

Executive Summary

State party:	Bosnia and Herzegovina
State, province or region:	Herzegovina-Neretva Canton, Ravno
Name of nominated property:	Vjetrenica Cave, Ravno
Geographical coordinates to the nearest second:	N 42° 50' 45" E 17° 59' 1"

Textual description of the boundary of the nominated property

Vjetrenica is a complex cave system with passage length of 7.323,9 m; as such, it is the second longest cave in Bosnia and Herzegovina. The cave consists of the main passage of Upper Vjetrenica, about 2,500 m in length, and numerous side passages, the most important being: Lower Vjetrenica, Absolon's upper and lower passage, Radovanović's passage, Leopard's passage, Wales passage and Ravno passage named after the nearby settlement of Ravno.

It is located within the protected landscape "Vjetrenica-Popovo polje". Cave Vjetrenica sits in the area of the south Dinaric karst, in a karst hill stretching from the outhern edge of the western part of the Popovo polje plains (Eastern Herzegovina) to the Adriatic Sea. Its entrance is located on the very edge of the Popovo polje plains, 300 meters east of the central part of the village of Zavala, at 260 meters above sea level, 12 km by air to the Adriatic Sea (Republic of Croatia). The main direction of the cave passages is south – southeast, or in the direction of the coast. Noteworthy, the cave is located in the immediate hinterland of the city of Dubrovnik, a leading tourist hub. In addition to Vjetrenica, the cave system includes the Lukavac spring, located below the entrance to Vjetrenica, and the smaller Bjelušica cave, above the entrance to Vjetrenica.

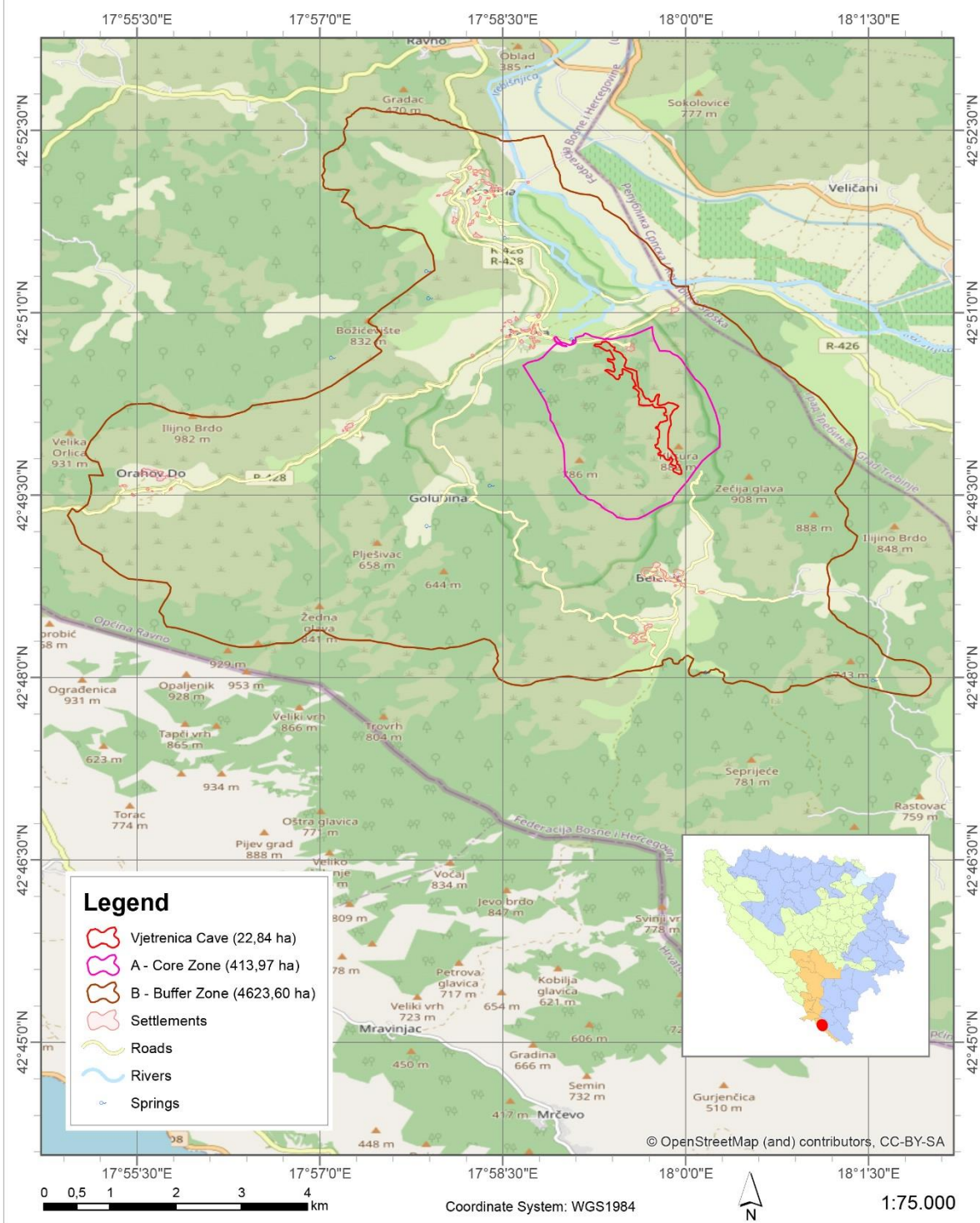
The cave has several permanent and disappearing streams and lakes, the largest some 180 m in length. It abounds in countless stalactites, flowstone, draperies, cascades and other cave formations. Also, it is one of the richest caves in the world in terms of its biological diversity, officially ranked as second, with 85 troglobionates. So far, over 231 cava taxa have been identified, of which over 65 stenoendemic. The remains of eight fossilised animals have been recovered in the cave, the largest being the cave bear (Carnivoria, *Ursus spelaeus* Rosenmüller, 1794) and one full skeleton of a leopard (Carnivoria, *Panthera pardus* (Linnaeus, 1758)). The rocks at the entrance to the cave have two carved stones, with drawings typical of medieval tombstones in the region. In scientific terms, Vjetrenica has been the site of numerous different forms of research, dating as far as back to the 16th century. In his work *Historia Naturalis* published in 77, Pliny the Elder makes a first reference to Vjetrenica in the mid-1st century a.d., with many references to follow by other authors, such as Getaldić. Systemic scientific research, however, will start only in late 19th century with Groller (1889), Vavrović (1893), Katzer (1903) and others. Vjetrenica Cave

was adjusted for tourist purposes even before 1940, with extensive works and lighting introduced in 1964, including a passageway of as many as 1800 meters long, and lighting in the length of 1050 meters, including a nearby motel built to accommodate tourists. The cave suffered major devastation in the period from 1991 to 1996, during the war.



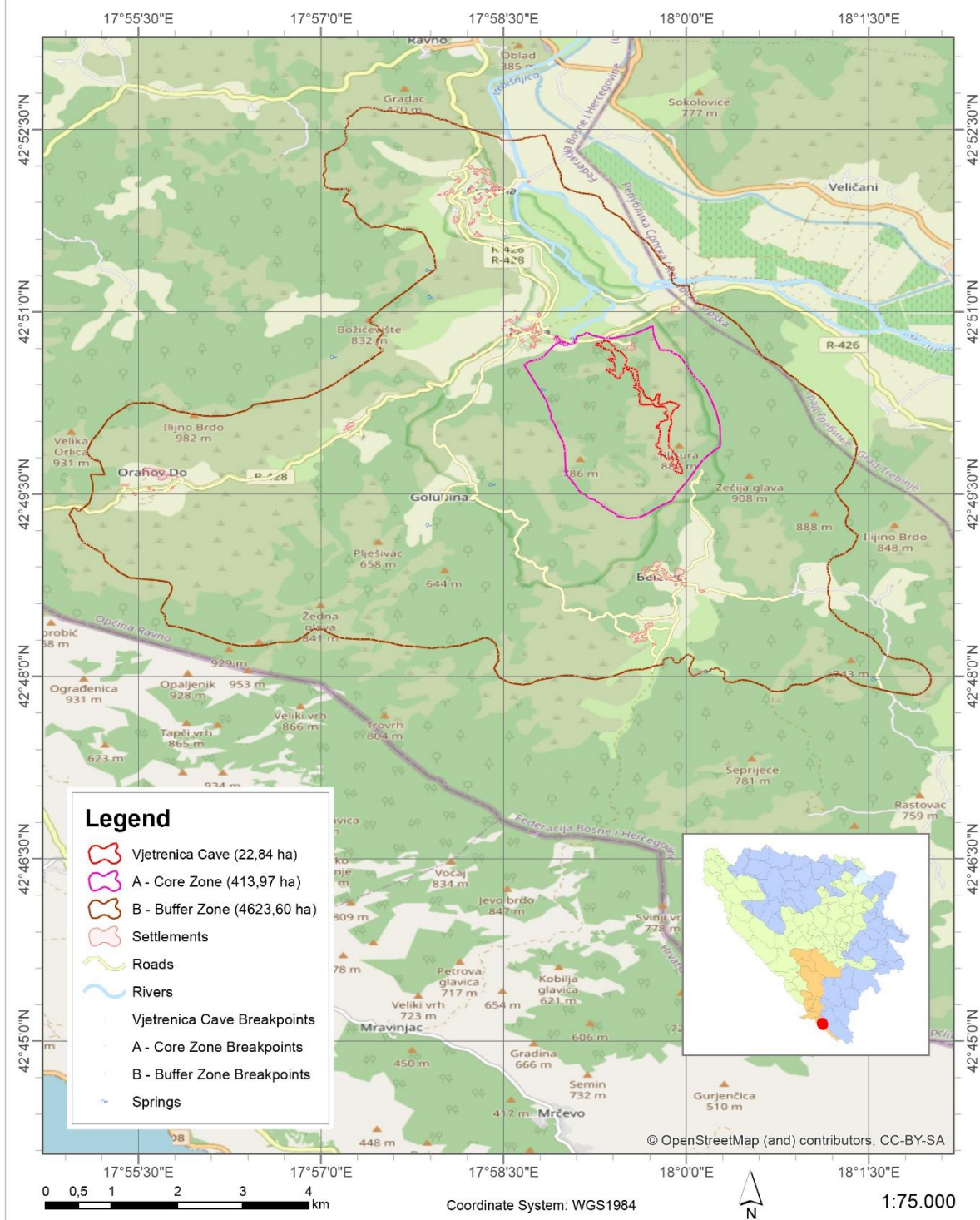
Map 1 Geographical location of “Cave Vjetrenica”

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VJETRENICA CAVE
 BOSNIA AND HERZEGOVINA



Map 2 Size map of the nominated property showing boundaries for Vjetrenica - Popovo polje

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VJETRENICA CAVE
 BOSNIA AND HERZEGOVINA



Map 3 Size map of the nominated property showing buffer zones for Vjetrenica - Popovo polje

Criteria under which property is nominated (itemize criteria)

Criterion vii - to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance

The cave system of Vjetrenica and its surroundings are exceptional and well-conserved manifestations of Karst topography. It reveals a broad range of karst features with its exceptional scale and aesthetic quality. Almost all passages in Vjetrenica are wide and high in their entire length. The cave consists of several passages that could be grouped into four levels: Main Level, Upper Level, Lower Level and Vertical Level. The Main Level is semi-horizontal and the longest in the cave. It runs from the cave entrance almost to the furthest point of the cave. This is also the level with the longest and widest passages in the cave: Main Passage (Glavni kanal) and Main Hidden Passage (Skriveni glavni kanal). Even with the debris on the cave floor, untypical horizontality of that level caused differences in views over the direction of the slope (and the direction of the former water flow) of the main part of the cave. The Lower Level is approximately 10 to 30 meters lower than the Main Level, comprising the Lower Lake (Donje jezero), Karaman's Lake (Karamanovo jezero), Absolon's Lower Passage (Donji Apsolonov kanal), Absolon's Upper Passage (Gornji Absolonov kanal) and Radovanović's Passage (Radovanovićev kanal). These passages are grouped in the first part of the cave, up to approximately 600 meters from the entrance.

The Upper Level consists of five passages – the Leopard Passage (Leopardov kanal), High Flowstone Passage (Visoki zasigani kanal), Platy Passage (Pločasti kanal), Wales Passage (Velški kanal) and Ravno Passage (Ravanjski kanal). These passages are some dozens and up to 120 meters higher than the Main Level, and sit at 1700 to more than 2500 metres from the entrance. An assumed, but undetected, fourth level – the Vertical Level of the cave is believed to consist of deep pits that lead from the surface of the terrain to the cave. Despite speleologists' efforts, none of these pits were found. The main proof of the pits' existence is the air movement at the entrance and inside the cave. Milosavljević (1979), from an unknown source, references 13 m/s as the highest speed of the wind at the entrance, while the highest recorded speed during the recent mapping of Vjetrenica was 8.5 m/s (Lučić & Sket 2003). Such a strong 'wind cave' is possible only in caves with multiple entrances situated at different heights. The movement of air is caused by differences in air pressures and temperatures between the open atmosphere and underground cavities and air velocity is fastest in narrow passages (Bögli 1980). During high waters, when the sump in the Main Passage is completely flooded, there is no wind at the entrance (I. Lučić, 2009, pers. comm.). In other words, pits are connected with a cave beyond the approximate 1000 metres from the entrance, where the sump is. Due to the topography of the hill above the cave, those pits should be at least 160 m deep to be connected with the known parts of the cave.

Several smaller streams, both permanent and intermittent, exist in the cave. Directions of the flows are on course towards or opposite of the entrance. There are also several water pools, the largest of which is the Great Lake (Veliko jezero) with some 180 m in length, and a few sumps that occasionally close some of the passages (Lučić & Sket 2003). The walls and ceiling of the cave are only sporadically covered with flowstone, in the form of thinner or thicker flowstone coating. Dripstones (stalactites and stalagmites) are rare in the cave due to the most prominent process present in the cave – breakdown. Breakdown is a mechanical failure of rocks comprising the walls

and ceiling of the underground cavities (Ford & Williams 1989).

The floor of almost the entire cave is covered with angular rocks of different size mixed with clayish sediment. Several sizable chambers are almost entirely filled with rock blocks, slabs and chips, in the form of piles tens of meters high. It is almost certain that rock breakdown at some points choked the passages by completely filling these and cutting the way into other unexplored parts of the cave. A good example of a breakdown choking the passages is the entrance into the widest passage – the Main Hidden Passage. The entrance that leads through the boulders is only some 50 x 50 cm. In addition to carbonate clasts, large quantities of clay are also found on the cave floor. According to Radovanović (1929) and Malez (1985) there are two different ages of clay. The older clay lays under the breakdown rocks, covered by the more recent clay. Scallops are spoon-shaped depressions created by a fast-turbulent water flow. Their shape could be used to determine the direction of paleoflow in relict caves (Ford & Williams 1989). In front of the cave entrance is a karst plain named Popovo polje. The Trebišnjica River, the largest European sinking river, passes through the plain. Before hydrotechnical interventions in the middle of the 20th century, Popovo Polje was flooded on an average 253 days a year (Milanović 2006). The hydrological function of Vjetrenica in the past caught attention of many researchers. Some of the authors agree that Vjetrenica had a function of a swallow hole for water from the Popovo Polje (Absolon 1916, Radovanović 1929, Cvijić 1950, Malez 1985, and that the cave spread all the way to the Adriatic coast. Milojević (1928 1938 and Zubčević & Gašparović (1958, however, argue the opposite – that water from Vjetrenica flows into the Popovo polje. The main argument in both points was the topography of the cave bottom from the entrance to the Great Lake. The problem was that the map drawn by Radovanović (1929) shows a slope in the direction inside the cave while maps drawn by Milojević (1938) and Zubčević & Gašparović (1958) show a slope in the direction of the cave entrance. The last map of the cave is the one published by Lučić & Sket (2003). According to that map, the entrance of the cave lies at some 8 metres above the Great Lake which is further at a distance of 1200 metres. In the Four-state Model (Ford & Williams 1989) of differentiation of phreatic and water table types of caves, Vjetrenica belongs to caves with a mixture of phreatic and water table levelled components, close to the ideal water table cave.

Criterion x - to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation

Vjetrenica is a remarkable and the most unique cave, located in the Popovo polje, a karstic plain in the south of Bosnia and Herzegovina. It is quite a sizable cave – more than 6000 meters have been explored, with several subterranean lakes (one is 180 meters long); and it has been known since Antiquity (Pliny the Elder makes a reference to the cave in his *Historia Naturalis*). It earned its name (vjetar = wind) thanks to a strong cold wind at almost all times. Yet, biodiversity is what gives it its uniqueness: while most caves on the planet harbour only a handful of animal species, Vjetrenica has the unique feature of sheltering more than a hundred, and is likely the richest in the world in terms of biodiversity. Among these cave species, more than half are endemic in the Popovo polje, while others are only known to inhabit Vjetrenica.

Vjetrenica is one of the most faunistically rich caves in the world (Culver & Sket, 2000), due to its

biogeographical position in the Dinaric karst, its size, and ecological heterogeneity. It is also one of the world's most prominent biodiversity hotspots for cave-dwelling fauna. In fact, 231 taxa were detected in Vjetrenica: two types of bacteria, 14 fungi, 35 protista and 180 animals, with 96 cave-dwelling taxa *Nitrospira* (1), *Gammaproteobacteria* (1), *Trematoda* (1), *Enopla* (1), *Gastropoda* (11), *Bivalvia* (1), *Hydrozoa* (2), *Amphibia* (1), *Myriapoda* (8), *Insecta* (11), *Entognatha* (4), *Crustacea* (36), *Arachnida* (9), *Polychaeta* (1), *Oligochaeta* (7), *Hirudinea* (1), and together with Lukavac spring and Bjelušica Cave, as parts of its system, Vjetrenica is a type locality for 38 taxa, of which 14 are strictly endemic, and tree are monotypic: *Zavalia vjetrenicae* ((Radoman, 1973))(*Gastropoda*), *Troglomysis vjetrenicensis* ((Stammer, 1933))(*Crustacea*) and *Nauticiella stygivaga* ((Moravec & Mlejnek 2002))(*Coleoptera*). Vjetrenica is inhabited by more than 49 troglobites and 56 stygobites.

Further monotypic genera, found in other speleological objects of the Popovo polje include: *Spelaeoconcha paganetti* (Sturany, 1901) (*Gastropoda*), *Marifugia cavatica* (Absolon & Hrabe, 1930) (*Polychaeta*), *Velkovrhia enigmatica* (Matjasic & Sket, 1971) (*Hydrozoa*), *Stalitella noseki* (Absolon & Kratochvíl, 1933) (*Araneae*), *Dinaria vjetrenicae* (Hadži, 1932) (*Opiliones*), *Typhlogammarus mrazeki* (Schaferna, 1907) (*Crustacea*), *Spelaeocaris pretneri* (Matjasic, 1956) (*Crustacea*) and *Proteus anguinus* (Laurenti, 1768), (*Vertebrata*, *Amphibia*).

Among the veterinary fauna, some taxa stand out, in particular: *Velkovrhia enigmatica* (Matjasic & Sket, 1971), the only one species of the genus, the only freshwater species of the family Bougainvilliidae and the only troglobiont species of Hydrozoa (Sket 2003). *Congerina kusceri* (Bole, 1962) is a living fossil, the only one of the hundred or so extinct species of congerina that peaked in the Upper Miocene, and which inhabited the freshwater remnants of the Dinaric and Pannonian seas in the Pliocene, and the only stigobiont shellfish (*Bivalvia*). *Marifugia cavatica* (Absolon & Hrabe, 1930) is the only freshwater serpulide (*Serpulidae*) and the only stigobiont tubeworm (*Polychaeta*) (Sket 2003).

Pholeoteras euthrix (Sturany, 1904) is the only known snail from the Cyclophoridae family in Europe, a relic of old tropical fauna (Sket, 2003).

Dina absoloni (Johansson, 1913) is the first discovered stigobiont species of leech (*Hirudinea*) in the world; *Proteus anguinus* (Laurenti, 1768) the well-known olm, is the only European troglobiont vertebrate. With as many as ten species of the genus *Niphargus* (*Amphipoda*), biological diversity of Vjetrenica is explained as a phenomenon of local radiation, not yet recorded in the world underground (Sket 2006). *Hadzia fragilis* (Karaman, 1932) (*Amphipoda*) is a typical species of crustacean for the genus *Hadziidae*. Vjetrenica is home to three troglobiont species of ten-legged crustaceans (*Decapoda*), of which two species of the genus *Troglocaris* (*T. anophthalmus* (Kollar 1848), *T. hercegovinensis* (Babić, 1922) and the only species of the genus *Spelaeocaris*, *Spelaeocaris pretneri* (Matjasic, 1956).

Vjetrenica Cave is a typical site of many invertebrates that exclusively inhabit the Vjetrenica system (according to Ozimec and Lučić, 2010). According to the data, as many as 14 of the 38 species for which the Vjetrenica system is a typical site are endemic to the Balkan Peninsula or are an endangered or vulnerable species.

Draft Statement of Outstanding Universal Value

Brief synthesis

Vjetrenica is one of the longest caves in Bosnia and Herzegovina. Topographic mapping is still in progress, meaning that its length exceeds the published 5699 m (Lučić & Sket, 2003). According to recent exploration and mapping, its length is 7.323,9 m meters (Ozimec et al., 2021.). In the past, the cave drew attention for its strong movements of air or ‘wind’ that blows from the cave in warm months and into the cave in cold months. The cave is located in the south Dinaric karst, between the Popovo polje plains (East Herzegovina) and Dubrovnik (Adriatic Sea, Croatia), as part of the Trebišnjica river system, the longest losing stream in Europe. The region is characterised by strong tectonic and geodynamic activity, high purity of carbonate (99.98%) and 2,000 millimetres of annual rainfall. For the first time in the world, biospeleological research of Vjetrenica established a cave hygropetric habitat, with a thin layer of water covering rocks.

In Vjetrenica, 231 taxa were detected in Vjetrenica: two types of bacteria, 14 fungi, 35 protista and 180 animals, with 96 cave-dwelling taxa. It is the very particular environmental conditions of the cave that provide a habitat for rare and threatened fauna. The cave also bears historic importance. Examples of leopards from Vjetrenica are known globally as best preserved and the most complete skeletons of its kind, with greatest importance in palaeontology. The remains are a testament to period spanning from 29000 to 37000 years, and corroborate the fact of their existence in earlier Pleistocene. Vjetrenica is both a nature and archaeological site.

Justification for Criteria

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Statement of integrity

The area of the Vjetrenica cave and its surroundings adequately represents both natural and cultural, terrestrial and aquatic features, as well as processes of importance for the long-term conservation of the rich biodiversity and exceptional natural beauty. Vjetrenica Cave is the most important and unique element of biodiversity of this part of the region. The area around the Vjetrenica cave also protects all major terrestrial vegetation species and important species habitats. The nomination of the Vjetrenica cave will include all the features that make up the outstanding universal value of the property. In addition to an internationally renowned site of Vjetrenica Cave, the nominated area includes lesser-known and as yet unexplored sites. We are thus in a position to permanently maintain the integrity of the designated property with the help of existing protective measures and safeguard provisions.

Vjetrenica Cave is a complex underground system that has not yet been fully explored, offering exceptional opportunities for further exploration of the karst underground of the Dinarides, primarily along the lines of physical speleology, geology, hydrology, ecology, biospeleology, paleontology, archeology; but also underground climatology, tectonics and more. Research brings us new insights about caves themselves, hydrogeological and ecological relations, the

present living world extremely rich endemic species and many other aspects important for this area, but also for the community as a whole.

The main threats to the integrity of the property include a wide range of anthropogenic influences (physical devastation, changes in the habitat and ecology of the cave, waste accumulation, collection and disturbance of cave fauna, uncoordinated urban development, population growth in the area above and around caves, old infrastructure, and illegal interventions at springs and tourist pressure). Total property compliance, and in particular the relationship between urban projects and landscapes, is sensitive to lack of proper control of new development.

Statement of authenticity for properties nominated under criteria (i) to (vi)

Not relevant as this property is nominated under criteria (vii) and (x)

Protection and Management Requirements

Vjetrenica Cave belongs to the system of karst areas, and it is the most endangered habitat type in BiH. Vjetrenica is a complex cave system and the longest cave in BiH, and it is also a hydrologically active cave system with active groundwater and underground lakes. The first form of protection of Vjetrenica took place already in 1952, and the relevant spatial planning documentation so far suggested that this area of Vjetrenica cave with the surroundings of the karst plateau and part of the Popovo polje should be under protection. However, the Vjetrenica cave area today does not enjoy formal legal protection; in order to achieve this, it is necessary to inspect the area as well as all other protected areas before 2003 in accordance with the 2013 Law on Nature Protection.

According to the Law on Nature Protection from 2013 (Official Gazette of FBiH, No. 66/13), which is partly harmonised with EU legislation, Vjetrenica Cave is a former natural monument, classified in Category III of protected parts of nature and is in the process of re-proclamation, entrusted to the competence of the regional administration or canton. For the procedure of classification into this category, it is necessary to determine the status of the Vjetrenica cave as a protected area.

In 2021, with the decision to declare this area as a protected landscape "Vjetrenica - Popovo Polje", this area receives formal legal protection, respecting all legally formal regulations and protection guaranteed by the Federal Law on Nature Protection of the Federation of Bosnia and Herzegovina. In 2021, the Municipality of Ravno held a session on 31.08.2021. (OV-III.60 / 21) adopted the Management Plan for the protected landscape "Vjetrenica-Popovo polje" for a period of 10 years.

Currently, the Ravno Municipality entrusted the management and care of the cave to Vjetrenica Public Company Ltd. Ravno, which performs daily management activities in the area, including maintenance of Vjetrenica cave. According to the current Development Plan, the Protected Landscape / Landscape "Vjetrenica - Popovo polje" covers an area of 4,710.17 ha

Name and contact information of official local institution/agency

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