in the Homolje area. Miljković (2018) proposed a geotourism route that offers participants the opportunity to visit the geosites for three days, which are the focus of this paper. The trip is intended for nature lovers and geotourists. Due to the complexity of the terrain, the trip is planned for a maximum of 10 participants, who during their stay will have the opportunity to get acquainted, not only with the natural heritage of the Homolje area but also with its anthropogenic values (cultural-historical, ethnological, traditional and gastronomic values).

This type of thematic route or excursion is an excellent tool for promoting the geomorphological heritage that this area of Eastern Serbia has and can significantly influence the education and raising awareness of the general public about vulnerability and the importance of protection geoheritage as an important element of our environment (Miljković 2018).

Conclusion

Homolje area is one of the cleanest ecological oases in Eastern Serbia due to its preserved nature, relatively low population, undeveloped industry, high afforestation, and a very pleasant climate. So far, geoheritage of this area has not been specifically investigated and most landforms and phenomena are only partially known to even the expert public, and represent values that need to be better explored, adequately protected and valorized. Geosites described in this paper which are under national protection are just as vulnerable as those who are not protected. They are usually neglected and marked with old and decaying panels (e. g. Samar Karst Bridge and The Osanička River Gorge with karst bridge). Only those who are unapproachable are spared from the negative impacts (e. g. tufa accumulations by the Perast River and Pogana Peć Cave).

It is not enough that natural phenomena became only a formal part of the National List of protected geoheritage sites of Serbia. Adequate management and respect of protection measurement are very important for preserving geosites, especially those that are accessible, capable of functional use and visits, and exposed to daily negative impact. The geomorphosites of the Homolje area are accessible to wide human use because there is no ticket payment system or expert monitoring that could prevent the negative impacts caused by the anthropogenic factor. When geosites are not adequately protected, it is impossible to control their pollution, damage or destroy. No natural phenomena can be restored to its original state if disturbed or permanently damaged. According to the assessment of the current state of the geomorphosites, it can be concluded that the

main problems of not recognizing the natural values of the Homolje area are the lack of information, insufficient to the absence of promotion, long distance of emissive centers, lack of functional and tourism facilities, etc. Municipality of Žagubica and Tourist Organization of Žagubica should upgrade its administration plan, succeed a higher level of protection, and improve tourism infrastructure for these geosites. Previous work on their protection can and must be significantly improved. Further steps should involve improving promotion (geotourism) on a wider scale, better interpretation and the local population should be educated about the significance of the phenomenon that surrounds them in order to preserve the nature of this region and reduce the negative anthropogenic influence.

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