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PROTECTED LANDSCAPE MANAGEMENT PLAN VJETRENICA - POPOVO POLJE



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CONTENTS

INTRODUCTION AND CONTEXT	
LEGISLATIVE FRAMEWORK FOR PROTECTED AREA MANAGEMENT	
MANAGEMENT PLAN PREPARATION PROCESS	
SCOPE AND CONTENT OF THE MANAGEMENT PLAN	
RESPONSIBILITIES FOR MANAGING AND IMPLEMENTING THE PLAN	
MANAGEMENT PLAN ACTIVITIES FINANCING	
PLAN PREPARATION PROCESS AND STAKEHOLDERS' INVOLVEMENT	24
MANAGEMENT PLAN MONITORING, EVALUATION AND REVISION	
LEGAL BASIS FOR THE PLAN REVISION	
MONITORING MANAGEMENT PLAN IMPLEMENTATION	
MONITORING AND EVALUATION OF THE MANAGEMENT PLAN IMPLEMENTATION	
COOPERATION WITH OTHER USERS OF THE AREA	
CROSS-BORDER COOPERATION	
AREA DESCRIPTION	
GEOGRAPHICAL-ADMINISTRATIVE AFFILIATION	
PHYSICAL AND GEOGRAPHIC CHARACTERISTICS	
GEOLOGICAL AND GEOMORPHOLOGICAL CHARACTERISTICS	
Tectonics	
Hydrological and hydrogeological characteristics	
CLIMATOLOGICAL CHARACTERISTICS	
PEDOLOGICAL CHARACTERISTICS	
VJETRENICA CAVE	
BIOLOGICAL CHARACTERISTICS OF THE AREA	
LANDSCAPE - TRENDS AND STATE	61
HABITATS AND BIODIVERSITY	63
Bacteria and fungi	
Algae	
Flora	

Vegetation	
Fauna	
Underground habitats of the Vjetrenica cave	
IDENTIFICATION OF RARE/ENDANGERED HABITAT TYPES	
IDENTIFICATION OF RARE AND ENDANGERED SPECIES	127
Identification of rare and endangered species of flora	
Identification of rare and endangered fauna species	
HISTORY AND DEVELOPMENT	
History of the Vjetrenica cave research	
Biospeleological research of Vjetrenica	
Cultural and historical values; monumental, architectural and cultural heritage	
USERS OF SPACE AND ECONOMIC VALUE	
Settlements and facilities	
Infrastructure	
Waste management	
Sectors and traditional activities	
Agriculture and livestock	
ASSESSMENT OF THE STATE IN THE AREA OF THE PROTECTED LANDSCAPE VJETRENICA - POPOVO POLJE	
Ecosystem state assessment	
Degree of ecosystem degradation	
Ecosystem capacity	
Conclusion on the assessment of the state of the area	
MANAGEMENT SECTION	
VISION	
THEMATIC SECTION A: PRESERVED DIVERSITY OF SPECIES, HABITATS AND KARST FORMS ENSURES UNIQUE BE	AUTY OF THE
NATURAL LANDSCAPE, AND THUS THE PRESERVATION OF A UNIQUE UNIVERSAL VALUE FOR PRESENT AND FUTURE GEN	ERATIONS 210
Preservation of the value of Vjetrenica cave and other underground habitats	
Preservation of favourable conditions of natural values, animal and plant species and habitat types of forest ecosystems	
Preservation of favourable conditions of natural values, animal and plant species and habitat types of meadow	
ecosystems	
Preservation of favourable conditions of natural values, animal and plant species and habitat types of aquatic ecosystem.	

THEMATIC SECTION B: PRESERVED CULTURAL HERITAGE TAKES AN IMPORTANT PLACE IN THE PRESENTATION OF VAL	
CONTRIBUTES TO THE PRESERVATION OF TRADITION AND CULTURAL IDENTITY OF THE AREA	249
Tangible cultural heritage is researched, restored, maintained, presented and used for management purposes	250
Cultural landscape preservation	
THEMATIC SECTION C: VISITS DO NOT DISTURB THE VALUES OF THE PROTECTED LANDSCAPE VJETRENICA - POPOVO PO	OLJE AND
PROVIDE VISITORS WITH AN UNDISTURBED AND COMPLETE EXPERIENCE, WHICH IN THE BEST POSSIBLE WAY PRESE	
PRESERVED BIOLOGICAL AND CULTURAL HERITAGE, GENERATES INCOME NEEDED FOR ITS PRESERVATION, BUILDS PUBLIC	
FOR NATURE CONSERVATION AND OPENS OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT OF THE LOCAL COMMUNITY	
Organized visitors' management Area in the service of local communities and measures to improve the tourist offer	259
Area in the service of local communities and measures to improve the tourist offer	
Offer presentation and education	272
Offer presentation and education	277
THEMATIC SECTION D: THE LOCAL COMMUNITY IS THE MAIN PARTNER OF THE MANAGER IN PRESERVING ITS VA	,
RECOGNIZES THE AREA AS AN IMPORTANT PART OF ITS IDENTITY AND ITS DEVELOPMENT IS BASED ON THE SUSTAINABLE	
OPPORTUNITIES PROVIDED BY THE PRESERVATION OF THE AREA	
Revival of agricultural production	
Development and networking of ecotourism offer	
THEMATIC SECTION E: THE PUBLIC COMPANY HAS ALL THE NECESSARY LEGAL, ORGANIZATIONAL, HUMAN AND I	
CAPACITIES, RESOURCES AND POWERS TO MANAGE THE AREA AND USES THEM TO CONTINUOUSLY IMPROVE ALL SEGM	
MANAGEMENT AND ORGANIZATIONAL CULTURE, THUS BUILDING COOPERATION WITH STAKEHOLDERS AND ITS ROLE IN D	
AND INTERNATIONAL CIRCLES	
Improve the area management system	
MANAGEMENT ZONING	304
PROTECTION ZONE I (A) - STRICT PROTECTION ZONE (A ZONE)	311
PROTECTION ZONE II (B) - ACTIVE PROTECTION ZONE (B)	317
PROTECTION ZONE III (C) – ZONE OF USE (C)	329
PROTECTION ZONE IV (D) - TRANSITIONAL PROTECTION ZONE (D)	334
REFERENCES	337





INTRODUCTION AND CONTEXT

The document presented here is first Management Plan of the Protected Landscape Vjetrenica - Popovo polje and it cover the period of implementation from 2021 to 2031.

The aim of the Management Plan (hereinafter referred to as: "the Plan") is to clearly and succinctly display key information about the area in one place, as well as the participatory process of established policies and strategies (through objectives and activities) that guide the management of the protected area and resources of the public company. The plan primarily assists the Public Institutions in the nature conservation sector to manage the protected area in an effective long-term manner. At the same time, it is also a public document available to everyone, enabling all decision-makers and the interested public to monitor the activities of the public company and to get involved in the management of the protected area through own involvement where possible thus contributing to the conservation of its values.

The Plan is structured in three key sections – introduction part, description of the area and management section. The introductory part contains the legal basis, the process of drafting the Plan and the process of evaluation, monitoring and review.

The descriptive part of the Plan describes the main natural and cultural values of the area and provides an overview of basic social activities in the area. In addition, this chapter gives an assessment of the current state of biodiversity in the area with identified pressures. The management part contains the vision, management objectives, evaluation of the situation and activities by objectives – Action Plan and management zonation.

In addition to these three main sections, the Plan also contains Annexes with consolidated additional information concerning individual themes, important for a more comprehensive understanding of the text. The document is accompanied by cartography maps that are provided in the Annexes.

Management, species protection, habitat protection, tourism and recreation, awareness raising, training and informing, sustainable use, management and administration, monitoring of the state, for which evaluations of key characteristics are elaborated, as well as defined specific and overall objectives of the activities. Each planned activity includes the following: planned implementation period, expected cooperation in implementation with external associates and institutions, and the estimated indicative costs of implementation (that do not include costs of regular business operations of the public company).

The vision and overall objectives of the Plan have been defined for a period of ten years, under the assumption that no extraordinary circumstances that are currently impossible to foresee will arise in the in the area of the Protected Landscape Vjetrenica - Popovo polje, causing substantial changes to the management context or characteristics of the area. Period of implementation of activities is determined by the timetable stated for each activity, and this aspect is also not specifically emphasized in the manner in which the activities are formulated.

Country	Bosnia and Herzegovina
Name of the protected area	Protected landscape "Vjetrenica-Popovo Polje"
Protection category	V. a) Protected landscape (Coastal landscape)
Geographic position	44° 11' 6.108'' N 17° 50' 45.564'' E
Area size	4.710,17 ha
Brief description of the area	The Vjetrenica site with its surroundings and part of Popovo polje is located in the centre of a typical Herzegovinian karst. The hydrological and hydrogeological characteristics of this area are particularly significant, which led to creation of a range of original karst processes, which resulted in numerous caves, pits, abysses and the whole world of groundwater architecture. Vjetrenica is a complex cave system with a canal length of 7,323.9 m, which is one of the longest caves in BiH. It was named after the strong wind at the entrance to the cave, but also inside the cave, which is especially pronounced in the summer and winter months. In addition, in hydrological terms, Vjetrenica is a hydrological active, speleological and drifty object with four autonomous water streams, as well as a dozen of smaller, periodical streams and underground lakes.
Law on declaring the are as protected landscape	Law on declaring the area of the Vjetrenica cave with a part of Popove polje a protected landscape "Vjetrenica-Popovo polje" (Official Gazette of



	the HNC, 2/2021 of 22 March 2021)
Relevant planning documents:	/
Responsible institution:	Herzegovina-Neretva Canton, Municipality of Ravno
Managing authority	Public company Vjetrenica llc Ravno
Date of establishment of the public company:	Registered on 7 September 2005 by the Municipality
Contact information:	Headquarters: Trg Ruđera Boškovića bb, 88370 Ravno Tel/Fax: +387 36 891 034; +387 36 819 061 Email: info@vjetrenica.ba



Legislative framework for protected area management

In order to preserve and rationally use the natural resources of this area, the area of the Protected Landscape Vjetrenica - Popovo polje was declared a protected area due to the emphasized landscape value, numerous endangered and rare species and habitats and rich cultural and historical heritage.

Assembly of the Herzegovina-Neretva Canton, at its session held on 22 March 2021 passed the *Law on declaring the area of the Vjetrenica cave with a part of Popovo polje a protected landscape "Vjetrenica-Popovo polje"* (Official Gazette of the HNC, 2/2021). Protected landscape "Vjetrenica - Popovo polje" covers an area of 4,710.17 ha. From the point of view administrative position, the area of coverage belongs to the municipality of Ravno or Herzegovina-Neretva Canton. The municipality of Ravno in the west and southeast is bordering with the Dubrovnik-Neretva County in the Republic of Croatia, in the northeast with the municipality of Trebinje, and in the north the border extends with the municipality of Neum. From the regional-geographical aspect, the protected area Vjetrenica-Popovo polje belongs to the Mediterranean macro-region of Bosnia and Herzegovina, i.e., the East-Herzegovinian mesoregion, the nodal-functional centre of which is the city of Trebinje. The main value of this area is the unique biological diversity and the area of the Vjetrenica cave. The entire area of Vjetrenica-Popovo polje belongs to the Trebišnjica river basin, that is, the Adriatic basin.

For the effective management of the protected area, it is important that these documents are mutually harmonized and based on expert knowledge about the area and its beneficiaries. In this way, the preservation of nature is enabled, with an even distribution of the benefits arising from the protection. The Law on Nature

Protection of the Federation of BiH (FBiH Official Gazette, 66/13) governs nature protection and management of protected areas in the Federation of BiH. The legislative framework for the institutional management of protected areas in BiH derives from Articles 151 and 152 of the Law on Nature Protection of the Federation of BiH, that is, Article 94 of the Law on Nature Protection of the Herzegovina-Neretva Canton. Both of the aforementioned regulations stipulate, inter alia, the obligation to designate a competent authority for the implementation of management measures to be applied in the protected area by a special regulation. According to the Law on Nature Protection of the Federation of BiH (Article 151), the management of a protected area is performed by a public institution or a public company. Public companies for the management of protected natural values from categories I and II, referred to in Article 134 of this Law, are established by the Government of the Federation of BiH. Public institutions/companies for the management of other protected areas and other protected natural values are established by cantonal governments.

Preparation, development and adoption of the Protected Landscape Management Plan Vjetrenica - Popovo polje are based on the provisions of the Law on Nature Protection (FBiH Official Gazette, 66/13) which requires the adoption thereof for protected areas in the Federation of BiH. According to the currently applicable FBiH Law on Nature Protection from 2013, protected nature objects are classified into six categories of protected areas:

- (1) Category Ia: Strict nature reserve; Category Ib: Wilderness area
- (2) Category II: National Park
- (3) Category IIIa: Nature Park; IIIb Monument of nature and nature characteristics
- (4) Category IV: area of habitats/species management
- (5) Category V: a) Protected landscapes: coastal landscape marine landscape b) Regional Park

(6) Category VI: Protected areas with sustainable use of natural resources.

The first and second category of protected areas are under the jurisdiction of the Federal authorities, while the other categories are under the jurisdiction of the cantons in the territory of which they are located.

The Law on Nature Protection of the Herzegovina-Neretva Canton (Official Gazette of the HNC, 12/17) is a new Law on Nature Protection and it governs the competencies of bodies performing nature protection activities, general nature preservation measures, the system of restoration, protection and complete nature conservation, sustainable use of natural resources, conditions for nature interventions, declaring and protection of natural values, manner of managing protected areas of nature, granting concessions in protected areas of nature, compensation to owners and users in the areas of nature which are subjected to limitations, liability for damages caused to nature, planning and organization of nature protection, inventory and monitoring of the state of nature, involvement of the public in decision-making on nature, performing administrative and professional tasks related to nature protection and preservation, financing of nature objects are classified into six categories:

- a) Nature park;
- b) Monument of nature;
- c) area of habitats/species management;
- d) Protected landscape: Land Marine
- e) Protected areas with sustainable use of natural resources;
- f) Regional Park

The concept of management plan for protected nature areas in the Federation of BiH is introduced by the Law on Nature Protection (FBiH Official Gazette, 66/13). The Law stipulates that the management of a protected

area is carried out on the basis of the Management Plan, as well as the Spatial Plan of the area of special characteristics. The protected area Management Plan aims to provide guidance and control the management and use of goods, as well as the development of human resources, financial resources, facilities, equipment, as well as the programs needed to support such management and use. The content of the Management Plan is stipulated by Article 156 of the Law on Nature Protection of the Federation of BiH (FBiH Official Gazette, 66/13). According to the regulations, Management Plans are adopted for a period of 10 years and can be reviewed after 5 years.

The Law on Nature Protection of the Federation of BiH stipulates that the management of a protected area is performed on the basis of the Spatial Plan of the area of specific features. No spatial plan of the area of specific features has been prepared for this area. Given the current situation of declaring the area as a relevant spatial planning basis for the needs of this Plan, the relevant spatial planning documentation will be used.

In accordance with Article 115 of the Law on Spatial Planning and Land Use at the level of the Federation of BiH, the Spatial Plan of Bosnia and Herzegovina for the period from 1981 to 2000 shall apply until the adoption of the Spatial Plan of the Federation of BiH, in the part which is not contrary to the Constitution of the Federation of BiH. In accordance with the law, the management of the protected area Protected Landscape Vjetrenica - Popovo polje will be carried out on the basis of the Plan adopted at the proposal of the mayor and adopted by the Municipal Council of Ravno municipality. A broad circle of stakeholders was involved in the preparation of the Plan: local authorities, associations, tourist organizations and communities, the business sector, scientific institutions, non-governmental organizations, individuals and others.

According to the Spatial Plan of BiH 1981-2000, the protected area Vjetrenica - Popovo polje is recognized as an existing geomorphological underground natural monument.

The BiH Spatial Plan also shows a projection of the protection of the area until 2000, which includes a wider area of protection than the one originally marked in 1981, thus covering the wider area of Zavala and Orahov Do under the planned protection, all the way to the border with the Republic of Croatia.

Preservation of natural resources and their improvement in relation to the current state, as well as revitalization of defined natural values represented the interest and objectives of spatial planning of BiH for the period 1981-2000.

The procedure for drafting the Spatial Plan of the Herzegovina-Neretva Canton (HNC) was initiated back in 2008, however, to date the document has not been formally adopted by the HNC Assembly.

The Municipality of Ravno adopted the Spatial Plan, as the basis for the protection of Vjetrenica. Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007-2017 (Municipality of Ravno, 2011) support the continuation of activities for the protection of the Vjetrenica cave, as well as the continuation of exploring other natural values of this municipality. The coverage provided in this Spatial Plan completely coincides with the boundaries of the protected area – Protected landscape Vjetrenica-Popovo polje.

Protected landscape management context

The Plan is a basic developmental, organizational and economic document of area management.

The Plan defines a long-term vision and strategic guidelines for guiding and managing a Protected Landscape. The main goal is to set ways and provide mechanisms for creating a long-term system of biodiversity and landscape protection, and additionally offer an area management system that is in line with the principles of sustainable use of natural, cultural and other assets.

The document provides clear guidelines for managers of the Protected Landscape Vjetrenica - Popovo polje on how to carry out activities on preservation, use and management of existing resources, protection and preservation of valuable cultural and historical heritage and respect for the needs of local communities.

The Plan contains basic information and guidelines for the protection but also sustainable use of the area, including the special interests of the local community. In this sense, the part related to the harmonization of the interests of all stakeholders (beneficiaries) in the area with the conditions of nature protection, as well as the part related to their education, as well as education of visitors to the area, is of special importance.

Protected landscape management activities for Vjetrenica - Popovo polje should:

> contribute to the achievement of a wider range of Protected Landscape management objectives, from protection to economic development; ensure responsible development in accordance with material, human and financial parameters;

> guide the daily decision-making and planning process headed by the Public company/Institution;

establish cooperation with the local community in order to ensure the long-term preservation of the natural values of the area

integrate private and public management.

Following the development of the Plan and its adoption, the management of the protected area Protected Landscape Vjetrenica - Popovo polje will receive a long-term planning document that will make the complex model of conservation and management understandable to the general public. Based on the Management Plan

for the Protected Landscape Vjetrenica - Popovo polje, a detailed Annual Program is prepared, by means of which the activities from the Management Plan are implemented.

Management Plan preparation process

The process of preparation of the Management Plan is set in accordance with the internationally adopted approach and the standards and guidelines for the development of management plans provided by the International Union for Conservation of Nature (IUCN). The process includes forming of a project team which, in addition to the representatives of the consultant, implies involvement of experts on specific topics.

Representatives of local, regional and state administration, various organizations, local population, academic institutions, non-governmental organizations and individuals who possess certain knowledge of the areas covered by the Plan or are in any way interested in participating in the process of their development were involved.

It is important to point out that the Plan includes the views and opinions of stakeholders from certain areas in order to better understand the problems of protection and use of the Vjetrenica - Popovo polje area and find possible solutions for better management of the protected values.

Scope and content of the Management Plan

This Management Plan was developed so as to provide guidelines for the management of the Protected Landscape Vjetrenica - Popovo polje and to preserve natural and cultural values and develop a framework for sustainable resource management.

The Plan, if properly implemented, should ensure achievement of the vision and main objectives of the area management, provide the competent institutions with a management path, as well as clear guidelines on how to successfully use tools, measures for long-term conservation of biodiversity and to develop and maintain management systems in accordance with sustainable use principles and preservation of natural and cultural heritage.

Guidelines for management, organization of activities, and monitoring the implementation and the state of biodiversity are important elements of this Management Plan.

Responsibilities for managing and implementing the Plan

The FBiH Ministry of Environment and Tourism is responsible for implementation of the Law on Nature Protection of the Federation of BiH (FBiH Official Gazette, 66/13) and international conventions in the field of nature protection in the Federation of BiH, for coordination of administrative and expert tasks for planning the sustainable use of natural resources. Control over the expert activity, legality of operations and bylaws of public institutions for management is performed by this Ministry.

The FBiH Ministry of Spatial Planning is responsible, inter alia, for the implementation of the Law on Spatial Planning and Land Utilization at the level of the Federation of Bosnia and Herzegovina, which especially refers to the spatial plans of areas of specific features.

The Ministry of Trade, Tourism and Environmental Protection of HNC is responsible for implementation of the HNC Law on Nature Protection (Official Gazette of HNC, 12/17) and international conventions in the field

of nature protection on the territory of HNC, for coordination of administrative and expert tasks related to nature protection and for planning the sustainable use of natural resources. Control over the expert activity, legality of operations and bylaws of public institutions for management is performed by this Ministry. The Ministry of Construction and Physical Planning of the HNC is responsible, inter alia, for implementation of acts on spatial planning and land use at the level of the HNC, which especially refers to the spatial plans of areas of special features.

In the process of revision and expansion of the protection area of the Vjetrenica Cave with the natural ensemble of Popovo polje, the Government of the Herzegovina-Neretva Canton entrusted its management to the public company Vjetrenica llc Ravno until the establishment of the cantonal public institution. Public company Vjetrenica llc. Is responsible, inter alia, for the implementation of protection measures and the implementation of the objectives of the protected area set by this Management Plan. Public company Vjetrenica llc Ravno has the entire organizational structure, as well as the Governing Board to which periodic reports on the implementation of Plans and Activities are submitted.

The Municipality of Ravno, recognizing the importance of this area and its protection, founded the Public company "Vjetrenica" llc Ravno in 2005, which operates in accordance with the regulations of public companies established by the Municipality. The Municipality, as the founder, co-finances sustainability through employee salaries and payments for regular maintenance of the cave.

Public company "Vjetrenica" llc Ravno performs the activity of protection, maintenance and promotion of the Protected Landscape Vjetrenica - Popovo polje. The Public company performs the activity of protection, maintenance and promotion of the value of the Protected Landscape Vjetrenica - Popovo polje in order to protect and preserve the authenticity of nature, ensure smooth running of natural processes and sustainable use of natural resources and monitors the implementation of nature protection conditions and measures. It

also supervises the manner of performing permitted economic activities, with the aim of ensuring the rational and sustainable use of natural resources.

Name of institution: Public company Vjetrenica llc Ravno *Headquarters:* Trg Ruđera Boškovića bb; 88370 Ravno; Bosnia and Herzegovina *Phone:* +387 36 891 034 *Fax:* +387 36 819 061 *E-mail:* info@vjetrenica.ba

Management Plan activities financing

Financing of protected areas is often a challenge because there is a small number of cases of protected areas that are financially independent, that is, they are dependent on the budget of institutions of higher order.

Management of Protected Landscape Vjetrenica - Popovo polje and the day-to-day work of the manager of the public company Vjetrenica should rely on clear financial mechanisms and specific financial resources necessary for the functioning of the company and the achievement of the objectives of the Management Plan.

Funds for the work of the public company Vjetrenica llc Ravno are ensured from:

- > Budget of the Municipality of Ravno
- Cantonal budget
- > Own revenues
- Donations and
- > projects at the Federal, cantonal and international level.

Following the example of the world's practice, other forms of financial support necessary for management should be based on the activities of funds and foundations of various agencies, NGOs, etc. Other sources include subsidies, donations, funds of local, federal, state and international institutions and organizations. It is envisaged that public companies may also receive funds from the municipal budgets in accordance with their programs insofar as they are an integral part of protected area management plans.

Plan preparation process and stakeholders' involvement

The process of preparing Management Plan is set in accordance with internationally adopted approach and the standards and guidelines for the development of management plans provided by the International Union for Conservation of Nature (IUCN).

In the process of drafting, consultative meetings were held with the management of the public company Vjetrenica llc Ravno on the occasion of which the current problems and shortcomings were analysed.

Due to the unfavourable situation caused by the COVID-19 pandemic and epidemiological measures, the meetings had to beheld online. The meetings were open to all stakeholders.

A consultative meeting was held on the occasion of which the preparation of the Management Plan for the Protected Landscape Vjetrenica - Popovo polje was presented. Due to the limited time set by the epidemiological measures as well as the number of participants, a survey was conducted in order to obtain the opinion of the local community on the advantages, disadvantages and possibilities of development and preservation of this area. Survey analysis, as well as photos from the meeting are available in the attachment.

After collecting and analysing data obtained in the participatory process, the expert team developed a draft Protected Landscape Management Plan.

MANAGEMENT PLAN MONITORING, EVALUATION AND REVISION

Legal basis for the Plan revision

The Plan is adopted for ten years with the possibility of its amendment after five years, and it sets out the state of the Protected area and the management objectives, activities to achieve management objectives and indicators of management efficiency.

Monitoring Management Plan implementation

Monitoring the Management Plan implementation should be set at the very beginning of its implementation. Following the expiry of the five-year period the results of the Management Plan implementation are analysed, and if necessary, the management Plan is revised in the manner and following the procedure as set out during its adoption.

Responsibility for the implementation of the Management Plan lies with the management of the public company. Based on the Plan for each year, the public company adopts an annual work program in which the objectives and activities are elaborated in detail. The work program is submitted to the competent authority

for confirmation. The work program determines in more detail the activities of the public company and the manner of professional assistance and counselling of the local population in performing their activities,

The work plan is one of the instruments for the implementation of the Management Plan and it defines, inter alia, the following:

- Revenues and expenditures forecasting;
- Capital expenditures proposed for the period covered by the work plan.

The management Plan defines the main indicators for monitoring and sources of verification for each of the defined objectives in order to enable the assessment of their implementation. Defined indicators and sources of verification can greatly facilitate the establishment of a system for monitoring the implementation of defined objectives. The implementation of the Plan requires a high degree of participation of identified stakeholders, especially local community.

Monitoring and evaluation of the Management Plan implementation

Monitoring the implementation of the Plan is aimed at ensuring timely detection of deviations in the implementation of planned measures and results related to the achievement of specific and overall objectives.

Monitoring also ensures the collection of experience needed for evaluations and corrections of the Management Plan. Measures for monitoring the effects of management consist of collection of data on indicators that prove, from the sources of verification, the implementation of the foreseen measures aimed at achieving specific objectives by the given topics. The evaluation of indicators is used in the preparation of the

annual work program of the public company and in the preparation of the revision of the Plan after the first five years of management.

Monitoring enables the acquisition of experience through the observation of the impact of management, in accordance with which management activities will be further adjusted. In accordance with the Plan, the employees of the public company will be responsible for monitoring of the implementation of various sections of the Plan. All employees should gather evidence and information that will show whether the objectives of the Plan are being achieved. Based on the results of monitoring the impact of the Plan, regular annual amendments to the program for monitoring implementation will be proposed. Thus, the activities for the coming year can be adapted to the experiences of the Plan, it is necessary to make a comprehensive assessment of the achievements, objectives and vision of the Plan, and the outcomes of the revision will be included in the management plan for the next period.

In accordance with the aforementioned plan, different persons within the Protected area management will be responsible for monitoring the implementation of different sections of the Plan. Given that the Plan includes a number of actions that must be implemented and whose implementation will be monitored, priority should be given to the establishment of a comprehensive system of reporting and archiving of information that the Protected Landscape will use on a daily basis. Such information will be the basis for regular meetings of the team for monitoring implementation of the Plan. Based on the results of monitoring the impact of the Plan, regular annual amendments to the program for monitoring implementation of the Plan will be proposed.

Cooperation with other users of the area

Cooperation with local government authorities (Herzegovina-Neretva Canton and the Municipality of Ravno) has a priority in the system of cooperation with other users of the Protected Landscape Vjetrenica - Popovo polje.

Cooperation with the bodies of the Federation of BiH, and especially with the competent ministries and the Environmental Protection Fund, also ensures realistic sources of funds for the implementation of action plans in the initial phase of management of the area, and cooperation with tourist agencies ensures funds for further system upgrades.

Cooperation with local residents and non-governmental organizations (NGOs) brings benefits through their participation in the preservation and protection of the Protected area. Moreover, in the same sense, the cooperation with the forestry management and with agricultural producers is useful and necessary.

It is important to establish cooperation with scientific and educational institutions (institutes, universities, schools), both for the implementation of research and monitoring, and for education of younger generations starting from participation in scientific projects to learning about the need for nature protection. All these institutions can be considered as stakeholders in the implementation of the Protected Landscape Management Plan Vjetrenica Popovo polje. The list of these and other stakeholders can serve as a basis for the development of the public company database with the titles, addresses and names of all stakeholders that should be included in certain activities related to the implementation of this Plan.

Cross-border cooperation

According to Article 134 of the Law on Nature Protection (FBiH Official Gazette, 66/13) areas of protected natural values may be cross-border connected with protected areas of another state. The management plan and measures of a protected area connected across a frontier are defined by agreement with the competent authority of the state in which the cross-border segment of a natural value is located. Protected Landscape Vjetrenica - Popovo polje is located near the border with the Republic of Croatia, and it is an important part of the southern karst. In the Republic of Croatia, this area is recognized as an integral and important part of the karst with strong impacts, with a certain degree of protection and which is dependent on waters coming from the territory of Bosnia and Herzegovina.

That is why it is especially important that the Public company Vjetrenica llc Ravno establishes cooperation with county authorities in the Dubrovnik-Neretva county in the Republic of Croatia, in charge of nature and environmental management, but also with the competent state authorities in the Republic of Croatia. Cooperation should be established through:

- ✓ joint projects from monitoring the state of endangered species to wetland restoration,
- ✓ joint promotion on the domestic and international market,
- implementation of unified management in similar habitats,
- exchange of knowledge on protected area management,
- ✓ organizing joint meetings and exhibitions.

The Public company should establish cooperation with public institutions of other protected areas with similar or same habitat characteristics in the region (Republic of Montenegro, Republic of Slovenia, Republic of Serbia, Republic of Albania, Republic of Macedonia, etc.)

Cooperation should be established through:



- Coordination of monitoring of the state and scientific and expert research,
- implementation of unified management of the same and similar common wetland habitats and natural values,
- protection of certain species with a large distribution range,
- joint tourist offer/joint promotion on the domestic and international market,
- exchange of knowledge on protected areas management.

AREA DESCRIPTION

Geographical-administrative affiliation

From the point of view of administrative position, the area of the Protected Landscape Vjetrenica-Popovo polje belongs to the Municipality of Ravno, that is, the Herzegovina-Neretva Canton. The Municipality of Ravno in the west and southeast borders with the Dubrovnik-Neretva County in the Republic of Croatia, in the northeast with the Municipality of Trebinje, and in the north the border extends with the Municipality of Neum. From the regional-geographical aspect, the Protected area Vjetrenica - Popovo polje belongs to the Mediterranean macro-region of Bosnia and Herzegovina, that is, the East-Herzegovina mesoregion, whose nodal-functional centre is the city of Trebinje. The entire area of Vjetrenica - Popovo polje belongs to the Trebišnjica river basin, that is, the Adriatic basin (Nurković and Mirić, 1998).

The space of the Protected area Vjetrenica - Popovo polje has a favourable traffic – geographical position in relation to the surrounding area. From the west, the Protected area can be accessed by the regional road Čapljina - Hutovo blato - Ravno, while from the northwest it is accessible by regional road communication Čapljina - Bregava valley - Stolac - Ljubinje - Popovo polje. From the east to Vjetrenica, there is a regional road route Foča - Gacko - Bileća - Trebinje-Popovo polje. Towards south and southeast, the area of Vjetrenica has a road communication that goes from the settlement of Ravno through the border crossing to the town of Slano in the Republic of Croatia, from where it has a connection to the Adriatic highway. Within the Protected area, there are several roads, mostly of local rank, which carry traffic for the needs of the local community of the Municipality of Ravno (Map 1, Map 2). The area where the Vjetrenica cave is located has been nominated for inscription on the World Heritage List under the protection of the United Nations Educational, Scientific and Cultural Organization - UNESCO.





Map 1. Geographical position of the Protected area Vjetrenica - Popovo polje in relation to municipalities, canton, state border and region



Map 2. Boundaries of the Protected Landscape Vjetrenica - Popovo polje

Physical and geographic characteristics

According to the data obtained from the "Feasibility study for the protection of natural value of the Vjetrenica cave and part of the Popovo polje in Ravno municipality", this area is dominated by limestone and dolomite deposits of Mesozoic and Cenozoic Paleogene flysch formations. The entire area belongs to the Trebišnjica river basin or the Adriatic basin. Due to the predominance of limestone and dolomite structure of the parent rock substrate, the surface river network is poorly developed. The exception is Popovo polje, on the surface of which there is actually a surface river flow of the river Trebišnjica, which only has a periodic hydrological function. Hydrogeological relations are quite complex due to the fact that part of the ground water drains into the Adriatic Sea while the other part flows into the river Trebišnjica. The dominant soil types of Vjetrenica were formed as a result of the relation between the geological structure, relief structure and climate specifics of the terrain. Fluvisols are dominant in Popovo polje, while lithosols and regosols are dominant in the above-ground part of Vjetrenica (Multipurpose land valuation in the Federation of Bosnia and Herzegovina, FBiH Ministry



of Agriculture, Water Management and Forestry, 2013).



Geological and geomorphological characteristics

The wider area of Vjetrenica - Popovo polje, in the western part of Popovo polje, is located in the south-eastern part of the Dinaric karst in which numerous surface and underground forms were developed. This area is characterized by geomorphological phenomena such as karst fields and a number of speleological objects (caves and pits). Karst field is a geological phenomenon in karst that represents the largest depressions in the limestone terrain. Karst field is formed by the combined action of tectonic forces (faults), river erosion and corrosion, less often only by merging karst inlets. Some karst fields, such as Popovo polje, were developed from river valleys (Cvijić, 1900). When it comes to the geomorphology of the Vjetrenica cave itself, according to the data from the Management Plan, Vjetrenica is a complex cave system with a canal length of 7,323.9 m, which is one of the longest caves in BiH. Although there are cave plans, it is important to point out that it has not yet been fully explored and therefore the existing plan is not complete. Vjetrenica Cave consists of the Main Channel of upper Vjetrenica which is about 2,500 m long and numerous side channels, the most important of which are Donja Vjetrenica, upper and lower Absolon Channel, Radovanović Channel,


Leopard Channel, Welsh Channel and Ravanjski (Ravno) Channel, named after the central settlement of Ravno.

A detailed geomorphological analysis was conducted up to the end of the part of the cave arranged for tourists, that is, up to the Hajdučki sto. Large underground halls with examples of collapsed ceilings and speleothem accumulations are characteristic features of the Vjetrenica cave.

The initial part is dominated by the main channel in which large accumulations of speleothems can be observed in some places. Just behind the Vjetroviti klanac, the channel passes through highly tectonic deposits that are intersected by numerous cracks where a large number of speleothems in the form of stalactites, stalagmites, soda straws and salts is deposited. At a number of locations in the cave, micro-reliefs were recorded, which were formed during phreatic and epiphreatic conditions, inactive hydrological phases, when a dense network of anastomosis was formed. Examples of this are the streamlines and niches in the part of the catchment hall (Nakapna dvorana) and the windows, niches, ceiling domes in the area of the entrance to Donja Vjetrenica. A part of the channel called Pjati is filled with a large number of cascades along the entire surface (width 16 m, length 78 m). These cascades are thought to have been caused by the accumulation of speleothems due to poor water flow. The calcite lake should be also mentioned, which is considered to have been 1 m deep, while its depth is now only 15 cm. Desiccation cracks (drying cracks) are clearly visible in the clay at the bottom, which actually indicate rapid drying and shrinkage of the sediment, resulting in cracking of the crust. Conditions in the Vjetrenica cave certainly weaken the sediment and make it susceptible to increased erosion, transport by air and water to other parts of the cave where it can be re-deposited. The Lukavac spring, located underneath the entrance to Vjetrenica, and the Bjelušica cave, located above the entrance to Vjetrenica, also belong to the cave system.

In geological terms, most of the area of Vjetrenica - Popovo polje is built of carbonate rocks deposited in the geological age of the Cretaceous era: limestones, dolomites and dolomitic limestones. In some layers of limestone, the percentage of calcium carbonate is up to 99.98%, which is also an indicator that in the distant future there will be a complete melting of rocks in Popovo polje. When it comes to the formation of the Vjetrenica cave, according to the data from the Management Plan, the Vjetrenica cave was formed as a result of numerous different processes that caused the genesis and development of speleological objects in the karst. Such processes refer to corrosion, erosion and collapse, which were influenced by the lithological characteristics of rocks, tectonics and climate, as well as hydrological conditions that still favour the shaping of Vjetrenica. The area where the Vjetrenica cave was formed was built of heavily karstic Malm and Lower Cretaceous limestone and dolomite. The processes of corrosion (chemical dissolution) are the dominant processes in the first phase of cave formation, and at the same time the slowest process that significantly prolongs the first phase of cave formation. As the corrosion process progresses, the cracks created by chemical dissolution are expanding and become interconnected, thus creating the conditions for a slow water flow. The occurrence of a slow flow causes more intense corrosion, and thus accelerate spread of cracks and their interconnection. At a later stage, in addition to the corrosion process, fluvial erosion plays a more important role. Within this phase, the water mechanically destroys the rock and carries particles that further destroy the flanks of the parent rock leading to widening of the main channel. The widening of the channel increases the range of the unstable ceiling built of cracks, interspersed with thin and thick layers of limestones and dolomites. In the initial stage, the canals are completely filled with water and phreatic conditions prevail. In the earlier phase of the formation of the Vjetrenica cave, which can practically be said to continue today, by lowering the erosion base and groundwater level, the ceiling collapses, forming high and spacious halls and galleries in the Vjetrenica system. This phase is characterized by sporadic deposition of speleotomes (Čičić, 2002).

In structural-tectonic terms, the Vjetrenica cave has numerous faults and systems of cracks that allow rapid penetration of water into the ground. The faults and cracks were formed under the influence of water currents

from different directions. Based on a review of the literature, it was concluded that even today the Vjetrenica cave has the function of a permanent/periodical spring. The clay deposits inside the Vjetrenica cave may be considered as one of the proofs of this claim. According to literature sources (Radovanović, 1929), there is a difference between autochthonous clay (formed in the cave) and allochthonous (introduced from the surface of the terrain above the cave) clay. The basic feature of the geological structure of the wider area are the limestone, dolomite and limestone-dolomite formations of the Jurassic and Cretaceous era, according to the authors of Basic Geological Map of Ston and Trebinje, Jurassic is divided into: J1,2 (Jurassic) black Jurassicbrown Jurassic, J 1,2 (Jurassic), Oxford-Kimmeridge J 2,3 (Jurassic), Kimmeridge-portlandian. Cretaceous era is divided to; 1K1 (Cretaceous), Hauterivian- Barremian, 2K1 (Cretaceous), part of the Barremian -the entire Aptian-part of the Albian, K1,2 (Cretaceous), Albian-cenomanian, K 1,2 (Cretaceous), cenomanian-turonian and K 3 (Cretaceous), senonian. Representation of Palaeocene-Eocene formations is limited, while the Quaternary dominates Popovo polje as an alluvial formation of the river Trebišnjica, proluvial materials and products of surface decomposition such as red soil appear to a limited extent. The registered formations tectonically belong to the high karst cover, they are tectonically broken with poor vegetation and represent an ideal environment for the occurrence of numerous karst phenomena such as caves, pits, abysses and narrow gorges, and numerous scrapes appear on the surface of limestone pavements (Map 3).



Map 3. Geological characteristics of the Protected Landscape Vjetrenica - Popovo polje

Tectonics

The wider area of the Vjetrenica cave system is located in the zone of high karst cover. The area is intersected by numerous faults, two main directions of faults striking (J. Marić):

- 1. longitudinal faults NW-SE
- 2. meridional faults N-S

The first group includes the most common regional faults (often reverse) which have a characteristic Dinaric direction of striking. In addition to these, this group also includes numerous faults of local character. Faults taken from the Basic Geological Map and faults determined by remote sensing are plotted on the developed geological map. The present faults of local character striking NW-SE and with less stability in the massif above Vjetrenica itself are probably the most responsible for the formation of the Vjetrenica cave system. Out of the regional and reverse ones, there is a wide zone of faulting and scallings in the direction of Grabov Do-Češljari-Golubinac-Belenići.

The second group of faults oriented in a north-south direction are characteristic from the point of view of intersecting and horizontally dislocating the masses contoured by the first group of reverse faults. On the developed map these would be the following faults: Čvaljina - Golubinac (Dubrave) which provided the basis for the development of the valley through which the road passes to Slano (HR) Zavala - Belenići, Kiev Do (Čičić, 2002).

By analysing the geological map from the aspect of tectonics, it is possible to clearly distinguish the Vjetrenica block which is separated by a reverse fault (scallings zone) that passes south of the Golubinac – Belenići move, and two faults Čvaljina - Golubinac and a fault of the same extension passing through Kijevo Dol. The block itself is intersected by the Budin Do – Belenići fault, which according to the set extension of the cave system in combination with numerous smaller faults so far determined only by remote sensing, "ensured" tectonic preconditions for the formation of Vjetrenica. The Kijev Do fault passes through the bed of the Brekovac

stream, although in the Basic geological map Trebinje paper it is listed as "photogeologically" noticeable. This fault, as seen on the field, brings into lateral contact the Jurassic J-2,3-Kimmeridge-portlandian dolomites with Cretaceous limestones 1K1- Hauterivian- Barremian (Šerifović and Smailbegović, perc. Commun.).

Hydrological and hydrogeological characteristics

The wider area of Vjetrenica belongs to the Trebišnjica river basin, which is part of the Adriatic basin. Large quantities of water flow out at the springs, which accumulate in the vast carbonate-karst underground or sink in Popovo polje and other karst fields. Due to the predominant limestone-dolomite structure of the parent rock substrate, the surface river network is poorly developed, with the exception of Popovo polje where the river Trebišnjica built a surface river flow that has only a periodic hydrological function. Protected Landscape Vjetrenica - Popovo polje belongs to the Trebišnjica river basin, that is, the Adriatic basin. According to hydrological research conducted so far in the area of Popovo polje, the existence of permanent springs has not been established. Significant periodical springs belonging to the group of water caves have been recorded, and their activity is related to the existence of a dolomite barrier between Popovo polje and the sea. Several such springs appear in the area around Zavala: spring Pokrivenik, Lukavac below the entrance to the Vjetrenica cave, and Čvaušnik and the Čvostik spring near Čvaljina (Map 4).

Ground water mainly flows towards the Pokrivenik spring. Pokrivenik spring has a total catchment area of about 8 km², and its waters flow towards the river Trebišnjica. The Lukavac spring basin leads it from the Pokrivenik spring basin in the length of 14 km², together with the overflow waters towards the Adriatic Sea. The catchment area of the Čvašnik spring and the Čvotik spring is significantly smaller than the previous two and it is 3.7 km².

The results of the chemical analysis, performed at 11 localities of Vjetrenica and the spring of Lukavac, indicate the presence of rocks through which groundwater seeps. These are waters with increased hardness of magnesium, which further indicates the flow of water through the limestone rocks. Increased hardness of magnesium was registered on the stream Visoke dvorane and the lake of the lower Vjetrenica. The ratio of



magnesium and calcium hardness of water at the Lukavac spring indicates a constant inflow of groundwater from the direction of Vjetrenica. We refer to the Vjetrenica cave as a hydrological active, speleological and drifty object with as many as four independent watercourses and dozens of smaller, periodic streams. There are also underground lakes, the largest of which is Veliko jezero, 180 meters deep.



Map 4. Hydrological map of the Protected landscape Vjetrenica - Popovo polje

In the hydrogeological breakdown of rock masses, four units can be distinguished that differ in porosity, conductivity and reservoir characteristics:

• Rocks of intergranular porosity and very good yield include quaternary unbound or very poorly bound deposits of gravel and sand covered with clayey carbonate powder, as well as conglomerates and talus material. The total mass of these alluvial deposits is dominated by gravel, sand, loam and humus cover on the soil surface.

• Rocks of intergranular porosity and moderate yield include quaternary unbound or very poorly bound clastic deposits, fluvial-glacial deposits, carbonate karst with red soil, deluvium, glacial and fluvioglacial material and most often they fill depressions (cavities, caverns) of karst inlets and large sinkholes.

• Cavernous and fissure porosity rocks with very good conductivity include limestones with sparse interbedding and dolomite intercalations. Most of the mentioned limestones are Jurassic and Cretaceous limestones, which mainly fill most of the protected areas. Within the terrain, their role is reflected in the function of the karst collector, the relatively deep karstification base and the primary directions of the flow along medium, large and very large regional faults.

• Rocks in which crack porosity predominates, and the appearance of caverns is mainly related to large faults. This type of rock implies solid carbonate rocks built of dolomitic limestones and dolomites and are mainly upper Jurassic and somewhat smaller lower Cretaceous deposits of dolomite and limestone, which occur in intermittent and elongated zones (Map 5).



Map 5. Hydrogeological map of the Trebišnjica basin (source: book "Vjetrenica - pogled u dušu Zemlje/a glimpse into the soul of the Earth", author: Ivo Lučić, Zagreb-Ravno 2003)

Climatological characteristics

According to the Management Plan, the wider area of the Vjetrenica protected area is located in the extreme northern part of the northern subtropical climate zone, in its periatlantic landscape sector. The dominance of meteorological influences of the mentioned zone, along with the relief predispositions of the wider area, presents the basic determinant of the formation of climate specificities both at the main and the climate subtypes level.

More specifically, in the wider area, moisture-rich air masses of the southwestern circulation, originating from the Gulf of Venice (Depression) and subtropical warm and dry air masses from the African North (North African anticyclone) alternate. These atmosphere centres of action for this region are of a seasonal character, since they are dominant in certain parts of the year, and in the second part of the year their influence is weakening. The aforementioned atmosphere centres of action alternate with each other. During the summer part of the year, the North African anticyclone is dominant, which weakens during the winter so that it is replaced by the dominant Gulf of Venice depression, which brings an abundance of moist and warm air originating from the Atlantic. Occasionally, during the winter period of the year, during certain, non-standard meteorological situations, cold and dry air masses originating from the continental interior arrive in this area, forming very cold and dry weather that usually lasts for several consecutive days. Such scheme in the spatial and temporal dynamics of centres of action directly reflects on the radiation and circulation processes in a wider part of the protected area, which results in forming of a larger number of local climates. The mountainous parts of the terrain have a pronounced vertical and horizontal disintegration with relatively high angles of slope and in general quite pronounced total energy of the relief. On the contrary, depressions of Popovo polje are characterised by low degree of total disintegration, as well as larger complexes of levelled soil of reduced karst-corrosion plateau, at altitudes between 500m and 800m. In the wider arch of the protected area of Vjetrenica, various meteorological phenomena can be formed during the winter part of the year, such as: radiation and advection fogs, weaker temperature inversions, etc.



Based on the above, it can be concluded that the climatological characteristics of the protected area Vjetrenica-Popovo polje are the result of the interaction of quantitative values of climatic elements and the influence of climatic factors. The most important climatic elements of the protected area Vjetrenica - Popovo polje are insolation, air temperature, relative humidity, cloudiness, precipitation and wind. The most important climatic factors are physical geographic position, relief, degree of continentality, frequency and directions of cyclonic and anticyclonic routes. In the wider area, one main climatic type can be singled out - Cs, which means Mediterranean climate with hot summer. Within the climatic subtype is characteristic in the area of Popovo polje and Zavala with altitudes up to 500m above sea level and implies a Mediterranean climate with hot summers. Csb climate subtype is dominant on the area where the altitude is over 500 meters above sea level and implies a Mediterranean climate with warm summers.

The mean annual temperature is 13 °C - 16 °C (Map 6). The period with mean monthly temperatures above 20 °C refers to June, July, August and September, which is why this area also shows subtropical features. The mean annual relative air humidity is about 70% at lower and up to about 80% at higher hypsometric levels, with the values being the highest during the winter part of the year and decreasing towards the summer period. The annual precipitation is quite high and ranges between 1,900 mm in the lower, up to about 2,100 mm in the highest hypsometric levels with one main precipitation maximum and one main precipitation minimum (Chart 1).

Rainfall dominates (about 130 days), while snowfall is rare, and it is mostly linked with only certain synoptic situations.

The wider area of Vjetrenica is dominated by winds of a regional character, which alternate according to the seasons. North, northwest and northeast winds are dominant, which is defined by the morphological openness from the area of Popovo polje. Vjetrenica was named after a strong wind at the entrance to the cave, but also inside the cave, especially pronounced in the summer and winter months. The strongest current was recorded at the very entrance to the cave, where it occasionally reaches over 15 m/s in the summer months. The air flow in the interior part of the cave arranged for tourists is weak to moderate, depending on the location, and the strongest flow was recorded at the entrance to the Vjetroviti klanac ('windy gorge'). The mean temperature of the cave is about 11 °C, and the humidity is up to 100%. All these characteristics are typical only for karst phenomena such as the Vjetrenica cave.





Chart 1. Climate diagram for Trebinje station, Popovo polje (time period 1981 - 2010) (source: rhmzrs.com)



Map 6. Mean annual temperature within the Protected landscape Vjetrenica - Popovo polje (according to: Management Plan for Vjetrenica Protected Area)

Pedological characteristics

The basic pedological characteristics of the wider area of Vjetrenica arose as a consequence of the dominant limestone and partly dolomite mineralogical-petrographic composition of the rock masses that make up the mountainous terrain. The exception is the area of Popovo polje, whose paedogenetic features are related to the presence of flysch Palaeocene-Eocene deposits located at the base of Quaternary deposits and which were the basis for the development of the crust of decay at the bottom of the field. An additional factor that influenced the dynamics of soil development is the bioclimatic complex, that is, the influences of the Mediterranean climate and vegetation of this area. The magnitude of their influence on the rock masses (which dominate in surface distribution) with a high percentage of calcium carbonate which is very susceptible to karst dissolution and leaching process. Given the above facts, the structure of the pedological cover is dominated by soils on limestones from the automorphic division of the soil, while only a small part (the area of the Popovo polje inlet) is represented by alluvial carbonate soils.

Automorphic soils in the area of Vjetrenica were formed by dissolving and decomposing the limestonedolomite rock complex by rainwater. Depending on the percentage composition of minerals, primarily CaCO₃, MgCO₃ and SiO₂, the intensity of biological decomposition and chemical decomposition of rock masses was determined, and thus the quality and speed of the pedological substrate.

Automorphic soils are the most undeveloped soils in this area, except in the area of Zavala, which also does not have a continuity of surface distribution, but these are most often rocky terrains or lithosol, composed mainly of loose skeleton whose depth is not more than 20 cm. The paedogenetic process is mainly based on the physical destruction and erosion of limestone-dolomite rock mass. The main types of automorphic soils that appear in this area are regosol, colluvium, calcomelansol and rendzina. Regosol (sirozem) is a undeveloped or poorly developed soil that is formed on loose substrates. It mainly occurs by physical erosion of the previously mentioned rock masses or rock terrain erosion. Colluvial soils are also underdeveloped or completely undeveloped soils formed by geomorphological processes of leaching and destruction of the parent rock substrate. Eroded and washed off material is further sedimented and conditions are created for the formation of pedological soil. Calcomelanosol can also be detected in the parent rock mass, and it is formed mainly by an acid reaction on hard and pure limestones or dolomites. The depth of the substrates in the area of interest is mostly chalk up to 30 cm. Limestone-dolomite black soil can very often form at the bottom of larger karst forms or smaller karst inlets, but very rarely substrate formation occurs. Rendzina is a type of soil that is formed in the later and advanced stages of the paedogenetic process and, therefore, has a more complex pedological profile than the previously mentioned types. This type of soil is characterized by the impossibility of mobilizing organic matter due to the small quantity of residues, so humus is mainly formed as a consequence of the accumulation of mineral components (Burlica and Vukorep, 1980).

In the protected area, these types of soils generally mix with each other, so that the types of transitional soil as well as the characteristic soil types can be clearly seen.

Hydromorphic soils in the area of Vjetrenica are presented as alluvial carbonate clay soils formed under the influence of groundwater and flood waters of Trebišnjica, which bring a larger amount of paedogenetic material into the substrate. The spatial distribution of these materials is defined by the transport power of the Trebišnjica river flow. Due to the flooding of rivers and the deposition of new material every rainy season, the development of this soil is hindered. Alluvial soils are suitable for growing all agricultural crops and they give high yields with regular irrigation. Along the coastal belt of Trebišnjica, the coarsest gravelly-sandy material is deposited, which is to a lesser extent combined with fine particles, the so-called clay fractions that serve as "fixatives" of the aforementioned loose material. As it moves away from the coastal area, the number of clayey, fine particles increases, and the number and quantity of particles of loose gravel material decreases, so that the finest material is deposited in the central zone where the presence of organic matter is at a high level and the humus horizon reaches 100 cm. depth. An overview of land types within the Protected landscape Vjetrenica - Popovo polje is shown on Map 7.



Map 7. Pedological characteristics of the Protected landscape Vjetrenica - Popovo polje



Vjetrenica Cave

The cave system of Vjetrenica and its surroundings are eminent and wellpreserved manifestations of karst topography. The area contains a wide range of karst features of exceptional scale and aesthetic quality. In Vjetrenica, almost all passages are wide and high along the entire length. The cave consists of several passages that can be grouped into four levels: main level, upper level, lower and vertical level. The main level is semi-horizontal, and it is the longest level in the cave. It starts from the entrance to the cave almost to its farthest point. At this level there are the longest and widest passages in the cave: the Main Passage (Main channel) and the Main Hidden Passage (Hidden Main channel). Even with the debris at the bottom of the cave, the unusual horizontality of that level leads to differences in opinion about 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 10-30 meters lower than the main level, and consists of Lower Lake (Donje jezero), Karaman Lake (Karamanovo jezero), Absolon Lower Passage (Donji Apsolonov kanal), Absolon Upper Passage (Gornji Absolonov kanal) and Radovanovic passage (Radovanovićev kanal). These passages are grouped in the first part of the cave, approximately 600 meters from the entrance. The upper level consists of five passages - Leopard Passage (Leopardov kanal), High Passage Stone (Visoki zasigani kanal), Plate Passage (Pločasti kanal), Wales Passage (Velški kanal) and Ravanjski kanal which are from tens to 120 meters higher than the main level. These passages are 1700 to more than 2500 meters away from the entrance. Presumed but not

discovered fourth level - the vertical level of the cave consists of deep pits leading from the surface of the terrain into the interior of the cave.

Despite the efforts of speleologists, none of these pits have been found. The main proof of the existence of the pit is the movement of air at the entrance and inside the cave. Milosavljević (1979), from an unknown source, stated 13 m/s as the highest wind speed at the entrance, while the highest recorded speed during the recent research of Vjetrenica was 8.5 m/s (Lučić and Sket, 2003). Such a strong wind is possible only in caves with multiple entrances located at different heights. Air movement is caused by differences in air pressure and temperature between the open atmosphere and underground cavities, and air velocity is the fastest in narrow passages (Bögli, 1980). During high waters, when the siphon in the Main Passage is completely flooded, there is no wind at the entrance (Lučić, 2009). This means that the pits are connected to the cave further than approx. 1000 m from the entrance, where there is a siphon.

Due to the topography of the hill above the cave, these pits should be at least 160 m deep in order to be connected to the known parts of the cave. There are several smaller streams in the cave, permanent and intermittent. The flow directions are towards the entrance or on the opposite side of it. There are also several water pools or lakes, the largest of which is the Great Lake (Veliko jezero) with a length of about 180 m, and several siphons that occasionally close some passages (Lučić and Sket, 2003). The walls and ceiling of the cave are only sporadically covered with mineral deposits of calcium carbonate - speleothem in the form of thinner or thicker coatings, but in the pit, there are several giant mineral deposits of calcium carbonate - speleothems. Speleothems (stalactites and stalagmites) are rare in the cave due to the most prominent process present in the cave - decay. Disintegration is the mechanical process of disintegration of rock that makes up the walls and ceiling of underground cavities (Ford and Williams, 1989). The floor of almost the entire cave is covered with corner rocks of various sizes mixed with clay sediment.

Several large chambers are almost filled with rocks, slabs, and small glomerate in the form of a pile several tens of meters high. It is almost certain that the collapse of the rocks at some points suffocated the passages by

completely filling them and carving a path into other unexplored parts of the cave. A good example of the action of ruined rock filling chambers is the closed entrance to the widest passage - the Main Hidden Passage. The entrance leading through the boulders is only some 50x50 cm wide. In addition to carbonate clasts, large amounts of clay are also found at the bottom of the cave. According to Radovanović (1929) and Malez (1985), there are two different ages of clay. The older clay is laid under the brittle rocks, while the younger one is covering it. Spindle lids are spoon-shaped depressions created by a rapid turbulent flow of water. Their shape could be used to move water directions in the past in relict caves (Ford and Williams 1989). In front of the entrance to the cave there is a karst field called Popovo Polje. The riverbed of the Trebišnjica River, Europe's largest subterranean river, runs through the field. Prior to hydrotechnical interventions that began in the mid-20th century, Popovo Polje was flooded in average 253 days a year (Milanović, 2006). The hydrological function of Vjetrenica has been an interesting topic for many researchers in the past. Some authors agree that Vjetrenica functioned as a transit point for water from Popovo Polje (Absolon, 1916, Radovanović, 1929, Cvijić, 1950, Malez, 1985), and that the cave expanded all the way to the Adriatic coast. Milojević (1928, 1938) and Zubčević and Gašparović (1958) have the opposite opinion - that the water from Vjetrenica actually flowed into Popovo Polje. The main argument in both statements was the topography of the end of the cave from the entrance to the Great Lake. The problem was that the map drawn by Radovanović (1929) showed a slope in the direction within the cave, while the maps drawn by Milojević (1938) and Zubčević and Gašparović (1958) showed a slope in the direction of the entrance to the cave. The entrance to the cave is located some 8 m higher than the Great Lake, which is 1200 m away (Lučić and Sket, 2003). In the model with four states of cave system geometry (Ford and Williams, 1989) distinguishing caves between the phreatic and water type, Vjetrenica belongs to caves with a mixture of ingredients in the form of phreatic and water, close to the ideal water cave. The last map of the cave (Map 8) was published by Ozimec et al. (2021).



Map 8. Map of Vjetrenica cave (source: Ozimec et al., 2021).

Biological characteristics of the area

According to the data provided by the "Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno", the ecosphere of the Vjetrenica-Popovo polje area consists of the atmosphere, pedosphere, hydrosphere and lithosphere. In each of these spheres there are living organisms, representatives of five large kingdoms: bacteria (Regnum Prokaryotae), protists (Regnum Protocysts), fungi (Regnum Fungi), plants (Regnum Plantae) and animals (Regnum Animalia).

The area envisaged by the Protected landscape Vjetrenica - Popovo polje belongs to the forest area of Europe due to its phytogeographical position (Horvatić, 1957, 1967; Lakušić, 1970; Trinajstić,



1984). However, the consequence of centuries of human activity in the protected area Vjetrenica-Popovo polje led to the differentiation of different habitat types and the degradation of certain primary ecosystems-forests. Thus, habitats such as forests, all types of shrubs, karst grasslands, meadows and pastures, gardens, fields, arable land are now clearly differentiated in this area (Redžić, 2007).



Soil leaching, action of winds, summer droughts and fires led to creation of dry grasslands typical of this area. These are mainly grasslands of the protected area, with sparse vegetation, resembling rocky deserts.

On the other hand, grasslands on which more soil was retained have more dense vegetation and they are richer in biological species. At higher altitudes, a special type of rocky grasslands developed, which is characterized by an extremely large number of biological species, containing a significant number of endemic species.

Extremely important habitats of the area of interest, Vjetrenica-Popovo polje, are cave habitats in which terrestrial and aquatic habitats and transitional habitats are distinguished. Karst cave habitats, similar to hygroperia, are habitats of a transitional character, with a permanent or occasional thin layer of water that overflows over the parent rock. There are two types of these habitats: hygropetric, habitats of a thin layer of water that flows over the walls of caves and flowstones, and habitats of marifugia deposits.

Landscape - trends and state

The overall quality of a space is the diversity and preservation of landscapes, their aesthetic and economic value and biological diversity of ecological systems, habitats and species, but also the implementation of scientific and expert research and protection and restoration measures, as an element of ethical responsibility for maintaining space for our descendants and the overall community. In the protected area Vjetrenica-Popovo polje there are two basic landscapes:

- a. Mediterranean-Mountainous landscapes
- b. Sub-Mediterranean landscapes

Within the sub-Mediterranean landscape, there is one exceptional ecosystem: a complex ecosystem of karst fields and fields in karst, which is consisted of the western part of Popovo polje with a hydrogeologicalmorphological phenomenon - the Vjetrenica cave. Each of these landscapes is characterized by its characteristic visual identity, but also by numerous diverse habitats that often give a recognizable landscape identity. The protected area continues in its southernmost part to the Mediterranean landscape of the coastal area of Southern Dalmatia (Republic of Croatia), the Mediterranean-Mountainous landscape, which in the northern part continues to the sub-Mediterranean landscape. The final, northernmost part of the protected area descends into the western part of Popovo polje, a complex ecosystem in which the entrance to the Vjetrenica cave is located. This entire environmental unit, from the southern edge of the western part of Popovo polje to the Adriatic Sea is indivisible and forms one hydrological, geomorphological, tectonic and cultural karst unit, which the famous Czech explorer called Paleoombla, alluding to the river that once flowed from Popovo polje to the present Ombla.

Biodiversity and habitats of the Protected landscape Vjetrenica - Popovo polje is divided into underground and above-ground part.



Figure 1. The area of the Protected landscape Vjetrenica - Popovo polje is a priceless ecological and economic value of the landscape of the entire Dinarides

Habitats and biodiversity

Bacteria and fungi

No serious research on bacteria and fungi has been carried out in the protected area of Vjetrenica-Popovo polje, so that the data for these two kingdoms are almost completely missing.

Algae

Algae have been explored so far only sporadically in the area of Herzegovina as part of lichen research, where they come in the community with fungi while, as far as is known, they have not been explored in the area around the Vjetrenica cave. According to the existing data for Herzegovina, we can expect a variety of green algae (Chlorophyta), especially epiphytes, which appear the bark of trees. Epilithic silicate algae (Bacillariophyta) grow on limestone rocks, and numerous green, silicate and gold (Chrysophyta) algae grow in the soil. We can also expect very interesting endolytic algae that live in closed cavities of limestone rocks, as well as very interesting and potentially endemic algae in caves and pits. Freshwater planktonic algae and freshwater benthos algae occur in ponds and wells.

Flora

Research on the flora of the aboveground part of the wider area of the Vjetrenica cave recorded 484 taxa, of which 42 were previously known



from the research area (Beck-Mannagetta, 1903-1924, 1927; Beck-Mannagetta and Maly, 1950; Beck-Mannagetta et al., 1967, 1974, 1983).

Of the previously recorded species, 12 have not been confirmed, 30 have been confirmed, while some species have been recorded for the first time (442). Among these recorded species, 21 species are endemic to the Balkans, while according to the Red List of Flora 38 taxa (10 vulnerable, 12 endangered, 5 critically endangered, 7 nearly endangered and 4 for which data are missing). A review of the data from literature as well as the results of research from Annexes 104 and II of the Habitats Directive discovered the amethyst meadow squill (Scilla litardierei Breistr. (1954)), while only *Ruscus aculeatus L.* and *Galanthus nivalis L.* were confirmed from Annex V. (Figure 2).





Vegetation

The subject area is phytogeographically located in the southern Adriatic province of the Mediterranean biogeographical region, which covers most of the southern areas of Bosnia and Herzegovina. The narrower category of forest land includes high beech forests, mixed beech and fir forests, mixed beech and fir forests with spruce and pure fir and spruce forests, pine forests, high sessile oak forests, forest crops, coppice forests of beech, oak, and mixed coppice forests, non-reproductive forests and usurpations. The distribution of vegetation types is influenced by a number of other factors, such as orographic, edaphic, but also by man, who contributes to the local formation of vegetation cover by the dynamics and scope of his activities. The vegetation of this area was investigated by, among others: Ritter-Studnička and Grgić (1975), Lakušić et al. (1982), Lovrić (1988), Redžić (2007), etc.

The main vegetation types that can be distinguished in the area include:

Forest and shrub vegetation

The area of the valley from Zavala to Češljari and further to the west of the state border with the Republic of Croatia, as well as the hills of Popovo polje above Čvaljina, and the relief indented area south of Zavala are overgrown with mostly low thermophilic shrubs and bushes, while no significant forest areas are recorded here, although in climate and zonal terms, the forest represents the ultimate vegetation phase (Fig. 3). This area is a transitional area between the Mediterranean and sub-Mediterranean zones. The relief indentation of the area introduces diversity and partly conditions the microclimatic conditions, which, including altitude and exposure, affect the distribution of vegetation. In the wider area of Vjetrenica, outside the influence of groundwater, the vegetation of low shrubs and bushes is formed mainly by elements of the order *Paliuretalia*. The vegetation of xerothermic deciduous forests and shrubs is built primarily by the communities of *Ostryocarpinionorientalis* association. On milder slopes of the terrain, within the *Ostryo-Carpinionorientalis* association, and with further degradation of shrubs, as their final degradation stage, sub-Mediterranean dry grasslands of

the order *Scorzonero-Chrysopogonetalia* are developed H-ić.et Ht. (1956) 1958. The mentioned communities of thermophilic shrubs are joined to the west by an increasing share of the Mediterranean elements of evergreen forests and matorral of the *Quercionilicis* association, which is especially pronounced west of Orahov dol. Namely, evergreen forests and holm oak matorral also include forests of the epimediterranean belt in which holm oak is mixed with deciduous species. The thermal character of the area's climate determines the development of these vegetation forms characteristic of the belt of evergreen forests and holm oak shrubs of the *Querceteailicis* order/class No.-Bl.1947, and the appearance of elements of the Eumediterranean rocks of the Thero-Brachypodietea order No.-Bl.1947 within dry grasslands.



Figure 3. Vegetation of forests and shrubs within the Protected landscape Vjetrenica - Popovo polje

Vegetation of dry grasslands

In the former forest habitats, under the influence of man, by pasturing, clearing and fires, various forms of thermophilic rocks and xerothermic meadows developed secondarily. Vegetation of sub-Mediterranean xerothermic grasslands of this area belongs to the order *Scorzonero-Chrysopogonetalia* H-ić et Ht. (1956) 1958 (syn. *Scorzoneretaliavillosae*) of the class *Festuco-Brometea* Br.-Bl. & R. Tx. 1943, and the most significant are the sub-Mediterranean rocks of the association *Chrysopogoni-Koelerionsplendentis*, *Satureionsubspicatae*, *Peucedanionneumayeri*, *Scorzonerionvillosae*, present in the area of the climate and zonal vegetation of the *Ostryo-Carpinionorientalis* association. The most widespread sub-Mediterranean rocky communities recorded in the wider area of Popovo polje are: the sage and sagebrush community (*Stipo-Salvietumofficinalis*), the fescue and keleria community (Festuco-Koelerietumsplendentis), the asphodel and karst community (Asphodelo-Chrysopogonetumgryčine), and the community of sedge and yellow knapwee (*Carici-Centaureetum rupestris*).

Due to the pronounced influence of the Mediterranean climate on this area, for the same reason that causes changes in composition of forest and shrub vegetation, an increased share of typically Mediterranean species can be observed in the vegetation of dry grasslands in this area. Thus, in the vegetation of dry grasslands of this area, there are elements of vegetation of eumediterranean rocks of the class *Thero-Bracyhpodietea*, and they include communities of *Cymbopogo-Brachypodionramosi* association, from the order *Cymbopogo-Brachypodietalia* H-ić. (1956) 1958 and the association *Thero-Brachypodionretusi*, from the order *Thero-Brachypodietalia* Br.-Bl.1947. The Euro-Mediterranean grasslands of the order *Thero-Brachypodietea* Br.-Bl.1947 are open, low grasslands, built mainly of annual plants, that is, the plants that complete their life cycle before summer droughts (therophytes and geophytes), which is why in the dry part of the year it is not possible to notice the richness of their plant composition. They develop on shallow carbonate soils, but also on deeper washed calcified soils throughout the Mediterranean. They are mainly used for pasturing, only to a lesser extent combined, but the use of medicinal, spicy, aromatic and wild edible plants should not be neglected (Figure 4). With succession, and cessation of use, they grow into bushes and matorral.



Figure 4. Vegetation of dry habitats in which widely used and well-known medicinal, aromatic and honey species *Salviaofficinalis* L. - sage finds its optimum

Vegetation of poorly grown terrestrial areas

Areas outside the constant water inflow with specific conditions of structure and wear of the geological base and slope, which includes vertical rocks and accumulations of mainly slightly movable rocks at their base, are overgrown with sparse vascular vegetation of rockery and scree plants. Rock vegetation is maintained as a natural permanent stage due to the specific conditions of vertical rocks with cracks in which fine soil and water are accumulated.

Due to the pronounced influence of the Mediterranean climate in the wider area of Popovo polje, the vegetation of this area is overgrown with vegetation of Adriatic coastal screes on a carbonate base of the order of the alliance *Peltarionalliaceae* (order *Arabidetaliaflavescentis* Lakušić 1966, order Thalaspietearotundifolii Br.-Bl.19) while the carbonate rocks with chasmophytic vegetation belong to the class *Asplenietaliarupestris* H.Meier) Br. - Bl. 34, that is, the orders *Moltkietaliapetraeae* Lakušić 1968 and *Amphoricarpetalia* Lakušić 1968.

In the area subject of research, habitats with chasmophytic vegetation can be found on steep rock sections, for example at the foot of Ilija hill, north of Orahov dol, and elsewhere where conditions in the form of constant rock wear and substrate removal do not allow soil development, and thus the plants





which are not adapted to such conditions. Habitats were identified with elements of communities of the order *Moltkietaliapetraeae* Lakušić 1968.



Figure 5. Vegetation of rock cracks on which a large number of endemic and endangered species found their place to live
Vegetation of part of Popovo polje with a review of the area around the Vjetrenica cave

Popovo polje is a typical karst field with various karst phenomena and a rich underground karst network. It is located at an altitude of about 220 - 250 m.a.s.l. According to its ecoclimatic characteristics, it is classified in the lower karst fields of eastern Herzegovina, and it is strongly influenced by the Mediterranean climate.

As opposed to the already described dry rocky pastures, which are maintained as a permanent stage by pasturing, wet karst meadows of the Mediterranean and sub-Mediterranean area develop in floodplain karst fields and river valleys, which are used mainly as meadows (Figure 6). At the same time, the grass vegetation of karst fields requires regular flooding in the wet part of the year, and then, by summer, the soil dries out significantly.

Special natural relations and processes created optimal ecological conditions for this area. This primarily refers to the presence of specific ecological factors that enabled a great diversity of habitats and species that are an integral part thereof. For natural balance in the connection of all components of nature or its biotic and physical factors, this area is a mosaic of different habitat types, and it is dominated by low thermophilic forests and underbrush, rocky terrains, dry karst pastures and underground habitats. This diversity is conditioned by geographical position, natural processes, but also by long-term anthropogenic influences. It is this mosaic that provides living conditions for a large number of species, both plant and animal.

The vegetation of thermophilic and hydrophilic and mesophilic meadows of Popovo polje generally belongs to the alliances of *Deschampsionmediae* (order *Holoschoenetalia vulgaris* Br.-Bl. ex Tchou 1948), *Molinio-Hordeionsecalini* and *Trifolionresupinati* (order *Trifolio-Hordeetalia*, Horvatić 1960). Meadows covered with clover and clusters (*Trifolio-Hordeetumsecalini* alliance) develop on moist soils with base reaction with high groundwater levels. They represent sub-Mediterranean moist low clover grasslands. They are mowed once a year, which, with the appropriate water regime, is an important condition for their maintenance. Small bushes (*Deschampsionmediae* community) meadows are also a significant type of grassland in the karst fields of the



sub-Mediterranean area of Bosnia and Herzegovina and neighbouring areas, and they develop on mineralwetland soil.



Figure 6. Vegetation of the Protected landscape Vjetrenica - Popovo polje in which there are wet meadows of the Mediterranean and sub-Mediterranean area



In summer, the soil dries out and cracks in some places. Characteristic species of these meadows is the small bush (*Deschampsiamedia* (Gouan) Roem. & Schult.). In the past, the grasslands of small bushes were used much more than today as meadows, and after mowing as pastures.

Part of Popovo polje east of the current course of Trebišnjica is largely cultivated and intensively processed. On the contrary, the part of Popovo polje west of the current course of Trebišnjica in the area around the Vjetrenica cave is mostly neglected and only some parts are used as pastures.

Along the old course of Trebišnjica and other periodical and permanent flows, and in depressions of the terrain where water is retained longer and the soil remains sufficiently moist, swamp vegetation with reeds and sedges develops. Wetland vegetation belongs to the order *Phragmitetalia* W. Koch 1926, that is, amphibious communities of the order *Isoëto-Nanojuncetea* Br.-BletTx 1943, which inhabit the contact zones of water and land, where occasional (natural) flooding and drying of habitats takes place.

Hygrophilous forests and shrubs of willow, poplar and wicker of the orders *Populetaliaalbae* Br-Vl 1931 and *Salicetaliapurpureae* Moor 1958 develop in similar conditions). Developed remains of such willow bushes can be seen along the old riverbed of Trebišnjica (vegetation of hydrophilic forests and bushes of the *Salijalbae*, *Salicionpurpureae* and *Viticionagni-casti*).At the same time, *Salicionbae* alliances represent a form of flood thermophilic forests and shrubs, which overgrow the shores of permanent or periodical watercourses and wetlands of the Mediterranean and sub-Mediterranean belt.

Vegetation of the entrance area of Vjetrenica

At the very entrance to the cave, the specific microclimatic conditions of increased humidity, shading and (in summer) the cold air currents from inside the cave are prerequisites for a kind of inversion of vegetation.

Namely, the stone base at the entrance to the cave is overgrown with plants characteristic of wetland rock habitats, such as some ferns of the *Aspleniaceae* family, or vegetation elements of carbonate rocks of the mountain belt, such as mossy merinka (*Moehringia muscosa L.*). The presence of mature mountain maple trees (*Acer pseudo platanus L.*), a species characteristic of the forests of the continental regions, is interesting, as opposed to the sub-Mediterranean vegetation of the surrounding above-ground area of Vjetrenica.

In the belt above the entrance, in addition to the vegetation of forests and underbrush similar to that of the wider area of Vjetrenica, some woody species are found to grow here by man action, such as evergreen cypress (*Cupressus sempervirensL.*), Acacia (*Robinia pseudacaciaL.*) and tree of heaven (*Ailanthusaltissima*) (Mill) Swingle).

Impact of man on vegetation

Land improvement interventions in Popovo polje, along with the conversion of land into agricultural land, and the abandonment of traditional agriculture led to major changes in the layout of the field. In the entire area subject of research, there is a significant share of areas that are neglected nowadays. Today, the central part of Popovo polje has turned into agricultural land. Intensively cultivated surfaces in the area of Čvaljina and Zavala are located east of the river Trebišnjica, and vineyards and orchards are the most common forms of land cultivation. The area subject of research in Popovo polje probably used to be more utilized for traditional forms of agriculture, and nowadays only a few smaller vineyards and pastures are maintained in it. The vegetation of arable and abandoned areas of Popovo polje belongs to the orders *Atriplici-Chenopodietaliaalbi* Tx. 1937, *Chenopodietaliamuralis* Br.-Bl. et al. 1936 and *Thero-Brometalia* Br.-Bl. 1947 of the class *Stellarieteamediae* Br.-Bl. 1921, while the vegetation of thermophilic abandoned habitats belongs to the order *Carthametalialanati* Brullo & Marceno 1985 of the class *Artemisietea vulgaris* Lohm., Prsg. et R. Tx. in R. Tx. 1950.



In the area of the surrounding smaller karst fields and right next to the settlements, only smaller plots under vegetable gardens and traditional olive groves and vineyards were observed (Figure 7).



Figure 7. Vineyards containing also autochthonous grape varieties

Since recently, a considerable attention is also paid to the issue of the spread of allochthonous invasive plant species. Thus, for example, the occurrence of the species *Ailanthusaltissima* (Mill.) Swingle (tree of heaven) (Figure 8) was observed in some places in the area under research, the spreading of which may pose a risk to the local natural vegetation due to rapid spreading by vegetative propagation. It grows well particularly in the southern parts, and spreads quickly along roads, forest edges and undershrubs, and in neglected ruderal and other open areas.



Figure 8. Vegetation of the Protected landscape Vjetrenica - Popovo polje with wet meadows of the Mediterranean and sub-Mediterranean area

Habitat types according to NATURA 2000 classification

The presence of a significant number of endangered and endemic plant species and typical and well-preserved habitat types of importance for the EU Habitats Directive, support the fact that the area Vjetrenica-Popovo polje is of global importance for the protection of European natural heritage (Council Directive 92/43/EEC, 1992; Milanović et al., 2015).

According to the data on habitats in the wider area of the Vjetrenica cave, the following habitat types are shown in Table 1.

NATURA 2000 CODE	LOCAL NAME
8310	Caves not open to the public
62A0	Eastern sub-mediterranean dry grasslands (Scorzoneretalia villosae)
6510	Lowland hay meadows
6540	Sub-Mediterranean grasslands of the Molinio-Hordeion secalini
8210	Calcareous rocky slopes with chasmophytic vegetation
*3180	Ephemeral karstic lakes
5210	Arborescent matorral with Juniperusoxycedrus and J. phoenicea
91F0	Lowland riparian hardwood forests
9250	Quercus trojana woods

Table 1. Habitat types according to Natura 2000 in the wider area of the Vjetrenica cave

9340

Quercus ilex woods



Fauna

The fauna of the area can be divided into two main groups:

A. Epigean or aboveground fauna

It lives at the contact of the atmosphere and the pedosphere, hydrosphere and lithosphere, which predominates in the area planned for protection. Animal communities (zoocenoses) are often associated with plant communities (phytocenoses). Many herbivorous species (phytophagous), especially beetles and butterflies, are associated with only a few host plants, sometimes a single one. Due to the pronounced karstification of the area, the water flows mainly underground, and the above-ground flows (hydrosphere) are less represented. Rare karst springs, occasional torrents, and ponds and wells are present.

<u>Terrestrial fauna</u> is represented by numerous invertebrates, of which the typical are snails (Gastropoda), earthworms (Oligochaeta), crustaceans (Crustacea), centipedes (Myriapoda), arachnids (Arachnida) and insects (Insecta). Of the vertebrates, amphibians (Amphibia), reptiles (Reptilia), birds (Aves) and mammals (Mammalia) are represented.

<u>Aquatic fauna</u> is rich in species, although aquatic habitats are rare, but they are poorly explored. The typical fauna includes planarian

(Tricladida), leeches (Hirudinea), crustaceans (Crustacea), while when it comes to aquatic insects, particularly pronounced are caddisflies (Trichoptera), aquatic flowers (Ephemeroptera), dragonflies (Odonata), aquatic beetles (Coleoptera), and when it comes to vertebrates, they include amphibians (Amphibia) and fish (Pisces).

Invertebrates

When it comes to the aboveground fauna of invertebrates, field research and review of data from literature for the wider area of the protected area Vjetrenica - Popovo polje identified a total of 248 invertebrate taxa (Ozimec et al., 2021), of which seven (7) species are endangered categories included on the Red List of the Federation of BiH, as well as (3) three species that are included in Annexes II and/or IV of the EU Habitats Directive (Table 2).



Table 2. List of endangered species according to IUCN, Red List of the Federation of Bosnia and Herzegovina and protected species according to the Habitats Directive, Annexes II and IV (Insecta) in the area of Popovo polje

Degree of threat and protection according to the according to the **Red Lists of Species IUCN threats Habitats Directive Red List of FBiH** Ammobatoidesabdominalis (Eversmann, 1. IUCN EN 7.3. 1852) CerambyxcerdoLinnaeus, 1758-great 2. HD II and IV **IUCN VU** capricorn beetle Europe NT Lucanuscervus (Linnaeus, 1758) - European VU on the FBiH 3. HD II 5.3.5. stag beetle Red List Europe LC *Gonepteryx cleopatra* (Linnaeus, 1758) VU on the FBiH 4. Red List Europe NT 2.1.3., 2.3.2., EN on the FBiH 5. Iolanaiolas (Ochsenheimer, 1816) 2.3.3., 7.3. Red List 1.3., 2.1.1., 2.1.2., 2.2.1., Europe NT 2.2.2., 2.3.2., 6. Ariciaanteros (Freyer, 1838) EN on the FBiH 2.3.3., 6.1., Red List 7.1.3., 7.3., 8.1.1., 9.3.4., 11.1., 11.2.

		Europe LC	
7.	Polyommatusadmetus Esper, 1783	EN on the FBiH	
		Red List	
		Europe LC	
8.	Charaxesjasius (Linnaeus, 1767)	VU on the FBiH	
		Red List	
		IUCN LC	
9.	Hipparchiastatilinus (Hufnagel, 1766)	VU on the FBiH	
		Red List	

Vertebrates

Fish

In the area of Popovo polje, the presence of 10 species of freshwater fish was recorded, of which five (5) are endemic to this area (*Delminichthysghetaldii*, *Telestesmetohiensis*, *Phoxinuskarsticus*, *Chondrostomaphoxinus* and *Squaliussvallize*) (Kottelat and Freyhof, 2007; Redžić, 2007; Sofradžija, 2009; Glamuzina et al., 2010; Ozimec et al., 2021. Ray-finned fish (Delminichthysghetaldii (Steindachner, 1882)) is an endemic freshwater fish species typical of Popovo polje, where it once had huge populations during the existence of the flood

It is the oldest fish population in Europe. Today, it is reduced to only a few smaller sites and is considered endangered species (EN). It is interesting that in Trebišnjica, the Lukavac spring and other springs there are other endemic and relict fish species such as Neretva chub (*Squaliussvallize* (Heckel & Kner, 1858), white chub (Leuciscuscavedanus, (Bonaparte, 1838)) and others (Table 3).





Table 3. List of endangered fish species according to IUCN, Red List of the Federation of Bosnia and Herzegovina and protected species according to the Habitats Directive, Annexes II and IV in the area of Popovo polje

Latin name	Endem ic	Degree of threat according to the Red Lists of Europe and the Red List of FBiH	Degree of threat and protection according to the Habitats Directive (Annexes II and IV)	IUCN threats
Alburnusarborella (Bonaparte, 1841)		Europe LC LC on the FBiH Red List		
<i>Delminichthysghetaldii</i> (Steindachner, 1882)	Х	IUCN VU EN on the FBiH Red List	HD II and IV	7.2.8., 8.1.1., 11.2.
Oncorhynchusmykiss (Walbaum, 1792)		LC on the FBiH Red List		
Phoxinuslumaireul (Schinz, 1840)		IUCN LC LC on the FBiH Red List		
<i>Phoxinuskarsticus</i> (Bianco& De Bonis, 2015)	Х			
Telestesmetohiensis (Steindachner, 1901)	Х	IUCN VU CR on the FBiH Red List	HD I and IV	7.2.8., 8.1.2., 9.3.4., 11.2.

Pomatoschistuscanestrinii (Ninni, 1883)		IUCN LC	HD II	
		LC on the FBiH		
		Red List		
Squaliussqualus (Steindachner, 1901)		IUCN LC		
Chondrostomaphoxinus (Heckel, 1843)	Х	IUCN EN		7.2.8., 7.2.11.,
		CR on the FBiH		11.2.
		Red List		
Squaliussvallize (HeckeletKner, 1852)		IUCN VU		7.2.8., 7.2.11.,
		VU on the FBiH		11.2.
		Red List		

Amphibians and reptiles

In the fauna of amphibians and reptiles, based on the results of field research and review of available literature (Lelo, 2007, Redžić, 2007; Lelo et al., 2015; Lelo and Zimić, 2020; Silajdžić et al., 2020; Ozimec et al., 2021), the presence of 28 species was determined in this area, of which 5 species are classified under the endangered categories on the Red List of the Federation of BiH, as well as 20 species that are included in Annexes II and/or IV of the EU Habitats Directive (Table 4).

Table 4. List of endangered amphibians and reptiles according to IUCN, Red List of the Federation of Bosnia and Herzegovina and protected species according to the Habitats Directive, Annexes II and IV in the area of Popovo polje

Species name	Lit.	Threat status	IUCN threats
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		Specie s know n from the literat ure	Degree of threat according to the Red Lists of Europe and the Red List of FBiH	Degree of threat and protection according to the Habitats Directive (Annexes II and IV)	IUCN threats
AM	PHIBIA				
1.	Proteus anguinus Laurenti, 1768	X	IUCN VU; VU on the EU RL EN on the FBiH Red List	HD II and IV	1.1.,1.3.,2.1.3,5.1.1.,5.3.5.,6.1.,9.2.3.,9.3.4.
2.	<i>Lissotriton vulgaris</i> (Linnaeus, 1758)	х	IUCN LC VU on the FBiH Red List		5.3.5., 7.2.8., 8.1.1.
3.	<i>Lissotritongraecus</i> (Wolterstorff, 1906)	Х			
4.	Bombinavariegata Linnaeus, 1758 – yellow-bellied toad	X	IUCN LC	HD IV	1.1.,1.2.,2.1.3.,2.3.3,3.2.,5.3.5.,

					9.2.3., 9.3.4.
5.	<i>Bufobufo</i> (Linnaeus, 1758) – common toad	Х	Europe LC		2.1.3., 8.1.2., 8.2.2., 9.3.4.
6.	<i>Bufoviridis</i> (Laurenti, 1768) – European green toad	х	IUCN LC	HD IV	2.1.3.,2.3.3.,4.1.,9.2.3.,9.3.4.
7.	<i>Hylaarborea</i> (Linnaeus, 1758) – tree frog	X	IUCN LC	HD IV	1.1., 1.2., 1.3., 2.1.2., 2.1.3., 2.2.1., 2.3.3., 5.1.1., 5.3.5., 8.1.1., 9.1.3., 9.2.3., 9.3.4.
8.	Rana dalmatina Bonaparte, 1839	Х	IUCN LC	HD IV	1.1.,2.1.3.,2.2.1.,2.2.2.,2.3.3.,5.3.5.,9.3.4.
9.	Pelophylaxridibundus (Palas, 1771)	Х	IUCN LC		
REP	REPTILIA				
10.	<i>Testudohercegovinensis</i> (Werner, 1899) – Dalmatian tortoise	х	IUCN NT VU on the FBiH	HD II and IV	1.1.,1.3.,2.1.2.,2.1.3.,

			Red List		2.1.4.,2.3.4.,4.1.,5.1.1.,7.1.3.,7.3.,8.1.1.,9.3.3.
11.	Testudohermanni (Gmelin, 1789)	Х	IUCN NT	HD II	1.1.,1.3.,2.1.2.,2.1.3.,2.1.4.,2.3.4.,4.1.,5.1.1.,7.1.3.,7.3.,8.1.1.,9.3.3.
12.	<i>Hemidactylusturcicus</i> (Linnaeus, 1758)	X	IUCN LC		
13.	Ophisaurusapodus (Pallas, 1775)	Х	IUCN LC	HD IV	2.1.3., 2.3.3., 5.1.3.
14.	Archaeolacertaoxycephala (Duméril&Bibron, 1839)	Х		HD IV	
15.	Lacertatrilineata (Bedriaga, 1886)	Х	IUCN LC	HD IV	2.1.3., 7.1.3.
16.	Lacertaviridis (Laurenti, 1768)	Х	IUCN LC	HD IV	
17.	Podarcismelisellensis (Werner, 1891)	Х	IUCN LC	HD IV	
18.	Coronellaaustriaca (Laurenti, 1768)		IUCN LC	HD IV	1.1., 2.1.3.,

+ minter -

					5.1.3., 7.1.1., 11.1.
19.	<i>Hierophisgemonensis</i> (Laurenti, 1768)	х	IUCN LC		2.1.3., 2.1.4., 2.3.4., 5.1.3., 9.3.4.
20.	<i>Platycepsnajadum</i> (Eichwald, 1831)	X	IUCN LC	HD IV	2.1.3., 4.1., 5.1., 7.1.3.
21.	Telescopusfallax(Fleischmann,1831)		IUCN LC	HD IV	1.2., 2.3.3., 4.1., 5.1.3.
22.	Zamenislongissima (Laurenti, 1768)	Х		HD IV	
23.	Zamenissitula (Linnaeus, 1758)	х	IUCN LC VU on the FBiH Red List	HD II and IV	2.1.4., 2.3.4., 5.1.1., 5.1.3.
24.	Natrixnatrix (Linnaeus, 1758)	Х	IUCN LC		
25.	<i>Elaphequatuorlineata</i> (Lacépede, 1789)		IUCN NT VU on the FBiH Red List	HD II and IV	1.1., 1.3., 2.1.3., 5.1.3.
26.	Natrixtesselata (Laurenti, 1768)	х			
27.	Vipera ammodytes (Linnaeus 1758)	Х	IUCN LC	HD IV	5.1.1., 5.1.3.

28	Elaphesitula (Linnaeus, 1758)	X	IUCN LC	HD II AND IV	2.1.4, 2.3.4.,
					5.1.1., 5.1.3.

Birds

From the available data from literature, in the area of the Protected landscape Vjetrenica - Popovo polje the presence of 78 bird species was established (Kitonić and Sackl, 2008/2009; Dervović and Kotrošan, 2011/2012; Topić and Kotrošan, 2011/2012; Silajdžić et al., 2020; Ozimec et al, 2021), of which 75 species are on the Red List of the Federation of BiH and 22 species on the list of the EU Directive on the Conservation of Wild Birds (Table 5).

Table 5. List of endangered birds according to IUCN, Red List of the Federation of Bosnia and Herzegovina and protected species according to the Habitats Directive, Annexes II and IV in the area of Popovo polje

No.	Latin name	Common name	Status (makes nests, does not make nests)	Red list of fauna of FBiH	IUCN status	EU Birds Directive	IUCN threat
1.	<i>Alaudaarvensis</i> Linnaeus, 1758	Eurasian skylark	Makes nests	LC	LC	BD IIb	
2.	Alcedo atthis Linnaeus, 1758	Common kingfisher	Does not make nests	NT	LC	BD I	

3.	<i>Alectoris graeca</i> Meisner, 1804	Rock partridge	Does not make nests	DD	NT	BD I, IIa	1.3., 2.1.3., 5.1.1., 8.1.2., 11.1., 11.4.
4.	<i>Anas platyrhynchos</i> Linnaeus, 1758	Wild duck	Makes nests	LC	LC	BD IIa, IIIa	
5.	<i>Anthuscampestris</i> Linnaeus, 1758	Tawny pipit	Makes nests	NT	LC	BD I	
6.	Anthustrivialis Linnaeus, 1758	Tree pipit	Does not make nests	LC	LC	-	
7.	Apus melba Linnaeus, 1758	Alpine swift	Makes nests	NT	LC	-	
8.	<i>Aquilachrysaetos</i> Linnaeus, 1758	Golden eagle	Does not make nests	EN	LC	BD I	2.2.2., 3.3., 4.2., 5.1.3., 8.5.1., 9.3.3., 11.1.
9.	<i>Ardeacinerea</i> Linnaeus, 1758	Grey heron	Does not make nests	VU	LC	-	2.1.4., 5.1.1., 5.1.3., 5.3.4., 8.1.1., 8.1.2., 8.5.2., 9.3.2.
10.	Buteo Linnaeus,	Common	Makes nests	LC	LC	-	3.3., 5.1.2.,

the second and

	1758	buzzard					5.1.3., 8.5.2., 9.3.3.
11.	<i>Carduelis cannabina</i> Linnaeus, 1758	Common linnet	Makes nests	LC	LC	-	
12.	<i>Carduelis</i> Linnaeus, 1758	European goldfinch	Makes nests	LC	LC	-	5.1.1., 5.1.2
13.	<i>Carduelis chloris</i> Linnaeus, 1758	European greenfinch	Makes nests	LC	LC	-	
14.	<i>Carduelis spinus</i> Linnaeus, 1758	Eurasian siskin	Makes nests	LC	LC	-	
15.	<i>Cecropis daurica</i> Laxmann, 1769	Red-rumped swallow	Makes nests	VU	LC	-	8.2.1.
16.	<i>Circaetus gallicus</i> J. F. Gmelin, 1788	Short-toed snake eagle	Does not make nests	VU	LC	BD I	2.1.3., 2.3.2., 3.3., 4.1., 4.2., 5.1.3., 5.3.3., 7.1.1., 9.3.3.
17.	<i>Circus aeruginosus</i> Linnaeus, 1758	Western marsh harrier	Does not make nests	VU	LC	BD I	2.3.2., 3.3., 5.1.2., 5.1.3., 5.3.3., 7.2.4.,

							9.2.3., 9.3.3.
18.	<i>Columbalivia</i> J. F. Gmelin, 1789	Common pigeon	Makes nests	LC	LC	BD IIa	
19.	<i>Corvus corax</i> Linnaeus, 1758	Common raven	Does not make nests	LC	LC	-	
20.	<i>Corvus cornix</i> Linnaeus, 1758	Hooded crow	Makes nests	LC	LC	-	
21.	<i>Cuculuscanorus</i> Linnaeus, 1758	Common cuckoo	Makes nests	LC	LC	-	
22.	<i>Cyanistescaeruleus</i> Linnaeus, 1758	Eurasian blue tit	Makes nests	LC	LC	-	
23.	<i>Delichonurbicum</i> Linnaeus, 1758	Common house martin	Makes nests	LC	LC	-	8.2.2., 11.4.
24.	Egrettagarzetta Linnaeus, 1766	Little egret	Does not make nests	VU	LC	BD I	
25.	<i>Emberizacalandra</i> Linnaeus, 1758	Corn bunting	Makes nests	LC	LC	-	
26.	Emberiza cia	Rock bunting	Makes nests	LC	LC	-	

	Linnaeus, 1766						
27.	<i>Emberizacirlus</i> Linnaeus, 1766	Cirl bunting	Makes nests	LC	LC	-	
28.	Emberiza melanocephala Scopoli, 1769	Black-headed bunting	Makes nests	NT	LC	-	
29.	Erithacusrubecula Linnaeus, 1758	European robin	Makes nests	LC	LC	-	
30.	<i>Falco naumanni</i> Fleischer, 1818	Lesser kestrel	Does not make nests	CR	LC	BD I	1.1.,1.2.,2.1.3.,2.2.3.,5.1.1.,5.1.3.,9.3.3.,11.2.,11.4.
31.	<i>Falco peregrinus</i> Tunstall, 1771	Peregrine falcon	Makes nests	DD	LC	BD I	2.3.2., 3.3., 5.1.1., 5.1.3., 5.3.3., 6.1., 7.1.1., 9.2.1., 9.3.3.
32.	<i>Falco tinnunculus</i> Linnaeus, 1758	Common kestrel	Makes nests	LC	LC	-	2.1.3., 2.3.2., 3.3., 5.1.1.,

							5.3.3., 7.1.1., 9.3.3.
33.	Falco vespertinus Linnaeus, 1766	Red-footed falcon	Does not make nests	-	NT	BD I	2.1.3., 2.3.2., 3.3., 5.1.1., 5.3.3., 7.1.1., 9.3.3.
34.	Fringilla coelebs Linnaeus, 1758	Common chaffinch	Makes nests	LC	LC	-	
35.	<i>Garrulus glandarius</i> Linnaeus, 1758	Eurasian jay	Makes nests	LC	LC	BD IIb	
36.	<i>Hippolaispallida</i> Hemprich&Ehrenb erg, 1833	Eastern olivaceous warbler	Makes nests	DD	LC	-	
37.	<i>Hirundo rustica</i> Linnaeus, 1758	Barn swallow	Makes nests	LC	LC	-	2.3.3., 5.1.1., 5.1.3., 7.2.3., 8.1.2., 9.3.3., 11.3.
38.	<i>Jynx torquilla</i> Linnaeus, 1758	Eurasian wryneck	Makes nests	LC	LC	-	
39.	Lanius collurio	Red-backed	Makes nests	LC	LC	BD I	

	Linnaeus, 1758	shrike					
40.	<i>Laniusexcubitor</i> Linnaeus, 1758	Great grey shrike	Makes nests	NT	LC	-	
41.	<i>Lanius senator</i> Linnaeus, 1758	Woodchat shrike	Makes nests	DD	LC	-	
42.	<i>Larus michahellis</i> Naumann, 1840	Yellow-legged gull	Does not make nests	-	LC	-	5.1.1., 5.1.3.
43.	<i>Lusciniamegarhyncho s</i> C. L. Brehm, 1831	Common nightingale	Makes nests	NT	LC	-	
44.	Melanocorypha calandra Linnaeus, 1766	calandra lark	Makes nests	-	LC	BD I	
45.	<i>Merops apiaster</i> Linnaeus, 1758	European bee- eater	Does not make nests	NT	LC	-	
46.	<i>Monticola saxatilis</i> Linnaeus, 1758	Common rock thrush	Makes nests	NT	LC	-	
47.	<i>Monticola solitarius</i> Linnaeus, 1758	Blue rock thrush	Makes nests	DD	LC	-	

48.	Motacilla alba Linnaeus, 1758	White wagtail	Makes nests	LC	LC	-	11.5.
49.	<i>Motacilla cinerea</i> Tunstall, 1771	Grey wagtail	Makes nests	LC	LC	-	
50.	<i>Oenanthehispanica</i> Linnaeus, 1758	Western black-eared wheatear	Makes nests	NT	LC	-	
51.	<i>Oenanthe oenanthe</i> Linnaeus, 1758	Northern wheatear	Makes nests	LC	LC	-	1.1., 2.1., 2.1.3., 5.1.1., 11.2.
52.	Oriolus oriolus Linnaeus, 1758	Eurasian Golden Oriole	Makes nests	LC	LC	-	
53.	Otus scops Linnaeus, 1758	Eurasian Scops Owl	Makes nests	NT	LC	-	2.1.4.
54.	Parus major Linnaeus, 1758	Great tit	Makes nests	LC	LC	-	11.5.
55.	Passer domesticus Linnaeus, 1758	House sparrow	Makes nests	LC	LC	-	
56.	<i>Passer hispaniolensis</i> Temminck, 1820	Spanish sparrow	Makes nests	NT	LC	-	9.3.3.

57.	<i>Phalacrocorax carbo</i> Linnaeus, 1758	Great cormorant	Does not make nests	VU	LC	-	2.4.3., 3.3., 5.1.1., 5.1.3., 6.1., 7.3., 8.5.2., 9.2.1., 9.2.3., 9.3.3., 11.2.
58.	Phoenicurus ochruros S. G. Gmelin, 1774	Black redstart	Makes nests	LC	LC	-	
59.	<i>Phylloscopus</i> <i>sibilatrix</i> Bechstein, 1793	Wood warbler	Makes nests	NT	LC	-	
60.	Phylloscopus trochilusLinnaeus, 1758	Willow warbler	Does not make nests	DD	LC	-	
61.	Pica Linnaeus, 1758	Eurasian magpie	Makes nests	LC	LC	BD IIb	
62.	<i>Picus viridis</i> Linnaeus, 1758	European green woodpecker	Makes nests	LC	LC	-	
63.	<i>Poecilelugubris</i> Temm inck, 1820	Sombre tit	Makes nests	LC	LC	-	

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64.	Ptyonoprogne rupestris Scopoli, 1769	Eurasian crag martin	Makes nests	LC	LC	-	
65.	<i>Saxicola rubetra</i> Linnaeus, 1758	Whinchat	Does not make nests	LC	LC	-	
66.	<i>Saxicola rubicola</i> Linnaeus, 1766	European stonechat	Makes nests	LC	LC	-	
67.	<i>Serinus serinus</i> Linnaeus, 1766	European serin	Makes nests	LC	LC	-	
68.	<i>Streptopelia decaocto</i> Frivaldszky, 1838	Eurasian collared dove	Makes nests	LC	LC	BD IIb	
69.	<i>Streptopelia turtur</i> Linnaeus, 1758	European turtle dove	Makes nests	LC	LC	BD IIb	2.1.3., 5.1.1., 5.1.2., 8.2.2., 9.3.3.,11.2., 11.3.
70.	<i>Sturnus vulgaris</i> Linnaeus, 1758	Common starling	Makes nests	LC	LC	BD IIb	2.3.3., 5.1.1.
71.	<i>Sylvia atricapilla</i> Linnaeus, 1758	Eurasian blackcap	Makes nests	LC	LC	-	

72.	Sylvia borin Boddaert, 1783	Garden warbler	Does not make nests	DD	LC	-	
73.	<i>Sylvia cantillans</i> Pallas, 1764	Eastern subalpine warbler	Makes nests	DD	LC	-	
74.	Sylvia communis Latham, 1787	Common whitethroat	Makes nests	LC	LC	-	
75.	<i>Sylvia melanocephala</i> J. F. Gmelin, 1789	Sardinian warbler	Makes nests	DD	LC	-	
76.	Tachybaptus ruficollis Pallas, 1764	Little grebe	Makes nests	NT	LC	-	
77.	<i>Turdusmerula</i> Linnaeus, 1758	Common blackbird	Makes nests	LC	LC	BD IIb	2.1.3., 5.1.1., 6.3., 8.2.1., 11.3.
78.	<i>Turdusphilomelos</i> C. L. Brehm, 1831	Song thrush	Makes nests	LC	LC	BD IIb	

<u>Mammals</u>

<u>Bats (Chiroptera)</u> are an extremely numerous groups of mammals in the area of the Protected landscape Vjetrenica –Popovo polje (Mazija, 2010; Mazija and Rnjak, 2016; Ozimec et al., 2021), where several endangered species have been registered (Table 6). According to earlier research conducted in this area, the most important colony was recorded in the railway tunnel near Čvaljina - a large colony of females with offspring of approximately 10,000 individuals of the species of Greater mouse-eared bat (*Myotis myotis*), and there are also species of Lesser mouse-eared bat (*Myotis*) and Common bent-wing bat (*Miniopterus schreibersii*). This colony and the structure itself are an extremely important aspect of the protection of the area at the local, national and international level.

Four species have been identified in the Bjelušica cave: lesser horseshoe bat (*Rhinolophus hipposideros*), Geoffroy's bat (*Myotis emarginatus*), Natterer's bat (*M. natterii*) and Kolombatovic's long-eared bat (*Plecotuskolombatovici*).

In addition, in the lower part of the monument (underground part) in the vicinity of the Vjetrenica cave (Zavala), a colony of bats of the Mediterranean horseshoe bat (*Rhinolophuseuryale*) was found, with about 45 individuals and 25 individuals of the Greater horseshoe bat (*Rh. Ferrumequinum*) and some specimens of Geoffroy's bat (*Myotis emarginatus*).

A bat skeleton was found in the first hall of the Vjetrenica cave, which indicates that although during previous and new research the presence of living bat individuals inside the structure has not been discovered, they still use it at least individually for a short time.

Table 6. List of endangered mammals according to IUCN, Red List of the Federation of Bosnia and Herzegovina and protected species according to the Habitats Directive, Annexes II and IV in the area of Popovo polje

	Species	Degree of	Degree of	
Latin name	known	threat	threat and	IUCN threat
	from the	according to	protection	

	literature	the Red Lists	according to	
		of Europe and	the Habitats	
		the Red List of	Directive	
		FBiH	(Annexes II	
			and IV)	
Rhinolophuseuryale	Х	EN on the FBiH	HD II and IV	2.3.3., 5.1.2., 6.1.,
(Blasius, 1853)		Red List		6.3., 9.3.4.
Rhinolophusferrumequinum (Schreber,	Х	VU on the FBiH	HD II and IV	2.1.3., 6.1., 7.3.,
1774)		Red List		9.3.4.
Rhinolophushipposideros (Bechstein,	Х	EN on the FBiH	HD II and IV	7.3., 9.3.4.
1800)		Red List		
Miniopterusschreibersii	Х	EN on the FBiH	HD II and IV	1.3., 3.3., 4.1.,
(Kuhl, 1817)		Red List		5.1.3., 5.1.4., 6.1.,
				6.3., 8.5.1., 9.3.3.
Myotis myotis	Х	EN on the FBiH	HD II and IV	
(Borkhausen, 1797)		Red List		
Myotis blythii	Х	EN on the FBiH	HD II and IV	1.1., 2.1.2., 5.1.3.,
(Tomes, 1857)		Red List		6.1., 6.3., 9.3.4.
Myotis emarginatus	Х	VU on the FBiH	HD II and IV	5.1.1., 5.1.3., 6.1.,
(Geoffroy, 1806)		Red List		6.3., 7.1.3., 7.3.
Myotis capaccinii	Х	VU on the FBiH	HD II and IV	1.1., 5.1.1., 6.1.,
(Binaparte, 1837)		Red List		6.3., 7.1.3., 7.2.8.,
				9.1.3., 9.2.3.,
				9.3.4.
Myotis nattereri	Х		HD II and IV	1.1., 1.2., 1.3.,
(Kuhl, 1817)				

				2.3.3., 4.1., 5.3.3., 5.3.4., 6.1., 6.3., 7.1.1., 9.6.1., 11.1.
Hypsugosavii (Bonaparte, 1837)	X	VU on the FBiH Red List	HD II and IV	11.1.
Pipistrelluskuhlii (Kuhl, 1817)	X	VU on the FBiH Red List	HD II and IV	
Pipistrellusnathusii	Х		HD II and IV	
(Keyserling&Blasius, 1839)				
Plecotuscf. Kolombatovici (Đulic, 1980)	X	Europe NT	HD II and IV	6.1.

Other mammals

The biodiversity of mammals of the Protected landscape Vjetrenica - Popovo polje has not been systematically investigated so far. Most of the data comes from yet unpublished inventory data, preliminary reviews of individual groups within the project and a small number of published research papers. The most representative one is the Balkan snow vole (*Dinaromys bogdanovi* (V. et E. Martino, 1922)), which is endemic to the Dinarides and a relict, tertiary monotypic genus, which often enters caves and has been recorded for the Bjelušica cave. Interestingly, it is also inhabited by endemic fleas of the genus *Chthenophthalmus*.

The highest count in this area were recorded for wild boar, fox and brown rabbit. These species are common and their survival in this area is not endangered. Other species of wild animals, primarily mammals, are rare or sporadic (Table 7).

Table 7. List of mammals according to IUCN, Red List of the Federation of Bosnia and Herzegovina and protected species according to the Habitats Directive, Annexes II and IV in the area of Popovo polje

No	Species	Red FBIH	list	Habitats Directive	Natura 2000	Bern Convention	CITES	IUCN threats
1	Susscrofa (Linaeus,	LC on	the					2.3.1., 2.3.3.,
	1758)	FBiH	Red					5.1.1., 5.1.3.,
		List	.1					8.1.2.
2	<i>Capreoluscapreolus</i>	LC on	the			Annex 3		2.2.3., 2.3.1.,
	(Linaeus, 1758)	FBiH	Red					2.3.2., 5.1.1.,
		List						5.1.3., 8.1.2., 8.3.
3	Canislupus (Linneaeus	EN on	the					o.s. 2.3.2., 2.3.3.,
3	1758)	FBiH	Red					2.3.2., 2.3.3., 5.1.3.
	1756)	List	Reu					5.1.5.
4	Vulpesvulpes	LC on	the					
	(Linneaeus 1758)	FBiH	Red					
		List						
5	Martesfoina (Erxleben,	LC on	the			Annex 3		2.1.3., 2.3.3.,
	1777)	FBiH	Red					5.1.1.
		List						
6	Melesmeles (Linneaeus	LC on	the			Annex 3		5.1.1.
	1758)	FBiH	Red					
		List						
7	Erinaceusconcolor	EN on	the					

		(Martin, 1837)	FBiH Red				
			List				
	8	Lepuseuropaeus (Pallas,	LC on the				1.1., 2.1.3.,
		1778)	FBiH Red				9.3.4.
			List				
9	9	Dinaromysbogdanovi	VU on the	HD II AND	da		
		(V. et E. Martino,	FBiH Red	IV			
		1922)	List				

B. Underground or hypogeanic fauna

It is divided into soil fauna (edaphic) and cave fauna (cavernicol), which inhabits the basic rocks, that is, the lithosphere.

<u>Soil fauna (Edaphic fauna)</u> is almost unknown in the area planned for protection. However, the famous German entomologist Edmund Reitter described in 1913, on the basis of a specimen collected in the vicinity of Ravno, the edaphic species of carabidae from the subfamily Scaritinae - *Reicheadella (Chaetomargoreicheia) zoufali* Reitter, 1913. After the description, this species was never found again and is considered endemic for this area. The edaphic habitats of karst sinkholes are particularly interesting.

<u>Cave fauna (cavern-dwelling fauna)</u> inhabits micro and macro cavities formed in the parent substrate, limestone. Cavities can be filled with air, so we are talking about cave terrestrial fauna (troglobionts) or with water inhabited by aquatic cave fauna (stigobionts). Cave fauna is one of the most pronounced elements of the fauna of the protected area. So far, over 232 cave taxa (Ozimec et al., 2021) have been identified, of which over 65 stenoendemic, out of which as many as 41 species have been described from the protected area, 38
from Vjetrenica and three further species from Baba cave near Čvaljina and Benetina cave. With each new research, numerous taxa new to science are discovered, which are yet to be described.

Underground habitats of the Vjetrenica cave

Vjetrenica Cave with over 7 kilometres of underground dry and submerged canals, is extremely rich in different habitat types. Caves with a large number of different habitats have the largest biodiversity in the world, that is, the largest number of underground, cavernous organisms has been identified there.

Hygopetric of Vjetrenica

A special habitat present in Vjetrenica is hygropetric, a combination of aquatic and terrestrial habitat. Hygropetric is a specific underground habitat in which a thin layer of water flows over the parent limestone rock or excrete flowstone. It usually appears very deep in the karstic lithosphere, that is, in the deepest parts of karst pits and under a thick layer of limestone in caves, above which groundwater accumulates and permanently seeps vertically.

For life in such a habitat, some organisms developed peculiar adaptations. It is primarily a diet, by which organisms are most often fed by filtration of running water, and their oral apparatus evolved into a filtration system. As the flow of water can be very strong periodically, additional adaptations happened in the evolution of gripping for solid ground, be it with strong grips in leeches or strong and long claws in springtail or beetles.

For the time being, three species from the hygropetrics have been identified in Vjetrenica: *Typhlogammarus mrazeki* Schäferna and underground beetles: *Hadesia vasiceki*, described in 1911, and *Nauticiella stygivaga*,

described in 2002, 90 years after hadesia. With the development of speleological techniques and following the conquest of deeper and deeper pits, every year more and more species specialized in hygropterics are discovered from the depths of the Dinarides, from more and more faunal groups. Representatives of underground beetles (Leptodirini) are especially largely represented, along with those of Vjetrenica *Croatodirus, Deelemaniella, Kircheria, Radziella, Tartariella* and *Velebitodromus*; leeches: *Croatobranchus* and *Trocheta*; springtail: *Tritomurusvellesi*, and as research progresses, numerous others will certainly folow (Ozimec et al., 2021).



<u>Biodiversity and endemism</u> of the fauna of the area for protection is still insufficiently known, but initial analysis shows an exceptional richness. In addition to a large number of Dinaric endemics, many endemics are very narrowly distributed, only in the area south of the Neretva, the wider area of Popovo polje or so far exclusively known from the area planned for protection. Endemics of such a narrow area are called stenoendemics, and among them there are mainly cave, relict species (living fossils). Their closest relatives became extinct in this area long time ago, and they survived in a kind of shelters (refuges) to this day. In the area planned for protection we find numerous tertiary, and some ancient species are even pre-tertiary relics.

Overview of underground habitats of Vjetrenica

According to the European classification of Natura 2000 habitats, most of the habitats of the Vjetrenica cave system belong to the habitat type 8310 – Caves not open to public. According to the *National Habitat Classification* and the *Manual for the determination of underground habitats in Croatia according to the EU Habitats Directive* (Gottstein, 2010), habitats primarily belong to the main habitat H:



underworld with three habitat subtypes with a total of 14 different habitats. In addition to the cave, there is also a habitat type A.2.1 Springs, with the spring Lukavac, which can also be periodical or permanent habitat of cave fauna. Spatial analysis of the collected fauna and identified various living communities and according to the hydrological function (and sediment occurrence) of some submerged canals, two subtypes were defined for habitats: H.1.1.4. Caves and cave systems with troglobitic invertebrates, H.1.1.5. Caves with troglophilic invertebrates and H.1.3.1. Underground streams (Table 8).

Table 8. Habitat system overview of Vjetrenica cave

H.1. Karst cave and pits	H.1.1. Terrestrial karst cave	H.1.1.1. Semi-caves and entrance (illuminated) parts of caves	H.1.1.1.1. Subtroglophile invertebrate caves	
		H.1.1.3. Caves and cave systems with subtroglophile vertebrates		
	habitats	H.1.1.4. Caves and cave systems with troglobitic invertebrates	H.1.1.4.1. Caves with moderate conditions with troglobiontic invertebrates	

	H.1.1.5. Caves with troglobitic invertebrates	H.1.1.5.1. Caves with troglobitic invertebrates
H.1.2. Amphibious karst cave habitats	H.1.2.1. Amphibious karst cave habitats	H.1.2.1.1. Hygropetric
H.1.3. Aquatic (freshwater) karst cave habitats		H.1.3.1.1. Subterranean rapids
	H.1.3.1. Underground streams	H.1.3.1.2. Endogenous subterranean rivers
		H.1.3.1.3. Exogenous subterranean rivers
		H.1.3.2.1. Subterranean lakes
	H.1.3.2. Subterranean standing water	H.1.3.2.2. Stones
		H.1.3.2.3. Ponds

112

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H.3. Subterranean interstitial spaces	H.3.1. Interstitial terrestrial habitats	H.3.1.1. Interstitial terrestrial habitats	H.3.1.1.2. Rock cracks
	H.3.2. Interstitial aquatic habitats	H.3.2.1. Interstitial aquatic habitats	H.3.2.1.1. Phreatic zone
H.4. Anthropogenic subterranean habitats	H.4.1. Anthropogenic terrestrial subterranean habitats	H.4.1.1. Mines and underground passages *	

*It primarily refers to parts of the main canal with a pronounced anthropogenic impact due to the construction of a tourist trail

Bacterial communities

Numerous studies of microbial films, published in the last few decades, testify to the exceptional biodiversity of the unique microworld of the underworld. For example, a comparative analysis of two independent studies of biofilms of the same morphology, with two different sampling sites in the Vjetrenica cave, showed differences in the composition of bacterial communities. Kostanješk et al. (2013) state that bacterial communities from the Lower Absolon's canal, called *Candidatus Troglogloeaabsoloni*, primarily form filamentous Betaproteobacteria, while on the surface of the biofilm there are representatives of the genus: Bacteriodetes, Actinobacteria, Planctomycetes and the class Gammaproteobacteria and Alphaproteobacteri.

However, in the clone library of microbial colonies from Vjetrenica from the sampling site in Donja Vjetrenica, the Nitrospirae genus predominates with 60% while Alpha- and Gamma-proteobacteria were not found (Pleše et al., 2011, 2016; Ozimec et al., 2021). This finding can be interpreted by different conductivity at the sampling sites and thus variations in the amount of dissolved solids, mostly nitrates, then magnesium and calcium, increases in the concentration of CaCO₃, MgCO₃ and total water hardness. Nitrospirae phylotypes obtained from three caves in the Dinarides: Vjetrenica, Veternica, Bistrac spring (Pleše et al., 2016), showed similarity with Candidatus Nitrospiradefluvii, which differs from other known bacteria that perform nitrate oxidation by the expression of the enzyme nitrite oxidoreductase (NXT).

This physiological adaptation to the conditions of a limited substrate allows bacteria a mixotrophic diet (Lückeretal., 2010) where small changes in the environment can affect the composition of the biofilm and indirectly also certain interspecies interactions.

Protists

A total of 36 species of protozoa have been recorded for the Vjetrenica cave, belonging to the following groups: naked and testate amoebae, heliozoa and ciliate. Naked amoebae are a polyphyletic group of protozoa. Their common feature is a variable body shape. However, even inexperienced observers may notice that there are significant differences between species. Species of naked amoebae recorded by Georgievski et al. (1956) are *Amoeba proteus, Trichamoebavillosa* (syn. *Amoebavillosa*) and *Pelomyxapalustris*.

Testate amoebae are a polyphyletic group of protozoa that have typical outer shells (tests) with one aperture, inside which there is an amoeboid cell. Georgievski et al. (1956) recorded the highest biodiversity of testate amoebae in Vjetrenica – a total of 21 species. The most numerous testate amoebae are those with finger-shaped pseudopodia (lobopodia), among which 19 species have been recorded. The following species from the genus *Difflugia* were recorded in Vjetrenica: *D. pyriformys, D. acuminata, D. globulosa, D. urceolata, D. corona D. manicata.* Members of the genus *Difflugia* are considered to be the most demanding group for determination since their shell is built of inorganic particles (mineral grains) from their environment bound

together by an organic matrix. Species whose shells are also made of agglutinated material bound by an organic matrix include: *Centropyxisaculeata*, *C. constricta* (sin. *Difflugiaconstricta*), *Heleoperapetricola* and *Phryganellahemisphaerica*.

Unlike species that build the shell from agglutinated grains from their environment, members of the species *Arcellaartocrea, A. hemisphaerica, A. vulgaris, A.* discoides and *Hyalospheniapapilio* have shells made entirely of organic material. Very interesting shells are present in the species *Quadrulellasymetrica* (syn. *Quadrulasymetrica*) which consist of symmetrically arranged square plates. Although individuals of *Nebelabursella* and *N. bohemica* also form their own plates of silicon dioxide, most often oval or round in shape. Members of the genus Nebela often incorporate silicate plates of other species in their shells (e.g., *Euglypha* and *Trinema*). *Cryptodifflugiaoviformis* is the smallest representative of the testate amoebae recorded in Vjetrenica. Among members of testate amoebae with a phyloid type of pseudopodia, which are very thin and most often long and delicate, only two species have been reported: *Euglyphaciliata. Pamphagushyalinus* is a testate amoeba of very unclear kinship status, which is why it is accompanied by numerous synonyms.

Sun-animalcules (Heliozoa) are a polyphyletic group of protozoa. Representatives of planktonic sunanimalcules recorded in Vjetrenica include *Actinosphaeriumeichornii Actinophrys sol*. These are frequent inhabitants of inland water plankton. Species *Hedriocystispellucida* has a small stand by which it is attached to the substrate. It inhabits inland waters and sediments. Ciliates (Ciliophora) are a monophyletic group of protozoa. The main feature of this group are short cilia that serve for movements of individuals, but they also allow for a more efficient feeding. A total of nine species typical of inland waters have been recorded in Vjetrenica. Out of the unsessile species of ciliates in Vjetrenica, the following were identified: Didiniumbalbiani, *Urostylagrandis, Stichotrichasecunda, Oxytrichaplatystoma, Stylonychiamytilus* and *Euplotescharon*. The smallest member of the ciliates in Vjetrenica is the species *Holophryasimplex*, only 18 µm in size, while *Urostylagrandis* stands out with its size of 400 µm. Of the sessile species, *Tokophryacyclopum* and *Epistylisplicatilis* were reported.

Algae

Members of the algae group need light for their survival, since they feed primarily by creating nutrients thanks to the process of photosynthesis. Therefore, algae are generally not associated with cave habitats. However, it is the colonies of algae (along with photosynthetic bacteria) that create the greenish color that can be seen on the entrance parts of many caves, including Vjetrenica. In caves arranged for tourist visits, green overgrowths (lampenflora) are formed under electric reflectors, which is made up of algae together with photosynthetic bacteria and mosses, entirely dependent on electric lighting. Unfortunately, the algae associated with the Vjetrenica cave have not been studied so far.

Fungus-like protists

Some habitats in Vjetrenica, such as various sediments, are suitable for the life of some species of fungus-like protists such as Mycetozoa (Landolt et al., 2006). Unfortunately, fungus-like protists have not been studied in the Vjetrenica cave so far, and there is very little data on them worldwide.

Fungi

Fungi that can live in caves are extremely susceptible to desiccation, therefore, the development of their life cycle in these conditions is significantly difficult or impossible. Therefore, slow-growing forms of fungi such as sexually or asexually formed fruit bodies, conidiophores, as well as mycelium visible to the naked eye are found in vast channels and at lower levels of Vjetrenica where there is no wind and where humidity is constantly high, as well as in nearby Bjelušica, which probably forms a unique cave system with Vjetrenica. One of the most important ecological factors for fungi in the underground karst area is moisture, so in dry speleological objects we generally do not find any visible traces of their activity. Furthermore, illuminance is crucial in species selection, as some fungi cannot achieve any part of their life cycle without the electromagnetic radiation that they receive from the Sun, so we do not find such species in the permanent dark zone, and most often the same applies in the twilight zone. Fungi need much less available energy for the development of the asexual than the sexual phase, and even less for the development of mycelium

(Matočec, 2002; Ozimec et al., 2021), which is why many species can be found only in these forms in the dark zones of caves and pits (in which constant conditions of low temperatures and low nutrient levels prevail).

Regardless of their origin, certain species of fungi can no longer survive outside cave habitats, e.g., due to their microevolutionary adaptation during ice ages (Matočec et al., 2014; 2019), with the elimination of populations outside cave ecosystems, we can talk about troglobionts or real cave fungi. Some of these species enter into a biotrophic connection with endemic cave arthropods referred to as endemobionts, and since they are usually linked with only one or a few of the closest congener arthropods, they themselves are endemic too. Taking into account the nutritional strategies of fungi in caves, fungi that thrive in the dark zone of cave ecosystems (troglotolerants and subtroglophiles) or are fully adapted to them (Tf and Tb) can generally be classified into two main groups: saprotrophs and parasites. Table 9 shows the overview of fungi of the Protected area Vjetrenica-Popovo polje.

Specie	Microhabitat	Substrate	Strategy	Troglophile s	
Section MUCOROMYCOTA, red Mucorales					
Mucormucedo	shelves of the damp dark zone	faeces of marten and dormouse	FS	Tt	
Section ASCOMYCOTA, class Pezizomycetes, order Pezizales					
Coprotuscf. Leucopocillum	shelves of the damp	small rodent	FS	?	

Table 9. Overview of fungal species within Protected area Vjetrenica-Popovo polje

	dark zone	droppings					
razred Eurotiomycetes	·	·	·				
Penicilliumvulpinum	shelves of the damp dark zone	faeces of marten	FS	sTp			
Penicilliumglandicola	shelves of the damp dark zone	faeces of marten and dormouse	FS, MP	sTp			
order Onygenales	order Onygenales						
Arthrodermacuniculi	floor of dump dark zones	faeces of marten	FS	sTp			
Gymnoascussp.	floor of dump dark zones	faeces of marten	FS	?			
Nannizziopsissp.	floor of dump dark zones	beetle remains	СР	sTp?			
class Leotiomycetes, order Helotiales							
Cistellaacuum	floor of dump dark zones	fallen juniper leaves	PS	Tx			
Dasyscyphellanivea	floor of dump dark	large wood	PS	Tt			

	zones		residue			
class Sordariomycetes, order Microasca	lles					
Cephalotrichumpurpureofuscum	floor of zones	dump	dark	rotten stems	PS	Tt
Cephalotrichummicrosporum	floor of zones	dump	dark	fungi	?	sTp
order Hypocreales						
Hypocreaminutispora	floor of zones	dump	dark	large wood residue	PS	Tx
Clonostachys rosea	floor of zones	dump	dark	faeces of dormouse	MP; AP	sTp
Metacordycepschlamydosporia	floor of zones	dump	dark	faeces of marten	АР	Tt

sTp – subtroglophiles, Tt – troglotolerant; Tx – trogloxene

FS – *fimicolous saprotroph; CP* – *chitinophilic; PS* – *plant saprotroph; AP* – *animal parasite; MP* – *mycoparasite*

Fauna – other organisms

The underground fauna of the Protected landscape of Vjetrenica-Popovo polje is rich in species that have adapted to the living conditions in the Dinaric karst. In the area of the municipality of Ravno, where the Protected Landscape Vjetrenica - Popovo polje is located, 321 taxes, members of 4 kingdoms (Regnum) of the

living world are described, of which two colonies from the kingdom of bacteria (Bacteria), 17 mycobiota (fungi) (Fungi), 36 from the kingdom of protozoa (Protozoa) and the largest number from the kingdom of animals (Animalia) - 266 taxes. Of all the above, as many as 137 taxes are cave organisms (Tb and Sb) (Ozimec et al., 2021).

Vjetrenica is one of the caves most rich in fauna in the world (Culver and Sket, 2000), due to the biogeographical position of the Dinaric Karst, its size and ecological heterogeneity. Vjetrenica is one of the world's most prominent biodiversity hotspots for cave fauna: 230 species have been discovered in Vjetrenica, of which as many as 96 are cave organisms (Tb and Sb) (Ozimet et al., 2021). Vjetrenica Cave is also a type finding site for 48 taxis, of which 47 have been validated (Lukić Bilelaetal., 2019; supplemented). Out of the total number of discovered species in the Vjetrenica cave, there are: 2 colonies of the bacterial kingdom, 35 protists, 14 species of fungi and 179 animals. Vjetrenica, together with the Lukavac spring and the Bjelušica cave, as integral parts of its system, a type locality for 48 species, of which 14 are strictly endemic and 3 species are monotypic: *Zavalia vjetrenicae* (Radoman, 1973) (Gastropoda), *Troglomysisvjetrenicensis* (Stammer, 1933) (Crustacea) and *Nauticiellastygivaga* (Moravec and Mlejnek 2002) (Coleoptera). Further monotypic genera, found in other speleological objects of Popovo polje are: *Spelaeoconchapaganetti* (Sturany, 1901) (Gastropoda), *Marifugiacavatica* (Absolon and Hrabe, 1930) (Polychaeta), *Velkovrhiaenigmatica* (Matjasic and Sket, 1971), (Hydrozoa), *Stalitellanoseki* (Absolon i Kratochvíl, 1933) (Araneae), *Dinariavjetrenicae* (Hadži, 1932) (Opiliones), *Typhlogammarusmrazeki* (Schaferna, 1907) (Crustacea), *Spelaeocarispretneri* (Matjasic, 1956) (Crustacea) and *Proteus anguinus*(Laurenti, 1768), (Vertebrata, Amphibia).

The border zone of the main passage and its sideways contain some entrance fauna typical for the region. The parietal fauna (on the cave walls) consists of the moth *Triphosasabaudiata* (Duponchel, 1830) and a large number (up to 10 specimens per square meter) of the species *Limonianubeculosa* (Meigen, 1804). Cave crickets *Troglophilusspp., Dolichopodaaraneiformis* (Burmeister, 1838) and centipede *Apfelbeckia* sp. are scarce. *Trogulustorosus* (Simon, 1885) as a representative of regional endemics is rare here.

Young crickets and centipedes are located up to 400 m from the entrance. The most common troglobite of the main corridor and distant parts is the large and very troglomorphic beetle *Antroherponapfelbecki*; some other beetles (*Speonesiotesspp., Neotrechusspp., Aphaenopsisspp.*) are less common and extremely rare. *Typhloglomeriscaeca* (Verhoeff, .1898) is limited to larger clay deposits. Individual specimens of the beetle *Travuniavjetrenicae* (Hadži, 1932) (*Laniatores: Travuniidae*) can be found in an active corridor known as the Absolon's canal. Particularly interesting is the hygropetric-like habitat (a thin film of water flowing down the rock) on walls with extensive stone deposits, inhabited by the special leptodirus beetle *Hadesiavasiceki* (J. Müller, 1911), as well as the large amphipod *Typhlogammarusmrazeki* (Karaman, 1972). In the fauna of Vjetrenica individual taxa stands out, in particular: *Velkovrhiaenigmatica* (Matjasic & Sket, 1971), the only species of the genus, the only freshwater species of the family Bougainvilliidae and the only troglobiont species of Hydrozoa (Sket, 2003). *Congeriakusceri* (Bole, 1962) is a living fossil, the only one of the hundred extinct congeri species that peaked in the Upper Miocene, inhabiting the freshwater remnants of the Dinaric and Pannonian seas in the Pliocene, and the only stigobiont mollusc (Bivalvia). *Marifugiacavatica* (Absolon & Hrabe, 1930), is the only freshwater serpulid (Serpulidae) and the only stigobiont tube-worm (Polychaeta) (Sket, 2003).

Pholeoteraseuthrix (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 stigobiont species of leech (Hirudinea) to be discovered in the world; *Proteus anguinus* (Laurenti, 1768), the famous human fish, is the only European troglobiont vertebrate. With as many as ten species of the genus *Niphargus* (Amphipoda), Vjetrenica is unique in the world, with as many as seven species of Vjetrenica being a type finding site. Such biodiversity of Vjetrenica is explained as a phenomenon of local radiation, not yet recorded in the world's underworld (Sket et al., 2006). *Hadziafragilis* (Karaman, 1932) (Amphipoda) is a typical species of crustacean for the genus and family Hadziidae. Vjetrenica is inhabited by as many as three troglobiont species of tenlegged 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 - *Spelaeocarispretneri* (Matjasic, 1956).

The animal communities in the cave waters are very diverse. In the past, the shallow pools in the main corridor contained an abundant population of shrimp (Troglocarisspp.) and the amphipod Hadziafragilis (Karaman, 1932). However, this fauna appears to have been indirectly destroyed by tourism-related activities. In the lakes of Donja Vjetrenica, the large, prickly and distinctly troglomorphic amphipod Niphargusbalcanicus (Absolon, 1927) is particularly characteristic, and according to the Encyclopedia of caves and karst science, this locality is the only known locality for the species Troglomysisvjetrenicensis (Stammer, 1933). The fast-flowing small stream in the Absolon's canal is particularly rich, among others, with the predatory amphipod Typhlogammarus, rich colonies of tiny hemispheres of Iglica absoloni, and occasionally Proteus anguinus (Laurenti, 1768). The Great Lake is particularly characterized by the specialized Niphargustrullipes (Sket, 1958) and the great N. vjetrenicensis (Karaman, 1950). Shrimp species are also common. It should be noted that as many as three and perhaps even four species of Atyidae (Spelaeocarispretneri (Matjasic, 1956), Troglocariscf. Anophthalmus (Kollar, 1848), T. hercegovinensis (Babić, 1922) and undescribed Troglocarissp.) are present in Vjetrenica. From the area of the municipality of Ravno, from 14 caves, which are type sites (TL), as many as 86 taxes (T5.3.) were described, of which 5 are not valid (2 in synonymy; 3 not described), therefore 81 are valid taxa, which positions it on the first place among municipalities in BiH, and probably in the world (Ozimec et al., 2021). A summary overview of the identified cave organisms of Vjetrenica is provided in Table 10 below.

Table 10. Summary of identified cave organ	nisms of Vjetrenica	(according to: Ozimec a	et al., 2021)
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Kingdom	Genus / Phyllum	Class /Classis	Taxa Nr.	Cave taxa
Bacteria	NITROSPIRAE	Betaproteobacteria	1	1

	ACTINOBACTERIA	Gammaproteobacteria	1	1
Fungi	ASCOMYCOTA	Leotiomycetales	1	0
		Pezizomycetes	1	0
		Eurotiomycetes	5	0
		Leotiomycetes	2	0
		Sordariomycetes	5	0
	ZYGOMYCOTA	Zygomycetes	1	0
Protista	AMEBOZOA	4	23	0
	CERCOZOA	Granofilosea	1	?
	CILIOPHORA	3	10	0
	HETEROKONTOPHYTA	Actinochrysophyceae	1	0
	OCHROPHYTA	Heliozoa	1	0
Animalia	PLATHELMIN THES	Turbelaria	8	8
	CNIDARIA	Hydrozoa	2	2
	NEMATODA	Adenophorea	3	0

	Secernentea	2	0
MOLLUSCA	Gastropoda	29	13
	Bivalvia	1	1
NEMERTINA	Enopla	1	1
ANNELIDA	Hirudinea	1	1
	Oligochaeta	18	14
	Polychaeta	1	1
ARTHROPODA	Arachnida	42	22
	Crustacea	56	39
	Entognatha	7	5
	Insecta	60	18
	Myriapoda	17	9
CHORDATA	Pisces	3	0
	Amphibia	1	1
	Reptilia	1	0

				A PAR
		Mammalia	13	0
SUM	17	37	321	137

Small hydrobioid gastropods, *Lanzaiavjetrenicae* (Kuščer, 1933) and the serpulide worm *Marifugiacavatica* (Absolon & Hrabe, 1930), are typical of small streams in remote parts of Vjetrenica. Numerous genera and species have a holo-dinaric distribution: *Proteus, Marifugia, Zospeumamoenum* (Frauenfeld, 1856), *Congeriakusceri* (Bole, 1962), two species of *Troglocaris* shrimp and others. *Titanetheshercegowinensis* (Verhoeff, 1900), *Monolistrahercegoviniensis* (Absolon, 1916), *Spelaeocaris* shrimp, *Dina absoloni* leech (Johansson, 1913) and all genera of beetles have a mero-dinaric distribution in the southeast. Some species of the genus *Niphargus*, Isopoda, Hadesiai *Typhloglomeris* are narrow endemics, even within the south-eastern Dinarides. For now, some species can be considered endemic to the Vjetrenica cave. The two species are particularly interesting; amphipoda *Hadezia* and crustacea *Troglomysis* are indisputably species of coastal marine origin, but here they are incorporated into freshwater fauna not associated with recent or ancient seas. Vjetrenica Cave is a typical place of many invertebrates that exclusively inhabit the Vjetrenica system (according to Ozimec and Lučić, 2009). According to data for as many as 14 of the 48 species for which the Vjetrenica system is a type locality, they are endemic to the Balkan Peninsula or are endangered or vulnerable species.

Identification of rare/endangered habitat types

Soil leaching, action of winds, summer droughts and fires led to creation of dry grasslands typical of this area. For the most part, such grasslands are those of the planned protected area, with sparse vegetation, resembling rocky deserts. Grasslands with more soil have more dense vegetation and they are richer in biological species, but it can be said that these habitats are in immediate danger due to the lack of rules to protect forests and the fact that in the area Vjetrenica-Popovo polje there are no protected forests. Today, dry grassland habitat types, which belong to the area of Vjetrenica-Popovo polje, are on the list of endangered and rare habitats as a result of depopulation, neglect, emigration and lack of use of machinery. The consequences of this are reflected in the overgrowth of mountain grasslands, which become covered with shrubs and forests, which further results in a significant loss of biological diversity. On the other hand, grasslands in the valleys are increasingly under anthropogenic pressure, which leads to their degradation and ultimately a reduction in the number of species that were typical of such grasslands.

The presence of a significant number of endangered and endemic plant species and typical and wellpreserved habitat types of importance for the European Union from the point of view of Habitats Directive, speaks in favour of the fact that the Protected landscape Vjetrenica - Popovo polje is of global importance for protection of European natural heritage and should be the part of the Natura 2000 ecological network in the future.

Out of these, the following stand out in particular:

- ✓ *3170 Mediterranean temporary ponds
- ✓ 5210 Arborescent matorral with Juniperus oxycedrus and Juniperus phoenicea
- ✓ *6220 Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*
- ✓ 62A0 Eastern sub-mediteranean dry grasslands (Scorzoneratalia villosae)
- ✓ 6540 Sub-Mediterranean grasslands of the Molinio-Hordeion secalini
- ✓ 8140 –Eastern Mediterranean screes *Drypidetaliaspinosae*
- ✓ 8210 Calcareous rocky slopes with chasmophytic vegetation
- ✓ 91AA Eastern white oak forest
- ✓ 9340 Quercus ilex woods.

Identification of rare and endangered species

Identification of rare and endangered species of flora

Research on the flora of the aboveground part of the Protected landscape Vjetrenica Popovo polje, recorded 484 taxa. Among the identified species, 21 species are endemic to the Balkan Peninsula, while according to the Red List of Flora of the Federation of BiH, 38 taxa stand out with a degree of endangerment (10 vulnerable, 12 endangered, 5 critically endangered, 7 almost endangered and 4 for which data are missing). A review of data from II and IV of the Habitats Directive found amethyst meadow squill (*Scilla litardierei*) (Figure 9), while only *Ruscus aculeatus* and *Galanthus nivalis* were confirmed from Annex V (Table 11).

Or. no	Latin name	Common name	Genus	Endem ic	Endanger ed	IUCN status	IUCN threats
1.	Anacamptispyramidalis (L.) Rich.	Pyramidal orchid	Orchidaceae		NT	LC	1.1., 1.3., 2.1.4.,2.2.3. , 3.2., 5.2.1., 8.1.1.
2.	Anthyllisvulneraria L. subsp. weldeniana (Rchb.) Cullen	Ilirski ranjenik	Fabaceae		VU		
3.	Aristolochiarotunda L.	Round- leaved birthwort	Aristolochiac eae		EN		
4.	Asperula scutellaris Vis.	Woodruff	Rubiaceae	din	EN		
5.	Campanulaaustroadriatic a D. Lakušić& Kovačić	Bellflower	Campanulace ae	din	NT		

Table 11. Endangered spec	ies of flora of the protected .	landscape of Vjetrenica-Popovo polje
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6.	Cardaminegraeca L.	Morska režuha	Brassicaceae		CR		
7.	<i>Centaurea glaberrima</i> Tausch	Goli različak	Compositae	din	EN		
8.	<i>Cerastiumligusticum</i> ViV. subsp. <i>trichogynum</i> (Möschl) P. D. Sell&Whitehead	Primorski rožac	Caryophyllac eae	balc			
9.	<i>Chaerophyllumcoloratum</i> L.	Šarena krabljica	Apiaceae	din	EN		
10.	<i>Crocus dalmaticus</i> Vis.	Dalmatian crocus	Iridaceae	din	EN	LC	There are some localized threats associated with habitat loss, but these are not considere d significant
11.	<i>Crocustommasinianus</i> He rb.	Tommasini's crocus	Iridaceae		CR		
12.	<i>Cyclamenhederifolium</i> Ai ton	Sowbread	Primulaceae		CR	LC	5.2.1, 11.1.
13.	<i>Dianthussylvestris</i> Wulfe nsubsp. <i>tergestinus</i> (Rchb.) Hayek	Wood pink	Caryophyllac eae		VU		

14.	Dittrichiaviscosa (L.) Greutersubsp. viscosa	Sticky fleabane	Compositae		EN		
15.	Edraianthustenuifolius (Waldst. & Kit.) A. DC.	Rock Bells	Campanulace ae	din	LC		
16.	Euphorbia fragifera Jan	Mirisna mlječika	Euphorbiacea e		VU		
17.	<i>Fritillariamessanensis</i> Raf. subsp. <i>gracilis</i> (Ebel) Rix	Dark fritillary	Liliaceae	din	VU		
18.	Galanthusnivalis L.	Common snowdrop	Amaryllidace ae		Annex V	NT	1.1., 2.1.4., 5.2.1., 11.1.
19.	Galium firmum Tausch	Žuti broć	Rubiaceae	balc			
20.	<i>Gladiolusillyricus</i> W. D. J. Koch	Wild gladiolus	Iridaceae		NT		
21.	Helleborus hercegovinus Martinis	Herzegovinia n hellebore	Ranunculace ae	din	VU		
22.	<i>Hieracium heterogynum</i> (Froel.) Gutermann	Hawkweed	Compositae	din			
23.	Iris tuberosa L.	Snake's-head iris	Iridaceae		CR		
24.	<i>Moltkiapetraea</i> (Tratt.) Griseb.	Modro lasinje	Boraginaceae	balc	NT		
25.	<i>Opopanaxchironium</i> (L.) W. D. J. Koch	Hercules' all- heal)	Apiaceae		EN		
26.	<i>Petteriaramentacea</i> (Sieber) C. Presl	Dalmatian Laburnum	Fabaceae	din	NT	LC	2.3.4.
27.	<i>Peucedanumcoriaceum</i> Rc hb. subsp. <i>pospichalii</i> (Thell.) Horvatić	Kožasta pukovica	Apiaceae		EN		

28.	<i>Rhamnus orbiculata</i> Bornm.	Okruglolisna krkavina	Rhamnaceae	balc			
29.	Romuleabulbocodium (L.) Sebast. & Mauri	Dugovača	Iridaceae		EN		
30.	Ruscusaculeatus L.	Butcher's- broom	Asparagacea e		VU; Annex V	LC	2.2.1., 2.2.2., 4.2., 5.2.1., 5.3.4., 7.1.1., 7.3.
31.	Salviapratensis L. subsp. bertolonii (Vis.) Soó	Meadow sage	Lamiaceae		NT		
32.	Scilla lakusicii Šilić	Lakušićev procjepak	Asparagacea e	din	EN		
33.	ScillalitardiereiBreistr.	Amethyst meadow squill	Asparagacea e	din	VU; Annex II		
34.	SeselitomentosumVis.	Pustenasto devesilje	Apiaceae	din	VU		
35.	<i>Sideritis romana</i> L. subsp. <i>purpurea</i> (Talbot ex Benth.) Heywood	Crveni divlji čaj	Lamiaceae	balc			
36.	Stachysrecta L.	Stiff hedgenettle	Lamiaceae		CR		
37.	<i>Tanacetumcinerariifoliu</i> <i>m</i> (Trevir.) Sch. Bip.	Dalmatian chrysanthem um	Compositae	balc	VU		
38.	Thalictrum flavum L.	Yellow meadow-rue	Ranunculace ae		EN		
39.	Trifoliumdalmaticum	Dalmatian	Fabaceae	balc			

	Vis.	clover					
40.	<i>Trifolium pignantii</i> Fauché&Chaub.	Pignant's clover	Fabaceae	balc	NT		
41.	<i>Tulipa sylvestris</i> L. subsp. <i>sylvestris</i>	Wild tulip	Liliaceae		EN		
42.	Veronica anagalloides Guss.	Faded speedwell	Plantaginace ae		VU	LC	There are no known significant past, permanen t, or future threats to this species.



Figure 9. Scillalitardierei Breistr. - endemic and endangered species, gene pool of immense importance

Identification of rare and endangered fauna species

Identification of rare and endangered species of invertebrates of subterranean fauna

Since Vjetrenica cave is a type locality of many invertebrates that exclusively inhabit the Vjetrenica system (according to Ozimec and Lučić, 2010), an overview of the degree of endangerment of these species is provided below. By analysing the list of species and comparing the list with the Red List of Fauna of the Federation of Bosnia and Herzegovina, IUCN list of endangered species and protection requirements imposed by the EU Habitats Directive, an assessment of threat classification is available for 18 species

Six species, *Dinaromys bogdanovi* (Martino, 1922), *Laemostenus (Antisphodrus) cavicola* (Schaum 1858), Niphargus vjeternicensis S. Karaman 1932, *Rhinolophus hipposideros* (Bechstein, 1800), *Squalius svallize* (Heckel & Kner, 1885, Simon), *Trogulus torosus* (1858), are classified as vulnerable (VU) according to the category of the Red List of the Federation of BiH, which means that these are species that are at risk of extinction in nature. Three species, *Adriaphaenops pretneri* (Scheibel, 1935), *Proteus anguinus* (Laurenti, 1768), *Rhinolophus hipposideros* (Bechstein, 1800), are classified as endangered species with a very high risk of extinction in the nature (Table 12).

At the same time, it is important to emphasize that the list of subterranean fauna includes species of importance for the European Union; *Congeria kusceri* (Bole, 1962), *Myotis emarginatus* (Geoffroy, 1806), *Proteus anguinus* (Laurenti, 1768), *Rhinolophus hipposideros* (Bechstein, 1800) are species listed in Annexes II and IV of the Habitats Directive. The species contained in the mentioned annexes require strict protection of the habitats of the species, that is, the species themselves.

Table 12. Overview of the species of underground fauna of the Vjetrenica cave with the threat category

No.	Latin name	IUCN threat category	Threat category according to the FBiH Red List	Habitat Directive (Annex II and IV)	IUCN threats (code)
1.	Adriaphaenopspretneri (Scheibel, 1935)		EN		
2.	Astrobunusdinaricus (Roewer, 1915)		LC		
3.	Congeriakusceri (Bole, 1962)	VU		II, IV	7.2.5., 7.2.7., 9.1.1., 9.1.2., 9.3.3.
4.	Dicranolasmaverhoeffi (Dahl, 1903)		LC		
5.	Dinaromysbogdanovi (Martino, 1922)	VU	VU		
6.	Hierophisgemonensis (Laurenti, 1768)	LC	LC		2.1.3., 2.1.4., 2.3.4., 5.1.3., 9.3.4.
7.	Laciniushorridus (Panzer, 1794)		LC		
8.	Laemostenus (Antisphodrus) cavicola (Schaum, 1858)		VU		
9.	Myotis emarginatus (Geoffroy, 1806)	LC	VU	II, IV	5.1.1., 5.1.3., 6.1., 6.3., 7.1.3., 7.3.
10.	Nelimatroglodytes (Roewer, 1910)		LC		
11.	Neotrechussuturalis (Schaufuss 1864)		EN		
12.	Niphargusvjeternicensis (S. Karaman, 1932)		VU		
13.	Opilio dinaricus (Šilhavý, 1938)		LC		
14.	Opilio saxatilis (C.L. Koch, 1839)		LC		
15.	Proteus anguinus (Laurenti, 1768)	VU	EN	II, IV	1.1., 1.3., 2.1., 5.1.1.,

					5.3.5., 6.1., 9.2.3., 9.3.4.
16.	<i>Rhinolophushipposideros</i> (Bechstein, 1800)	LC	EN	II, IV	7.3., 9.3.4.
17.	Squaliussvallize (Heckel&Kner, 1858)	VU	VU		7.2.8., 7.2.11., 8.1.1., 11.2.
18.	Trogulustorosus (Simon, 1885)		VU		



Identification of rare and endangered invertebrate species of aboveground fauna

Regarding the aboveground fauna of invertebrates, field research and review of data from literature for the wider range of the protected area Vjetrenica - Popovo polje, 7 species of invertebrates was determined, which are classified as endangered categories on the Red List of the Federation of BiH, as well as two species included in the Annexes II and/or IV of the Habitats Directive of the European Union (Table 13).

Table 13. List of endangered species according to IUCN, Red List of the Federation of Bosnia and Herzegovina and protected species according to the Habitats Directive, Annexes II and IV (Insecta) in the area of Popovo polje

Species	Degree of threat according to the Red Lists of Europe and the Red List of FBiH	Degree of threat and protection according to the Habitats Directive (Annexes II and IV)	IUCN threats(code)
1. Ammobatoidesabdominalis (Eversmann, 1852)	IUCN EN		7.3.
2. <i>Cerambyxcerdo</i> Linnaeus, 1758 – great capricorn beetle	IUCN VU	HD II and IV	
 Lucanuscervus (Linnaeus, 1758) –European stag beetle 	IUCN LC VU on the FBiH Red List	HD II	5.3.5.
4. Gonepteryx cleopatra (Linnaeus, 1758)	IUCN LC VU on the FBiH Red List		

5. Iolanaiolas (Ochsenheimer, 1816)	Europe NT EN on the FBiH Red List	2.1.3., 2.3.2., 2.3.3., 7.3.
6. Ariciaanteros (Freyer, 1838)	Europe NT EN on the FBiH Red List	1.3., 2.1.1., 2.1.2., 2.2.1., 2.2.2., 2.3.2., 2.3.3., 6.1., 7.1.3., 7.3., 8.1.1., 9.3.4., 11.1., 11.2.
7. Polyommatusadmetus Esper, 1783	Europe LC EN on the FBiH Red List	
8. Charaxesjasius (Linnaeus, 1767)	Europe LC VU on the FBiH Red List	
9. <i>Hipparchiastatilinus</i> (Hufnagel, 1766)	IUCN LC VU on the FBiH Red List	

Identification of rare and endangered vertebrate species of aboveground fauna

In the fauna of amphibians and reptiles, based on the results of field research and review of available literature, the presence of 4 species at risk (VU) I and 1 species in the category of endangered species on the Red List of the Federation of BiH was identified in this area, as well as 20 species listed in Annex II and/or IV of the EU Habitats Directive.

Of the ornithofauna species, one species is classified as critically endangered, while six are classified as vulnerable, and eleven species are listed in Annex I of the EU Birds Directive. As for the other findings, it is important to mention two rare species in BiH (Table 14) that exist as nesting birds in this area:

✓ *Falco peregrinus* Tunstall, 1771 - a grey falcon that probably nests within the range or in a narrower zone, and it is one of the rarest and most endangered birds in BiH

✓ *Melanocorypha calandra* Linnaeus, 1766 – calandra lark that is among the three rarest bird species in BiH.

Table 14. List of endangered species of amphibians, reptiles and birds in the areas of Protected area Vjetrenica-Popovo polje

Species	Degree of threat according to the FBiH Red List and IUCN	Degree of threat and protection according to the Habitats Directive (Annexes II and IV) and Birds Directive (Annex I)	IUCN threats (code)
Amphibia – amphibians			
 Lissotriton vulgaris (Linnaeus, 1758) -common newt 	VU on the FBiH Red List		5.3.5., 7.2.8., 8.1.1.
2. <i>Bufoviridis</i> (Laurenti, 1768) – European green toad		HD IV	2.1.3., 2.3.3., 4.1., 9.2.3., 9.3.4.
3. Hylaarborea (Linnaeus, 1758) – tree frog		HD IV	1.1., 1.2., 1.3., 2.1.2., 2.1.3., 2.2.1., 2.3.3., 5.1.1., 5.3.5., 8.1.1.,

			9.1.3., 9.2.3., 9.3.4.
4. Rana dalmatina (Bonaparte, 1839)			1.1., 2.1.3., 2.2.1.,
- Agile frog		HD IV	2.2.2., 2.3.3., 5.3.5.,
			9.3.4.
5. <i>Proteus anguinus</i> (Laurenti, 1768)	EN on the FBiH		1.1., 1.3., 2.1.3,
- human fish	Red List	HD II and IV	5.1.1., 5.3.5., 6.1.,
	Red List		9.2.3., 9.3.4.
6. Bombinavariegata (Linnaeus,			1.1., 1.2., 2.1.3.,
8 (,		HD IV	2.3.3, 3.2., 5.3.5.,
1758) – yellow-bellied toad			9.2.3., 9.3.4.
Reptilia – reptiles			
			1.1., 1.3., 2.1.2.,
1. Testudohercegovinensis (Werner,	VU on the FBiH	HD II and IV	2.1.3., 2.1.4., 2.3.4.,
1899) – Dalmatian tortoise	Red List		4.1., 5.1.1., 7.1.3.,
			7.3., 8.1.1., 9.3.3.
2. Ophisaurusapodus (Pallas, 1775) –		HD IV	2.1.3., 2.3.3., 5.1.3.
Sheltopusik			2.1.3., 2.3.3., 3.1.3.
3. Archaeolacertaoxycephala			
(Duméril&Bibron, 1839) – Sharp-		HD IV	
snouted rock lizard			
4. Lacertatrilineata (Bedriaga, 1886)		HD IV	212 712
– Balkan green lizard			2.1.3., 7.1.3.
5. <i>Lacertaviridis</i> (Laurenti, 1768) –		HD IV	
European green lizard			
6. <i>Podarcismelisellensis</i> (Werner,		HD IV	

1891) – Dalmatian wall lizard			
7. <i>Coronellaaustriaca</i> (Laurenti,		HD IV	1.1., 2.1.3., 5.1.3.,
1768) – Smooth snake			7.1.1., 11.1.
8. <i>Platycepsnajadum</i> (Eichwald,		HD IV	2.1.3., 4.1., 5.1.,
1831) – Dahl's whip snake			7.1.3.
9. Telescopusfallax (Fleischmann,		HD IV	1.2., 2.3.3., 4.1.,
1831) – European cat snake			5.1.3.
			1.1., 1.3., 2.1.2.,
10. Testudohermanni (Gmelin, 1789) –		HD II	2.1.3., 2.1.4., 2.3.4.,
Hermann's tortoise			4.1., 5.1.1., 7.1.3.,
			7.3., 8.1.1., 9.3.3.
11. Zamenislongissima (Laurenti,		HD IV	
1768) – Aesculapian snake			
12. Zamenissitula (Linnaeus, 1758) –	VU on the FBiH	HD II and IV	2.1.4., 2.3.4., 5.1.1.,
European ratsnake	Red List		5.1.3.
13. Elaphequatuorlineata (Lacépede,	VU on the FBiH	HD II and IV	1.1., 1.3., 2.1.3.,
1789) – four-lined snake	Red List		5.1.3.
14. Vipera ammodytes (Linnaeus		HD IV	5.1.1., 5.1.3.
1758) – horned viper			5.1.1., 5.1.5.
15. Elaphesitula (Linnaeus, 1758) –		HD II AND IV	2.1.4, 2.3.4., 5.1.1.,
Leopard snake		ΠΟΠΑΝΟΙΥ	5.1.3.
Aves – birds			
1. Alcedoatthis (Linnaeus, 1758)–	NT on the BiH Red	BD-I	
Common kingfisher (NG)	List	DD-1	
2. Anthuscampestris (Linnaeus,	NT on the BiH Red	BD-I	

1758) – Tawny pipit (G)	List		
3. <i>Aquilachrysaetos</i> (Linnaeus, 1758) – Golden eagle (NG)	EN on the BiH Red List	BD-I	2.2.2., 3.3., 4.2., 5.1.3., 8.5.1., 9.3.3., 11.1.
4. <i>Ardeacinerea</i> (Linnaeus, 1758) – Grey heron (NG)	VU on the FBiH Red List		2.1.4., 5.1.1., 5.1.3., 5.3.4., 8.1.1., 8.1.2., 8.5.2., 9.3.2.
5. <i>Cecropisdaurica</i> (Laxmann, 1769) - Red-rumped swallow (G)	VU on the FBiH Red List		8.2.1.
6. <i>Circaetusgallicus</i> (J. F. Gmelin, 1788) – Short-toed snake eagle (NG)	VU on the FBiH Red List	BD-I	2.1.3., 2.3.2., 3.3., 4.1., 4.2., 5.1.3., 5.3.3., 7.1.1., 9.3.3.
 <i>Circusaeruginosus</i> (Linnaeus, 1758) - Western marsh harrier (NG) 	VU on the FBiH Red List	BD-I	2.3.2., 3.3., 5.1.2., 5.1.3., 5.3.3., 7.2.4., 9.2.3., 9.3.3.
8. <i>Egrettagarzetta</i> (Linnaeus, 1766) - Little egret (NG)	VU on the FBiH Red List	BD-I	
9. Falco naumanni (Fleischer, 1818) - Lesser kestrel (NG)	CR on the FBiH Red List	BD-I	1.1., 1.2., 2.1.3., 2.2.3., 5.1.1., 5.1.3., 9.3.3., 11.2., 11.4.
10. Falco peregrinus (Tunstall, 1771) – Peregrine falcon (G)	DD on the FBiH Red List	BD-I	2.3.2., 3.3., 5.1.1., 5.1.3., 5.3.3., 6.1., 7.1.1., 9.2.1., 9.3.3.
11. Falco vespertinus (Linnaeus, 1766)- Red-footed falcon (NG)	NT IUCN	BD-I	2.1.3., 2.3.2., 3.3., 5.1.1., 5.3.3., 7.1.1.,

			9.3.3.
12. <i>Laniuscollurio</i> (Linnaeus, 1758) – Red-backed shrike (G)		BD-I	
13. <i>Melanocoryphacalandra</i> (Linnaeus,1766) - Calandra lark (G)		BD-I	
14. <i>Phalacrocoraxcarbo</i> (Linnaeus, 1758) - Great cormorant (NG)	VU on the FBiH Red List	-	2.4.3., 3.3., 5.1.1., 5.1.3., 6.1., 7.3., 8.5.2., 9.2.1., 9.2.3., 9.3.3., 11.2.

The mammal fauna was analysed on the basis of available data from literature, whereby 14 species of mammals are on the Red List of the Federation of BiH, of which 8 species have the status of endangered and 6 species have the risky status. Out of the identified mammalian species, 1 species is included in Annex II and/or IV of the Habitats Directive of the European Union (Table 15).

Table 15. List of endangered mammal species in the areas of Protected area Vjetrenica-Popovo polje

Species	Degree of threat according to the FBiH Red List and IUCN	Degree of threat and protection according to the Habitats Directive (Annexes II and IV)	IUCN threats(code)
1. <i>Rhinolophuseuryale</i> (Blasius, 1853)	EN on the FBiH	HD II and IV	2.3.3., 5.1.2., 6.1.,
Mediterranean horshoe bat	Red List		6.3., 9.3.4.
2. Rhinolophusferrumequinum	VU on the FBiH	HD II and IV	2.1.3., 6.1., 7.3.,

(Schreber, 1774) – Greater horseshoe bat	Red List		9.3.4.
3. <i>Rhinolophushipposideros</i> (Bechstein, 1800) - lesser horseshoe bat	EN on the FBiH Red List	HD II and IV	7.3., 9.3.4.
 4. Miniopterusschreibersii 5. (Kuhl, 1817) – Common bent- wing bat 	EN on the FBiH Red List	HD II and IV	1.3., 3.3., 4.1., 5.1.3., 5.1.4., 6.1., 6.3., 8.5.1., 9.3.3.
<i>Myotis myotis</i> (Borkhausen, 1797)- Greater mouse-eared bat	EN on the FBiH Red List	HD II and IV	
7. <i>Myotis blythii</i> (Tomes, 1857) – Lesser mouse-eared bat	EN on the FBiH Red List	HD II and IV	1.1., 2.1.2., 5.1.3., 6.1., 6.3., 9.3.4.
 <i>Myotis emarginatus</i> (Geoffroy, 1806) - Geoffroy's bat 	VU on the FBiH Red List	HD II and IV	5.1.1., 5.1.3., 6.1., 6.3., 7.1.3., 7.3.
9. <i>Myotis capaccinii</i> (Binaparte, 1837) – Long-fingered bat	VU on the FBiH Red List	HD II and IV	1.1., 5.1.1., 6.1., 6.3., 7.1.3., 7.2.8., 9.1.3., 9.2.3., 9.3.4.
10. Myotis nattereri (Kuhl, 1817) – Natterer's bat		HD II and IV	1.1., 1.2., 1.3., 2.3.3., 4.1., 5.3.3., 5.3.4., 6.1., 6.3., 7.1.1., 9.6.1., 11.1.
 Hypsugosavii (Bonaparte, 1837) – Savi's pipistrelle 	VU on the FBiH Red List	HD II and IV	
12. <i>Pipistrelluskuhlii</i> (Kuhl, 1817) - Kuhl's pipistrelle	VU on the FBiH Red List	HD II and IV	
13. <i>Pipistrellusnathusii</i> (Keyserling &Blasius, 1839) – Nathusius's pipistrelle		HD II and IV	

<i>Plecotuskolombatovici</i> (Dulic, 1980)- Kolombatovic's long-eared bat		HD II and IV	6.1.
15. <i>Canislupus</i> (Linneaeus 1758) – wolf	EN on the FBiH Red List		2.3.2., 2.3.3., 5.1.3.
16. <i>Erinaceusconcolor</i> (Martin, 1837) - Southern, white-breasted hedgehog	EN on the FBiH Red List		
17. <i>Dinaromysbogdanovi</i> (V. et E.Martino, 1922) – Balkan snow vole	VU on the FBiH Red List	HD II AND IV	

History and development

History of the Vjetrenica cave research

Vjetrenica Cave as the backbone of protection of Vjetrenica is a complex cave system with a canal length of approximately 7,323.90 meters and it is one of the longest caves in Bosnia and Herzegovina. It consists of the main canal Gornja Vjetrenica about 2500 meters long and numerous side canals, the most important of which are: Donja Vjetrenica, upper and lower Absolon's canal, Radovanovic canal, Leopard canal, Welsh canal and Ravanjski canal, named after the central settlement Ravno. Vjetrenica is located in the area of the South Dinaric karst, in a karst hill that stretches from the southern edge of the western part of Popovo polje (eastern Herzegovina) to the Adriatic Sea. The entrance is located on the very edge of Popovo polje, 300 meters east of the centre of the village of Zavala, at 260 meters above sea level, 12 km of air distance to the Adriatic Sea (Republic of Croatia). The main direction of the cave canals is south – southeast, that is, in the direction of the sea. Location of the cave is important tourist centre. Apart from Vjetrenica, the cave system includes the Lukavac spring, which is located underneath the entrance to Vjetrenica, and the smaller Bjelušica cave, which is located above the entrance to the Vjetrenica cave. The appearance of a strong wind at the entrance to the cave is the cave is important tourist centre.
name – Vjetrenica (wind). The wind force at the entrance to the cave in the summer months occasionally reaches over 15 meters per second. Vjetrenica Cave is Vjetrenica is a hydrological active, speleological and drifty object with four autonomous water streams, as well as a dozen of smaller, periodical streams and underground lakes. There are also underground lakes, the largest of which is the Great Lake (Veliko jezero), 180 meters long. The cave is characterized by large underground halls with examples of collapsed ceilings and accumulations of speleothems. The average temperature of the cave is about 11.0 °C.

Vjetrenica was first mentioned in the middle of the 1st century AD in the work History of Nature/Povijest prirode (Historia Naturalis) published in 77 by Pliny the Elder, and later by numerous authors, such as Getaldić. In the first half of the 20th century, the growing interest in cave fauna and karst geomorphology and hydrology resulted in scientific research of the cave. One of the most important explorers of the cave was Karel Absolon. The Czech geographer, zoologist and palaeontologist discovered new passages in the cave, described the troglobitic fauna and he was the first to suggest that the length of Vjetrenica could be 15-20 kilometres, all the way to the coast or under the sea (Absolon, 1916). He was the first one to state that Vietrenica is an underground drainage canal from Popovo polje. Jovan Cvijić, a well-known geomorphologist, in his work published 23 years after his death (Cvijić 1950) agreed with Absolon that the waters from Popovo polje flowed through Vjetrenica and other underground passages to the Adriatic Sea and the Neretva River. Milojević (1928) had a different opinion about the hydrological function of Vjetrenica. He classified the cave as a former underground tributary of Popovo polje. The first scientific discussion of Vjetrenica (Radovanović, 1929) was a detailed morphological and hydrological study of the cave with a map of the entire cave with cross-sections of passages - known at the time. Radovanović (1929) assumed that Vjetrenica was created as a drainage passage of the lake that was created in Popovo polje. Milojević (1938) did not agree with Radovanović's statement regarding the hydrological function of the cave and had doubts about the map of the latter, so he performed a precise trigonometric levelling of the Main Passage (Glavni prolaz), from the entrance to the Great Lake. Contrary to the map drawn by Radovanović (1929), Milojević (1938) stated that the entrance was located lower from the Great Lake and that Vjetrenica could only be a tributary of water in Popovo Polje.

Zubčević and Gašparović (1958), based on the slope in the direction towards the entrance and erosion markings on the cave walls, concluded that Vjetrenica is an older tributary of Popovo polje, which is today in the phase of loss of hydrological function. The cave was explored by Mirko Malez in 1954, 1957 and 1967 (Malez, 1970). The complete plan with the use of theodolites was made in 1958 by the company Energoinvest and the Speleological Association "Bosnian-Herzegovinian Karst". The latest speleological research conducted since 2000 by speleologists of the SD Speleological Society "Velebit" from Zagreb resulted in the discovery of new canals and the most accurate topographic design.

After visiting the Vjetrenica cave in 1967, speleologists from the "South Wales Caving Club" discovered two new passages in Vjetrenica in 1968. In one passage, later called the Leopard passage, they discovered a carnivorous skeleton from which they collected head and lower jaws. In the other part of the cave they found traces of carnivorous paws. The results of their work in Vjetrenica were written in an unpublished report (Caving Club South Wales, 1968). The head and lower jaws collected by speleologists from Wales were identified as a leopard (Panthera pardus Linnaeus, 1758) by Malezi Pepeonik (1969). In their work, they also give a brief description of the cave and the remains of the leopard skeleton based on photographs by Welsh speleologists. Malez (1971) published almost the same work in the yearbook of the Yugoslav Academy of Sciences and Arts. In a brief description of the paleontological findings in Vjetrenica, Slišković (1979) concluded that a leopard fell through a pit and died at the site where it was found. The geological description of one part of the cave was made by Petrović et al. (1979). In the same year, Gašparović (1979) gave an overview of speleological work in Vjetrenica. After several seasons of paleontological research in Vjetrenica, Malez (1985) was able to find the skeletal remains of one leopard, but his team could not reach the remains of the skeleton from the Leopard's passage due to the high water level. He also identified paleontological findings found by a tourist guide in Vjetrenica such as the bear Ursussp and Ursusarctospriscus (Goldfuss, 1818), rodents (Microtinae), and bats (Rhinolophus ferrumequinum (Schreber, 1774)). The bibliography on the Vjetrenica cave from 1585 to 1985 was compiled by Kapel (1986). Lučić and Sket (2003) published a discussion of Vjetrenica where they combined all previous scientific papers on the cave together with new data from

recent speleological research of the cave. Miculinić (2007) gave a brief description of paleontological research in Vjetrenica when the bones and teeth of three leopards (one was the remnant of the skeleton of a previously collected head and jaw) and one bear was collected. Research conducted by the Zagreb palaeontologist Kazimir Miculinić from 2007 to 2012 identified three more leopard skeletons and parts of a cave bear skeleton (*Ursus spelaeus* Rosenmüller, 1794).

Biospeleological research of Vjetrenica

Biospeleological research of Vjetrenica began in the late 19th century with the visit of the German zoologist Karl Verhoeff and the Austrian expert on beetles (*Coleoptera*), Gustav Paganetti Hummler, who referred to the cave as cave in Zavala (*Höhlebei Zavala*). Hundred years ago, Vjetrenica was considered biologically very poor (Absolon, 1916). However, after the cave spider *Stalagtia hercegovinensis* (Nosek, 1905) and the underground beetles (*Coleoptera, Choleviniae, Leptodirini*) *Antroherponapfelbecki* (Müller, 1910) and *Hadesiavasiceki* (Müller, 1911) were described from it, Vjetrenica became very interesting for biologists. The interest in Vjetrenica was particularly demonstrated by the Czech biospeleologist Karel Absolon, who visited Vjetrenica at least 27 times between 1908 and 1922 and who discovered a large number of taxa that are already known elsewhere, but also a large number of new species for science. Unfortunately, Absolon never published his list of species, nor his biospeleological cadastre *Biospeläologica Balcanica*; the number of identified organisms was subsequently published, 47 taxa for Vjetrenica and 51 for smaller Bjelušica (Pretner, 1976), which is considered part of the Vjetrenica cave system. Interest in Vjetrenica has not ceased throughout the 20th century. Most research was conducted in the 1930s and then in the 1950s.

The author of the first published inventory is German biospeleologist Benno Wolf within his catalogue Animalium Cavernarum Catalogus, printed in the period from 1934 to 1938, in which he listed 35 species from Vjetrenica based on 32 references, with an additional 8 from Bjelušica (Wolf, 1934-1938). The second inventory of habitats was published in 1951 by the Bosnian biologist Adem Buturović with 13 taxa from Vjetrenica and 12 from Bjelušica (Buturović, 1951). In one professional hydrobiological study from 1956, 64 species were registered, including all known members of the Protozoa group (Georgijevski et al., 1956). A much longer list

was published by the Slovenian biospeleologist Egon Pretner in 1963 with 54 species (Pretner, 1963), while the Bosnian biologist Sofija Mikšić (1979) published a list of 25 species. In 2003, Slovenian biospeleologist Boris Sket, together with BiH speleologist Ivo Lučić, published a comprehensive inventory of fauna, which includes the Vjetrenica and Bjelušica caves, and the Lukavac spring with 111 taxa, including 75 troglobionts. The inventory was published as part of the monograph "Vjetrenica - a glimpse into the soul of the Earth" (Vjetrenica - pogled u dušu Zemlje) which describes every higher and lower taxon of Vjetrenica, analysing various aspects of habitat and underground fauna of the entire Popovo polje, including its vulnerability.

Among the authors, Stanko Karaman is leading in the number of described taxa with 9 taxa, followed by Karel Absolon (alone and together with others) and Karl Verhoeff, followed by Janez Matjašič with 7 taxa, F. Kiefer and L. Kulczynski with 5 taxa each, and many others. It should be noted that the biospeleological research of Vjetrenica for the first time in the world determined the habitat of hygroperia, cave habitats of rocks through which water flows in a thin layer and described the first organism specialized in this habitat and - the beetle *Hadesia vasiceki*, J. Müller, 1911.

Since 2004, systematic biospeleological research of Vjetrenica has been organized by Speleological Association Vjetrenica from Ravno and the Croatian Biospeleological Society. In addition to microclimatic measurements, fauna collection, macro photography of cave organisms in the cave (in situ), a computer database for cave fauna was created, which is systematically loaded with data from the literature and the latest field research data, including new taxa for cave fauna. During this period of research, numerous new taxa for the fauna of Vjetrenica were identified, among them some new taxa for science. Numerous taxa were macro photographed for the first time. The microclimate of the structure was periodically measured, and the CO₂ content of the building has been measured for the first time.

The latest inventory of fauna of the Vjetrenica cave from May 2010, which is subject to further amendments, includes 232 species of living organisms, of which 2 bacteria, 9 chromists, 14 fungi, 27 protozoa and 180 animals, including 103 species of true cave animals: Turbellaria (5), Hydrozoa (1).), Gastropoda (12), Bivalvia

(1), Nemertina (1), Polychaeta (1), Oligochaeta (6), Hirudinea (1), Palpigradi (1), Araneae (6), Opiliones (2), Pseudoscorpiones (3))), Copepoda (6), Ostracoda (4), Decapoda (4), Isopoda (7), Amphipoda (12), Chilopoda (2), Diplopoda (5), Collembola (4), Diplura (1), Thysanura (1)), Coleoptera (14), Vertebrata (1). With as many as 102 species of true cave animals, of which 47 terrestrial troglobionts and 56 aquatic stigobionates. Vjetrenica cave, in addition to the Postojna cave in Slovenia, is the most important cave in the world in biological terms.

Vjetrenica has both archaeological and paleontological significance. At the entrance to the cave there are two drawings typical of stećak tombstones, and the latest research established the first archaeological discoveries for the cave, a piece of pottery and a bone needle. A summer house of an unknown Roman aristocrat was built at the entrance to Vjetrenica, and the air flow from the cave served as one of the first cooling systems (Grmek and Balabanić, 2000).

During 1952, Vjetrenica was put under protection for the first time, by a decision of the Institute for the Protection of Cultural Monuments and Natural Rarities of the People's Republic of BiH, under number 979/52. Since 1965, in accordance with the Law on Nature Protection (Official Gazette of SR BiH, 4/65, 5 February 1965), Vjetrenica was classified in the category of "special geological reserves". In 2004, Vjetrenica was nominated for the UNESCO World Heritage List.

Vjetrenica Cave was arranged for tourist purposes before 1940, and the cave was extensively arranged and electrified in 1964, the trail was arranged in the length of 1800 meters and electrified in the length of 1050 meters, and a motel was built nearby to receive tourists. A great devastation occurred between 1991 and 1996, during the War of independence.

Cultural and historical values; monumental, architectural and cultural heritage

Despite almost complete lack of systematic research of cultural and historical heritage in the municipality of Ravno, that is, the narrower area of the planned Protected landscape Vjetrenica - Popovo polje, there are cultural and historical assets of exceptional importance from all historical periods on the field.

By means of archaeological methodology only a dozen sites were identified that are based exclusively on accidental findingd and reconnaissance, except for systematic archaeological research at the Church in Zavala and part of the monastery complex in Zavala.

The prehistoric period is currently marked by accidental findings of pottery (Vjetrenica, Orlovica) and finding sites of the Bronze and Iron Ages with characteristic settlements – forts and graves in the shape of stone mounds. This type of immovable monumental heritage belonged to the holders of the so-called Posusje and Cetina cultures that in the Early and Middle Bronze Age inhabited mainly the area of Herzegovina and central Dalmatia, organizing smaller rural agglomerations of open and fortified type, which indicates a nomadic agricultural and livestock population.

Lack of knowledge on the Paleolithic and Neolithic periods can be attributed to the state of exploration, that is, the space is unexplored. The caves that served as shelters and temporary dwellings are potential archaeological sites of Paleolithic man, and the Mesolithic and Neolithic populations that followed.

Without systematic research, it is difficult to set the date of the hillfort settlements, which have a common feature – position on a hill, protection by a dry stone wall and the phenomenon of the so-called pottery from fortified sites. In the forts, the continuity of life can often be traced from the Bronze and Iron Ages to the establishment of Roman rule. Hillfort settlements were identified in Čvaljina, Orahov Do, Golubinac and Zavala.

The finds of late antique-early Christian tomb in Golubinac testifies to the continuity of settlement in this area. Most of the material evidence in the area of protected landscape Vjetrenica was left from the medieval period in the form of cemeteries under stećak tombstones. Most of the stećak tombstones are of high-quality workmanship and various ornaments, which testifies to the high spiritual and material achievements of the medieval population, and their number indicates to a significant population of this area in the pre-Turkish period. All characteristic forms of this type of stone tombstones are represented, from amorphous specimens to superbly worked chests, gabled tombstones and tombstones, with a diverse repertoire of motifs. The necropolises of stećak tombstones from this area are Zavala-Crkvina, Belenići-Groblje (cemetery), Kiev Do-Groblje (cemetery), Orahov Do-Donje polje, Golubinac-Groblje (cemetery), and medieval graves in front of the Vjetrenica and Orlovica caves, with about eighty monuments.

The pre-Romanesque church is traditionally dedicated to St. Peter in the position of Crkvina in Zavala, from which the stone pluteus originate, with motifs of the Eucharist of exceptional artistic value, and which today can be seen in the Museum of Herzegovina in Trebinje. It is one of the most important sites of its kind in general.

In the complex of the Orthodox monastery in Zavala, which is mentioned at the beginning of the 16th century, there are frescoes from the 17th century which are considered to be the highest quality paintings in BiH from the Ottoman period.

The Archaeological Site of Zavala-Crkvina and the Architectural Ensemble of the Presentation of the Blessed Virgin Mary in Zavala (Zavala Monastery) have the status of a National Monument of BiH.

A special feature of Vjetrenica – Popovo polje are the stone mills that represent the legacy of agricultural life in this area. The mills used to be very important economic facilities, the purpose of which was to grind cereals of all kinds and turn them into the basic foodstuff. Today they are in the phase of disappearing. In rare cases, they have been reconstructed as individual cultural-historical monument or part of a cultural environment, most often for tourist purposes. The two most common names used for this type of traditional commercial

building are: watermill or mill (*vodenica-mlinica*). These structures of tangible cultural heritage have not been protected by law to this day.

ARCHITECTURAL ENSEMBLE OF THE PRESENTATION OF THE BLESSED VIRGIN MARY IN ZAVALA (ZAVALA MONASTERY), Zavala, Ravno

The architectural ensemble consists of a church with a bell tower, a subwall with an access tunnel and a terrace, a new monastic quarter, a well, an old school and a cave (hermitage) located in Zavala, 3 km east of Ravno. The monastery is first mentioned in historical sources at the beginning of the 16th century. Frescoes from the 17th century are considered to be the highest quality paintings in BiH created during the Ottoman rule. The repertoire illustrated in Zavala is very rich. The choice of themes was particularly chosen and indicates that the painter knew iconography very well. The examination established that the frescoes were made on the base of three layers of mortar. The layers are loosely bound, and they can be separated. The iconography was done using *alsecco* or *frescosecco* technique. It has the status of a national monument of Bosnia and Herzegovina.

VELJA GRADINA, Zavala, Ravno

Prehistoric hillfort with the remains of a dry stone wall from the Bronze or Iron Age located above the village of Zavala towards Golubinac.

CRKVINA, Zavala, Ravno

At the position of Crkvina in Zavala, there are archaeological remains of a pre-Romanesque church, according to the tradition dedicated to St. Peter. The single nave building with a square apse measures 13.60 x 6.20 m.

Archaeological excavations in 1957 uncovered stone plutei with Eucharistic motifs depicting birds drinking water from a chalice, of exceptional artistic value, and today they are in the Museum of Herzegovina in Trebinje. There is a necropolis with 28 previously identified stećak tombstones at the same site. It has the status of a national monument of Bosnia and Herzegovina.

VJETRENICA, Zavala, Ravno

At the entrance to the Vjetrenica cave there is a tomb dating to the 15th century, partly buried in living stone, with two reliefs with a motif of hunting and a knight's tournament above it. Before the renovation of this area, there were fragments of prehistoric or medieval pottery (Mihajlović, 1890). The latest research established archaeological finds in the cave, a bone needle and a piece of pottery. A summer house of an unknown Roman aristocrat was built at the entrance to Vjetrenica, and the air flow from the cave served as one of the first cooling systems (Grmek and Balabanić, 2000).

ORLOVICA, Zavala, Ravno

A late medieval tomb was found in front of the entrance to the Orlovica cave, and deeper inside the cave there are fragments of Bronze Age pottery from the Posusje culture.

GRADINA, Golubinac, Ravno

In the area of Bobanska brda (hills) there is a prehistoric hillfort from the Bronze or Iron Age.

PASI, Golubinac, Ravno

The late antique-early Christian vaulted tomb is located at the Pasi site in the village of Golubinec in the Ravno municipality, approximately halfway between the church and the cemetery on the left side of the road from Zavala to Belenići. The vault of the tomb, made of hewn stone, bound with plaster, collapsed. The entrance with threshold and door is preserved.

GOLUBINAC, Golubinac, Ravno

In addition to the Catholic cemetery and church, six stećak tombstones were identified.

GRADINA, Orahov Do, Ravno

A prehistoric hillfort above the village with the remains of a dry stone wall from the Bronze or Iron Age.

DONJE POLJE, Orahov Do, Ravno

Necropolis with five previously recorded stećak tombstones.

KIJEV DO, Kijev Do, Ravno

A necropolis with about 30 previously recorded stećak tombstones next to the Catholic church and village cemetery.

GRADINA, Čvaljina, Ravno

A prehistoric hillfort with poorly preserved remains of dry stone walls from the Bronze or Iron Age with surface findings of fragments of prehistoric pottery is located on a dominant hill above the village.

GROBLJE/CEMETERY, Belenići, Ravno

In the active cemetery in front of the church of St. Ilija in Belenići there is a necropolis of stećak tombstones.

MLINICE, Popovo polje

The specific hydrological character of this karst field and the rich grain-bearing area conditioned the construction of numerous mills on the abysses. The abysses were a convenient place where the necessary drop of water could be obtained in order to start the water wheel. There used to be 43 such mills along the entire course of Trebišnjica. Today, there are only the remains of those mills. The mills operated only when the waters of Trebišnjica were high enough to flow into the abysses and start the mills. In order to protect the mills from high waters, stone protective walls were built around the mill buildings. The mills did not operate during very high and low water levels and during the summer dry period.

Ćirina staza, railway track

The historic narrow-gauge railway with a steam locomotive runs from Mostar along the Neretva River, through Čapljina, Popovo polje, Ravno, and near Ivanica, crossing the border with Croatia all the way to Dubrovnik. The construction of the railway began in 1898 and ended in 1901. During its existence, Ćiro was connecting places in Herzegovina and was bringing them life, and today the railway has been reconstructed into a cycle path. The Austro-Hungarian monarchy, which ruled on the territory of Bosnia and Herzegovina at

the end of the 19th and the beginning of the 20th century, built a network of narrow-gauge railways (0.76 m wide). It built the railways primarily as strategic military facilities, and they were connecting the southern Adriatic ports with the cities in the hinterland and with the Central Europe. The railways in Herzegovina were built as part of the Southern railway, and the first section of that railway from Metković to Mostar, 42.4 km long, was released for traffic on 13 June 1885, while the railway from Gabela to Zelenika in the Bay of Kotor (Montenegro), 155.5 km long, with branches from Hum to Trebinje (16.7 km) and Uskoplje to Gruž in Dubrovnik in the Republic of Croatia (16.5 km), was released in 1901. The narrow-gauge railway served the people, connected countries, regions, peoples and cultures.

Users of space and economic value

Settlements and facilities

The municipality of Ravno consists of a large, rural, preserved area of 323 km². By analysing the types of settlements, it was determined that in the municipality of Ravno there is no settlement of urban character (according to the planning categorization of urban city settlements IV, the lowest category are settlements of over 2,000 inhabitants) and that these are extremely small and underdeveloped settlements, small villages (Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON doo, IGH Mostar doo).

According to the Spatial Plan, the Municipality of Ravno has 55 settlements with a total of 1,391 inhabitants. The settlements with the largest number of inhabitants (Ivanica 250, Ravno 244 and Trebinje 185) are also the central settlements that cover other settlements with their services. Such services include facilities for primary education, facilities intended for daily supply of the population, local community service facilities and post office, health centre, police station and space for social activities (Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON doo, IGH Mostar doo).

The area of Vjetrenica-Popovo polje, which is planned for protection, includes eight smaller settlements (Map 9), namely the settlements of Zavala, Čvaljina, Belenići, Kijev Do, Golubinac, Orahov Do, Budim Do, Češljari with a total of 678 inhabitants.

Map 9 shows the settlements within the boundaries of the protected area, while based on the map it is possible to see the population density for each of the eight settlements that fall within the scope of the planned Protected area Vjetrenica-Popovo polje. The settlements of Zavala, Orahov Do and Belenići have the highest number of inhabitants, while the least populated are Čvaljina, Kijev Do and Golubinac. According to the 2013 Census (FBiH Statistics Institute), the settlements of Budim Do and Češljari are not inhabited.

Since tourism is a branch that would enable the growth and development of the Municipality of Ravno, the research and determination of space for the development of tourism is taken seriously. Thus, in the area of Ravno, outside the area of the settlement, on the surface of about 66 ha, a catering and tourist zone (ethno village) is planned. Numerous tourist facilities are planned in the entire area of the municipality for which it is still necessary to present the plans and the planning permissions. Each tourist facility or all buildings in the tourist zone must be in the function of the use of space, built in accordance with the criteria of area protection, blended into the environment and landscape, respecting the rules of existing architecture (Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON doo, IGH Mostar doo).

In the vicinity of the settlement on the traffic route towards Slano on the Adriatic coast, the area of "Dubrava" and "Orahov do" is flattened. In this area, tourist zones with a total area of 266 ha are planned in order to present the Vjetrenica cave and connect with tourist facilities on the gravitational part of the Adriatic coast (Amendments to the Spatial Plan of the Municipality of Ravno for the period 2007-2017).



Map 9. Settlements within the protected area Vjetrenica - Popovo polje

Infrastructure

Transport infrastructure

The municipality of Ravno, that is, the wider area of Vjetrenica-Popovo polje is connected by a traffic network with other parts of BiH, but also with the neighbouring Republic of Croatia. Road connections are especially important in order to take advantage of the proximity of the large tourist market of the Dubrovnik coast.

The traffic network in the Municipality of Ravno consists of:

✓ part of the main road M20 Dubrovnik-Trebinje-Ljubinje-Stolac-Mostar (8 km in the Municipality of Ravno);

✓ part of the regional road R 426 Čapljina-Hutovo-Ravno-Zavala (24 km in the Municipality of Ravno);

✓ part of the regional road R 428 Zavala-Češljari-Orahov do-Ružni dolac-border crossing Lozica (10km in the Municipality of Ravno) and further to the town of Slano (Republic of Croatia) from where it has access to the Adriatic highway.

Within the area, which is allocated for protection, there are also local roads that carry traffic for the needs of the local population of the Municipality of Ravno. Map 10 shows a part of the traffic network within the protected area Vjetrenica-Popovo polje, where the layout and density of roads can be seen. It is easy to see that the densest part of the traffic network is around the settlements of Zavala, Čvaljina and Belenići, while in other parts it includes the represented roads that connect the settlements of Kiev Do, Orahov Do and Češljari.



Map 10. Transport network within the protected area Vjetrenica - Popovo polje

According to the *Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno*, there has been no railway traffic since the 1970s, when the line to Dubrovnik was abolished.

According to the *Spatial Plan of Herzegovina-Neretva Canton 2012-2022* the goals of the development of the road transport network are to raise the level of development of the transport network to the level of European countries and thus enable the development of the transport system and inclusion in the transport system of BiH.

As key goals, according to the *Road Development Strategy of Herzegovina-Neretva Canton* (Official Gazette of HNC, 4/2006), the following stand out:

- construction of expressways in order to make optimal use of connections and planning of connections to European corridors (Corridor Vc and Adriatic-Ionian Corridor)
- harmonization with the planned traffic corridors of the neighbouring cantons
- maintenance and improvement of the existing road network, improvement of traffic safety
- reconstruction and/or construction of unfinished sections of regional roads¹.

According to the Proposal of the Strategy and Action Plan for the Development of the Highway Network in the Federation of BiH in 2008, it was emphasized that the Adriatic-Ionian Highway will be developed in the direction from Počitelj to Stolac, then to Neum and further along Popovo polje towards the border with Montenegro. The highway will have connections to Slano and to Dubrovnik and Trebinje, respectively. The area of the Municipality of Ravno coincides with the possible direction of the highway, but due to the lack of construction and spatial research, relief and other spatial restrictions, it is currently impossible to define its spatial position. Although the described direction is general, it points to the conclusion that the Adriatic - Ionian highway will go through the area of the Municipality of Ravno. Its spatial position is impossible to be defined in a planned way, given the complexity of the relief and other spatial limitations, as well as the lack of

¹Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)

any construction - spatial research. In any case, the area of the Municipality coincides with the direction of the possible position of the highway².

Water supply infrastructure

Neum-Hutovo-Ravno water supply system, with a total length of 20 km, supplies water to the settlements in Popovo polje. Due to the lack of good quality sources of drinking water in the Municipality of Ravno, water is delivered from the neighbouring Municipality of Neum, only to the settlements of Ravno, Velja Međa, Trnčina, Turkovići, Zagorac, Pećina and Trebinje. The aforementioned water supply system is also the only water supply system for the Municipality of Ravno, however, due to the small number of inhabitants, it is economically unprofitable to create a new one, although active efforts are being undertaken on planning and implementing a plan for expanding or upgrading the water supply system. The biggest problem occurs in the summer when water supply to the Municipality of Ravno is significantly difficult. The problem arises as a result of interruption of water supply due to inadequate and poor-quality material used in the construction of water pipes as well as the reduced amount of water delivered by Public Utility Company Neum³.

In other populated areas of the Municipality of Ravno, the water supply is individual, that is, rainwater is collected by a system of small cisterns near the residential building.

In almost the entire area covered by the protected area Vjetrenica - Popovo polje, the great importance of water systems and potential water protection areas within the scope are foreseen⁴. Future development of activities in protected area Vjetrenica - Popovo polje must be harmonized with protection measures that will be in force in water protection zones.

² Feasibility study of protection for the protected natural value of the Vjetrenica cave and the part of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

³ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)

⁴ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

Permanent sources and springs are rare in Popovo Polje. They belong to the group of caves with water, and their activity is related to the existence of a dolomite barrier between Popovo polje and the sea. In periods of large and medium waters, after longer precipitation, significant quantities of water appear from these springs, and in dry summer periods the inflow is relatively small. The most significant quantities of groundwater are found in the siphon parts of underground caverns. In the area around Zavala, several such springs appear, which contain water even in the driest periods.

Among them, the most important are:

- ✓ Pokrivenik (Mareva Ljut)
- ✓ Lukavac below the entrance to the Vjetrenica cave
- ✓ Čvaušnik and the spring Čvostik near Čvaljina⁵

These springs are untapped, and they do not have the set water protection zones. As already stated in the previous text, and which can be seen on Map 11, the sources within the protected area Vjetrenica-Popovo polje are shown. On the other hand, the most remote settlements from all sources are the settlements of Orahov Do and Kiev Do. Orahov Do is at the same time the second settlement in terms of population right after the settlement of Zavala.

Endangerment of surface and groundwater is a consequence of uncontrolled discharge of industrial and faecal wastewater into groundwater and watercourses, waste disposal in unforeseen municipal landfills and intensive use of chemicals in agricultural activities. The problem of waste disposal in unsanitary landfills in water protection zones is especially emphasized, which creates a risk of developing bacterial pollution,

⁵ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o



significant organic pollution, nitrite pollution, changes in water temperature, increased turbidity and water hardness⁶.

⁶ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)



Map 11. Sources in the scope of the protected area Vjetrenica - Popovo polje

Electricity supply infrastructure

The area of the Municipality of Ravno is connected to the electricity network via SS 35/10 kV Ivanica. The 10 kV voltage network is constructed mainly by overhead lines and consists of power lines and 10/0.4 kV tower substations. The substations are located in the settlements of Donja Trebimlja, Gornja Trebimlja, Špilja, Velja Međa, Ravno- 2 TS, Rupni Do, Brestica, Zavala, Čvaljina, Orahov Do and Ivanica 3 - SS⁷.

Map 12 shows the position of transmission lines and substations in the area of settlements that fall within the scope of the protected area Vjetrenica-Popovo polje.

The current needs for electricity supply are small, but in the case of commercial facilities it is necessary to carry out reconstruction and upgrade in order to prevent voltage drops for the end consumers. In the future, it is planned to upgrade the transmission network, develop the distribution network and enable a better supply to the population, as well as encourage the use of alternative energy sources if possible.

⁷ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o



Map 12. Spatial layout of substations within the protected area Vjetrenica - Popovo polje

Sewage

In the area of the Municipality of Ravno, there is no organized system of drainage and wastewater treatment, except for individual settlements. In the settlement of Zavala, in 2010 a treatment plant was built as part of a public toilet for visitors to Vjetrenica. During the construction of Ledenica tourist facility, purifiers were installed, which will be replaced following the completion of the construction of a separate sewage and water purification system for the settlement of Ivanica⁸.

Waste management

In HNC, a strategy for municipal waste management has not yet been developed, nor have macro-locations been determined with facilities within which municipal waste would be controlled. Since there is no waste control system, it is impossible to make a rough assessment of the generation, movement and disposal of municipal waste. Municipal waste refers to household waste and waste from production and/or service activities that is similar in composition to household waste. Specific quantities of waste per capita range from 0.5 kg/day/inhabitant, which means that if it is assumed that there are about 600 - 800 permanent residents, the amount of waste per year does not exceed 10 tons⁹.

In the area of the Municipality of Ravno, a significant number of illegal landfills have been registered that need to be rehabilitated. The municipal communal landfill is located outside the scope of the future protected area. Field research identified the problem of negligent waste disposal along the road within the scope of Vjetrenica-Popovo polje, mostly by traffic participants.

⁸ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)

⁹ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

Recently, the Municipality of Ravno has launched an initiative of investing in infrastructure for municipal waste collection, by setting up 40 containers at the level of the entire municipality. Disposal of municipal waste is performed by public company "Komunalno" a.d. Trebinje, which collects waste from the territory of the municipality of Ravno and takes it away twice a week from the territory of the municipality of Ravno to the municipal landfill in Trebinje.

Sectors and traditional activities

Forestry

In the area of HNC, two categories of forest land have been identified, the basic and the more specific category. The basic category of forest land includes¹⁰ high forests, coppice forests and other forest areas.

In the area of HNC, the most represented are categories IV, V, VI and VII of forest land, of which the most represented is category VII, while the least represented is the category of forest land IV.

A total of 49.88% of the area of HNC or 217,856.58 ha falls on forests. According to population estimates, this data indicates that there are 1.38 ha of forest per capita. 79% of the total forest land or 172,374 ha is in social ownership, while 21% or 45,482 ha is in private ownership¹¹.

20,285.65 ha of forest land belongs to the municipality of Ravno.

The need for the use of polyvalent functions was noticed, especially through the segregation of:

- protected forests,
- protective forests (protection of springs and watercourses, protection against erosion, landslides, etc.)
- special purpose forests (nature reserves, national parks, natural monuments, protected landscape, etc.).

¹⁰ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

¹¹ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)

Protected forests are forests that are particularly important for the observation and monitoring of ecosystems and in terms of forests whose purpose is to preserve seed stands.

Protective forests are of special importance in the protection of springs, especially drinking water springs and watercourses, conservation of surface waters, protection against pollution and protection against the negative effects of surface erosion caused by precipitation and thus protection against landslides. Special purpose forests are actually the basic elements for the establishment of national parks, nature reserves, natural monuments and protected landscapes.

Forest management and administration is performed according to forest management plans for individual economic units and refers to simple biological reproduction of forests, that is, care of offspring and saplings, stand cleaning, thinning, land improvement, forest monitoring and arrangement, as well as implementation of breeding measures aimed at rejuvenation and expansion of forests and ultimately the improvement of the forest fund¹².

The planned silvestry works are aimed¹³ at protection and improvement of the forest fund, valorisation of the landscape, especially along the sections of the main road, improvement of sports, recreation and health function of forests, protection of soil from erosion, improvement of water regime, increase of wood mass, protection from flood waters.

The area of interest Vjetrenica - Popovo polje, due to its phytogeographical position, belongs to the forest area of Europe, and without the anthropogenic impact, the largest part of the area would be naturally covered with forest vegetation. The forest does not primarily appear only in the area of Popovo polje itself and on steep

¹² Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

¹³ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

rocks, rock creeps and similar habitats. As a consequence of anthropogenic influence, today more than half of the forest fund is represented by degraded forms of vegetation (matorral, garrigue, underbrush, shrubs and rocky terrains). However, all types of underbrush, as well as karst grasslands, meadows and pastures, gardens, fields, arable land and orchards, were created by secondary human action, that is, deforestation (felling and burning) of the original forest vegetation and due to forest fires. There are no protective forests or special purpose forests in the considered area. Moreover, no forestry activity was recorded in the observed coverage. Map 13 shows the classification of forests and the distribution of categories within the Protected landscape Vjetrenica - Popovo polje. There are forest plantations near the settlement of Budim Do, and coppice forests are spread over the majority of the area of the Protected landscape. Unproductive areas in terms of forest development are located near the settlement of Orahov Do, as well as the settlement of Golubinac where this type of area is the largest within the scope of the protected area.





Map 13. Forest areas within the protected area Vjetrenica - Popovo polje

Agriculture and livestock

According to the Spatial Plan of HNC, agriculture is a key point of the HNC economy that needs to be fully modernized, specialized and developed on the market. It is imperative to preserve agricultural land in terms of guiding the construction and use of non-agricultural areas outside of good quality agricultural areas.

It is necessary to stop the degradation of small farms and depopulation of valuable agricultural land and prevent the fragmentation of agricultural land, which would lead to an increase in land ownership and ultimately better utilization and use of new unutilized agricultural land¹⁴.

In order to expand good quality agricultural land and increase yields, it is necessary to use modern and controlled agro-technical procedures such as hydromelioration, agromelioration, reparcelling, etc. For this purpose, it is necessary to introduce programs for arranging and recultivating agricultural land.

According to the document "Strategy of agricultural development and agricultural development in rural areas of HNC"¹⁵ the highest quality land is land of agrozone I or land with land capability classes I-IV. In the area of HNC, land of capability class I was not registered, and lands of capability classes II and IVa are the least represented. It is useful to point out that in the entire area of HNC, land of capability class II is registered only in the municipalities of Ravno and Čapljina, in the percentage of 0.52% of the total land (2,285.86 ha). 27.58% (650.56 ha) of the highest quality agricultural land belongs to the municipality of Ravno. Map 14 shows the land capability classes of agricultural land and their distribution in the protected area Vjetrenica-Popovo polje, where it can be clearly seen that in the area around the settlements Zavala and Čvaljina there are registered lands and agrozones (I-IV land capability class) *which are defined as land intended exclusively for intensive agricultural production*.

 ¹⁴ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)
¹⁵ Strategy of agricultural development and development of agriculture in rural areas of HNC 2012-2017 (2012)



Map 14. Land capability classes of agricultural areas within the scope of protected area Vjetrenica - Popovo polje

The second agrozone (land capability class V and VI) includes lands defined as *lands intended for semi-intensive agricultural production*. Such lands are located in the settlements of Orahov Do, Kiev Do and Belenići. The largest part of the land of the protected area Vjetrenica-Popovo polje belongs to the agrozone III (land capability class VII and VIII) under which the land is defined as *land for extensive agricultural production*.

In the area of the Municipality of Ravno, agriculture is almost completely neglected due to small arable land areas and their fragmentation, as well as disorganized production. Natural and created potentials are not exploited, which leaves open the possibility for the development of production, primarily the production of healthy food¹⁶.

CORINE LandCover is a digital database on the state and changes of land cover and land use throughout Europe. Using CORINE LandCover, Map 15 shows the condition of the land cover in the planned protected area Vjetrenica-Popovo polje.

Strengthening and developing agricultural activity has been recognized as the second main development path of the Municipality of Ravno, which in the past was the dominant path of development. Modern agricultural production is based on the constant need and use of quality seed and planting material. High quality seed and planting material is needed for new orchards and vineyards, as well as for crop production and the expansion of shaped urban settlements and landscaped areas. Joint planning of nursery production several seasons in

¹⁶ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

advance with regard to the choice of species and substrate would ensure the possibility of producing a larger quantity and better-quality propagation material¹⁷.

In the offer of the overall agricultural activity, it is necessary to more intensively affirm livestock production as the primary branch of agriculture. The degree of intensification of agriculture is measured by the share of livestock in it because livestock is the first phase of processing primary agricultural production in which the stakes are mostly low value while the results are mostly high value.

¹⁷ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)



Map 15. State of land cover in the scope of the protected area Vjetrenica - Popovo polje

Stability and development of farming and its competitiveness on the market depends on the external (vegetative, generative and health of seedlings) and internal quality of seedlings (varietal purity and identity, health status - viruses, pests), price competitiveness and quantity of seedlings¹⁸.

It is necessary to work on the harmonization of national legislation with EU regulations in order to permanently address the issue of rootstock mother plants, as well as the preservation of basic and indigenous planting material.

Restrictions in development are primarily related to the need to preserve and protect natural resources, that is to protect watercourses, soil, valuable parts of natural heritage, forests, cultural and historical heritage and landscapes. The most significant problem in the development of the agricultural branch is the uncontrolled release of water, which leads to flooding of orchards and vineyards and arable agricultural land, which presents a barrier to dealing with these activities¹⁹.

Given the ecological and orographic circumstances, animal husbandry has multiple and leading importance. It also enables the employment of the working population throughout the year and is thus considered the most labour-intensive branch of production and significantly improves the income of agricultural holdings. A more intensive activation of this branch of the economy would also create the conditions for the demographic coverage of the area. Moreover, the opportunity for the protection of indigenous products would be reflected as encouraging also through tourism ventures, and thus would connect the two branches, both of which are the leading paths of development of the Municipality of Ravno²⁰.

¹⁸ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)

¹⁹ Feasibility Study for the protection of the natural value of the Vjetrenica cave and parts of Popovo polje in the municipality of Ravno, OIKON d.o.o., IGH Mostar d.o.o

²⁰ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)

According to the data obtained from the hunting association "Lisac" Ravno, the entire area of the planned coverage of Vjetrenica-Popovo polje corresponds to the area for which the aforementioned association has approved hunting concession in the period 2016-2026. The association uses the area planned for protection for hunting and recreation. According to the Annual Management Plan of the Hunting Association "Lisac" for 2011/2012 the main game species in this area are roe deer, wild boar, rabbit, grey partridge, rock partridge, and the secondary ones include wolf, Eurasian woodcock and quail. Indigenous fauna prevails although the induced one is also present. A small number of species have appeared on their own in this locality, such as the wild boar (*Susscrofa*).

Fishing

Fishing as a branch of economy in HNC is regulated by the *Law on Freshwater Fisheries of HNC* (Official Gazette, 4/14) which regulates the use and management of aquatic biological resources, their protection, conservation and improvement, as well as professional training of employees in freshwater fisheries. The law also sets out the development of sport fishing, fishing tourism and fishing recreation, as well as fishing zones within which Ravno fishing zone is defined. Fishing zone is a part of a fishing area that includes certain watercourse or water surface and all smaller watercourses that flow into it and thus form a unique ecosystem. Fishing zones are determined by the Cantonal Ministry in accordance with the law. The Law on Determining fishing areas/zones sets out their boundaries and purpose (commercial and sport fishing).

The annual fee for the use of Ravno fishing zone is 400.00 KM in accordance with the *Decision on determining the starting prices of the annual fee for the use of part of the fishing area - fishing zones in the Herzegovina-Neretva Canton* (Decision no. 01-1-02-2242/10).

Based on the *Law on Freshwater Fisheries* (FBiH Official Gazette, 64/04), the *Rulebook on the manner, tools and means by which fishing is performed* was adopted.
HNC has a great potential of quality waters for fish farming, and watercourses are mainly used which, from the quantitative and qualitative point of view, meet the conditions for the production of salmonid fish. There is generally no commercial catch of fish in the entire HNC, so we can only talk about sport fishing. According to the Spatial Plan of HNC²¹, strategic goals were set which would enable, with proper fisheries policy, the flourishing of this branch in the entire HNC, which would further result in water conservation, significant improvement of economies, full meeting of needs throughout the Federation of BiH and enabling access to the EU market.

Since the area of the Municipality of Ravno does not have large above-ground sources, no change in the situation in this industry is expected.

Small and medium entrepreneurship

In the area covered by Vjetrenica-Popovo polje, there is a catering facility Gostionica Zavala as an SME business activity.

The local population is mostly engaged in the cultivation of vines and figs, and they use these crops for the purpose of processing and production of wine, dried fruit and the like, but there are no reliable data on these activities.

The expected improvement of the living standard of the local population through private entrepreneurship and job creation in the section of tourism and related activities has not been achieved in its full capacity. Special emphasis should be placed on the protected area Vjetrenica-Popovo polje, that is, on the development of its tourist function, which should be part of a sustainable area with a balanced economy, ecology, cultural and other values and will provide better and more promising living conditions.

²¹ Spatial Plan of the Municipality of Ravno - Amendments to the Spatial Plan of the Municipality of Ravno 2007 - 2017 (2011)

A form of support to local communities is also an opportunity to implement an agri-environmental program. Popovo Polje is known for good quality arable land with an exceptional emphasis on the most environmentally friendly production. The biggest potential problems are the frequent flooding of arable land, insufficient ecological culture and occasional devastation of the area²².

Mining

HNC has rich mineral ore resources, but the existence, knowledge and research of ore-rich localities is not sufficient for the long-term development of industries that require the use of ores²³. Out of the mineral resources of the Municipality of Ravno, deposits of construction and decorative stone have been registered at a total of two locations, with a total area of about 75 ha. In the vicinity of the settlement of Zaplanik, the exploitation field Repinac, the exploitation of the mineral raw material of limestone as a technical-construction material²⁴ has been approved. Rare occurrences of bauxite have not been more seriously investigated²⁵. No data were found in the literature on the existence of surface mines or the exploitation of underground minerals on the protected area Vjetrenica - Popovo polje. Map 16 shows the position of areas where, according to the spatial planning documentation, it is possible to use mineral raw materials, and it is clear that there are no such areas in the area of coverage. As already mentioned in the previous text, and as can also be seen in Map 16, there are no mineral mines in the protected area. A desk review of the literature revealed only the fact that there is a plan to exploit limestone near Vjetrenica²⁶, north of the extreme boundary of the range.

²² Management plan for the protected area "Vjetrenica", OIKON d.o.o., IGH Mostar d.o.o.

²³ Spatial plan of Herzegovina-Neretva Canton 2012-2022.

²⁴ Integrated development strategy of the Municipality of Ravno 2019-2027.

²⁵ Amendments to the Spatial Plan of the Municipality of Ravno for the period 2007-2017

²⁶ Amendments to the Spatial Plan of the Municipality of Ravno for the period 2007-2017



Map 16. Areas for exploitation of mineral raw materials in the scope of protected area Vjetrenica - Popovo polje

Non-wood forest products

Non-wood forest products include various fruits of forest trees and shrubs, mushrooms, medicinal herbs and tree seeds. In this sense, we consider as non-wood forest products: biomass of total forest vegetation, flowers, seeds, nuts, berries and other fruits, tree bark, roots, pine cones and fruits of other vegetation within the forest, moss, lichens, ferns, grass, reeds, medicinal and edible herbs, mushrooms, vegetable juice or resin, honey, leaf, grass or pasture cover.

The medicinal plant sector has no clear links with other economic sectors of the agricultural sector, although it is particularly important for the processing sector. This sector is extremely important to keep active due to labour engagement in rural areas. The priority is to study measures for the rational and sustainable use of natural resources, and accordingly it should be mandatory to identify all secondary forest products in order for individual species to retain their defined status or be transferred from lower defined categories (rare, endangered, risky, protected) to those economically significant.

In the protected forest zones, it is necessary to monitor and control the harvesting of medicinal plants. According to the



data obtained during the development of this document, the inhabitants of the protected area mainly collect herbs such as immortelle, wormwood, St. John's wort and garland thorn.



Tourism

Tourism is a branch of economy that in the modern development of this activity extends to almost all areas (in terms of space) and to all other activities, i.e. branches of economy and represents one of the backbones of development. Tourist demand is increasingly segmented and there is an increasing importance of the so-called other types of tourism (e.g. sports - recreational, cycling, equestrian, rural, cultural tourism, cave tourism, all related to the characteristics of the tourist attraction base which the wider area has at its disposal).

Within the mentioned philosophy of tourism and the principles of sustainable development, the principles of rural development, the realization of the conversion ability of sustainable tourism to convert natural and cultural, even intangible goods into economic goods, without losing their protective features, and in addition rich and various tourist attractions, one should look for the concept of tourist offer. All forms of tourism (cultural, business, transit, rural, health resort, excursion, etc.) have the conditions in the Municipality of Ravno.

Tourism is one of the most promising industries, which in the future, in addition to agriculture, will be the backbone of the development of this area. What especially characterizes the municipality of Ravno is the Vjetrenica cave, the beauty of the landscape almost untouched by the modern civilization (the phenomenon of Popovo polje and the river Trebisnjica), ten kilometers distance from the sea and the strong tourist destination of Dubrovnik and its surroundings. With its rich historical, monumental and sacral heritage and architecture it opens opportunities for the development of all forms of tourism in this area. Vjetrenica Cave, located 5 km from the centre of the municipality, with a total length of 1300 m of well-tended trails for visitors, is a unique location for tourism development in this part of Europe. The trail is secured with a protective fence and illuminated in the length of 600 m.

Right next to the entrance to the cave there is the Biospeleological Museum Vjetrenica, a specially created unit that shows the natural, biospeleological and historical units of this part of the Herzegovinian karst as a natural phenomenon. In the lower part of the Museum building, there is an exhibition and sales area, where souvenirs and products of the local community are sold. A tour of the museum is included in the price of entering the Vjetrenica cave.

On the path towards the entrance to Vjetrenica, there is an Information Centre that is designed as an educational and information digital centre that should present the richness and beauty of the cave in an innovative way before entering it.

These facilities are managed by public company Vjetrenica llc Ravno.

In the first year of the work and operation of the public company "Vjetrenica", in 2010, only 500 visitors were recorded. In 2016, the cave Vjetrenica was visited by 8,753 visitors. In 2017, 9,836 visitors were recorded, while in 2019 the number of visitors was 15,000. According to the data on the number of visits, a constant increase in the number of visitors is evident.

A special tourist potential of the Protected landscape Vjetrenica - Popovo polje is the old abandoned narrowgauge railway, popularly called Ćirina staza (railway), which used to connect Dubrovnik and Boka Kotorska with Sarajevo and further with Vienna. The construction of the railway began in 1898, and the railway was inaugurated in 1901. The construction of the railway is considered to be perhaps the most difficult construction project in the country at the time due to the complexity of the terrain and the condition that the railway had to be protected from attacks from the sea. The construction of houses and backyards for railway employees and their families also contributed to this, and in areas that the then authorities considered unreliable, buildings were built like fortresses, with loopholes, and no construction was allowed around them. Therefore, the railway is in itself a monumental and historical heritage with a unique architecture, and it connects three countries of BiH, Croatia and Montenegro.

On the route of this line there is a hotel "Hotel Stanica Ravno", which is a renovated railway station. As part of its offer in addition to the accommodation service, the hotel also offers the services of a restaurant with a terrace and a wine cellar.

Today, these characteristics make the railway an interesting bicycle route, which is defined by the route of the old narrow-gauge railway Ćiro. Since 2016, the railway route has been in the function of cycling tourism. So far, two bicycle races have been organized by the public company Vjetrenica llc. and the Herzegovina Bike Association from Mostar. There has also been an increase in individual visits by cyclists. It is important to emphasize that cycling and walking routes have been established through the municipality of Ravno within the Blue trail of Via Dinarica trail. Its management is not defined because it is given to cycling clubs for free use.

The number of tourists who visited the municipality of Ravno is increasing year after year. Visitors who stay for longer number of nights in this area are mainly foreign nationals from the following countries: Germany, USD, United Kingdom, France, etc., while the number of overnight stays by domestic guests is lower. The reasons for this could be due to the fact that domestic guests mostly come for a day trip, while foreign guests mostly have different tourist habits, which are most often reflected in a multi-day stay.

Table 16 provides an analysis of visitors who visited the municipality of Ravno during 2018 and 2019 with the structure of guests and the number of overnight stays.



Table 16. Overview of the number of registered overnight stays based on official data for 2018 and 2019

Municipality of Ravno	2018		2019				
	Arrivals	Overnight stays	Arrivals	Overnight stays			
GERMANY	45	50	46	52			
SLOVENIA	/	/	50	50			
SAD	20	20	49	49			
UNITED KINGDOM	41	43	44	44			
FRANCE	38	42	/	/			
CROATIA	30	34	/	/			
BELGIUM	/	/	34	38			
NETHERLANDS	24	24	25	25			
BOSNIA AND HERZEGOVINA	22	40	24	31			

In the immediate vicinity of the Protected landscape Vjetrenica - Popovo polje there are several restaurants and one accommodation unit with a restaurant. Inn Zavala is located within the scope of the Protected landscape, near the cave Vjetrenica in an area with ethno ambience, which can serve a large number of guests and there are also accommodation units - apartments. Cafe bar Srednjice is a complex with a shop and a coffee bar. In addition to the inner part, Proctor also has an outer part - a terrace. Tavern Oblat is located towards the route to Zavala on the main road. It is built in the traditional Herzegovinian style and offers rich dishes of traditional cuisine.

Cultural and historical heritage in the function of tourism

The cultural and historical heritage is extremely rich, starting from prehistoric Illyrian forts and mounds (barrows) through valuable Roman remains to medieval churches and stećak tombstones, which have not yet been protected or valorised in touristic terms.

In the Protected Landscape Vjetrenica - Popovo polje there are two monuments out of a total of six recorded in the Municipality of Ravno:

- Ravno Zavala Zavala Monastery: National Monument "Architectural ensemble of the Church of the Presentation of the Blessed Virgin Mary in Zavala, Municipality of Ravno" (Official Gazette of BiH, 104/06)
- Ravno Zavala Remains of the pre-Romanesque church of St. Petra: National Monument "Archaeological Site Crkvina in Zavala, Municipality of Ravno" (Official Gazette of BiH, 98/09)

In the Protected Landscape Vjetrenica - Popovo polje there are also stećak tombstones.

Zavala Monastery, that is, the "Architectural ensemble of the Church of the Presentation of the Blessed Virgin Mary" in Zavala, Ravno Municipality, is located 3 km east of Ravno, on the left bank of Trebišnjica river. The oldest written document about Zavala dates from 1514. The monastery in Zavala was damaged during the war, but the Church of the Presentation of the Blessed Virgin Mary did not suffer major damage. It was declared a National Monument in March 2003 and ranks 489th on the Provisional List of National Monuments of Bosnia and Herzegovina. Data on the number of visits to this monastery are not known, but according to estimates, this monastery is visited by the same number of visitors as the Vjetrenica cave. Entrance to the monastery is free of charge.

Remains of the pre-Romanesque church of St. Peter: National Monument "Archaeological Site of Crkvina in Zavala, Municipality of Ravno", a site that appears in the literature under various names "Petkovica", "Crkvina", "Crkvine" and "Crkvište", is located in the main part of Zavala, in the settlement of Vali, between the hills of Ostrog and Klisura. It is a pre-Romanesque church dedicated to St. Peter. At this place now there

are the archaeological remains of the church of St. Peter and a necropolis with 28 recorded stećak tombstones. Church of St. Peter is the 490th National Monument of Bosnia and Herzegovina. Data on the number of visits to this Church are not known.

Stećak tombstones

Lack of knowledge on the Palaeolithic and Neolithic periods can be attributed to the lack of systematic research of the area. The caves that served as shelters and temporary dwellings are potential archaeological sites of Paleolithic man and the Mesolithic and Neolithic populations that followed. Most of the recorded material evidence comes from the medieval period, in the form of a cemetery under stećak tombstones.

Most of the stećak tombstones are of high-quality workmanship and various ornaments, which testifies to the high spiritual and material achievements of the medieval population, and their number indicates to a significant population of this area in the pre-Turkish period. All characteristic forms of this type of stone tombstones are represented, from amorphous specimens to superbly worked chests, gabled tombstones and tombstones with a diverse repertoire of motifs. The necropolises of stećak tombstones have been recorded in five of the eight settlements included in the protected area (in Zavala (Crkvina), Belenići, Kije Do, Orahov Do, Golubinac) with about eighty monuments.

A late medieval tomb was found in front of the entrance to the Orlovica cave, and fragments of Bronze Age pottery from the Posusje culture were found inside. At the entrance to the Vjetrenica cave there is a tomb dating to the 15th century, partly buried in living stone. Fragments of prehistoric or medieval pottery have also been found. The latest research established archaeological finds in the cave, bone needle and a piece of pottery.

As part of the cultural heritage, 2 events are held – Grgurovi hukovi and Ravan Summer Days of Culture). The number of visitors ranges from 50-70 people each year.

Assessment of the state in the area of the protected landscape Vjetrenica - Popovo polje

Ecosystem state assessment

Assessment of the state in the area of impact of the Protected Landscape Vjetrenica - Popovo polje refers only to those factors that in accordance with the Law on Nature Protection of the Federation of BiH (FBiH Official Gazette, 66/13), Law on Nature Protection of Herzegovina-Neretva Canton (Official Gazette of the HNC, 12/17) and the Law on Protected Landscape Act Vjetrenica - Popovo polje may affect the area or indirectly affect the change in the quality of key natural values due to which this area has been declared protected.

This includes various activities that are the result of socio-economic development, especially in the populated parts of the Protected Landscape Vjetrenica - Popovo polje such as agriculture, industry, crafts, communal infrastructure with landfills and the transport.

Each environmental unit, including the area of the Protected Landscape Vjetrenica - Popovo polje, is built of landscapes, which consist of four basic elements: relief, vegetation, water and anthropogenic elements (civilization tradition). Anthropogenic influence is crucial and present not only in elements of the civilization tradition, but in all elements of the landscape. It is reflected to a lesser extent on the relief, but to a much greater extent on vegetation and water, which is especially evident in the area of Popovo polje, which is meliorated, that is, the river Trebišnjica is channelled into a concrete bed, and the entire field is turned into agricultural land. The rest of the protected area, the hills between Popovo polje and the Adriatic Sea, was anthropogenized to a much lesser extent, in a mosaic manner, with smaller examples of cultivated karst fields, dry stone walls, ponds and wells, however more vegetatively degraded or deforested. Thus, the diversity of the landscape of the protected area, the richness of habitats, as well as the general biodiversity of space, is not only the work of nature, but also of man, who created partly open, semi-natural landscapes, rich in diverse

habitats, through the development of civilization from primary, often uniform landscapes (floodplain karst fields, wetlands (depressions), mountain forests, karst rocky terrains). The landscape as we know it today in the area of the Protected Landscape Vjetrenica - Popovo polje, and the habitats we find in them, are a direct product of human influence primarily through agriculture and forestry, and hydropower and urbanization interventions, and to a lesser extent through industry and roads, and as such it is an inseparable part of the cultural heritage. This anthropogenic impact can be extremely negative, as in Popovo polje itself, from the destruction of certain habitats, primarily periodic karst lakes, floodplain grasslands, wetlands, all the way to groundwater ecosystems, to pronounced agrarianization and urbanization, or artificialisation of the landscape. On the other hand, on the sub-Mediterranean hills, prominent processes of degradation of primary vegetation have led to the encouragement of erosion and the formation of barren and naked karst.

Architectural interventions left their mark on the image of the landscape under research, which is acceptable in the case of traditional buildings made of natural and original materials, primarily stone, incorporated into the surroundings, but there are often architecturally incompatible settlements, roads, industrial complexes. However, some of our landscapes have the exceptional architectural value, especially in the karst area, and one of the important factors in creating the landscape as we know it today was the impact of man-cattle breeder and domestic animals on the environment, which is pronounced in the wider area of Popovo polje. According to the historical development of the landscape of the area Vjetrenica-Popovo polje, we can highlight three prominent phases. By the 17th century, there was a balance between the carrying capacity of the natural environment and human activity. In the second phase from the 17th to the 20th century, the processes of immigration, sedentarization and intensified farming stand out, which significantly increases the pressure on the natural environment. The third phase from the beginning of the 20th century is marked by depopulation which leads to succession and deforestation, that is, deforestation and erosion processes. The process of depopulation was especially prominent after the War of independence from 1991 to 1996, when the acts of war led to almost complete and permanent abandonment of the space, and thus to a reduction in pressure on natural resources. At the same time, a new danger emerged as a result of war and depopulation, ranging from the remaining minefields and toxic chemical remnants of warfare to the uncontrolled use of natural resources (quarries) and the selection of waste disposal sites. It is necessary to emphasize the direct impact of elements of agrobiodiversity, that is, traditional breeds and varieties on the ecological systems of karst grasslands and karst arable land, but also with a large, mostly negative impact on forests, wetlands and waters. Existing landscapes owe much of their current appearance to the long-term influence of man in the area where reclamation interventions were conducted, swamps drained, forests cut down, matorral burned, cattle grazed, ponds and wells created, karst meadows mowed, dry stone walls built and thus arable land was created and cleaned from stone, as well as fields and sinkholes and typical karst ecosystems. Thus, the maintenance of the landscape so far is the result of the centuries long traditional management of protected space, that is, the traditional landscape anthropogenic equilibrium. Although traditional management is not exclusively positive for the preservation of landscape values and there have been major or minor devastations within these systems in the past, especially between the 17th and 20th century, we can say that the positive elements of landscape conservation are dominant. The fact that this spatial management is not an automatic mechanism, becomes especially evident from the second half of the 20th century when the pronounced depopulation of rural space and at the same time the neglect of existing landscapes begins. There are many reasons why it is in the interest of the entire local community, but also the entire Bosnia and Herzegovina to manage the existing landscapes in the area of Vjetrenica - Popovo polje and their preservation. We can define eight key reasons:

- 1. Primary quality of space
- 2. Aesthetic value of space
- 3. Economic value of space
- 4. Preservation of ecological systems
- 5. Habitat (biotope) conservation
- 6. Conservation of the living world (biodiversity)
- 7. Ethical commitment to future generations
- 8. Ethical commitment to the international community

The primary quality of a space is the overall diversity of landscapes and all elements of their preservation, as opposed to the overall quality of space consisting of all elements of landscape management. The primary quality of a space is value that can be measured by objective methods and by which it can be determined that the protected area is of better quality, and thus more important and valuable in relation to a large number of European countries that irreversibly devastated (meliorated) their space. The vast majority of developed European countries are dominated by artificial or, only to a lesser extent, semi-natural landscapes, so these preserved landscapes are of special value for Europe. Within the primary quality of the space, the western part of Popovo polje with the Vjetrenica cave stands out for its value and uniqueness.

The aesthetic value of the space is an important element of preserved and diverse landscapes, and it is especially valuable for the promotion of the landscape. Aesthetic value refers not only to natural but also to anthropogenic elements, especially architectural ones, and it is often the basis for some of the most important economic activities, such as tourism. Thus, we must point out certain preserved architectural units, settlements built of stone houses, suitable for evolution into ethno villages, the Orthodox monastery Zavala, units of karst fields, such as Orahov do and others. The economic value of preserved landscapes has so far been assessed through the sum of the values of primary resources, the so-called raw materials that can be used in industry, and the existing economic and human infrastructure. Today economic value can be defined through the market value of space or even through absolute value. We believe that the economic value of the protected area Vjetrenica-Popovo polje lies primarily in tourism, especially recreational and rural. Within the landscape of this area there are ecological systems, and within them numerous habitats or biotopes, but similarly as with the discovery of new species for our living world, further research and more detailed analysis will certainly identify new ones. All these habitats do not have the same importance, that is, biodiversity, and they are also not equally endangered, so it is very important to develop and apply mechanisms for objective recognition of habitat values and protection of those that are really exposed to the highest risk. The most important ecosystems of the Vjetrenica-Popovo polje protected area are underground cave ecosystems with an extremely large number of cave habitats, aquatic and terrestrial. Each habitat in ecological terms is built of numerous

ecological niches with special abiotic factors and, most importantly, inhabited by numerous species, i.e. members of all five known kingdoms of the living world. The richness of species makes up the biological diversity or biodiversity of a particular ecological niche, their sum, biodiversity of habitats, and finally the biodiversity of the landscape. The underground cave habitats of the Vjetrenica-Popovo polje protected area stand out with their large number of endemic and relict cave species, the largest in the world. In ethical terms, it is our obligation to preserve the landscapes of the area for future generations, who also inherit this obligation. In order to preserve them, we need to know what we have, so each element of protection must be preceded by research.

Thus, this study is only a guideline for future research and complete valorisation of space. Preservation of existing landscapes is also our commitment to the international community because we are the direct successors of our space, and thus responsible for all elements of the landscape. This commitment is defined by several Conventions, among which the Convention on Biological Diversity proclaimed in 1992 in Rio de Janeiro should be highlighted. Due to the extremely valuable cave water habitats and the associated extremely rich fauna, preventive action should be undertaken, and the protection zone should certainly include a wider hydrological area in which no hydro-technical interventions or waste disposal can be carried out. Finally, the most endangered habitats of the protected area Vjetrenica-Popovo polje should be highlighted. Among the numerous habitats, the habitats of karst pastures and meadows, aquatic habitats of springs, ponds and wells, and traditional agricultural systems are especially endangered: arable land, orchards and vineyards. The most efficient measure for the maintenance and preservation of these habitats and the associated wildlife is the encouragement of traditional agriculture and animal husbandry, combined with the tourist offer of premium products.

Degree of ecosystem degradation

The area of the Protected Landscape Vjetrenica - Popovo polje belongs to the forest area of Europe due to its phytogeographical position. The consequence of centuries of human activity on the Protected Landscape Vjetrenica - Popovo polje led to the degradation of the primary ecosystem and the differentiation of different habitat types. Thus, habitats such as forests, wetlands, all types of shrubs, karst grasslands, meadows and pastures, gardens, fields, arable land are now clearly differentiated in this area.

Numerous secondary ecosystems (meadows and induced pastures) can be observed in the area of Vjetrenica -Popovo polje. Tertiary ecosystems in the context of settlements are also present, with those on the protected area Vjetrenica - Popovo polje being rural and very small settlements with a very small demographic structure.

All changes in ecosystems and habitats ultimately affect either changes or degenerative changes in the cave ecosystem. Pressure on ecosystems is any type of impact that could lead to its endangerment or to permanent changes in the ecosystem, such as:

- Morphological changes of habitat (due to degradation of natural values)
- ✓ Habitat quality changes (pollution)
- ✓ Functional changes of habitat and wider environment (habitat fragmentation and increase of marginal effect)
- ✓ Changes in the structure of communities (due to the introduction of invasive species).

Pressures on ecosystems can be generally divided according to their origin, that is, according to the type of origin, into:

- ✓ Natural pressures
- ✓ Anthropogenic pressures.

Natural pressures can occur in the form of rare catastrophic natural phenomena such as: floods, fires, earthquakes, landslides, etc, and as constantly present natural processes of low intensity, such as natural erosion processes, leaching of nutrients in the soil due to the large slope of the terrain, natural selection, natural extinction of species and similar.

Anthropogenic pressures are those that occur due to various human activities in an area, such as:

✓ Agriculture (causes an increase in nutrients within the ecosystem and the use of pesticides)

✓ Urbanization (leads to the formation of municipal wastewater, wastewater from industry and technological processes, leachate from unsanitary and illegal landfills of municipal waste, inadequate disposal of hazardous and non-hazardous waste, the emergence of illegal landfills of municipal waste and illegal construction and usurpation of space)

✓ Tourism (construction activities in building tourist facilities, direct use of natural resources in equipping tourist facilities, irresponsible tourist behaviour and unregulated tourist activities such as off-road driving, illegal harvesting of plants or theft of plants by uprooting, tourist vehicles may increase the risk of introduction of allochthonous (foreign) and invasive species, and the behaviour and frequency of human presence can cause disturbance in the behaviour of animals, etc.)

Existing infrastructure and its use (transport, water, and energy infrastructure)

Planned construction of new infrastructure

 Economic activities in the protected area (forestry activities, deforestation, and inadequate way of transporting wood assortments)

Excessive hunting and fishing

 \checkmark Other activities of the local population (such as emissions from fireplaces or forest fires caused by the negligence of the population/picnickers).

Natural pressures have a lower rate of invasiveness to protected areas than anthropogenic ones because: (i) they are either very rare (ii) or they occur in very low intensity over a long period of time for which the species manage to adapt to the new conditions.

Depending on the category of protected area management, anthropogenic pressures will be more or less pronounced. Human impact is inversely proportional to the level of management in a protected area, and they are expected to be more pronounced in the lower protection categories of an area. In addition to the listed possible types of endangerment of ecosystems in the protected area, the high intensity of pressures of anthropogenic origin can lead to the loss of fundamental values of the area that led to the placement of a particular area under protection. Protected areas are most often centres of genetic and species diversity, biocenosis diversity, morphological diversity, biotope and/or habitat diversity of endemic species and often represent national reserves of these values, so it is necessary to reduce pressures on protected area ecosystems at least to ecosystem tolerance levels. Table 17 below lists the potential pressures on the area of the subject scope and a description of their mode of action, while Table 18 lists the anthropogenic pressures on the ecosystems of the Vjetrenica cave.

Identified threat	Description	Impact / Consequences								
	Hydropower system "Trebišnjica"	The constructed hydropower system on Trebišnjica significantly affects the water regime in the abyssal zone of Trebišnjica								
Hydromorphological pressures	Continuationofconstructionofhydropowersystem	Further construction of the hydropower system on Trebišnjica (the so-called Upper Horizons/Gornji horizonti) due to the connections of groundwater bodies with the								

Table 17. Anthropogenic threats in the area of the Protected Landscape Vjetrenica - Popovo polje

	"Trebišnjica"	sources of the Buna, Bunica and especially			
		Bregava will affect the water regime of these watercourses			
Pressures on water quality	Agricultural activity	In agricultural activities in this area, more and more fertilizers, pesticides, and herbicides are used, and through the soil and groundwater and surface water it affects the increase of nutrients (especially phosphorus) in waters			
	Wastewater and settlement sewage	Household wastewater and other rainwater from urban areas reach either groundwater (throug septic tanks) or flow into depressions, canals an watercourses, and affect groundwater quality and in the settlements of Ravno and Zavala sanitation system has been set.			
	Landfills	A number of illegal landfills in the area covered by the service of collection and disposal of municipal waste and emergence of new illegal landfills in cleaned areas			
Biological pressures Occurrence	-	Deliberate introduction of commercial fish species and commercial plant species leads to reduction of the areas of natural habitats and to reduction in the population of species dependent on these habitats			
	Occurrence of invasive species	Invasive species of fauna (e.g., common rock-rose) and flora (e.g. ragweed) occupy the habitats of indigenous species			

	Global biological	Diseases of plant and animal species may lead to						
	changes	the extinction of some species that live in the area						
		of the Protected Landscape						
		Long-term change of substitution of some habitats						
		with the others, which may occur due to the						
	Succession of plant	constant reduction of water areas of Popovo polje,						
	species	but also due to the abandonment of some						
		traditional activities (extensive livestock) leads to						
		the neglect of pastures and meadows						
		Groundwater abstraction for irrigation changes						
		relations, which in some conditions can lead to a						
		decrease in groundwater levels.						
	A • 1.	The use of chemicals affects soil and water						
	Agriculture	pollution. The absence and extinction of extensive						
		livestock causes the disappearance of meadows						
		and pastures, which affects the landscape, but						
Pressures from traditional		also biodiversity.						
activities		Excessive, unregulated hunting and poaching						
		endanger indigenous game populations, disturb						
	Hunting	the balance and peace in the Protected Landscape,						
		leading to species disturbance						
		Excessive and uncontrolled harvesting of various						
		species of medicinal, ornamental and						
	Picking medicinal	economically valuable plants leads to the						
	plants	destruction of specially protected rare species,						
		damage to plants and habitats, disturbance of						
		sum ge to planto and incluso, distarbulice of						

		fauna and reduction of biodiversity in the area.
	Tourism	Uncontrolled forms of tourist visits to the area can lead to disturbance, species damage, uncontrolled waste, causing incidents (fires, injuries) and other forms of disturbance to the natural state of the area.
	Mining	Quarrying in quarries in the wider area disrupts the natural landscape
Pressures from other activities	Transport infrastructure	Roads that pass along the edge or through the area of the Protected Landscape, in addition to occupying natural space and interfering with the passage of certain animal species, are also a source of disturbance (noise, night lighting) and a possible source of pollution of the surroundings.
	Energy infrastructure	Energy infrastructure, in addition to occupying the space, disrupts the natural landscape, and it is also a possible source of radiation
	Fires	Usually occurring in agricultural activities pose threats to species and habitats
	Droughts	Prolonged droughts can significantly affect the numbers of some vulnerable and rare species, which are already exposed to other pressures.
Insufficient capacity	Legislation	Inadequate legal solutions or non-implementation the regulations in the field of waste management, hunting, environmental protection and water protection can significantly hinder the protection

		of natural values of the area.
	Management resources (assets, human resources, equipment)	Lack of funds for the basic functions of protection and supervision of the Protected Landscape, lack of human capacity in the management system, lack of equipment and other resources, can significantly affect the protection of the area
	Non-compliance and non- cooperation between different institutions and sectors (under capacitated)	High exposure of the area to external influences requires coordinated action of different sectors of environmental protection, especially water, utilities, spatial planning and use of space, and the lack of such cooperation creates new risks.
	Lack of knowledge and awareness of local residents	Local residents that have interest in preserving the value of the Protected Landscape and knowledge of why this is necessary and how to do it is the best keeper of this area, and the lack of cooperation creates dual damage - the local residents not only do not protect it but they use it uncontrollably for their needs.
Climate change	Climate change	Expected further balance reduction of intensification of climate extremes, with consequences for sensitive ecosystems dependent on water regime
	Snow and ice	Occasional occurrences of snow and ice outside

the usual climatic conditions endanger the populations of some species that find food and shelter there.

Table 18. Anthropogenic pressures on Vjetrenica cave ecosystems

Pressure	Mode of action	Explanation						
Physical devastation	 Breaking of flowstone Damaging flowstone by incisions, signatures and installations Archaeological and paleontological probes (substrate excavations) Entry of various items, numerous and various interventions on and along the tourist trail 	In speleological structures, most often we encounter the breaking and removal of speleothems, primarily stalactites and stalagmites, and the engraving and writing of various inscriptions and symbols. In those with smaller entrance openings, there is a deliberate closing of the entrance by backfilling and caving in, with stones, earth and other material. Complete destruction of a speleological structure is relatively rare, almost exclusively due to extensive construction work and less often by quarrying when such structures are in the area of the quarry. Special forms of devastation are archaeological and paleontological excavations, by means of which the morphology changes significantly, but also the ecology of speleological objects. Furthermore, the tourist arrangement of						

		speleological objects in which the arrangement of infrastructure (trails, installations, lighting) more or less devastates the cave and affects the ecology. Finally, a smaller form of devastation is the installation of a protective door at the entrance to the speleological object. Near Vjetrenica, almost all forms of physical devastation are present, and the impacts due to the infrastructural construction of the tourist trail are particularly pronounced.
Changes of habitat and cave ecology	 Installed protective front door Filling and concrete works in the main cave canal Devastation of numerous cave habitats along the tourist arrangement Installation of electrical installations along the entire cave and lighting of the cave Microclimate change, primarily warming Potential occurrence of green overgrowth (lampenflora) next to lighting fixtures Potential fall and collapse of unstable rocks and stones on the tourist 	Due to physical interventions and elements of spatial devastation, habitats can be affected, in terms of their physical devastation or changes in habitat ecology. Such impact is present in several directions. Firstly, cave habitats were physically changed by backfilling, rock rearrangement and concrete works; there is an impact on the change, that is, disruption of groundwater flow, closing the door reduced the entry of bat populations and thus the introduction of guano into the cave, and consequently the disappearance of guanophilic fauna, e.g. genus <i>Laemostenus</i> . The installation of bulky metal lighting fixtures led first to heating of the air, and thus to the change of environmental factors, and subsequently by

	trail	rusting and the introduction of metal into the habitats, which has been remedied today. A special type of impact on habitats is the periodic flooding of a part of the cave, but it is a natural impact on the habitats and ecology of the cave.
Garbage accumulations	 Tourists Speleologists and researchers who leave or lose equipment Remains due to works 	A large number of speleological objects serve as landfills, especially cave structures near settlements and roads. In Vjetrenica, a smaller amount of waste was found, primarily inorganic garbage along the tourist part of the cave, remaining from previous researchers and visitors, but also due to the physical arrangement of the cave.
Collection and disturbance of cave fauna	 Too many researchers Taking out without permission 	Some speleological structures, especially those easily accessible and arranged for tourists, but also those biospeleologically rich and important, are under attack by professional collectors and collectors of fauna. In the area of the Dinarides, there are extremely frequent cases of collection and export of cave fauna outside the borders of their home countries.

Ecosystem capacity

Due to the pronounced tourist-recreational function of the Protected Landscape Vjetrenica - Popovo polje, the growing number of facilities, the development of programs and services for visitors, the consequences resulting from the development of tourism are possible. Negative consequences are related to the excessive arrival of visitors in a relatively short period in a relatively small area (locality), which burdens the environment, and especially natural and cultural values.

The main goal of the visits to the protected area Vjetrenica-Popovo polje is to raise awareness of visitors in terms of minimizing the impact on the environment inside and outside the protected area. Visitors must be given the opportunity of experience on the basis of which they will understand and be able to appreciate the natural and cultural-historical values of the area. Such goals are achieved by the so-called organized system of visits which represent, for an acceptable number of groups (so-called acceptable carrying capacity) a systematic sequence of visits which includes places/locations (info points, lookouts, caves), trails (educational, cycling, walking), directions and means of transport, duration of the visit, security measures, etc. Visiting the protected area Vjetrenica-Popovo polje must be in accordance with the category of protection and management objectives of the area.

According to the data obtained from the representatives of the current manager of the Vjetrenica cave, public company "Vjetrenica" llc., in 2009 the capacity assessment of the Vjetrenica cave was conducted and the maximum number of visitors to the cave was determined of 240 people in one working day. In the current conditions, the number of visitors to the Vjetrenica cave rarely exceeds 100 people, mainly when it comes to educational, school or research visits. Since the process of planning the construction of tourist facilities is underway and active work is being done on the promotion of the Vjetrenica cave, an increase in the number of visitors is to be expected. On the other hand, it is necessary to act in accordance with the data that will be obtained through monitoring and recalculation of visitor carrying capacity.

Conclusion on the assessment of the state of the area

The presence of a wealth of species and habitats in the area of the Protected Landscape Vjetrenica - Popovo polje indicates the high specialization of the area. The presence of species from the Habitats Directive and the EU Birds Directive confirms that this area is also of national, regional, and global importance for the protection of species and habitats from the aspect of aboveground fauna.

Natural habitats and primary ecosystems are quite well preserved considering the war events and processes that followed in the post-war period in the entire area of the Municipality of Ravno. A major problem in the protected area Vjetrenica-Popovo polje are the remaining unexploded remains, which limits the inventory of types of parts of the terrain given the impossibility of free movement. Since the number of residents is small and there are no urban settlements, the degree of threat to nature is lower compared to areas that are in the process of expansion and industrialization. On the other hand, the fact that in the Municipality of Ravno, which includes the area of interest, there is no sewerage system or organized waste disposal system, it is indisputable that in the near future there will be negative consequences that will affect the ecosystem, habitats and species. It is important to note that all infrastructure construction plans of any area should be carefully planned to take into account their impact on the environment, important and valuable natural habitats and all types of flora and fauna living in the area.

One of the problems that disturbs still well-preserved state of the environment is the frequent flooding of Popovo polje, which hinders the meadow vegetation. Rainwater and landslides caused by the same issue are also the biggest problem for primary forest ecosystems, which leads to the gradual but certain degradation of these extremely important and irreplaceable ecosystems. Degradation of forests as primary ecosystems creates secondary ecosystems, in which important species and their habitats are lost in the process of degradation. Primary ecosystems change under the influence of environmental factors, but anthropogenic influences are far more important for the protection of the area. It is necessary, although innumerably, to inform the local population about the consequences of excessive harvesting of forest medicinal plants in order to preserve biodiversity and plan ways of sustainable use of biodiversity.

In addition, in order to adopt adequate measures and methods of protection and determine ways to promote the area intended for protection, it is necessary to introduce regular monitoring of habitats and flora and fauna to monitor changes caused by both natural factors and changes caused by anthropogenic impact. Regular monitoring of the state of the environment would provide sufficient information that could serve as a tool in planning the protection and sustainable use of the otherwise rich biodiversity of this area.

MANAGEMENT SECTION

VISION

Protected Landscape Vjetrenica - Popovo Polje, is a place of experience and learning about the uniqueness of karst and other natural and cultural values. It is an example of good management of a protected area in cooperation with the local community in which preserved nature represents the foundation of sustainable development.

Thematic sections:

The Action Plan is developed through the following five thematic sections derived from the vision:

A. Preserved diversity of species, habitats and karst forms ensures unique beauty of the natural landscape, and thus the preservation of a unique universal value for present and future generations.

B. Preserved cultural heritage takes an important place in the presentation of values and contributes to the preservation of tradition and cultural identity of the area.

C. Visits do not impair the value of the Protected Landscape Vjetrenica - Popovo polje and provide visitors with an undisturbed and complete experience, which in the best possible way presents the preserved biological and cultural heritage, generates income needed for its preservation, builds public support for nature conservation and opens opportunities for sustainable local community development.

D. The local community is the main partner of the Manager in preserving its values, it recognizes the area as an important part of its identity and its development is based on the sustainable use of opportunities provided by the preservation of the area.

E. The public company has all the necessary legal, organizational, human and material capacities, resources and powers to manage the area and uses them to continuously improve all segments of management and organizational culture, thus building cooperation with stakeholders and its role in domestic and international circles.

VISION													
Thematic section A	Thematic section Theme B	Thematic section Theme C	Thematic section Theme D	Thematic section Theme E									
Specific objective A.1	Specific objective B.1	Specific objective C.1	Specific objective D.1	Specific objective E.1									
Overall objective A.1.1	Overall objective B.1.1	Overall objective C.1.1	Overall objective D.1.1	Overall objective E.1.1									
Activities	Activities	Activities	Activities	Activities									

* Schematic representation of the structure of the Action Plan

Thematic section A: Preserved diversity of species, habitats and karst forms ensures unique beauty of the natural landscape, and thus the preservation of a unique universal value for present and future generations

Specific objective 1: Preservation of the value of Vjetrenica cave and other underground habitats

Indicators:

- Cave ecosystems and habitats are preserved
- Underground fauna and populations of key species are stable
- The underground part of the Protected Landscape Vjetrenica Popovo polje is explored and protected

Specific objective 2: Preservation of favourable conditions of natural values, animal and plant species and habitat types of forest ecosystems

Indicators:

- Forest habitats are in a favourable state of preservation
- Populations of significant species are stable

Specific objective 3: Preservation of favourable conditions of natural values, animal and plant species and habitat types of forest ecosystems

Indicators:

- Meadow and grassland habitats are preserved
- Populations of significant species are stable

Specific objective 4: Preservation of favourable conditions of natural values, animal and plant species and habitat types of aquatic ecosystems

Indicators:

- Existing aquatic habitats are in a favourable state of preservation
- Populations of significant species are stable
- Preservation of the value of Vjetrenica cave and other underground habitats

Preservation of the value of Vjetrenica cave and other underground habitats

There are two exceptional Natura 2000 cave species in the protected area: the human fish (Proteus anguinus) and the congeria (Congeria kusceri). Out of as many as 25 confirmed human fish sites in the entire Popovo polje area, most of them are located in the planned protected area. Congeria was described from the planned protected area, that is, from the Žira cave, which is its type finding site (locus typicus), and the protected area is the only protected area in BiH, where there are several sites of this relict species. Moreover, there is a large number of typical cave sites in the protected area from which a large number of species have been described. Vjetrenica with Bjelušica cave are on the leading place, from which as many as 48 species have been described, of which 47 have been validated (Lukić Bilela et al, 2019; amended), which is certainly not the final number, and there are further type sites: Baba (Čvaljina), Crnulja, Grabrovica, Zira (not included) and others. All these typical speleological structures are of high importance and represent Natura habitats 8310 (Caves not opened to the public). The wider area of Popovo polje has been speleologically and biospeleologically explored for over 435 years, with over 300 speleological structures identified, of which only a part was explored. Looking at the narrower area of Popovo polje, which is located in the municipality of Ravno, recent systematic research began in 2002 and continues to this day. A new and to date the most accurate topographic image of Vjetrenica and the current complete list (Check list) of cave organisms of Vjetrenica were made, with sporadic research of several nearby speleological structures. Both the cave design and its list of biodiversity are constantly updated with new data from recent research. As a synthesis of the conducted research through 2016, an exhibition was

made and in March 2017 the Biospeleological Museum Vjetrenica was opened. In 2016, a system of regular monitoring of Vjetrenica was established through cooperation of various partners. Through the project: Inventory, mapping and monitoring of the population of Natura species of human fish (*Proteus anguinus*) and congerias (*Congeria kusceri*) and Natura habitat 8310 (Caves not open to the public), in the protected area Popovo polje - Vjetrenica in 2019 in cooperation with the Environmental Protection Fund of the Federation of BiH, 19 planned activities were carried out and the final Study (Ozimec et al., 2020) was prepared, which in addition to the basic report includes three attachments: Speleological and biospeleological cadastre of Ravno Municipality, Cadastral sheets and Biospeleological cadastral sheets from the reference (Lukić Bilela et al, 2019). In the above-ground part, in the immediate vicinity of the entrance to the Vjetrenica cave, there is a information and education centre built in 2020.

For now, only the Vjetrenica cave is open to the public, while other underground structures are relatively inaccessible and not arranged for tourist visits. Vjetrenica was arranged for tourist needs before 1940, and the cave was extensively arranged and electrified in 1964, with the trail arranged in the length of as much as 1800 meters and electrified in the length of 1,050 meters, and a motel was built nearby for reception of tourists. Large devastations inside and outside the cave took place in the period from 1991 to 1996. During 2009, the lighting in the cave was done so that part of the old installations was removed, and new low-voltage lighting was installed. Currently, the tourist trail is arranged and lit up to the area of Hajdučki sto (1300 m).

THEMATIC SECTION A: PRESERVED DIVERSITY OF SPECIES, HABITATS AND KARST FORMS ENSURES UNIQUE BEAUTY OF THE NATURAL LANDSCAPE, AND THUS THE PRESERVATION OF A UNIQUE UNIVERSAL VALUE FOR PRESENT AND FUTURE GENERATIONS.													
	INDICATORS	2 0 2 1	PE 2 0 2 2	2 0 2 3	2 0 2 4	OF 2 0 2 5	RE 2 0 2 6	ALI 2 0 2 7	2 0 2 8	TIC 2 0 2 9	2 0 3 0	2 0 3 1	Implementation cost Associates

SPECIFIC OBJECTIVE 1: Preservation of the value of Vjetrenica cave and other underground habitats								
OVERALL OBJECTIVE 1.1 Monitoring of Vjetrenica								
Cave								
A1.1.1. Monitoring of microclimatic conditions of Vjetrenica cave	Installed monitoring devices; report						Own funds	Experts
A1.1.2. Continuous monitoring and chemical analysis of water in the Vjetrenica cave	Installed monitoring devices; report						Financing from the Funds	Experts
A1.1.3. Monitoring of cave habitats and underground fauna of invertebrates in speleological structures and springs of Vjetrenica caves	Reports, analyses continuously						Financing from the Funds and foreign funds	Experts
A1.1.4. Monitor the status of underground species and preserve the ecological characteristics of the habitats of troglobionates and troglophilic fauna in Vjetrenica cave	Reports, analyses continuously						Financing from the Funds and foreign funds	Experts
A1.1.5. Initiate research activities on radon, microplastics and heavy metals in the Vjetrenica cave	Report on implemented activities						Financing from the Funds and foreign funds	Experts
A1.1.6. Explore, analyse, and monitor the condition of the lampenflora of Vjetrenica	Reports, analyses continuously						Foreign funds	Experts

cave								
OVERALL OBJECTIVE 1.2. Monitoring of underground habitats								
A1.2.1. Establishment of underground habitats monitoring	Installed monitoring devices; Report						Own funds and foreign funds	Experts
A1.2.2. Bat colonies monitoring	Reports, analyses continuously						Financing from the Funds and foreign funds	Experts
A1.2.3. Regular monitoring of underground habitats and underground fauna of invertebrates in speleological structures and springs	Reports, analyses continuously						Foreign funds	Experts
OVERALL OBJECTIVE 1.3.								
Active protection measures								
in order to ensure preservation of natural								
processes in the cave system								
A1.3.1. Develop zoning of Vjetrenica cave with entry protocol; Develop a Visit Plan, systematic research and monitoring of cave condition	Cave zoning map; The protocol on the research of the interior of the cave is harmonized with the Rulebook on the internal order						Own funds	Experts
A1.3.2. A1.3.2. Perform inventory and investigate the distribution of bat species in speleological structures, cracks in rocks and	Reports, analyzes continuously						Financing from the Funds and foreign funds	Experts

anthropogenic objects, identify important areas for their conservation with regard to the use of space and issue management recommendations.								
A1.3.3. Active monitoring of access to speleological structures	Continuous activity; with a permission to explore						Own funds	Employees
A1.3.4. Continuously perform arranging activities in the cave	Continuous activity, prepared report on the measures taken						Own funds	Employees
A1.3.5. Review the carrying capacity for tourist visits to the cave according to the results of monitoring and the condition of the cave	Annual plan of tourist visits produced on the basis of research results and calculation of tourist carrying capacity						Own funds	Employees
A1.3.6. Monitor the microclimatic conditions of Vjetrenica due to the use of the cave and, if necessary, take appropriate measures	Continuous activity, prepared report on the measures taken						Own funds	Employees
A1.3.7. Continuously upload research on species and habitats into the information system and cadastre (portal)	Continuous activity, a research report prepared						Own funds	Employees
A1.3.8. Develop evacuation and rescue plan (GSS protocols incorporated into	Evacuation and rescue plan developed						Financing from the Funds and own funds	Employees

the plan)								
OVERALL OBJECTIVE 1.4. Appropriate measures for establishing sustainable environmental characteristics								
A1.4.1. Prepare a detailed plan for regulation of the Vjetrenica cave	A detailed plan for regulation of the cave prepared						Own funds	Employees
A1.4.2. Limit and/or if possible, stop disturbing of bats (develop a plan)	Developed protocols for dealing in the hibernation process Protocol for dealing						Own funds	Experts
A1.4.3. Remove excess construction material, waste, parts of abandoned infrastructure, etc. from Vjetrenica cave.	Removed material taken out of the cave						Own funds	Employees
A1.4.4. Renovate dilapidated cave infrastructure (fences, lighting fixtures, electricity) (if needed)	Renovated dilapidated cave infrastructure						Own funds, financing from the Funds, foreign funds	Employees

Preservation of favourable conditions of natural values, animal and plant species and habitat types of forest ecosystems

The area of the Protected Landscape Vjetrenica -Popovo polje belongs to the forest area of Europe


due to its phytogeographical position. However, the consequence of centuries of human activity in the protected area Vjetrenica - Popovo polje led to the differentiation of different habitat types and degradation of certain primary ecosystems forests. Thus, habitats such as forests, all types of shrubs, karst grasslands, meadows and pastures, gardens, fields, arable land are now clearly differentiated in this area. In the area of the Protected Landscape Vjetrenica - Popovo polje there are no protective forests or forests with special purpose. Moreover, no forestry activity was recorded in the observed coverage. There are forest plantations near the settlement of Budim Do, and coppice forests are spread over the majority of the area of the Protected Landscape. Unproductive areas in terms of forest development are located near the settlement of Orahov Do, as well as the settlement of Golubinac where this type of area is the largest within the scope of the protected area.

The diversity of ecosystems and habitats of the project area was made on the basis of information provided in the Guide through habitat types of BiH according to the EU Habitats Directive, as well as on the basis of findings obtained by field research, which was conducted in the past. Habitats that are particularly pronounced here include: Arborescent matorral with *Juniperusoxycedrus* and *J. phoenicea*, 91AA Eastern white oak forest, 91F0 Lowland riparian hardwood forests, 9250 Quercus trojana woods and 9340 Quercus ilex

woods. Although these are coppice forests that have no economic value, these habitats are particularly important from the point of view of fauna diversity.

The biggest threat in this area is the lack of interest of the forest management company to manage this area, thus there are successions and changes in forest cover. Forest trails have overgrown in this area, which is a major problem in the event of fires and other extreme weather conditions that threaten the conservation of aboveground habitats and diversity.

The hunting association "Lisac", which operates in this area, performs occasional actions of creating forest paths and maintaining them.

The diversity of forest fauna was not sufficiently researched so that there are no data for some groups, such as fungi, for bird fauna the data are obtained using data from literature and their status needs to be confirmed in the same way as for mammal fauna. The only group that has been studied in detail and belongs partly to the forest fauna is the diversity of insects.

 THEMATIC SECTION A: PRESERVED DIVERSITY OF SPECIES, HABITATS AND KARST FORMS AND STABLE

 PROCESSES ENSURE UNIQUE BEAUTY OF THE NATURAL LANDSCAPE, AND THUS THE PRESERVATION OF A

 UNIQUE UNIVERSAL VALUE FOR PRESENT AND FUTURE GENERATIONS.

 PERIOD OF REALIZATION

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	INDICATORS	2 0 2 1	2 0 2 2	2 0 2 3	2 0 2 4	2 0 2 5	2 0 2 6	2 0 2 7	2 0 2 8	2 0 2 9	2 0 3 0	2 0 3 1	Implementation cost	Associates
SPECIFIC OBJECTIVE 2. Preservation of favourable conditions of natural values, animal and plant species and habitat types of forest ecosystems														
OVERALL OBJECTIVE 2.1. Tracking and continuous monitoring A2.1.1. Identify gaps in basic biodiversity data of NATURA	Deficiencies in research of certain groups identified												Own funds, Funds, financing from	Experts
A2.1.2. Establish standards for data collection and processing with	Collection and processing standards established												the Funds, foreign funds Financing from the Funds, foreign funds	Experts

available biodiversity information system.								
A2.1.3. Develop a forest biodiversity monitoring plan for the entire area	Biodiversity monitoring plan developed for the entire area						Financing from the Funds, foreign funds	Experts
A2.1.4. Conduct research on fungi species in forests and create databases	Research report; List of species by localities; Distribution of species in the area; List of impacts by localities; Management recommendations						Own funds, financing from the Funds, foreign funds	Experts
A2.1.5. Conduct flora research and supplement databases	Updated base and map of flora						Own funds, financing from the Funds, foreign funds	Experts
A2.1.6. Monitor endemic species and significant	Reports, updated database						Own funds, financing from the Funds,	Experts

communities							foreign funds	
A2.1.7. Conduct research on the state and endangerment of significant plant species and communities in forests	Updated base; supplemented maps and report from the conducted research						Own funds, financing from the Funds, foreign funds	Experts
A2.1.8. Conduct research on forest invertebrate species and their habitats	Research report with data for GIS; List of species by localities; Distribution of species in the area; List of impacts by localities; Management recommendations						Own funds, financing from the Funds, foreign funds	Experts
A2.1.9. Conduct research on ornithofauna species, key habitats and movements of these species	Research report with data for GIS; List of species by localities; Distribution of species in the area; List of impacts by localities; Management recommendations						Own funds, financing from the Funds, foreign funds	Experts

A2.1.10. Conduct Research report with research on selected data for GIS; mammal species, List of species by	Own funds,Expertsfinancing from
	mancing from
	the Funds,
their key habitats localities;	foreign funds
and the movements Distribution of	
of these species species in the area;	
List of impacts by	
localities;	
Management	
recommendations	
A2.1.11. Conduct Identify endangered	Financing from Experts
monitoring of the species; conduct	the Funds
state and monitoring and	
conservation analysis:	
measures of Management	
endangered animal recommendations	
species	
A2.1.12. Regularly Identify target	Own funds, Experts
monitor the habitats; Create	financing from
conservation status monitoring	the Funds,
of target habitat protocols;	foreign funds
types monitoring results	Ŭ
A2.1.13. Monitor the Research report;	Financing from Experts
state of invasive List of species by	the Funds
species in forest localities;	
ecosystems Distribution of	
species in the area;	
List of impacts by	
localities;	
Management	
recommendations	
A2.1.14. Monitor the Monitoring reports	Financing from Experts
state (succession) of with GIS data	the Funds

surfaces affected by degradation								
A2.1.15. Monitoring the impact of climate change on the state of forest ecosystems	Monitoring reports with GIS data						Financing from the Funds, foreign funds	Experts
OVERALL OBJECTIVE 2.2. Active protection measures in order to ensure the preservation of natural processes in the cave system								
A2.2.1. Monitor and influence spatial interventions in order to have the least possible impact on forest values of ecosystems and landscape habitats of the protected area Vjetrenica	Activity report; The authenticity of the landscape and traditional landscape values preserved						Own funds	Employees
A2.2.2. Provide food supplies for wintering birds and other animals in case of snow, ice and other natural disasters	Organized feeding of animals in forest ecosystems during unfavourable winter conditions						Own funds	Employees

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A2.2.3. Through	Number of reports							Own funds	Employees
enhanced	on conducted								
surveillance and	inspection; Activity								
enforcement of	report;								
criminal provisions	Share of recorded								
combat illegal	cases of illegal								
poaching	fishing in the reports								
	on conducted								
	inspections is								
	decreasing								
A2.2.4. Establish and	Number and							Own funds	Employees
promote	descriptions of								
cooperation with	initiated								
hunting associations	collaborative								
and, based on	initiatives;								
monitoring and	Joint projects								
tracking of fauna	launched								
species (hunting									
game), provide									
inputs for									
sustainable hunting									
and use									
A2.2.5. Cooperate in	Nature protection							Own funds	Employees
the development of	measures								
hunting	incorporated into the								
management plans	hunting management								
for hunting grounds	plans;								
within the scope of	Number of								
the protected area in	supervisory activities								
order to comply	over the								
with the conditions	implementation of								
of nature protection	the plan								
and monitor their	-								
			_						L]

implementation								
A2.2.6. Cooperate in	Nature protection						Own funds	Employees
the development of	measures							
forest management	incorporated into the							
plans for state and	forest management							
private forests and	plans for state							
monitor the use of	forests;							
forests in	Number of							
accordance with	supervisory activities							
nature protection	over the							
guidelines	implementation of							
	the plan							F 1
A2.2.7. Provide	Achieved						Own funds	Employees
assistance to forest	cooperation with							
companies in	forest companies;							
regulating and	assistance provided							
monitoring the	in regulating the							
collection of wild	unpermitted export							
products from	of species from the							
nature (e.g., fungi	PA							
and medicinal								
plants) in special								
protection zones A2.2.8. Promote and	Assistance to forest						Own funds	Employage
	companies in the						Own runds	Employees
provide assistance in maintenance of	maintenance of forest							
forest roads for the	roads with							
	recommendations							
purpose of	obtained from							
supervision,	obtained from							

monitoring of the	monitoring results							
state and fire								
protection								
A2.2.9. Establish a	Manitaria a managemetar						Time a since for an	Transita
	Monitoring reports;						Financing from	Experts
program to monitor	Recommendations						the Funds	
the occurrence of other diseases or	for management							
allochthonous	adjustment							
species in the forest								
ecosystem A2.2.10. In	List of localities			 		 	Einanaina fuana	Eurorto
accordance with the	where measures are						Financing from the Funds,	Experts
recommendations of	implemented						foreign funds	
the research results,	renovations and						toreign tunus	
implement active	maintenance;							
measures for the	Description of							
restoration and	implemented							
maintenance of	conservation							
important forest	measures							
ecosystems	ineasures							
A2.2.11. Eliminate or	Elimination Plan						Own funds,	Experts
reduce populations	developed;						Financing from	Experts
of invasive species	Annual reports on						the Funds	
according to the	removal						the Fulkes	
obtained monitoring	implementation with							
results	data on elimination							
	sites, quantity of							
	species eliminated							
OVERALL								
OBJECTIVE 2.3.								
Establishment of								
measures to create								

sustainable environmental characteristics								
A2.3.1. Participation	Cooperation with						Own funds	Employees
and cooperation in	competent							
the development of	authorities for							
the project for	implementation;							
remediation of	prevention measures							
illegal landfills (if	to conserve target							
necessary)	species incorporated							
A2.3.2. Assistance in	Assistance in filling						Own funds	Employees
the maintenance of	the spatial database							
forest clearings	of forest clearings							
(glades) within	and bushy marginal							
forests and along	areas; List and areas							
roads and bushy	of sites where							
marginal areas as	maintenance is							
important habitats	carried out; Proposed							
for biodiversity	conservation							
conservation.	measures submitted							
	to the competent							
	authorities - Forestry							
	companies							
A2.3.3. Record	Spatial database of						Financing from	Experts
private areas of	forest land;						the Funds and	
forest land (forests	List of criteria and						foreign funds	
and clearings -	priority areas for							
meadows,	purchase							
grasslands within								
forest complexes),								
determine criteria								
and priorities for								
purchase (in order								

to preserve biodiversity and management)								
A2A2.3.4. Participation and cooperation in the removal of illegal landfills and restoration of ecosystems resulting from illegal landfills (if necessary)	Cooperation with competent authorities for implementation, restoration of forest ecosystems						Own funds	Employees
A2.3.5. Strengthen supervision together with forest inspection and monitor the implementation of misdemeanour provisions, prevent illegal logging	Number of reports on conducted inspection; Share of recorded cases of illegal logging						Own funds	Employees

Preservation of favourable conditions of natural values, animal and plant species and habitat types of meadow and grassland ecosystems

Today, the area of the Protected Landscape Vjetrenica - Popovo polje is characterized by a high degree of endemism of meadows and grassland.

Soil leaching, action of winds, summer droughts and fires led to creation of dry grasslands typical of this area. These are mainly grasslands of the protected area, with sparse vegetation, resembling rocky deserts.

On the other hand, grasslands on which more soil was retained have more dense vegetation and they are richer in biological species. At higher altitudes, a special type of rocky grasslands developed, which is characterized by an extremely large number of biological species, containing a significant number of endemic species.

Coastal grasslands are extremely important due to the fact that they have two growing seasons a year, in the spring and after the rains in the fall. These grasslands are especially botanically interesting due to the fact that up to 100 plant species can be determined on some hundred square meters, which makes them the most biologically diverse habitats in Europe. At the same time, these types of pastures form the basis of branches of economy such as cattle breeding and beekeeping. Today, many of these grassland habitat types, which belong to the proposed protected area Vjetrenica - Popovo polje, are on the list of endangered and rare habitats as a result of depopulation, neglect, emigration and lack of use of machinery. The consequences of this are reflected in the overgrowth of mountain grasslands, which become covered with shrubs and forests, which further results in a significant loss of biological diversity. On the other hand, grasslands in the valleys are increasingly under anthropogenic pressure, which leads to their degradation and ultimately a reduction in the number of species that were typical of such grasslands.

The diversity of ecosystems and habitats of the project area was made on the basis of information provided in the Guide through habitat types of BiH according to the EU Habitats Directive, as well as on the basis of findings obtained by field research, which was conducted in the past. Habitats that are particularly pronounced here include: *6220 Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*, 62A0 Eastern sub-mediterranean dry grassland, 6510 Lowland hay meadows, 6540 Sub-Mediterranean grasslands of the *Molinio-Hordeion secalini* and 8140 Eastern Mediterranean screes *Drypidetaliaspinosae*.

The processes of succession and gradual overgrowing are quite pronounced due to the poor use of traditional activities such as animal husbandry or the cultivation of vineyards or olive groves. In the past, the grasslands of the small bush that inhabits the meadows of Popovo polje were used much more than today as meadows, and after mowing as pastures. Part of Popovo polje east of the current course of Trebišnjica river is largely and intensively cultivated. In contrast, the part of Popovo polje west from the current course of Trebišnjica river, in the area around the Vjetrenica cave, is mostly neglected and only some parts are used as pastures.

Such condition of meadows and grasslands is particularly conducive to the settlement of invasive species that represent a threat to the species that inhabit this area. The diversity of fauna in these habitats has not been systematically investigated, so today there are data on certain groups such as insects, while for other groups of fauna there are only data from literature.



THEMATIC SECTION A: PRESERVED DIVERSITY OF SPECIES, HABITATS AND KARST FORMS ENSURES UNIQUE BEAUTY OF THE NATURAL LANDSCAPE, AND THUS THE PRESERVATION OF A UNIQUE UNIVERSAL VALUE FOR PRESENT AND FUTURE GENERATIONS.

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	INDICATORS	2 0	Implementation cost	Associates										
		2 1	2 2	2 3	2 4	2 5	2 6	2 7	2 8	2 9	3 0	3 1		
SPECIFIC OBJECTIVE 3: Preservation of favourable conditions of natural values, animal and plant species and habitat types of forest ecosystems OVERALL OBJECTIVE 3.1.														
: Tracking and continuous monitoring														
A3.1.1. Identify gaps in basic data on meadow and grassland biodiversity and conduct research in these	Deficiencies in research of certain groups identified and analysed												Own funds, financing from the Funds, foreign funds	Experts

areas								
A3.1.2. Harmonize data collection and processing standards with the available biodiversity information	Collection and processing standards harmonized						Financing from the Funds, foreign funds	Experts
system. A3.1.3. Develop and implement a plan to monitor the biodiversity of meadows and grasslands for the entire area	Biodiversity monitoring plan developed for the entire area						Financing from the Funds, foreign funds	Experts
A3.1.4. Encourage and conduct research on fungal species in meadows and grasslands and create databases	Research report with data for GIS; List of species by localities; Distribution of species in the area; List of impacts by localities; Management recommendations						Own funds, Financing from the Funds, foreign funds	Experts
A3.1.5. Encourage and conduct research on flora	Updated base and map of flora						Own funds, Financing from the Funds, foreign funds	Experts

and supplement databases and flora maps of meadows and grasslands								
A3.1.6. Monitor endemic species and significant communities of meadow and grassland flora	Reports, updated database						Own funds, Financing from the Funds, foreign funds	Experts
A3.1.7. Encourage research of the state and level of endangerment of significant plant species and communities of meadows and grasslands	Updated base; supplemented maps and report from the conducted research						Own funds, Financing from the Funds, foreign funds	Experts
A3.1.8. Encourage and conduct research on meadow and grassland invertebrate species and their habitats	Research report with data for GIS; List of species by localities; Distribution of species in the area; List of impacts by localities; Management recommendations						Own funds, Financing from the Funds, foreign funds	Experts

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A3.1.8. Investigate and conduct research on flora at the entrance to cave systems	Research report with data for GIS; List of species by localities; Distribution of species in the area; List of impacts by localities; Management recommendations						Own funds, Financing from the Funds, foreign funds	Experts
OVERALL OBJECTIVE 3.2. Active protection measures in order to ensure the preservation of natural processes in the cave system								
A.3.2.1. Regular monitoring of the state of target habitat types of meadows and grasslands	Monitoring reports with data for GIS that contain at least: area covered by habitat type, structure and function of habitat, prospects for the future; Recommendations for management adjustment						Own funds, Financing from the Funds, foreign funds	Experts

		and the second				ALC: NO.	and a second second		
A3.2.2. Conduct	Report on							Own funds,	Experts
monitoring of	monitoring, number							Financing from	
the state and	of individuals, state							the Funds,	
conservation	of population,							foreign funds	
measures of	endangerment and							-	
endangered	habitat quality								
animal species	assessment with								
of meadows and	recommendations								
grasslands	for further								
0	monitoring and								
	conservation								
	measures;								
	Recommendations								
	for management								
	adjustment								
A3.2.3. Regular	Report on							Own funds,	Experts
monitoring of	monitoring, number							Financing from	Experts
the state of rare,	of individuals, state							the Funds,	
endangered and	of population,							foreign funds	
strictly	endangerment and							loreign funds	
protected plant	habitat quality								
species of	assessment with								
grasslands and	recommendations								
meadows	for further								
meadows									
	monitoring and conservation								
	measures;								
	Recommendations								
	for management								
OVERALL	adjustment								
OVERALL									
OBJECTIVE 3.3.									
Establishment									

of measures to create sustainable environmental characteristics								
A3.3.1. Record ownership relations on areas under targeted habitat types and determine priorities for purchase (in order to preserve biodiversity and management)	Spatial database for grassland areas; Priority list for purchase						Own funds	Employees
A3.3.2. Establish cooperation with owners of targeted habitat types of priority meadows and grasslands in order to provide guidelines for maintenance	List of contacted owners; Number of collaborations						Own funds	Employees
A3.3.3. Remove and prevent spreading of invasive species	Description of implemented removal measures by localities; Updated spatial						Own funds, foreign funds	Employees

	database; Areas from which invasive species have been removed							
Encourage the rehabilitation of the landscape along the constructed infrastructure corridors and rehabilitation area.	Landscape remediation plans developed; along the constructed infrastructure corridors and the reconstruction area, the landscape rehabilitated.						Own funds, foreign funds	Employees

Preservation of favourable conditions of natural values, animal and plant species and habitat types of aquatic ecosystems

Permanent sources and springs are rare in Popovo Polje. They belong to the group of caves with water, and their activity is related to the existence of a dolomite barrier between Popovo polje and the sea. In the periods of large and medium waters, after longer precipitation, significant quantities of water appear from these springs, while in dry summer periods the inflow is relatively small. The most significant quantities of groundwater are found in the siphon parts of underground caverns. In the area around Zavala, several such springs appear, which have water even in the driest periods. Among them, the most important are:

- Pokrivenik (Mareva Ljut)
- Lukavac underneath the entrance to the Vjetrenica cave
- Čvaušnik and the Čvostik spring near Čvaljina

These springs are untapped and they do not have the set water protection zones. Along the old course of Trebišnjica and other periodical and permanent flows, and in depressions of the terrain where water is retained longer and the soil remains sufficiently moist, swamp vegetation with reeds and sedges develops. Wetland vegetation belongs to the order *Phragmitetalia*, that is, amphibious communities of the class *Isoëto-Nanojuncetea*, which inhabit the contact zones of water and land, where occasional (natural) flooding and drying of habitats takes place. In similar conditions, hygrophilous forests and shrubs of willows, poplars and willows of the orders *Populetaliaalbaei Salicetaliapurpureae* develop. Developed remains of such willow shrubs can be seen along the old Trebišnjica riverbed (vegetation of hydrophilic forests and shrubs of the *Salicionalbae*, *Salicionalbae* alliance represent the form of flooded thermophilic forests and shrubs, which overgrow the shores of permanent or occasional watercourses and wetlands of the Mediterranean and sub-Mediterranean belt.



Figure 10. Vitexagnus-castusL. - a medicinal and honey-bearing species that builds special communities here

The diversity of ecosystems and habitats of the project area was made on the basis of information provided in the Guide through habitat types of BiH according to the EU Habitats Directive, as well as on the basis of findings obtained by field research, which was conducted in the past. Habitats that are particularly pronounced here include: 8210 Calcareous rocky slopes with chasmophytic vegetation, * 3170 Mediterranean temporary ponds and * 3180 Ephemeral karstic lakes.

Endangerment of surface and groundwater is a consequence of uncontrolled discharge of industrial and faecal wastewater into groundwater and watercourses, waste disposal in non-sanitary and illegal landfills, and intensive use of chemicals in agriculture. Given the hydro-geological structure of the karst area and the catchment area of the major springs, groundwater is particularly sensitive to sources of pollution. At the springs in the karst area with karst fields - Popovo polje, huge quantities of water flow out, which accumulate in the vast carbonate-karst underground or sink in Popovo polje and other karst fields. Carbonate complex intensely tectonically distorted and karstified, with strong transverse and diagonal faults resulted in the development of privileged groundwater routes towards the sea. The outflow takes place in the coastal zone, at the contact of limestone and other less permeable rocks. Pollution of groundwater and springs occurs from the wastewater of settlements since the settlements in their catchment area do not have a sanitary network with treatment plants, and also from chemical agents used in agriculture in Popovo polje and other fields in the catchment area of the source. The problem of waste disposal in non-sanitary landfills located in the water protection zones of the source should be emphasized, which can cause bacteriological pollution, significant organic pollution, nitrate pollution, occasional salinity, unfavourable water temperature, high hardness and increased turbidity.

THEMATIC SECTION A: PRESERVED DIVERSITY OF SPECIES, HABITATS AND KARST FORMS ENSURES UNIQUE BEAUTY OF THE NATURAL LANDSCAPE, AND THUS THE PRESERVATION OF A UNIQUE UNIVERSAL VALUE FOR PRESENT AND FUTURE CENERATIONS

		PK							ERA		NS.			-
				PERI	OD	OF R	EAL	IZA	ΓΙΟΝ	1				
		2	2	2	2	2	2	2	2	2	2	2	Implementation	
	INDICATORS	0	0	0	0	0	0	0	0	0	0	0	costs	Associates
		2	2	2	2	2	2	2	2	2	3	3		
		1	2	3	4	5	6	7	8	9	0	1		
SPECIFIC														
OBJECTIVE 4.														
Preservation of														
favourable														
conditions of														
natural values,														
animal and plant														
species and														
habitat types of														
aquatic														
ecosystems														
OVERALL														
OBJECTIVE 4.1.														
Tracing and continuous														
monitoring A4.1.1. Identify	Deficiencies in												Own funds,	Exporte
	research of certain												Financing from	Experts
gaps in basic													the Funds,	
biodiversity data and conduct	groups identified												,	
research in these	and analysed												foreign funds	
areas A4.1.2. Promote	antinuousla (h.												Own funds	Emailances
	continuously, the												Own runas	Employees
speleological,	number of													
biospeleological,	permits issued by													

hydrogeological, geological and other research	the ministry							
A4.1.3. Harmonize data collection and processing standards with the available biodiversity information system.	Collection and processing standards harmonized						Financing from the Funds, foreign funds	Experts
A4.1.4. Develop and implement biodiversity monitoring plan for the entire area	Biodiversity monitoring plan developed for the entire area						Financing from the Funds, foreign funds	Experts
A4.1.5. Conduct continuous monitoring of aquatic ecosystems state (Temperature, flow, Seasonal discharge)	Spatial monitoring database (GIS); Established and regular uploading of data in databases; Annual status reports;						Own funds, Financing from the Funds, foreign funds	Experts
A4.1.6. Perform inventory and monitor moist, wetland and aquatic habitats in the PA	Research report with data for GIS; List of species by localities; Distribution of species in the area;						Financing from the Funds, foreign funds	Experts

	List of impacts by localities; Management recommendations						
A4.1.7. Monitor and maintain existing springs and aquatic habitats	Spatial monitoring database (GIS); Established and regular uploading of data in databases; Reports on the status and number of sources as well as reports on indicator species					Financing from the Funds, foreign funds	Experts
A4.1.8. Encourage and conduct research on aquatic invertebrate species and their habitats	Research report with data for GIS; List of species by localities; Distribution of species in the area; List of impacts by localities; Management recommendations					Financing from the Funds, foreign funds	Experts

	D 1 1						T ¹ · <i>C</i>	
A4.1.9. Encourage	Research report						Financing from	Experts
and conduct	with data for GIS;						the Funds,	
research of fish	List of species by						foreign funds	
species, their	localities;							
habitats and	Distribution of							
movements in	species in the							
water bodies	area;							
	List of impacts by							
	localities;							
	Management							
	recommendations							
A4.1.10.	Research report						Financing from	Experts
Encourage and	with data for GIS;						the Funds,	1
conduct research	List of species by						foreign funds	
on amphibians	localities;						0	
and reptiles and	Distribution of							
their key habitats	species in the							
	area;							
	List of impacts by							
	localities;							
	Management							
	recommendations							
A4.1.11. Conduct							Financing from	Experts
monitoring of the							the Funds,	
state and							foreign funds	
conservation								
measures of								
endangered								
aquatic organisms								
OVERALL								
OBJECTIVE 4.2.								
Active protection								
measures in								
								I

order to ensure the preservation of natural processes in the								
cave system								
A4.2.1. In accordance with the recommendations of the research results, implement active measures for the rehabilitation and maintenance of wetland habitats, swamps and	List of localities where measures of Rehabilitation and maintenance are implemented; Description of implemented conservation measures							Employees
springs A4.2.2. Eliminate or reduce populations of invasive species according to the obtained results	Elimination Plan developed; Annual reports on removal implementation with data on elimination sites, quantity of species eliminated						Own funds, foreign funds	Experts, Employees
A4.2.3. Combat illegal fishing through enhanced surveillance and	Number of reports on conducted inspection; The share of recorded						Own funds	Employees

enforcement of	cases of illegal							
criminal	fishing in the							
provisions	reports on							
	conducted							
	inspections is							
	decreasing							
A4.2.4. Identify	GIS data record						Own funds	Employees
sources of point	report;							
pollution on	Pollution list;							
aquatic	Management							
ecosystems	recommendations							
(Surface and								
groundwater)								
A4.2.5. Establish	Agreed						Own funds	Employees
cooperation with	cooperation on							
the competent	data exchange;							
institutions on the	Septic tank							
recording and	control results							
control of	available							
permeability of	to the public							
septic tanks and	company;							
their regular								
emptying, and as								
a matter of								
priority in the								
areas of high risk								
of pollution.								
A4.2.6. Protect	List of localities						Financing from	Experts
migration routes	where warning						the Funds,	
(especially	signs should be						foreign funds	
amphibians)	placed on the							
during the	possible presence							
reproductive	of a large number							

cycle	of amphibians and reptiles on the roads at the time of their migration to and from the places where their reproduction							
	takes place.							
OVERALL	takes place.							
OBJECTIVE 4.3.								
Establishment of								
measures to								
create sustainable								
environmental								
characteristics								
A4.3.1. Promote	Established						Own funds	Employees
and establish	cooperation with						Owninando	Employees
cooperation with	competent							
the competent	authorities;							
authorities for the	recommendations							
regulation of	for sustainable							
water bodies	use and							
	management							
A4.3.2. Establish	Established						Own funds	Employees
cooperation on	cooperation with							1 2
the project	the competent							
"Exploration well	authorities for							
in the area of	project							
Popovo polje"	implementation,							
aimed at	incorporated							
preserving the	guidelines for							

ecosystem	sustainable conservation of biodiversity and habitats							
A4.3.3. Participation and cooperation in the development of the project of remediation of illegal landfills and wastewater drainage from them (if necessary)	Cooperation with competent authorities for implementation, Solving wastewater problems in the implementation process						Own funds	Employees
A4.3.4. Participation and cooperation in the removal of illegal landfills and restoration of ecosystems caused by illegal landfills (if necessary)	Cooperation with competent authorities for implementation, restoration of ecosystems						Own funds	Employees

Thematic section B: Preserved cultural heritage takes an important place in the presentation of values and contributes to the preservation of tradition and cultural identity of the area.

Specific objective 1. Tangible cultural heritage is researched, restored, maintained, presented and used for management purposes

Indicators:

- Promoted tangible cultural offer
- Achieved cooperation with key actors related to tangible cultural heritage

Specific objective 2. Intangible cultural heritage is researched, maintained, presented and used for management purposes

Indicators:

- Promoted tangible cultural offer
- Achieved cooperation with key actors related to cultural intangible heritage

Specific objective 3. Through cooperation with the local population and the inclusion of settlements with preserved traditional cultural landscape in the visits system

Indicators:

- Number of initiatives for preservation of landscape heritage
- Number of educations

Tangible cultural heritage is researched, restored, maintained, presented and used for management purposes

The area of Vjetrenica - Popovo polje represents a special wealth of tangible cultural heritage. The prehistoric period is currently marked by accidental finds of pottery (Vjetrenica, Orlovica) and Bronze and Iron Age sites with characteristic settlements - forts and graves in the form of stone mounds (Agricultural and livestock population from the Early and Middle Bronze Age).

Lack of knowledge on the Palaeolithic and Neolithic periods can be attributed to the lack of systematic research of the area. The caves that served as shelters and temporary dwellings are potential archaeological sites of Palaeolithic man and the Mesolithic and Neolithic populations that followed.

Without systematic research, it is difficult to set the date of the hillfort settlements, which have a common position on the hill, protection by a dry stone wall and the appearance of the so-called pottery from fortified sites. In the forts, the continuity of life can often be traced from the Bronze and Iron Ages to the establishment of Roman rule. Hillfort settlements were identified in Čvaljina, Orahov Do, Golubinac and Zavala.

The finding of late antique-early Christian tomb in Golubinac testifies to the continuity of settlement in this area. Most of the material evidence in the area of protected landscape Vjetrenica was left from the medieval period in the form of cemeteries under stećak tombstones.

The necropolises of stećak tombstones from this area are Zavala-Crkvina, Belenići-Groblje (cemetery), Kiev Do-Groblje (cemetery), Orahov Do-Donje polje, Golubinac-Groblje (cemetery), and medieval graves in front of the Vjetrenica and Orlovica caves, with about eighty monuments.

The Archaeological Site of Zavala-Crkvina and the Architectural Ensemble of the Presentation of the Blessed Virgin Mary in Zavala (Zavala Monastery) have the status of a National Monument of BiH.

Stone mills also represent a special cultural material heritage of this area. Today, they are abandoned and

Ćirina staza is a form of cultural material heritage with its accompanying facilities that need to be renovated and put into operation. The municipality of Ravno has already started activities to popularize this railway as a bicycle route.

Active protection measures should be applied to national monuments, as well as monuments from other categories of special importance to the Municipality. It is necessary to revive the monuments through detailed valorisation and planning documentation and give them a new function that will not impair the original value of the monument.

THEMATIC SECTION B: PRESERVED CULTURAL HERITAGE TAKES AN IMPORTANT PLACE IN THE														
PRESENTATION OF VALUES AND CONTRIBUTES TO THE PRESERVATION OF TRADITION AND														
CULTURAL IDENTITY OF THE AREA.														
		PERIOD OF REALIZATION												
		2	2	2	2	2	2	2	2	2		2	Implementation cost	Associates
	INDICATORS	0	0	0	0	0	0	0	0	0	0	0		
		2	2	2	2	2	2	2	2	2	3	3		
		1	2	3	4	5	6	7	8	9	0	1		
SPECIFIC														
OBJECTIVE 1.														
Preservation of														
tangible														
cultural														
heritage in the														
strict coverage														
area OVERALL														
OVERALL OBJECTIVE														
1.1.														
Rehabilitation														
and regular														
maintenance of														
cultural														
heritage														
facilities														
B1.1.1.	Participate in												Own funds	Employees
Participate in	the planning of													
the planning of	research and													
research and	restoration of													
restoration of	cultural													
cultural	heritage in													
heritage	cooperation													
	with the													
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	competent													
	authorities.													
B1.1.2. Develop	Created						Own funds	Employees						
a database on	database with							1 9						
recorded and	specified types													
protected	of cultural													
cultural assets	assets, their													
in the area	status in the													
	protection													
	system and													
	the pertaining													
	maps.													
B1.1.3.	Number of						Foreign funds	Employees,						
Initiate projects	implemented							Experts						
for the	projects with													
presentation of	museums and													
the cultural	other													
heritage of the	competent													
protected zone	institutions on													
in cooperation	the													
with museums	presentation of													
and other	the cultural													
competent	heritage of the													
institutions.	protected zone													
B1.1.4. Include	Number of						Own funds	Employees						
in the tourist	localities of													
offer and equip	necropolises of													
with the	stećak													
necessary	tombstones													
tourist	included in the													
infrastructure	tourist offer													
the	and equipped													

necropolises of stećak tombstones which currently have the status of a national monument	with the necessary tourist infrastructure.							
B1.1.5. In cooperation with the competent authorities promote and participate in the rehabilitation of historic mills in Popovo polje	Number of rehabilitated mills; public- private partnership accomplished						Own funds, foreign funds	Employees, Experts
B1.1.6. Promote renovation of old houses - ethno-houses as places of presenting and education about the traditional way of living.	Raising awareness about the renovation and reconstruction of old houses						Own funds, foreign funds	Employees
B1.1.7. Promote maintenance of Ćirina staza, its conversion and protection	Raising awareness about preserving Ćirina staza by						Own funds	Employees

	creating new content and offers							
B1.1.8. Monitor the state and regularly maintain the area around the facilities of tangible cultural heritage	Annual report on performed works						Own funds	Employees
OVERALL OBJECTIVE 1.2. Research and promotion of cultural heritage								
B1.2.1. Promote archaeological research in the Protected Landscape Vjetrenica - Popovo polje	Analysis of archaeological potentials of the sites in the protected zone; Annual reports on research and conservation works						Own funds, Foreign funds	Employee, Experts

Cultural landscape preservation

The traditional cultural landscape has been preserved only in a small part of the settlements in the area of the Protected Landscape Vjetrenica - Popovo polje. Preservation of the original matrix of the karst, spatially scattered settlements, with hamlets consisting of several courtyards, with traditional one-story stone houses, farm buildings, yards, hedges, fences, gardens, orchards, arable land, forest clearings, meadows and pastures with livestock and hives, can still be seen in parts of the rural settlements of Orahov Do and Čavaljina.

Several buildings have been renovated in the old architectural traditional cultural spirit and there is a tendency to modernize the cultural landscape.

In accordance with the circumstances of society, it is necessary to encourage and promote the traditional cultural landscape in order to preserve the identification of the traditional cultural landscape of this area and it is necessary to include it in the tourist offer of this area.

Thematic section C: Visits do not disturb the values of the Protected Landscape Vjetrenica - Popovo polje and provide visitors with an undisturbed and complete experience, which in the best possible way presents the preserved biological and cultural heritage, generates income needed for its preservation, builds public support for nature conservation and opens opportunities for sustainable development of the local community

SPECIFIC OBJECTIVE 1. Organized visitor management

Tourism does not disturb the natural values of the Protected Landscape and provides visitors with an undisturbed complete experience, thus presenting the preserved biodiversity values in the best possible way.

Indicators:

- Visits are organized and functional
- Visitors do not present disturbance to the appearance of the landscape
- Visitors are safe and informed
- Tourist signage is set up and provides guidance to visitors in a clear way
- Tourist capacities are built and contribute to the appearance of the area

SPECIFIC OBJECTIVE 2. Space in the service of local communities and measures to improve the tourist offer

The space used by the local community and the visitors was renovated and it is functional

Indicators:

- Achieved cooperation on key projects for the local community
- The space is in the service of the local community and visitors

SPECIFIC OBJECTIVE 3. Presentation of the offer and education

The space was presented, and visitors were educated about the importance of nature and its values **Indicators:**

- Created educational programs for adults and children
- Printed material is educational and provides sufficient information about the space
- Protected Landscape maps are printed
- Marking important international dates
- Holding of the international speleological camp
- Support the local community in marking important dates

SPECIFIC OBJECTIVE 4. Marketing and promotion

Marketing and promotion

Indicators:

- Developed marketing strategy
- The website upgraded and customized for visitors
- Social networks have enough information about the area.

Organized visitors' management

Today, the tourist offer of the Protected Landscape Vjetrenica - Popovo polje is based on individual or group visits to the Vjetrenica cave. Vjetrenica Cave, located 5 km from the centre of the municipality, with a total length of 1300 m of well-tended trails for visitors, is a unique location for tourism development in this part of Europe. The trail is secured with a protective fence and illuminated in the length of 600 m. The cave has 7.3 km of examined canals and over 22 km of assumed total length, it is adorned with rich cave decorations of all kinds (stalagmites, stalactites, cave columns, bathtubs), a high degree of biodiversity in the cave, then more than 200 animal species adapted to life underground and fantastic paleontological findings that take us back 35,000 years in the past. Vjetrenica has a unique hydrological system of the cave (dominated by the Great Lake/Veliko jezero) in symbiosis with the hydrology of Popovo polje, with a constant temperature of 11.2 degrees and the strong winds at the entrance to the cave in summer. The cave





is an ideal location for educational tourism and school excursions because the offer includes a tour of the first biospeleological museum in BiH, which was opened in 2013.

Most of the cave organisms living in the cave can be seen in the museum, including a replica of the Pardus panther, whose skeleton was found in the cave, and it is in the National Museum in Sarajevo. It is the largest discovery of its kind in the world, whose age is estimated at more than 35,000 years. Due to its peculiarities, the Vjetrenica cave is highly ranked in all speleological circles and associations both in BiH and in the world.

Possible pressures on the natural and cultural values of the Vjetrenica cave are related to the number of visitors and the construction of infrastructure and other buildings and activities related to tourism. For sizing the space for the tourist functions of the cave, it will be necessary to calculate the physical and environmental carrying capacity of the visits, for which the ecological sensitivity and the carrying capacities of potentially the busiest localities are decisive.

Visitors should have clear protocols and information for behaviour in the cave. Monitoring of visits should be clearly developed and the informing and access to information in real-time should be made available to stakeholders, that is, to visitors.

Launching new tourist signage projects increases the value of the area and gives new experiences to the tourist offer. By adding new tourist offers that are in line with the biological carrying capacity of the area, the value of this area for visitors is increased.

THEMATIC SECTION C: VISITS DO NOT DISTURB THE VALUES OF THE PROTECTED LANDSCAPE VJETRENICA - POPOVO POLJE AND PROVIDE VISITORS WITH AN UNDISTURBED AND COMPLETE EXPERIENCE, WHICH IN THE BEST POSSIBLE WAY PRESENTS THE PRESERVED BIOLOGICAL AND CULTURAL HERITAGE, GENERATES INCOME NEEDED FOR ITS PRESERVATION, BUILDS PUBLIC SUPPORT FOR NATURE CONSERVATION AND OPENS OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT OF THE LOCAL COMMUNITY

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			PER	IOD	OF F	REAL	IZA	ΓΙΟΝ	J				
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	0	0	0	0	0	0	0	0	0	0	0	-	Assoc
INDICATORS	2	2	2	2	2	2	2	2	2	3	3	cost	iates
	1	2	3	4	5	6	7	8	9	0	1		
System of visits to												Own funds	Emplo
protected area													yees
Vjetrenica - Popovo													-
polje created													
Monitoring values of												Own funds	Emplo
established													yees
indicators for cave													-
visits, 6-monthly report													
on the number of													
visitors													
Updated information												Own funds	Emplo
on all communication													yees
channels (up to date) as													5
soon as possible													
Online ticket sales												Own funds	Emplo
system (e-ticket)													yees
established;													-
	INDICATORS INDICATORS System of visits to protected area Vjetrenica - Popovo polje created Monitoring values of established indicators for cave visits, 6-monthly report on the number of visitors Updated information on all communication channels (up to date) as soon as possible Online ticket sales system (e-ticket)	INDICATORS 2 0 2 1 System of visits to protected area Vjetrenica - Popovo polje created Monitoring values of established indicators for cave visits, 6-monthly report on the number of visitors Updated information on all communication channels (up to date) as soon as possible Online ticket sales system (e-ticket)	INDICATORS2 2 0 2 2 12 2 2 2 1System of visits to protected area Vjetrenica - Popovo polje created-Monitoring values of established indicators for cave visitors-Monitoring values of established indicators for cave visitors-Updated information on all communication channels (up to date) as soon as possible-Online ticket sales system (e-ticket)-	INDICATORS2220002221231231231231231231231231231231231231231231231311	INDICATORS2222200000222221234Image: System of visits to protected area Vjetrenica - Popovo polje createdImage: System of visits to protected area Vjetrenica - Popovo polje createdImage: System of visits to protected area Visits, 6-monthly report on the number of visitorsImage: System of visits to protected area Visits, 6-monthly report on the number of visitorsImage: System of visits of the number of visitorsImage: System of visits visitsImage: System of visits visits	INDICATORS 2 2 2 2 2 2 2 2 0 0 0 0 0 0 2 2 2 2 2 2 2 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 1 1 1 1 1 1 2 3 4 5 1 1 1 1 1 1 1 2 3 4 5 1	INDICATORS2222222000000022222222123456System of visits to protected area Vjetrenica - Popovo polje createdImage: Colspan="4">Image: Colspan="4"Image: Colspan="4">Image: Colspan="4"Image: Colspan="4"	INDICATORS222222220000000022222222212345671234567123456712345671234567123456712345671234567111 </td <td>PERIOD OF REALIZATION222222222000000000022222222222123456781111111111234567811111111123456781111111111234567811111111112345678111<t< td=""><td>PERIOD OF REALIZATION22<t< td=""><td>INDICATORS 2 3 3 4 5 6 7 8 9 0 Image: System of visits to protected area Vjetrenica - Popovo polje created Image: State Sta</td><td>$\begin{array}{ c c c c c c c c c c c c c c c c c c c$</td><td>PERIOD OF REALIZATIONImplementation22111<!--</td--></td></t<></td></t<></td>	PERIOD OF REALIZATION222222222000000000022222222222123456781111111111234567811111111123456781111111111234567811111111112345678111 <t< td=""><td>PERIOD OF REALIZATION22<t< td=""><td>INDICATORS 2 3 3 4 5 6 7 8 9 0 Image: System of visits to protected area Vjetrenica - Popovo polje created Image: State Sta</td><td>$\begin{array}{ c c c c c c c c c c c c c c c c c c c$</td><td>PERIOD OF REALIZATIONImplementation22111<!--</td--></td></t<></td></t<>	PERIOD OF REALIZATION22 <t< td=""><td>INDICATORS 2 3 3 4 5 6 7 8 9 0 Image: System of visits to protected area Vjetrenica - Popovo polje created Image: State Sta</td><td>$\begin{array}{ c c c c c c c c c c c c c c c c c c c$</td><td>PERIOD OF REALIZATIONImplementation22111<!--</td--></td></t<>	INDICATORS 2 3 3 4 5 6 7 8 9 0 Image: System of visits to protected area Vjetrenica - Popovo polje created Image: State Sta	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	PERIOD OF REALIZATIONImplementation22111 </td



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	Registration systems established for											
	entry and exit of											
	visitors from the visitor											
	system											
C1.1.5. Encourage organized visits	Number of organized										Own funds	Emplo
	visits											yees
	List of organizers											
	(protected area,											
	agencies, etc)											
C1.1.6. Improve the tourist offer and the	Number of individuals										Own funds	Emplo
quality of service in the protected area	interested in											yees
in cooperation with the local	cooperation; Research											
community	of visitors' perception											
	of the quality of the											
	offer											
C1.1.7. Design and establish programs	Established programs										Own funds	Emplo
that meet the specific needs and	tailored to guided											yees
capabilities of guided groups of visitors	groups; Share of											
	agency guests using the											
	programs;											
C1.1.8. Consider introduction and	Developed study with										Own funds	Emplo
justification of multi-seasonal tourist	opportunities for											yees
offer (health, recreational and other	tourism development											
tourism)	throughout the year											
	with the potentials of											
	the region											
C1.1.9. Define programs for visitors	Established programs										Own funds	Emplo
with special needs	tailored to visitors with											yees
	mobility difficulties,											
	with seasonal versions;											
	Number of visitors											
	using the programs;											

	the second	1000	and the second second	10 C	and the second second	10000	and the second second	and the second	ALC: NOT THE OWNER OF	and the	The second second second	1000		and the second se
C1.1.10. Encourage strengthening and	Cyclotourism programs												Own funds	Emplo
development of the offer for cycling	and offer expanded													yees
paths and trails	and supplemented													
	with additional													
	contents													
OVERALL OBJECTIVE 1.2.														
Supervision and implementation of														
code of conduct for visitors														
C1.2.1. Review and supplement the	Redesign of the new												Own funds	Emplo
website of the public company	website of protected													yees
	area Vjetrenica -													
	Popovo polje													
C1.2.2. Vjetrenica website has a special	Created website for												Own funds	Emplo
portal for researchers with a defined	Vjetrenica; Number of													yees
degree of authorization	registered users of the													
	site													
C1.2.3. Provide up-to-date information	Up to date information												Own funds	Emplo
on code of conduct in all established	on all communication													yees
communication channels	channels													
C1.2.4. Enable the website visitors to get	The website should												Own funds	Emplo
acquainted with the code of conduct in	provide each visitor													yees
the protected area, provide them with	with information on													
route maps	the code of conduct,													
	route maps and													
	dangers in the													
	protected area													
C1.2.5. Information boards with clear	Information boards												Own funds	Emplo
information, pictograms placed in a	placed in prominent													yees
prominent place in order to inform	places for the protected													-
visitors about the rules and dangers in	area visitors													
the protected zones														

			and the second se	A CONTRACTOR OF	all the second	and a second second	the lot of	ALC: NO.	No. of Concession, Name of Street, or other	CANE A		
C1.2.6. Allocate a sufficient number of	Number of nature										Own funds	Emplo
nature guardians from the public	guardians present at											yees
company, necessary for effective control	individual locations;											
of compliance with the rules in the	Number of recorded											
protected area, depending on the	cases of illicit											
number of visitors and the season	behaviour; Number of											
	evidence of											
	misconduct;											
OVERALL OBJECTIVE 1.3. Tourist	continuously										Own funds	Emplo
signage/ information												yees
C1.3.1. Tourist signage set in places that	Tourist signage										Own funds	Emplo
indicate the values of the Protected	installed											yees
Landscape Vjetrenica Popovo polje												
C1.3.2. Tourist signage - pictograms	Pictograms placed in a										Own funds	Emplo
placed in prominent places clearly	prominent place clearly											yees
indicate a danger or threat	indicating a danger or											
	threat											
C1.3.3. Regularly monitor the signalling	Monitoring reports										Own funds	Emplo
system efficiency and give	with recommendations											yees
recommendations for its improvement	for improvement											
C1.3.4. Developed interactive map of	Map set on key places										Own funds	Emplo
the protected area Vjetrenica Popovo												yees
polje with indicated values of the												
protected area clearly placed at the												
entrance												
C1.3.5. Developed and maintained	Trail state and marking										Own funds	Own
signalization on trails	reports; especially bicycle	Ś										funds
	signals											
C1.3.6. Continuous marking with	All significant localities										Own funds	Emplo
standardized signposts of all significant	in the wider area of the											yees
localities	protected zone are											
	marked with brown											



signpostsImage: Constraint of the state of the existingImage: Constraint of the existingImage: Constraint of the existingImage: Constraint of the existingOwn funds,	
infrastructure	
C141 Participation in maintenance of The state of the existing Own funds	
CI.I.I.I unceptuon in manachance or fine state of the existing Own funds,	Emplo
the infrastructure for visitors infrastructure meets funds from the	ne yees
the needs of visitors founder	-
C1.4.2. Developed and equipped Open and active Own funds,	Emplo
information and educational centre near information and foreign funds	s yees,
the Vjetrenica cave educational centre for	Expert
visitors; number of	s
visitors per year;	
visitors' satisfaction	
C1.4.3. Mapping and arranging Established and Foreign funds	s Emplo
networks of themed hiking trails reconstructed themed	yees
hiking trails; number of	
trails	
C1.4.4. Participation in organization of Preparation of a study Founder's	Emplo
rest areas; picnic places; benches of the organization of funds, finance	
space and installation from the Fund	ds
of park furniture;	
setting up a park	
furniture and picnic	
places for families	
C1.4.5. Participation in organization of Preparation of a study Foreign funds	s Expert
camping sites; and the establishment of for the establishment of	s,
Glamping tourism a camping place; study	Emplo
for the development of	yees
Glamping tourism with	
additional forms of	
offer (stargazing, sea	
route, etc.)	
C1.4.6. Participation in the Established karst trail Foreign funds	s Emplo



	and the the second second	1000	10.0	-	- Arrist	and the second	-	Contraction of the	1000	ALC: NO	1.00		
establishment of the Karst trail	between different Municipalities in												yees
	Herzegovina or even												
	different countries,												
	with accompanying												
	infrastructure												
C1.4.7 .Participation in the construction	Preparation of study,											Foreign funds	Emplo
of a lookout with an accompanying	obtaining permits and												yees
educational trail	establishing a lookout												
	(sea route); Number of												
	visitors; completed												
	educational trail to the												
	lookout												
C1.4.8. Cooperation on the construction	A new cycle path was											Foreign funds	Emplo
of a new cycle path through Popovo	built from Popovo polje												yees
polje from Ravno to Zavala	Ravno to Zavala;												
	number of users;												
	supporting												
	infrastructure												
C1.4.9. Participation in the regulation of	Regulated rest area											Foreign funds,	Emplo
the rest area "Čvaljina"	"Čvaljina"; number of											Own funds	yees
	visitors												
OVERALL OBJECTIVE 1.5. Security of													
individual and organized visits	A 1 1												F 1
C1.5.1. Continuously implement all	Annual reports on											Own funds	Emplo
recommended measures to ensure the	implemented security												yees
safety of visitors within the visiting	measures within the												
system, and introduce additional	visiting system; All												
measures if necessary	places where there is a possibility of falling												
	with fatal consequences												
	are fenced and marked												
	in accordance with												
	in accordance with												

	the second	and the second se	Contraction of the local division of the loc	1000	A STATE OF THE OWNER OF	and the second se	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	a company	and the second	A DECK OF THE OWNER	Pro California	and the second se	And Personnel States
	safety standards;												
	Number of rescue												
	interventions												
C1.5.2. Establish a regular review of	Implemented works											Own funds	Emplo
risk identification for visitors (risky	and report on												yees
trees and rock mass) and implement	implemented measures												
security measures in accordance with	for rock mass removal;												
identified needs	Implemented works												
	and reports on												
	implemented measures												
	to remove risky trees												
C1.5.3. Mark all trails according to the	All trails are marked											Own funds	Emplo
level of difficulty of the tour	according to the level												yees
	of difficulty of the tour												

Area in the service of local communities and measures to improve the tourist offer

The area of the Protected Landscape Vjetrenica - Popovo polje is the Municipality of Ravno and the whole area of the Municipality of Ravno is relatively isolated, because it is distant from other municipal and regional centres, and it stretches along the border with the Republic of Croatia. Roads that are local and uncategorized are in rather poor condition and tend to become overgrown.

The development of the Municipality itself should follow the tourist trends in the Protected Landscape Vjetrenica - Popovo polje. Introduction of video surveillance is necessary from the point of view of the safety of the local community and the visitors themselves.

Landscaping of public areas in the Protected Landscape Vjetrenica – Popovo polje should be a commitment aimed at the aesthetic and experiential impression of visitors and the local community.

Cooperation with the forest company and business enterprises in the remediation of roadblocks and road overgrowing must be a commitment.

Protecting groundwater from various effluents is also one of the key challenges in this area. The state of water protection is reflected primarily through the endangerment of surface and groundwater as a result of uncontrolled discharge of wastewater into groundwater and watercourses, waste disposal in non-sanitary and illegal landfills. Given the hydro-geological structure of the karst area and the catchment area of significant springs, groundwater is particularly sensitive to sources of pollution. Groundwater pollution comes from the wastewater of settlements, since the settlements in their catchment area do not have a sanitary network with treatment plants for chemical agents used in agriculture in Popovo polje.

Rehabilitation of the existing condition and water protection should be achieved by construction of sewage systems of settlements and economic facilities with treatment plants and discharges, construction of wastewater pre-treatment devices before discharge into sewage, rehabilitation of existing landfills and ban on construction of economic facilities emitting harmful and dangerous substances.

THEMATIC SECTION C: VISITS DO NOT DISTURB THE VALUES OF THE PROTECTED LANDSCAPE VJETRENICA - POPOVO POLJE AND PROVIDE VISITORS WITH AN UNDISTURBED AND COMPLETE EXPERIENCE, WHICH IN THE BEST POSSIBLE WAY PRESENTS THE PRESERVED BIOLOGICAL AND CULTURAL HERITAGE, GENERATES INCOME NEEDED FOR ITS PRESERVATION, BUILDS PUBLIC SUPPORT FOR NATURE CONSERVATION AND OPENS OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT OF THE LOCAL COMMUNITY

				PERI	[OD	OF R	EAL	IZA	ΓΙΟΝ	J				
	INDICATORS	2	2	2 0	2	2	2	2	2	2	2	2 0	Implementation	Associates
		0 2	02	2	0 2	02	02	02	0 2	02	0 3	0 3	cost	Associates
		2 1	2	2	$\frac{2}{4}$	5	6	7	8	2 9	0	1		
		T		5	4	5	0		0	9	0	T		
SPECIFIC														
OBJECTIVE														
2. Space in														
the service of														
local														
communities														
and measures														
to improve														
the tourist														
offer														
OVERALL														
OBJECTIVE														
2.1.														
Landscaping														
of the area	A ' 1 ' 1 1 '												0 (1	T 1
C2.1.1.	Assistance provided in												Own funds	Employees
Providing	arranging fire paths													
assistance in														
arranging														
auxiliary														
paths for the														
purpose of														

easier								
firefighting								
C2.1.2.	Video surveillance						Own funds	Employees
Providing	introduced on the							
assistance in	Zavala plateau							
the								
introduction								
of video								
surveillance								
in the								
protected area								
Vjetrenica -								
Popovo polje								
C2.1.3.	Public areas						Own funds	Employees
Participation	landscaped							
in	_							
landscaping								
of public								
areas in the								
protected area								
OVERALL								
OBJECTIVE								
2.2								
Development								
of public								
infrastructure								
C2.2.1.	Based on the study;						Own funds,	Employees
Assistance in	arranged and installed						Foreign funds	
the	lighting							
reconstructio								
n of lighting								
in the								
Vjetrenica								

cave from "Hajdučki sto" to "Veliko jezero" (800 m)								
C2.2.2. Supervision over the regulation of the Bitomišlja spring and construction of the overflow basin	Supervision over the regulation of the Bitomišlja spring and the construction of an overflow basin so as not to disturb the natural values of the strict protection zone						Financing from the Funds, foreign funds	Employees
C2.2.3. In cooperation with the competent authorities, carry out systematic waste management in the narrower part of the protected zone.	Waste is organized; there are no illegal landfills; waste disposal is systematic						Own funds	Employees
C2.2.4. In cooperation with the competent	Sanitation is established; promotion is a continuous process						Own funds	Employees

	No. of Concession, Name	Management of Street, or other		and the second second	10 m 10 m	ALC: NO.	and the second second	Statistics and	and the second second	the second se	
authorities,											
encourage the											
construction											
of a sanitation											
system in											
accordance											
with the											
objectives of											
groundwater											
protection											

Offer presentation and education

One of the ways to achieve the preservation of the protected area is through education and interpretation of natural and cultural values. Understanding the value of the Protected Landscape Vjetrenica - Popovo polje, the threats to which it is exposed and awareness of the need to preserve the rich cultural and natural heritage are the basic steps in protection. Getting acquainted with the terms of nature protection, code of conduct in the protected area, the importance of plant and animal species and their habitats for humans and the preservation of cultural heritage is of particular importance when we are aware of the necessity of human coexistence with nature. The involvement of the local population in the process itself (through their activities) is of great importance. Such cooperation lays the foundations for effective protection and promotion of the value of the Protected Landscape Vjetrenica - Popovo polje.

Protected areas play an important role in education and, as examples of natural areas that have not undergone rapid development, represent a place where children and adults can learn about a positive attitude towards nature. In order to achieve this additional meaning of the existence of a protected area, it is necessary to interpret the values of the area in a way that is obvious to all visitors. Due to the great diversity of natural,

landscape and cultural-historical values in a small area and easy accessibility, the Protected Landscape Vjetrenica - Popovo polje is a very suitable area for education.

It is necessary to adjust education for adults and children in order to achieve the maximum effect of education, but also to bring closer its importance to all age groups.

Promotional materials are an important means of market communication and informing potential visitors, but also building the image of the Protected Landscape Vjetrenica - Popovo polje. Special attention should be paid to the design and level of information in the printed promotional material. Although until now there was a printed presentation for this area, it was not sufficient, and it did not meet the basic needs of visitors. Creating interactive maps for navigating in nature should be an added value of the area but also a powerful promotional tool.

Public company Vjetrenica llc Ravno regularly marks important dates in nature protection through professional guides, presentations and educational activities. The International Speleological Camp needs to be continued and extended to a larger number of days.

It is necessary to consider the possibility of holding a voluntary action of cleaning up illegal landfills within the protected landscape and thus raise awareness, both of local community and all others, about the inevitable negative impact of man on the environment and nature.

Events held with the local community need to be supported and continued to be held.

THEMATIC SECTION C: VISITS DO NOT DISTURB THE VALUES OF THE PROTECTED LANDSCAPE VJETRENICA - POPOVO POLJE AND PROVIDE VISITORS WITH AN UNDISTURBED AND COMPLETE EXPERIENCE, WHICH IN THE BEST POSSIBLE WAY PRESENTS THE PRESERVED BIOLOGICAL AND CULTURAL HERITAGE, GENERATES INCOME NEEDED FOR ITS PRESERVATION, BUILDS PUBLIC SUPPORT FOR NATURE CONSERVATION AND OPENS OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT OF THE LOCAL COMMUNITY

]	PER	IOI	DO	F R	EA	LIZ	ATI	[ON	1				
	INDICATORS	2 0 2 1	2 0 2 2	2 0 2 3	2 0 2 4	2 0 2 5	2 0 2 6	2 0 2 7	2 0 2 8	2 0 2 9	2 0 3 0	2 0 3 1	0 In 3	plementation cost	Associates
SPECIFIC OBJECTIVE 3. Presentation of the offer and education															
OVERALL OBJECTIVE 3.1. Development of educational programs													Ov	wn funds	Employees
C3.1.1. Develop adult education programs presented through expert guides of the protected area	Developed education programs; Expert guides trained to provide an outstanding education experience												Ov	wn funds	Employees
C3.1.2. Develop education programs for children presented through interactive models and expert guides of the protected area	Developed education programs; Expert guides trained to provide an outstanding education experience												Ov	vn funds	Employees
C3.1.3. Develop education programs for children and adults with	Education programs developed in cooperation with specialized												Ov	wn funds	Employees

disabilities	institutions; Expert guides trained to provide an outstanding education experience							
C3.1.4. Train external associates in the field of education and expert guidance of visitors	Number of trained external associates						Own funds	Employees
C3.1.5. Support and participate in the implementation of extracurricular activities of educational institutions	Number of activities in which the public company participated						Own funds	Employees
C3.1.6. Organize themed workshops and events for the local population and other beneficiaries of the protected area in order to make them familiar with the work of the management of the area, and also with the historical, traditional, biological and cultural values of the protected zone.	Number of workshops and events held for the local population and other beneficiaries of the protected area. The local population and other users are familiar with the work of the public company and are more familiar with the values of the protected zone						Own funds	Employees
OVERALL OBJECTIVE 3.2. Printed materials and web pages (for sale and/or distribution through educational programs)								

C3.2.1. Print promotional	Number of materials						Own funds	Employees
material	produced							
C3.2.2. Print maps of the	Number of maps sold						Own funds	Employees
protected area for sale	-							
C3.2.3. Present the	Number of copies sold						Own funds	Employees
monograph of Vjetrenica	_							
for sale								
C3.2.4. Present the	Vjetrenica monograph						Own funds	Employees
monograph of Vjetrenica	presented on the website							
with key images on the	of the protected area							
website of the protected								
area								
C3.2.5. Develop a	Number of manuals						Own funds	Employees
manual for guides	distributed							
(public institutions and								
external) of visitor								
groups								
C3.2.6. Develop	Number of materials						Own funds	Employees
educational materials for	produced; Number of							
children (picture books,	copies sold/distributed							
colouring books,	per year							
workbooks, board								
games, etc.), which								
interpret the value								
OVERALL OBJECTIVE								
3.3. Marking important								
dates and events								
C3.3.1. Continue to mark	Number of events marked						Own funds	Employees
significant dates in	per year							
nature conservation								
C3.3.2. Develop and	Number of events and						Own funds	Employees
implement events and	campaigns conducted;							

campaigns related to								
various endangered								
values of the area (illegal								
landfills, invasive								
species, etc.)								
C3.3.3. Encourage and	Event marking; number of						Own funds	Employees
facilitate international	visitors							
speleological camp-								
event								
C3.3.4. Encourage	event organization;						Own funds	Employees
holding of events	number of visitors							
Summer days of culture								
of Ravno								
C3.3.5. Encourage	event organization;						Own funds	Employees
holding of the	number of visitors							
manifestation Grgurovi								
hukovi								

Marketing and promotion

Promotion of the protected area is conceived as an instrument for improving the tourist function of the protected area and the best possible harmonization with its scientific and educational function on the principles of sustainable development, and as such it has certain peculiarities. They refer to the approach to forming of a tourist product that is not a classic tourist product, but an experience.

The marketing of the protected area is completely subordinated to it, but it is also possible to use all acceptable forms of "classic" marketing activities by which the protected area will be adequately valorised. Although the financial effects of marketing are often cited as relevant, in terms of increasing the level of protection (which requires financial resources), the effect in terms of raising awareness of the value of the protected area through publications, promotional materials, workshops for children or outdoor schools is also important, that is,

publishing certain scientific and professional publications that will contribute to increasing the level of knowledge and awareness of the need for nature protection.

First of all, it is necessary to develop a marketing strategy that should integrate the above elements. It should ensure key guidelines for action.

Flora, fauna, caves, karst fields and archaeological sites provide an opportunity to acquaint visitors with natural and cultural values. Unfortunately, the previous efforts of the public company Vjetrenica llc Ravno in the field of education and interpretation were not enough to present the full capacity of the offer existing in this area.

Creating new communication channels will help develop the *"True Rural Experience Brand"* because ultimately the visibility gains will be exceptional.

Sponsorship and B2B models are very popular concept applied in protected areas today. By expanding the offer and offering the concept of sustainability and support for biodiversity, new opportunities are opening up that have not been available so far.

- POPOVO POLJE THE BEST POSSI INCOME NEED	ION C: VISITS DO AND PROVIDE VI BLE WAY PRESENT ED FOR ITS PRESE OPPORTUNITIES	SITC [S TH RVA	ORS V HE PI TIOI	NITH RESE N, BU	H AN ERVE JILD	UN D BI S PU	DIST OLC BLIC	TURE DGIC DSU	BED A AL A PPOI	AND AND RT F(CO CUL OR N	MPLI TUR JATU	ETE EXPERIENCE, AL HERITAGE, GE JRE CONSERVATI	WHICH IN ENERATES ON AND
	INDICATORS	2 0 2 1	2 0 2 2	PERI 2 0 2 3	2 0 2 4	OF R 2 0 2 5	EAL 2 0 2 6	IZA 2 0 2 7	2 0 2 8	2 0 2 9	2 0 3 0	2 0 3 1	Implementation cost	Associates
SPECIFIC OBJECTIVE 4 Marketing and														

promotion								
OVERALL								
OBJECTIVE 4.1.								
Marketing -								
framework activities								
	Descalared						Orang familie	T
C4.1.1.	Developed						Own funds,	Employees
Development of	marketing						financing from the Funds	
marketing	strategy for the						the Funds	
strategy for the	protected area; with the							
protected area Vjetrenica Popovo								
polje	guidelines of the unique brand PA							
poije								
	Vjetrenica Popovo polje							
C4.1.2. Define	Defined criteria						Own funds	Employees
criteria for	are						Own fullus	Employees
cooperation with	communicated to							
travel agencies	potential partner							
and tour	agencies							
operators in line	ugeneies							
with the								
management								
objectives								
C4.1.3. Establish	Annual report on						Own funds	Employees
and implement all	implemented							1 5
communication	activities, with							
channels of the	analysis of results							
online marketing	and							
strategy	recommendations							
elaborated in the	for the next							
Marketing	period							
Strategy	_							

C4.1.4. Establish	Regular						Own funds	Employees
channels (website,	maintenance of							I J J
Facebook group,	the contact base;							
etc.) regularly	Number of							
provide all	recipients of							
necessary	information by							
information and	types of							
communicate	stakeholders;							
with all								
stakeholders,								
tourist boards,								
local								
communities,								
partner agencies,								
service providers,								
etc.								
C4.1.5. Develop	Number of						Own funds	Employees
multimedia	multimedia							
content for the	content.							
purpose of	Regular websites							
promoting	maintenance.							
natural and								
cultural values								
C4.1.6. Based on	In line with						Own funds	Employees
the guidelines of	strategy							
the Marketing	guidelines, to							
Strategy, act at	promote the							
the local, regional	protected area							
and international								
level								

C4.1.7. Establish	Number of joint						Own funds	Employees
links with other	protected areas							1 0
protected areas	appearing							
from Bosnia and	together in the							
Herzegovina for	promotion;							
the purpose of	number of tourist							
joint promotion	events, fairs or							
and presentation	other events at							
	which the							
	promotion took							
	place							
	Number of B2B						Own funds	Employees
C4.1.8. Encourage	meetings;							
B2B and	sponsorships							
sponsorship	number							
models								

Thematic section D: The local community is the main partner of the Manager in preserving its values, it recognizes the area as an important part of its identity and its development is based on the sustainable use of opportunities provided by the preservation of the area.

SPECIFIC OBJECTIVE 1 Revival of agricultural production

Agricultural production of local, high-quality, branded, traditional products revived, which contributes to the preservation of biodiversity and the identity of the area, the recognizability of the offer of the Protected Area and the economic opportunities of the local community.

Indicators:

- Number of trained eco-agricultural craftsmen
- Number of local ecological agricultural producers is growing
- Share of revived traditional agricultural landscape is growing

SPECIFIC OBJECTIVE 2 Development and networking of ecotourism offer

Through the cooperation of all decision makers in the development and networking of a diverse ecotourism offer, which is aligned with the needs of preserving the value of the protected landscape and the well-being of the local community, the area has become a family destination suitable for multi-day stay.

Indicators:

- Quality and diversity of the ecotourism offer is growing
- Number of providers of ecotourism services in the local community is growing
- Networking and promotion of ecotourism services

Revival of agricultural production

Preservation of traditional agricultural production is the only way to preserve many values of the Protected Landscape Vjetrenica – Popovo polje. With the disappearance of agricultural activities, grasslands and all their biodiversity are disappearing too, as well as the cultural landscape marked by them. The entire biodiversity of old varieties and breeds is disappearing. An important part of the area's identity and intangible cultural heritage is also disappearing. The area is weakening economically and demographically, as an important source of employment is disappearing, settlements whose purpose of existence was the agricultural use of the surrounding area are dying out, the security provided by the ability to produce their own food is disappearing.

Due to all this, the encouragement, preservation and revival of traditional agricultural production is an important task of the Public Institution, which takes care of the preservation of all these values. The main reason for the disappearance of traditional agricultural production is its non-competitiveness in markets dominated by products of highly productive industrial agriculture. That reason, however, is lost in the context of today's so-called "Experience economy", if the production is marketed on the local tourist market that seeks and values – it is willing to pay a higher price - for branded, traditional, high quality products, because by offering such products "with a story", the destination itself provides the guests with an additional experience and this is how it gains on the quality, attractiveness, recognizability and value.

Protected landscape Vjetrenica–Popovo polje is a place where a large number of foreign guests pay visits, who come for the experience, it is an ideal "business environment" for the revival of traditional agricultural production. In addition to such an ideal market for its products, and the wider surrounding area, it has a number of other advantages that form an excellent foundation for the successful revival of traditional agricultural production. Part of the live agricultural production is still preserved. The area is known for the production of honey, wine and olives, but also other agricultural goods that have been traditionally grown for centuries as indigenous local varieties.

There is a long list of obstacles in the desired revival of traditional agriculture. Family farms have their production organized on relatively small areas. The total volume of production is small, with an even smaller part being processed into a final product of higher added value. Sale of products is uncertain, with an unknown buyer, price and other conditions. Production is fragmented into a lot of unrelated, disorganized producers, and the products are mostly unbranded and of uneven quality. Such products are not price competitive in the current market, which in turn results in a lack of financial resources to start and develop production.

The main opportunity is the placement of the entire production through branding, high quality tourist offer, primarily the one managed by the public company Vjetrenica llc Ravno, but also through other caterers who

will follow the market demand for experience and quality. There is room for development, because current demand significantly exceeds supply. In addition, products can be marketed through presentation and sales events, and through the development of agritourism offer and the so-called "doorstep selling". Certification of traditional products (controlled geographical origin, *Lika Quality* and other quality requirements) would ensure their market recognition, as well as the possibility of respecting their specificity in public procurement procedures.

A major threat to the desired scenario is the continuation of the current dominant trends of depopulation, emigration, aging and deagrarianisation, as well as the gradual decline of interest in agriculture, due to the perception of opportunities for easier and faster earnings through tourism.

THEMATIC SECTION D: THE LOCAL COMMUNITY IS THE MAIN PARTNER OF THE MANAGER IN PRESERVING ITS VALUES, IT RECOGNIZES THE AREA AS AN IMPORTANT PART OF ITS IDENTITY AND ITS DEVELOPMENT IS BASED ON THE SUSTAINABLE USE OF OPPORTUNITIES PROVIDED BY THE PRESERVATION OF THE AREA.

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				PER	IOD	OF F	REAL	IZA	ΓΙΟΝ	J				
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		0	0	0	0	0	0	0	0	0	0	0	ntation	Associates
	INDICATORS	2	2	2	2	2	2	2	2	2	3	3	cost	1100000000000
		1	2	3	4	5	6	7	8	9	0	1	•••••	
SPECIFIC														
OBJECTIVE 1.														
Revival of														
agricultural														
production														
OVERALL														
OBJECTIVE 1.1.														
Agricultural														

revitalization activities								
D1.1.1. Explore the opportunities of encouraging and supporting the competitiveness and sustainability of agricultural production that supports the conservation of biodiversity	Report on the analysis of opportunities and models by which the public company can encourage agricultural production that supports nature conservation						Own funds	Employee s
D1.1.2. Carry out informing of the local population about the possibilities of agricultural development, especially organic production and incentives.	Number of workshops, lectures and participants						Own funds	Employee s
D1.1.3. Encourage the traditional way of land use (mowing and pasturing) with incentives for the local residents.	Area of traditionally used grasslands (mowing and pasturing);						Own funds	Employee s
D1.1.4. Ensure the possibility of selling traditional agricultural	Number of events						Own funds	Employee s

products at events of the public company								
D1.1.5. Promote	Number of farms						Own	Employee
farms and landlords	involved in visiting						funds	s
who sell or use	programs							
agricultural								
products or								
maintain traditional								
construction,								
backyards and								
gardens.								
D1.1.6. Promote	A quality system of						Own	Employee
establishment of a	locally grown food						funds	S
quality system of	established.							
locally grown food	Number of certificates							
through appropriate	issued							
certificates.								
D1.1.7. Encourage	Number of associations						Own	Employee
the production of	and crafts involved in						funds	S
traditional products	the production of							
and souvenirs from	traditional products							
natural raw	and souvenirs from							
materials (stone,	domestic raw materials;							
wool, wood) and work on the	Examples of revitalization of							
revitalization of	traditional crafts.							
traditional crafts.	traditional craits.							
D1.1.8. Participation	Number of						Own	Employee
in the process of	collaborations achieved						funds	s
establishment and	conaborations achieved						iulius	5
operation of the								
Agribusiness Centre								
rightbusiness Centre								

D1.1.9. Encourage the preservation of the existing traditional field	The traditional field allotment preserved						Own funds	Employee s
allotment								
D1.1.10. Map	Preparing of a study of						Own	Employee
agricultural	mapping of agricultural						funds	s
products that can be	products of importance							
protected						 		
OVERALL								
OBJECTIVE 1.2.								
Monitoring,								
promotion and								
education of								
agriculture and local residents								
	Number of the second second						Own	T
D1.2.1. Encourage,	Number of programs held; Number of						funds	Employee
develop and implement research	participants per held						Tunus	S
and educational	program							
programs related to	program							
agricultural								
production that								
support the								
conservation of								
biodiversity								
D1.2.2. Encourage	Number of producers						Own	Employee
the use of organic	of healthy organic food						funds	s
fertilizers without	section of the sectio							
the use of pesticides								
and pollutants								
D1.2.3. Regularly	Regular						Own	Employee
inform the local	communication						funds	s

population about the possibilities of using subsidies for agricultural production	established							
D1.2.4. Inform owners and users of agricultural land and management authorities on the obligation to remove and prevent the spread of ragweed and other allochthonous invasive species	Number of conducted informative contents						Own funds	Employee s
D1.2.5. Put into operation and regularly maintain agricultural areas owned by the Municipality	Agricultural areas put into operation and regularly maintained						Own funds	Employee s

Development and networking of ecotourism offer

Currently, in the area of the Protected Landscape Vjetrenica – Popovo polje, visitors come on day trips while continuing with their trip to other destinations. The reason for this lies in the lack of sufficiently attractive, diverse, rich offer of additional facilities and experiences that would keep the visitors.

In the area of the Protected Landscape Vjetrenica – Popovo polje currently there are insufficient accommodation capacities. The great potential for the development of accommodation and additional facilities lies in the development of rural households.
With the aim of developing rural tourism, it is necessary to consider opportunities for additional income and sales of products to visitors in rural areas. In this way, visitors will receive authentic service and experience through tourist services, that is, the opportunity to escape from the stressful urban environment by consuming tourist services and stay in rural areas. The offer of rural tourism should be based on the ambience, culture and worldview that are close to the natural environment, using heritage, that is, the tradition as a basis for creating a tourist offer. For successful tourism management in rural areas, it is important to look at management as a long-term process that aims to ensure the competitiveness of the destination and a high standard of living and preserve the cultural and natural identity of the destination itself.

In addition, it is necessary to work on expanding the offer and on networking the offer of the local community by encouraging and nurturing the tradition and cultural landscape of this area.

Stronger promotion of the vision of eco-destination development, as the best option for tourism development of the region, better coordination of all decision makers, encouragement of further development of adventure, agro, gastro, cultural, eco-tourism offer whose attractiveness derives from offering authentic experience of all values of the area and thus the effective encouragement of further growth of accommodation capacities and touristization of the area – all this would contribute to the faster development of the wider area towards recognizable ecotourism destination. Public company Vjetrenica d.o.o Ravno should take the role of leader in this, because such development also contributes to the realization of its mandate: preserving and ensuring the preconditions for experiencing the value of the area.

THEMATIC SECTION D: THE LOCAL COMMUNITY IS THE MAIN PARTNER OF THE MANAGER IN PRESERVING
ITS VALUES, IT RECOGNIZES THE AREA AS AN IMPORTANT PART OF ITS IDENTITY AND ITS DEVELOPMENT
IS BASED ON THE SUSTAINABLE USE OF OPPORTUNITIES PROVIDED BY THE PRESERVATION OF THE AREA.ImplementationPERIOD OF REALIZATIONImplementationAssociates

Overall objective 2	INDICATORS	2 0 2 1	2 0 2 2	2 0 2 3	2 0 2 4	2 0 2 5	2 0 2 6	2 0 2 7	2 0 2 8	2 0 2 9	2 0 3 0	2 0 3 1	cost	
SPECIFIC OBJECTIVE 2. Development and networking of ecotourism offer														
OVERALL OBJECTIVE 2.1 Development of a networked tourist offer														
D2.1.1. Collaborate on development projects of various types of tourist offer in the wider region, including cycling tourist offer, trekking offer, various types of tourist offer of nature-based experience, gastronomic offer, etc.	Number of various forms of compatible tourist offer for which successful cooperation has been achieved through a joint development project/program												Own funds	Employees
D2.1.2. Design,	Number of												Own funds	Employees

arrange, organize	created offers							
and promote								
programs for								
multi-day stay in								
cooperation with								
foreign tourism								
organizations								
OVERALL OBJEC	TIVE 2.2.							
Encouraging the d								
tourist offer in the								
	nent of eco-tourism							
offer								
D2.2.1. In	Number of						Own funds	Employees
cooperation with	created offers							
the local								
community,								
organize a tourist								
offer based on								
seasonal customs								
(fruit collection,								
grape picking,								
collection of								
medicinal herbs)								
D2.2.2.	Number of						Own funds	Employees
Participation in	distributed guides							
the development	and content							
of an online								
digital guide								
D2.2.3. Develop	Number of						Own funds	Employees
and provide	disseminated							
sufficient	materials							
informative								
materials on the								

protected area and the offer in the wider region for local								
landlords								
D2.2.4. Encouraging private entrepreneurial initiatives in traditional activities and	Education and professional assistance in the development of cultural tourism						Own funds	Employees
forms of cultural tourism.								
D2.2.5. Assist the local residents in designing and implementing content for tourists and visitors	number of advisory seminars held						Own funds	Employees
D2.2.6. Support and promote the development of the rural tourism in the protected zone and in wider area	Workshops on the development of rural tourism in the protected area held						Own funds	Employees
D2.2.7. Encouraging the development of family farms in rural tourism	Number of households included in the tourist offer						Own funds	Employees

Thematic section E: The public company has all the necessary legal, organizational, human and material capacities, resources and powers to manage the area and uses them to continuously improve all segments of management and organizational culture, thus building cooperation with stakeholders and its role in domestic and international circles.

SPECIFIC OBJECTIVE 1: To improve the area management system

Indicators:

- All documents relevant to management drafted and adopted
- The manager has sufficient management capacity
- Project team for monitoring and implementation established
- The manager has technical management equipment
- Developed integrated information database for Protected Landscape Vjetrenica Popovo polje

Improve the area management system

The management of the Protected Landscape Vjetrenica – Popovo polje until the establishing of the Cantonal Public Institution, was entrusted to the public company Vjetrenica llc Ravno in accordance with Article 22 of the Law on the proclamation of the area of the Vjetrenica cave with a part of Popovo polje as protected landscape Vjetrenica - Popovo polje.

Public company Vjetrenica llc Ravno was established in order to achieve economic interest in the management of state-owned tourist values, unification and coordination of activities of common interest in the field of tourism in the Municipality of Ravno. The public company has five (5) employees and a director.

Considering the Law on the proclamation of the area of the Vjetrenica cave with a part of Popovo polje as a protected landscape "Vjetrenica - Popovo polje" and the entrustment of the management of this area to the public company Vjetrenica llc Ravno, it is necessary to update and supplement the governance documents of this Company.

It is necessary to review the main tasks of the public company:

- a) regular activities which include inventory of natural values, protection and monitoring of biological diversity, monitoring of environmental parameters (water, soil, air), monitoring of the protected area, environmental education and other activities related to protected area management documents;
- b) program activities which include promotion and use of the area through marketing and development of products and services of protected area, supervision of plans and management and concessions awarded to sectors of economy, local communities, cooperation with professional institutions, state institutions, authorities and non-governmental sector, participation in research projects and programs, other program activities.

In addition, it is necessary to conduct job classification and define the internal organization of the Company, including the number and qualifications of employees by means of the Rulebook on internal organization. In addition, it is necessary to create and update all regulations and internal documents.

The public company also has a council that has the responsibility to decide on the number and structure in order to achieve a balance in representing public/general and special/specific interests.

Public company must continuously take care of employees' training. As a special problem, the public company is facing issues in the process of continuous monitoring and implementation of projects, and therefore it is necessary to plan a special service that will perform these tasks.

In addition to the above, equipment for the successful implementation of the protection is necessary. The public company owns part of the equipment needed for management, but a large investment is needed in this part.

In the economic part, it is necessary to consider different models of financing the work of the public company. So far, the company's activity has been mostly financed from the municipal budget and project grants.

The public company does not have a unified database and it is mostly partial, so it is necessary to establish a database and complete it.

Thematic section E: The public company has all the necessary legal, organizational, human and material capacities, resources and powers to manage the area and uses them to continuously improve all segments of management and organizational culture, thud building cooperation with stakeholders and its role in domestic and international circles.

				PEF	RIOD	OF R	EALI	[ZAT]	ION					
		2	2	2	2	2	2	2	2	2	2	2	Impleme	
	DIDICATOR	0	0	0	0	0	0	0	0	0	0	0	ntation	Associate
	INDICATORS	2	2	2 3	2 4	2 5	2	2	2 8	2	3	3	cost	S
		1	2	3	4	5	6	7	8	9	0	1		
SPECIFIC														
OBJECTIVE														
1. Increasing														
capacity														
OVERALL													Founder,	
OBJECTIVE 1.1.													Own	
Organization of													funds	
work, human														
resources														
management and														
development of														
organizational														
culture	Dulahaali iah												Easter day	
E1.1.1. Develop,	Rulebook, job classification												Founder,	
adopt and update													own	
all regulations	and related												funds	
related to the	documents are													
structure, methods	mutually													
of work of	harmonized, in													
employees of	accordance with													

public company	regulations and							
(Rulebook on	meet the needs							
internal	of management							
organization,	-							
Labour Rulebook,								
etc.), in accordance								
with the								
organizational,								
professional and								
human resources								
needs for the								
implementation of								
the Management								
Plan and applicable								
regulations					 	 		
E1.1.2. Ensure	Number of						Founder,	
continuous	conducted						own	
professional	trainings						funds	
training of key								
personnel			 	 	 	 		
E1.1.3. Improve	Annual						Founder,	
monitoring	training;						own	
activities and	number of						funds	
establish periodic	successfully							
visits to the wider	trained							
area in order to	personnel							
identify external								
pressures							т 1	
E1.1.4. Create and	Organization of						Founder,	
continuously train	a team for						own	
a team for	applying,						funds	
applying, reporting	reporting and							
and	implementation							

implementation of international and domestic projects	of projects; number of completed projects; number of trainings							
E1.1.5. Ensure employment of key personnel of the Protected Landscape in accordance with the organization of the public company, and especially the supervisor	Number of newly employed personnel units according to the current job classification; Employed Chief Supervisor						Own funds	Employe es
E1.1.6. Actively participate in the processes of drafting local and regional spatial and development plans in the wider area of the Protected Landscape	Number of initiatives and number of attendances at meetings						Own funds	Employe es
OVERALL OBJECTIVE 1.2. Maintenance and procurement of equipment for the protection service and construction								

and maintenance of new and existing infrastructure								
E1.2.1. Perform assessments on the annual level, of the condition and needs for maintenance, servicing and procurement of equipment by organizational units	Inventory and condition of assets.						Own funds	Employe es
E1.2.2. Procure equipment and means for the work of professional services	Annual procurement plan prepared. Equipment and means for work meet the needs of the public company						Own funds, founder's funds	Employe es
E1.2.3. Purchase 2 vehicles for the ranger service	Procured environmentall y friendly green vehicle for the needs of the supervisory service						Own funds, founder	Employe es
E1.2.4. Procurement of equipment for the	Procured equipment for the second part						Founder	Employe es

second part of the	of the							
information and	information and							
educational centre	educational							
	centre							
E1.2.5. Develop the	Within the						Own	Employe
plan and economic	organization of						funds	es
justification of the	the public							
project of ecological	company,							
fees for entering the	develop a study							
Protected	on the potential							
Landscape	of introducing							
1	ecological fees							
E1.2.6. Encourage	Number of						All	
and invest in the	concluded						available	
model of	contracts						means	
concessions and								
public-private								
partnerships								
OVERALL								
OBJECTIVE 1.3.								
Improve and								
ensure a								
sustainable								
financing system								
E1.3.1. Develop	Annual						Own	Employe
annual financial	financial plans						funds	es
management plans	adopted by the							
	Governing							
	Board and							
	implemented							
E1.3.2. Develop a	Long-term						Own	Employe
long-term financial	financial plan						funds	es
plan of costs and	developed							

revenues of the public company in order to achieve self-sustainability of the protected area, including risk analysis								
E1.3.3: Ensure additional sources of funding by applying the projects for tenders and programs of national and international institutions	Number of projects on a three-year basis						Own funds	Employe es
E1.3.4. Provide permanent sources of funding through the state, cantonal and municipal budgets, donations and own source revenues	Permanent sources of funding provided; number of contracts, grants, etc.						Own funds	Employe es
E1.3.5. Design new ways of revenue generation of the public company	New revenue- generating programs						Own funds	Employe es
OVERALL OBJECT Competence develop institutionalization and membership	oment,							

E1.4.1. Design and implement training programs for auxiliary trainers (external associates) and guides of the public company	New Programs designed and launched; number of trained trainers						Own funds	Employe es
E1.4.2. Design and implement training programs for tourist guides from travel agencies that bring visitors to the Protected Landscape, to guide them through the standard tour programs of the offer	New programs designed and launched; number of tourist guides						Own funds	Employe es
E1.4.3. Encourage cooperation with universities in the development of research projects	Number of achieved memoranda of cooperation						Own funds	Employe es
E1.4.4. Establish the exchange of knowledge and experience with similar and other protected areas in the country and	Number of achieved collaborations; number of visits						Own funds	Employe es

abroad.								
E1.4.5. Create	Number of						Own	Employe
conditions for the	volunteers						funds	es
inclusion of								
volunteers and								
trainees in the work								
of the								
administration								
E1.4.6. Organize	Number of						Own	Employe
joint initiatives	achieved						funds	es
with neighbouring	collaborations;							
protected areas on	number of							
opportunities for	memoranda of							
sharing problem	cooperation							
solution								

MANAGEMENT ZONING

Zoning in a protected area is one of the main steps of protection planning because it divides the area into different smaller areas and provides a scheme of management activities in these parts. In this regard, zoning, that is, classification of area unit management, represents a range of management options within a protected area.

Accordingly, in line with the procedure the area of consideration may be determined for Vjetrenica-Popovo polje as follows:

- \checkmark strict protection zones
- ✓ active protection zones
- ✓ zones of use
- ✓ transition zones.

When managing a protected area which according to the national and IUCN categorization of protected areas belongs to lower categories of protected area management, the goal is to establish a harmonious interaction of natural values and anthropogenic activities in the close environment, by protecting basic natural values in the observed range, and by ensuring traditional use of land, preserving cultural value, through the implementation of educational and scientific activities, allowing tourist and sports-recreational activities and by means of construction and/or reconstruction of the necessary ancillary facilities using the indigenous, ethno-building tradition.

The realization of the stated goals can be carried out only if the permitted activities and interventions are determined by zones in the protected area and if protection and improvement measures are continuously implemented in order to reduce and/or eliminate negative anthropogenic impacts, manifested through previously described pressures on ecosystems.

The conditions and restrictions in use refer exclusively to the area of the legally declared area of the Protected Landscape "Vjetrenica - Popovo polje", which is managed and for which the public company Vjetrenica d.o.o Ravno is responsible. Areas outside the boundaries of the Protected Landscape, which may act as protection zones, the public company will take care of only indirect measures to encourage the development of complementary activities, guiding spatial development and land use, and educating the local population.

Protected landscape "Vjetrenica - Popovo polje" covers an area of 4,710.17 ha, and in accordance with the degree of protection, four protected zones have been identified (Map 17):

A (Strict protection zone): A1 (Vjetrenica Cave) and A2 (Vjetrenica cave dripstone);

✓ B (Active protection zone): B1 (Buffer zone of Vjetrenica cave dripstone), B2 (Mine areas), B3 (Trebišnjica river), B4 (Natural values of flora, fauna and important habitats), B5 (Water sources), B6 (Cultural and historical sites);

✓ C (Zone of use): C1 (Settlements), C2 (Agricultural areas), C3 (Catering and tourist complexes purpose);

✓ D (Transition zone): D1 (Forest land in the settlements of Čvaljina, Zavala, Belenići, Kijev Do, Golubinac and Orahov Do) and D2 (Infrastructure in the settlements of Čvaljina, Zavala, Belenići, Kijev Do, Golubinac and Orahov Do) (Table 19).

Depending on other spatial aspects, the listed zones B and C are further divided into several subzones (Map 18). Subzones are denoted by a suffix in order to differentiate zones whose units are represented in the area of several settlements, or which are spatially separated - labels:

✓ B2.1 (Mine areas - Zavala), B2.2 (Mine areas - Belenići);

✓ B4.1 (Natural values of flora, fauna and important habitats in Čvaljina), B4.2 (Natural values of flora, fauna and important habitats in Zavala), B4.3 (Natural values of flora, fauna and important habitats in Belenići), B4.4 (Natural values of flora, fauna and important habitats in the settlement of Kijev Do), B4.5 (Natural values of flora, fauna and important habitats in the settlement of Golubinac);

✓ B6.1 (Sacral facilities), B6.2 (Stećak tombstones);

C1.1 (Settlement Čvaljina), C2.1 (Settlement Zavala), C3.1 (Settlement Belenići), C4.1 (Settlement Kijev Do), C5.1 (Settlement Golubinac), C6.1 (Settlement Orahov Do);

C1.2 (Agricultural land in Čvaljina), C2.2 (Agricultural land in Zavala), C3.2 (Agricultural land in Belenići), C4.2 (Agricultural land in Kijev Do), C5.2 Agricultural land in Golubinac), C6.2 (Agricultural land in Orahov Do);

✓ C2.3 (Catering and tourist complexes purpose in the settlement of Zavala), C6.3 (Catering and tourist complexes purpose in the settlement of Orahov Do).



Map 17. Protection zones within the Protected Landscape Vjetrenica - Popovo polje



Map 18. Protected zones and subzones within the Protected Landscape Vjetrenica – Popovo polje



Table 19. Overview of areas and subzones of the Protected Landscape Vjetrenica-Popovo polje

ZONA	SUBZONE I	SUBZONE II	NATURAL VALUES	AREA (ha)%	% OF TOTAL SURFACE AREA
Strict	A1	Underground	l and aboveground part of Vjetrenica cave	22,98	0,488%
protection zone	A2	Dripstone of	the Vjetrenica cave	390,81	8,297%
(A)	TOTAL ZON	NE A		413,79	8,79%
	B1	The buffer zo	ne that connects to the cave and the	342,60	7,27%
		dripstone of t	the Vjetrenica cave		
	Во	B2.1	Mine suspected areas	13,90	0,30%
	B2	B2.2	Mine suspected areas	38,35	0,81%
	B3	Trebišnjica Ri	iver	38,52	0,82%
		B4.1	Natural values of flora, fauna and important habitats in the settlement of Čvaljina	3,13	0,07%
Active protection zone (B)		B4.2	Natural values of flora, fauna and important habitats in the settlement of Zavala	10,43	0,22%
	B4	B4.3	Natural values of flora, fauna and important habitats in the settlement of Belenići	4,70	0,10%
		B4.4	Natural values of flora, fauna and important habitats in the settlement of Kijev Do.	1,56	0,03%
		B4.5	Natural values of flora, fauna and important habitats in the settlement of Golubinac	1,57	0,03%

	B5		Sources	2,00	0,04%
		B6.1	Cultural and historical monuments	2,05	0,04%
	B6		(architectural ensemble)		
	DO	B6.2	Cultural and historical monuments	6,08	0,13%
			(stećak tombstones)		
	TOTAL ZOI	NE B		464,89	9,87 %
(C) Zone of use		C1.1	Čvaljina settlement	9,45	0,20%
(C)	C1	C1.2	Agricultural land in the area of Čvaljina settlement	493,86	10,48%
		C2.1	Zavala settlement	12,63	0,27%
	C2	C2.2	Agricultural land in the area of Zavala settlement	157,36	3,34%
		C2.3	Catering and tourist complex	61,55	1,31%
		C3.1	Belenići settlement	5,20	0,11%
	C3	C3.2	Agricultural land in the area of Balenići settlement	100,40	2,13%
		C4.1	Kijev Do settlement	4,60	0,10%
	C4	C4.2	Agricultural land in the area of the Kijev Do settlement	34,68	0,74%
		C5.1	Golubinac settlement	1,90	0,04%
	C5	C5.2	Agricultural land in the area of the Golubinac settlement	31,45	0,67%
		C6.1	Orahov Do settlement	5,11	0,11%
	C6	C6.2	Agricultural land in the area of Orahov Do settlement	68,95	1,46%
		C6.3	Catering and tourist complex	188,80	4,01%
	TOTAL ZONE C			1175,94	24,97%
Transition zone	D1	Forest land	·	2.549,33	54,1%

12 sources					N. D. D. D. S.
(D)	D2	TS infrastructure		106,21	2,25%
	TOTAL ZON	NE D		2.655,54	56,38%
TOTAL				4.710,16	100%

PROTECTION ZONE I (A) – strict protection zone (A zone)

The first protected zone (Strict protection zone, zone A) with an area of 413.79 ha, is an area of the highest values, which must be fully preserved. Zone A consists of two interconnected spatial units, designated as: A1 and A2.

Sub-zone A1 with an area of 22.98 ha represents the zone of the Vjetrenica cave of exceptional geomorphological, speleological and hydrological value and the value of the diversity of speleofauna for the protected area range. This zone includes the underground and aboveground part of the Vjetrenica cave, which extends from north to south from the settlement of Zavala in the north, to Gradac all the way to elevation 570. The cave further extends between the elevation of Oštra glava and Brekova glava all the way to the extreme southern point of Klisura (elevation 872).

Sub-zone A2 with an area of 390.81 ha, includes the dripstone of the Vjetrenica cave, which is located in the aboveground part around the Vjetrenica cave with which it forms a natural hydrogeological connection, and it is located near the settlements of Zavala, Golubinac and Belenići. From the location of the entrance to the cave in the settlement of Zavala in the far north, the dripstone extends towards east to the settlement of Budim Do, where it further bends south over Brekovac (elevation 889) and Klisura (elevation 839), all the way to Vranić (elevation 848). The boundary of the dripstone further bends north up to elevation 787 and Krstino brdo (elevation 549), all the way to the local road near Zavala, and it follows its boundary with the rest of the northern part until the end of the zone or the initial location of the cave entrance in Zavala settlement. "Lukavac" and "Bitomišlja" springs also belong to the A2 zone, which are located in the area of the dripstone, and which form a hydrogeological connection with the cave and the wider area of the A2 zone. The springs are located near the settlements of Zavala and Krstino brdo.

Etrict protoction gone values (A gone)

Strict protection zone values (A zone)

The main values of the first protected **A1 zone** are made up of:

• geological and geomorphological value: Vjetrenica cave

a) Vjetrenica cave belongs to the system of karst area which is the most ecologically endangered habitat type in BiH. Vjetrenica is a complex cave system and one of the longest caves in BiH, and it is also an hydrological active, speleological and drifty object with active underground water flows and underground lakes. The first form of protection of Vjetrenica dates back to 1952, and all relevant spatial planning documentation to date propose protection of the area of the cave Vjetrenica with the surrounding area of the karst plateaus and part of Popovo polje. Vjetrenica is a complex cave system with a canal length of 7013.90 m.

b) pits, abysses and the world of groundwater architecture. Vjetrenica is a hydrological active, speleological and drifty object with four autonomous water streams, as well as a dozen of smaller, periodical streams and underground lakes.

• exceptional value of biodiversity of Vjetrenica cave with **232 species of speleofauna**

Vjetrenica cave is a type locality for 38 species of speleofauna:

- 1. Scutariellastammeri Matjašič 1958 (Temnocephalida, Scutariellidae)
- 2. Stygodyticolahadzii Matjašič 1958 (Temnocephalida, Scutariellidae)
- 3. Lanzaiavjetrenicae Kuščer 1933 (Gastropoda, Hydrobiidae)
- 4. Zavaliavjetrenicae Radoman 1973 (Gastropoda, Hydrobiidae)
- 5. Vitreakiliasi Pinter 1972 (Pulmonata Zonitidae)
- 6. Eukoeneniaremy Conde 1974 (Palpigradi, Eukoeniidae)
- 7. Stalagtia (Stalagtia) hercegovinensis (Nosek 1905) (Araneae, Dysderidae)
- 8. Stalitellanoseki Absolon&Kratochvil 1933 (Araneae, Dysderidae)
- 9. Tegenariaconveniens Kulczynski 1914 (Araneae, Agelenidae)
- 10. Lephtyphantesspelaeorum Kulczynski, 1914 (Araneae, Linyphiidae)

- 11. Chthonius (C.) occultus Beier 1939 (Pseudoscorpiones, Chthoniidae)
- 12. Neobisium (Blothrus) vjetrenicae Hadži 1933 (Pseudoscorpiones, Neobisiidae)
- 13. Dinariavjetrenicae (Hadži, 1932) (Laniatores, Travuniidae)
- 14. Diacyclopskaramani (Kiefer 1932) (Cyclopidae)
- 15. Eucyclopsinarmatus Kiefer 1932 (Cyclopidae)
- 16. Acanthocyclopstroglophilus (Kiefer 1932) (Cyclopidae)
- 17. Pseudocypridopsishartmanni Petkovskietall., 2009 (Ostracoda, Cyprididae)
- 18. Troglocarishercegovinensis (Babić 1922) (Decapoda, Atyidae)
- 19. Troglomysisvjetrenicensis Stammer 1936 (Mysidacea, Mysidae)
- 20. Monolistra (P.a) hercegoviniensis Absolon 1916 (Isopoda, Sphaeromatidae)
- 21. Proasellushercegovinensis (S. Karaman 1933) (Isopoda, Asellidae)
- 22. Armadillidiumabsoloni Strouhal 1939 (Isopoda, Armadillidiidae)
- 23. Niphargusbalcanicus (Absolon 1927) (AmphipodaNiphargidae)
- 24. Niphargusboskovici S. Karaman 1952 (AmphipodaNiphargidae)
- 25. Niphargusvjeternicensis S. Karaman 1932(AmphipodaNiphargidae)
- 26. Niphargustrullipes Sket 1958 (AmphipodaNiphargidae)
- 27. Niphargusfactor G. Karaman & Sket 1991 (AmphipodaNiphargidae)
- 28. Nipharguscvijici S. Karaman 1950 (AmphipodaNiphargidae)
- 29. Nipharguszavalanus S. Karaman 1950 (AmphipodaNiphargidae)
- 30. Hadziafragilis S. Karaman 1932 (Hadziidi, Hadziidae)
- 31. Lithobius (T.) sketi MaticetDarabantu 1968 (Chilopoda, Lithobiidae)
- 32. Typhloiulus (A.) edentulus Attems 1951 (Diplopoda, Julidae)
- 33. Plusiocampa (Stygiocampa) remyi Conde 1947 (Diplura, Campodeidae)
- 34. Hadesiavasiceki (J. Müller 1911) (ColeopteraCholevidae)
- 35. NauticiellastygivagaMoravecetMlejnek 2002 (Coleoptera Cholevidae)
- 36. Speonesiotes (S.) schweitzeriJeannel 1941 (Coleoptera Cholevidae)

37. Aphaenopsis (A.) pretneri Scheibel 1935 (Carabidae, Trechini)38. Aphaenopsis (S.) arenstorffianus Absolon 1913 (Carabidae, Trechini)

b. Vjetrenica cave is a habitat for 14 species of speleofauna that are specific only to the locality of Vjetrenica (*) and the following endangered (EN) and vulnerable species (VU):

1. Aphaenopsis (Adriaphaenops) pretneri (Scheibel, 1935*) - status EN on the FBiH Red List

- 2. Armadillidiumabsoloni (Strouhal, 1939*)
- 3. Dinaria vjetrenicae (Hadži, 1932) *
- 4. Eukoeneniaremy (Conde, 1974*)
- 5. Lanzaia vjetrenicae (Kuščer, 1933*)
- 6. Lephtyphantesspelaeorum (Kulczynski, 1914*)
- 7. Narentianavjetrenicae (syn. Zavaliavjetrenicae) (Radoman 1973*)
- 8. Nauticiellastygivaga (MoravecandMlejnek, 2002*)
- 9. Neobisiumvjetrenicae (Hadži, 1933*)
- 10. Niphargusfactor (G. Karaman and Sket, 1991*)
- 11. Nipharguszavalanus (S. Karaman, 1950*)
- 12. Scutariellastammeri (Matjašič, 1958*)
- 13. Troglomysisvjetrenicensis (Stammer, 1936*)
- 14. Typhloiulus (Attemsotyphlus) edentulus (Attems, 1951*)
- 15. Dinaromysbogdanovi (Martino, 1922) status VU on the FBiH Red List
- 16. Laemostenus (Antisphodrus) cavicola (Schaum, 1858) status VU on the FBiH Red List
- 17. Myotis emarginatus (Geoffroy, 1806) status VU on the FBiH Red List
- 18. Neotrechussuturalis (Schaufuss 1864) status EN on the FBiH Red List
- 19. Niphargusvjeternicensis (S. Karaman, 1932) status VU on the FBiH Red List
- 20. Proteus anguinus (Laurenti, 1768) status EN on the FBiH Red List
- 21. Rhinolophushipposideros (Bechstein, 1800) status EN on the FBiH Red List

22. Squaliussvallize (Heckel&Kner, 1858) – status VU on the FBiH Red List
23. Trogulustorosus (Simon, 1885) – status VU on the FBiH Red List

• geomorphological value: above-ground parts of the associated karst ecosystem above the Vjetrenica cave.

The main values of the first protected **A2 zone** are made of:

- hydrological values: two water springs: "Lukavac" and "Bitomišlja"
- hydrogeological connection of the dripstone with the Vjetrenica cave.

Permitted activities in the first protected zone

Permitted activities in the first protected zone (zone A) include:

- 1. scientific research activities,
- 2. educational activities,
- 3. setting up smaller information boards providing visitors with a brief insight into the value of the site and warnings, as well as insight into the prohibitions that apply in this zone,
- 4. planning a trail for visitors that will be at a sufficient distance from natural values,
- 5. site visits, in compliance with all rules and prohibitions in force for this zone
- 6. in the above-ground part, harvesting of trees for cultivation and sanitary purposes in order to preserve and improve the health of forest stands, in accordance with applicable regulations and with prior obtaining consent and approval in accordance with the law.

Consents and permits must be obtained for permitted activities.

PROHIBITION MEASURES - Prohibited activities in the first protected zone (A)

In the first protected zone (Strict protection zone, zone A) protection measures include the protection and preservation of specific natural features of this zone, which include:

- 1. ban on unauthorized entry into the area of the Vjetrenica cave,
- 2. ban on the destruction and alienation of cave ornaments, minerals and raw materials from the Vjetrenica cave and ban on exceeding the maximum possible daily capacity of visiting the Vjetrenica cave,
- 3. prohibition of disturbance of the natural hydrological regime of water resources,
- 4. prohibition of deforestation, uprooting or any damage to trees other than breeding and sanitary felling,
- 5. ban on exploitation of mineral raw materials,
- 6. ban on collection of medicinal plants,
- 7. ban on the collection of specimens of flora and fauna, in particular endemic, endangered and protected species,
- 8. ban on planting allochthonous plant communities and introduction of allochthonous animal species,
- 9. ban on introduction of genetically modified species,
- 10. ban on transferring nests and disturbing birds,
- 11. ban on disposal of any types of waste,
- 12. ban on the use of open flames except in places designated for those purposes by the manager of the protected area,
- 13. ban of all other activities that may violate the purpose of the protected area,
- 14. ban on the use of natural resources (except for already existing use for water supply) and exclusion of any other forms of use of space and activities, except for scientific research and controlled education,
- 15. ban on hunting,
- 16. ban of construction activities and interventions in the area, except for the purpose of ensuring the passability of paths and roads for controlled access
- 17. visits to natural value sites under the supervision of rangers and area managers.

PROTECTION ZONE II (B) - Active protection zone (B)

In the second protected zone (Zone of active protection, zone B) with an area of 464.90 ha, the preservation and protection of the authentic state of nature is ensured primarily, and it is characterized by an active type of protection. This area includes a zone characterized by conservation and rehabilitation of habitats and protection of species, with the removal of invasive species. This zone includes all protected, endangered, endemic species of flora and fauna, and habitats. In the second protected zone there are more springs and cultural and historical monuments. Zone B consists of six spatial units, designated as: B1, B2, B3, B4, B5 and B6.

Zone B1 with an area of 342.60 ha, is a buffer zone that connects to the cave and the dripstone of the cave Vjetrenica, as a natural hydrological connection aimed at protection of the area, but also the use of space for hunting activities given the hunting concession in the area. Zone B1 is territorially spread over the area of three settlements, namely Zavala, Golubinac and Belenići. The area of the buffer zone extends in the east from the settlement of Budim almost all the way to the border of the protected area, from where it bends to the south, east of Klisura all the way to the settlement of Belenići. From Belenići, the border extends to the point Valin do, after which it extends in a north-westerly direction towards the settlement of Golubinac and the hill V. Gradina all the way to the north and the local road in Zavala where it continues to the dripstone of the cave.

Zone B2 with an area of 52.25 ha, is a zone of mine suspected areas and it is located on two separate spatial units marked as sub-zones B2.1 and B2.2:

• Subzone B2.1 represents the area of mine suspected areas with a coverage of 13.90 ha. This subzone is located within the boundaries of the settlement of Zavala, and it is located in the far east of the protected area. The site leans on the buffer zone of active protection of the cave, all the way to the border of the protected area in the east from where it descends south over Oštri vrh all the way to elevation 824 Sovar.

• Subzone B2.2 represents the zone of mine suspected areas with a total coverage of 38.35 ha. The zone leans on the border of the aforementioned subzone in the Zavala unit, from where it descends south over Oštri vrh all the way to elevation 824 Sovar, together with another separate locality in the south of the previous one at the locality Zečija glava.

Although the mentioned subzones B2.1 and B2.2 do not contain valuable natural and cultural-historical values, these zones have been recognised within the Expert judgement in order to prioritize the demining of the terrain and ensure the safety of visitors.

Zone B3 with an area of 38.52 ha represents the zone of the river Trebišnjica. This zone represents a continuous surface area of the river Trebišnjica which extends in the area of two settlements, Čvaljina and Zavala. Its boundary follows the riverbed and includes a part of the river Trebišnjica which is located on the territory of a protected area that includes a part of Popovo polje, starting from the northernmost point near Grabovac, through the settlement Čvaljina to elevation 262 Muhareva Ljut.

Zone B4 includes all natural values (endangered and/or protected and/or endemic species of flora and fauna and important habitats for the preservation of natural values), which have been established in the aboveground part of the protected area. The total area of the determined natural values is 21.40 ha, which are distributed within the boundaries of all settlements with the exception of the settlement of Orahov Do. The identified species of flora and fauna represent the species of importance for biodiversity. This zone is divided into five sub-zones designated as:

• B4.1 (Natural values of flora, fauna and important habitats in the settlement of Čvaljina, area of 3.13 ha),

- B4.2 (Natural values of flora, fauna and important habitats in the settlement of Zavala, area 10.43 ha)
- B4.3 (Natural values of flora, fauna and important habitats in the settlement of Belenići, area of 4.70 ha)
- B4.4 (Natural values of flora, fauna and important habitats in the settlement of Kijev Do, area 1.56 ha)

• B4.5 (Natural values of flora, fauna and important habitats in the settlement of Golubinac, area of 1.57 ha).

A complete list of endangered and or protected and/or endemic species of flora and fauna and important habitats of the aboveground part of the protected area with the sub-zones to which they belong is set out in Table 19.

Zone B5 with a total area of 2.00 ha is represented by water source sites as significant hydrological values of the protected area. This zone is located near the settlements of Čvaljina, Zavala, Golubinac and Belenići.

Zone B6 with a total area of 8.13 ha is represented by cultural and historical monuments, and it is divided into two sub-zones, B6.1 and B6.2.

• B6.1 represents a set of cultural and historical monuments which includes two national monuments and sacral buildings "Architectural ensemble of the Church of the Presentation of the Blessed Virgin Mary in Zavala, Municipality of Ravno" (Zavala Monastery) and the Archaeological Site Crkvina in Zavala, Ravno Municipality, (Remains of pre-Romanesque Church of St. Peter), located in the vicinity of the settlement of Zavala with an area of 2.05 ha.

• Zone B6.2 includes cultural monuments in the form of stećak tombstones that are spread in the settlements of Orahov Do, Golubinac, Belenići, Zavala and Čvaljina, with an area of 6.08 ha.

Active protection zone values (B zone)

The basic values of zone B1 consist of hydrogeological connection of the dripstone with the Vjetrenica cave. It represents the buffer zone that builds on the cave and the dripstone of the Vjetrenica cave, as a natural hydrological connection in order to protect the area.

Zone **B2** does not contain natural and cultural-historical values, and it is a zone of mine suspected areas (subzones B2.1 and B2.2) which require urgent demining.

The basic value of the zone **B3** is a part of the watercourse of the river Trebišnjica.

Zone B4, with sub-zones 4.1, 4.2, 4.3, 4.4 and 4.5, includes all natural values (endangered and/or protected and/or endemic species of flora and fauna and important habitats for conservation of natural values), which were identified in the aboveground part of the protected area, as follows:

Table 20. *List of endangered and/or protected and/or endemic species of flora and fauna and important habitats of the aboveground part of the protected area with sub-zones*

Natural value	Latin name (common name)	Status of endangerment			
B4.1 - Endange	B4.1 - Endangered and/or protected and/or endemic species of flora and fauna and important habitats in				
the settlement of	of Čvaljina				
Habitat	Verbenionsupinae Slavnić 1951 - Nanocyperion	* Natural habitats threatened with			
	vegetation of SE Europe (*3170)	extinction in the EU			
Habitat	Carpinion orientalis Horvat 1958 - Eastern white oak				
	forest and oriental hornbeam shrubs (91AA)	-			
Flora	Aristolochia rotunda L. (Okruglasta vučja stopa)	EN on the FBiH Red List			
	(round-leaved birthwort)	EN OR THE FORT REA LIST			
Flora	Peucedanum coriaceum Rchb.subsp. pospichalii	EN on the FBiH Red List			
	(Thell.) Horvatić	EN ON THE FOIRT REA LIST			
Flora	Thalictrum flavum L. (yellow meadow-rue)	EN on the FBiH Red List			
Flora	Veronica anagalloides Guss. (Faded speedwell)	VU on the FBiH Red List			
Flora	Asperulas cutellaris Vis. (woodruff)	EN on the FBiH Red List			

Flora	Crocus dalmaticusVis. (Dalmatian crocus)	EN on the FBiH Red List			
Flora	Moltkia petraea (Tratt.) Griseb.	NT on the FBiH Red List			
Flora	Scilla lakusicii Šilić (Lakušićev procjepak)	EN on the FBiH Red List			
Flora	<i>Tanacetum cinerariifolium</i> (Trevir.) Sch. Bip. (Dalmatian chrysanthemum)	VU on the FBiH Red List			
Flora	<i>Tulipa sylvestris</i> L. subsp. sylvestris (wild tulip)	EN on the FBiH Red List			
Flora	Crocus dalmaticus Vis. (Dalmatian crocus)	EN on the FBiH Red List			
Flora	Crocus tommasinianus Herb (Tommasini's crocus)	CR on the FBiH Red List			
Fauna	Iolanaiolas Ochsenheimer, 1816 (iolas blue)	EN on the FBiH Red List			
Fauna	Ariciaanteros Freyer, 1838 (blue argus)	EN on the FBiH Red List			
Fauna	Charaxes jasius Linnaeus, 1767 (foxy emperor)	VU on the FBiH Red List			
Fauna	Hipparchiastatilinus Hufnagel, 1766 (tree grayling)	VU on the FBiH Red List			
Fauna	<i>Testudohercegovinensis</i> Werner, 1899 (Dalmatian tortoise)	VU on the FBiH Red List			
B4.2 - Endanger	B4.2 - Endangered and/or protected and/or endemic species of flora and fauna and important habitats in				
the settlement of	of Zavala	_			
	Asplenietea trichomanis (BrBl. in Meier et BrBl.				
Habitat	1934) Oberd. 1977 - vegetation of carbonate rock	-			
	fissures (8210)				
Ushitat	Drypidetalia spinosae Quézel 1964 - Eastern				
Habitat	Mediterranean screes (8140)	-			
Habitat	Molinio-Hordeion secalini Horvatić 1934 – Balkan's				
	Submediterranean moist meadow (6540)	-			
Habitat	Carpinion orientalis Horvat 1958 - Eastern white oak				
Habitat	forest and oriental hornbeam shrubs (91AA)	-			

Flora	Cardamine graeca L. (Morska režuha)	CR on the FBiH Red List
Flora	<i>Campanula austroadriatica</i> D. Lakušić& Kovačić Bellflower	NT on the FBiH Red List
Flora	<i>Opopanaxchironium</i> (L.) W. D. J. Koch (Hercules' all-heal)	EN on the FBiH Red List
Flora	<i>Anthyllisvulneraria</i> L. subsp. <i>weldeniana</i> (Rchb.) Cullen (woundwort)	VU on the FBiH Red List
Flora	Dianthussylvestris Wulfensubsp. tergestinus (Rchb.) Hayek Wood pink	VU on the FBiH Red List
Flora	<i>Dittrichiaviscosa</i> (L.) Greutersubsp. <i>viscosa</i> (sticky fleabane)	EN on the FBiH Red List
Flora	<i>Tanacetumcinerariifolium</i> (Trevir.) Sch. Bip. (Dalmatian chrysanthemum)	VU on the FBiH Red List
Flora	Aristolochiarotunda L. (round-leaved birthwort)	EN on the FBiH Red List
Flora	<i>Dittrichiaviscosa</i> (L.) Greutersubsp. <i>viscosa</i> (sticky fleabane)	EN on the FBiH Red List
Flora	Peucedanum coriaceum Rchb.subsp.pospichalii (Thell.) Horvatić (Kožasta pukovica)	EN on the FBiH Red List
Flora	Aristolochiarotunda L. (round-leaved birthwort)	EN on the FBiH Red List
Flora	Veronica anagalloides Guss. (Faded speedwell)	VU on the FBiH Red List
Flora	Aristolochiarotunda L. (round-leaved birthwort)	EN on the FBiH Red List
Flora	<i>Dittrichiaviscosa</i> (L.) Greutersubsp. <i>viscosa</i> (sticky fleabane)	EN on the FBiH Red List
Flora	Euphorbia fragifera Jan (Mirisna mlječika)	VU on the FBiH Red List
Flora	Peucedanumcoriaceum Rchb.subsp.pospichalii (Thell.)	EN on the FBiH Red List

	Horvatić (Kožasta pukovica)	
Flora	Scillalitardierei Breistr. (Amethyst meadow squill)	VU on the FBiH Red List
Flora	Crocustommasinianus Herb. (Tommasini's crocus)	CR on the FBiH Red List
Flora	CyclamenhederifoliumAiton (sowbread)	CR on the FBiH Red List
Flora	Cardamine graeca L. (Morska režuha)	CR on the FBiH Red List
Flora	CyclamenhederifoliumAiton (sowbread)	CR on the FBiH Red List
Flora	<i>Fritillariamessanensis</i> Raf. subsp. <i>gracilis</i> (Ebel) Rix (dark fritillary)	VU on the FBiH Red List
Flora	Romuleabul bocodium (L.) Sebast. & Mauri (Dugovača)	EN on the FBiH Red List
Flora	Ruscusaculeatus L. (Veprina)/ butcher's-broom	VU on the FBiH Red List
Flora	Cardaminegraeca L. (Morska režuha)	CR on the FBiH Red List
Flora	<i>Campanulaaustroadriatica</i> D. Lakušić& Kovačić (Bellflower)	NT on the FBiH Red List
Flora	CrocustommasinianusHerb. (Tommasini's crocus)	CR on the FBiH Red List
Flora	Cyclamenhederifolium Aiton (sowbread)	CR on the FBiH Red List
Flora	<i>Dittrichiaviscosa</i> (L.) Greutersubsp. <i>viscosa</i> (sticky fleabane)	EN on the FBiH Red List
Flora	Iris tuberosa L. (snake's-head iris)	CR on the FBiH Red List
Flora	Ruscusaculeatus L. (butcher's-broom)	VU on the FBiH Red List
Fauna	Iolanaiolas (Ochsenheimer, 1816), iolas blue	EN on the FBiH Red List
Fauna	Ariciaanteros (Freyer, 1838) (the blue argus)	EN on the FBiH Red List
Fauna	Charaxesjasius (Linnaeus, 1767) two-tailed pasha	VU on the FBiH Red List
Fauna	Hipparchia statilinus (Hufnagel, 1766) tree grayling	VU on the FBiH Red List
Fauna	Testudohercegovinensis Werner, 1899 (Dalmatian	VU on the FBiH Red List

	tortoise)			
B4.3 - Endangered and/or protected and/or endemic species of flora and fauna and important habitats in				
the settlement of Belenići				
Habitat	Scorzoneretaliavillosae Kovačević 1959 - suvi stepski	_		
	sub-mediterranean dry grasslands (62A0)	-		
Habitat	Scorzoneretaliavillosae Kovačević 1959 - sub-			
	mediterranean dry grasslands (62A0)	-		
Flora	Anthyllisvulneraria L. subsp. weldeniana (Rchb.)	VU on the FBiH Red List		
гюга	Cullen (Woundwort)	V O ON THE FULL RED LIST		
Flora	DianthussylvestrisWulfensubsp. tergestinus (Rchb.)	VU on the FBiH Red List		
гюга	Hayek (Wood pink)	V O ON THE FDIFI RED LIST		
Flora	AsperulascutellarisVis. (woodruff)	EN on the FBiH Red List		
Flora	Euphorbiafragifera Jan (Mirisna mlječika)	VU on the FBiH Red List		
Flora	Scilla lakusicii Šilić (Lakušićev procjepak)	EN on the FBiH Red List		
Flora	Anthyllisvulneraria L. subsp. weldeniana (Rchb.)	VU on the FBiH Red List		
гюга	Cullen (Woundwort)	V O ON THE FDIFI RED LIST		
Flora	Chaerophyllum coloratum L. (Šarena krabljica)	EN on the FBiH Red List		
Flora	Salviapratensis L. subsp. bertolonii (Vis.) Soó	NT on the FBiH Red List		
гюга	(meadow sage)	NT ON the FBIH Red List		
Flora	Anacamptispyramidalis (L.) Rich. (pyramidal orchid)	NT on the FBiH Red List		
Flora	Anthyllisvulneraria L. subsp. weldeniana (Rchb.)	VU on the FBiH Red List		
	Cullen (Woundwort)	V U on the FBIFI Red List		
Flora	Asperula scutellarisVis. (woodruff)	EN on the FBiH Red List		
Flora	Chaerophyllum coloratum L. (Šarena krabljica)	EN on the FBiH Red List		
Flora	Dittrichiaviscosa (L.) Greutersubsp. viscosa (sticky	EN on the FBiH Red List		
FloraHelleboryHelleboryVU on the FBiH Red ListFloraMoltkiapetraea (Tratt.) Griseb. (Modro lasinje)NT on the FBiH Red ListFloraStachys recta L. (stiff hedgenettle)CR on the FBiH Red ListFloraTanacetumcinerariifolium (Trevir.) Sch. Bip. (Dalmatian chrysanthemum)VU on the FBiH Red ListFloraTrifolium pignantii Fauché&Chaub. (Pignant's clover)NT on the FBiH Red ListB4.4 - Endanger- the settlement-Trifolium granatii Fauché&Chaub. (Pignant's clover)NT on the FBiH Red ListHabitatScorzoneretaliavillosae Kovačević 1959 - sub- mediterranean dry grasslands (62A0)-FloraSalvia pratensis L. subsp. bertolonii (Vis.) Soó (meadow sage)NT on the FBiH Red ListFloraPetteriaramentacea (Sieber) C. Presl (Dalmatian Laburnum)NT on the FBiH Red ListFloraPetteriaramentacea (Sieber) C. Presl (Dalmatian Laburnum)NT on the FBiH Red ListFloraScorzoneretaliavillosae Kovačević 1959 - suvi stepski sub-mediterranean dry grasslands (62A0)NT on the FBiH Red ListFloraScorzoneretaliavillosae Kovačević 1959 - suvi stepski sub-mediterranean dry grasslands (62A0)NT on the FBiH Red ListFloraPetteriaramentacea (Sieber) C. Presl (Dalmatian Laburnum)NT on the FBiH Red ListHabitatScorzoneretaliavillosae Kovačević 1959 - suvi stepski sub-mediterranean dry grasslands (62A0)NT on the FBiH Red ListFloraMoltkiapetraea (Tratt.) Griseb. (Modro lasinje)NT on the FBiH Red List		fleabane)		
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Flora	Seseli tomentosum Vis. (Pustenasto devesilje)	VU on the FBiH Red List
Flora	<i>Dittrichiaviscosa</i> (L.) Greutersubsp. <i>viscosa</i> (sticky fleabane)	EN on the FBiH Red List
Flora	Ruscusaculeatus L. (butcher's-broom)	VU on the FBiH Red List
Flora	Anthyllisvulneraria L. subsp. weldeniana (Rchb.) Cullen (Woundwort)	VU on the FBiH Red List
Flora	Chaerophyllumcoloratum L. (Šarena krabljica)	EN on the FBiH Red List
Flora	Crocustommasinianus Herb. (Tommasini's crocus)	CR on the FBiH Red List
Flora	Cyclamenhederifolium Aiton (sowbread)	CR on the FBiH Red List
Flora	Ruscusaculeatus L. (butcher's-broom)	VU on the FBiH Red List
Flora	<i>Tulipasylvestris</i> L. subsp. <i>sylvestris</i> (wild tulip)	EN on the FBiH Red List
Fauna	<i>Gonepteryxcleopatra</i> Linnaeus, 1758 (Cleopatra butterfly)	VU on the FBiH Red List
Fauna	Ariciaanteros Freyer, 1838 (blue argus)	EN on the FBiH Red List
Fauna	Polyommatusadmetus Esper, 1783 (anomalous blue)	EN on the FBiH Red List
Fauna	Lissotriton vulgaris Linnaeus, 1758 (common newt)	VU on the FBiH Red List
Fauna	<i>Lucanus cervus</i> Linnaeus, 1758 (European stag) beetle	VU on the FBiH Red List
Fauna	<i>Elaphe quatuorlineata</i> Lacépede, 1789 (four-lined snake)	VU on the FBiH Red List

The main values of **B5 zone** are hydrological values (sources) in the area of other protected zones, in the settlements of Čvaljina, Zavala, Golubinac and Belenići.

In **zone B6** there are:

• two national monuments (**sub-zone 6.1**) of the building "Architectural ensemble of the Church of the Presentation of the Blessed Virgin Mary in Zavala, Municipality of Ravno" (Zavala Monastery) and the Archaeological Site Crkvina in Zavala, Ravno Municipality, (Remains of the pre-Romanesque church of St. Peter)

• stećak tombstones that are widespread in the settlements of Orahov Do, Golubinac, Belenići, Zavala and Čvaljina (**sub-zone 6.2**).

Permitted activities in the second protected zone

In the second protected zone (zone B) the permitted activities include:

- a) scientific research activities,
- b) educational activities,
- c) hunting in accordance with the approved hunting management plan,
- d) replenishing ecological restoration of existing watercourses,
- e) physical and spiritual recreation,
- f) site visits, in compliance with all rules and prohibitions in force for this zone
- g) improvement of infrastructure (trails, benches)
- h) setting information content from appropriate indigenous materials,
- i) research, use, restoration and presentation of cultural and historical heritage,
- j) improvement of space with educational contents (information boards),
- k) establishment of fences around the sites made of autochthonous materials,
- l) arranging promenades and trails,

m) other activities in the area to the extent that enables the improvement of the situation in relation to the existing one and the presentation of the natural and/or cultural-historical good without endangering its primary value,

n) carrying out regular active management activities aimed at species conservation or habitat maintenance

o) harvesting of trees for cultivation and sanitary purposes in order to preserve and improve the health of forest stands, in accordance with applicable regulations and with prior obtaining consent and approval in accordance with the law.

Consents and permits must be obtained for permitted activities.

PROHIBITION MEASURES - Prohibited activities in the second protected zone (B)

In the second protected zone (Active protection zone, zone B) protection measures include the protection and preservation of natural and cultural-historical values and the implementation of measures of targeted (active) protection, and these are related to:

a) prohibition of deforestation, uprooting or any damage to trees other than cultivation and sanitary purposes felling,

b) ban on exploitation of mineral resources,

c) ban on the collection of medicinal plants,

d) ban on mushroom picking,

e) ban on the collection of specimens of flora and fauna, in particular endemic, endangered and protected species,

f) prohibition of intentional introduction of invasive species,

g) prohibition of pasturing,

h) prohibition of agricultural activities,

i) prohibition of construction, except for facilities that are in the function of management of the protected area,

j) prohibition of the use of open flames, except in specially marked and arranged places,

k) prohibition of waste disposal,

l) prohibition of alienation of cultural and historical values,

visits to sites of natural and cultural-historical values should be carried out under the supervision of Area manager rangers.

PROTECTION ZONE III (C) – Zone of use (C)

The third protected zone (Zone of use, zone C) with an area of 1,115.9.94 ha, is mostly the zone corresponding to agricultural land, but includes two subzones with the purpose of building catering and tourist complexes planned for the development of tourist activities and facilities, as well as areas of settlements. Zone C is divided into six spatial units, designated as: C1, C2, C3, C4, C5 and C6, which belong to the following spatial units: cadastral municipality Čvaljina, cadastral municipality Zavala, cadastral municipality Belenići, cadastral municipality Grmljani, cadastral municipality Kijev Do, cadastral municipality Golubinac, cadastral municipality Orahov Do.

one C1 represents the largest spatial unit within this zone with a surface of 503.31 ha. This zone is located in the area of the settlement Čvaljina and unites the populated area as well as the second agrozone (V and VI land capability class) and the third agrozone (VII-VIII land capability class). In Zone C1, a hunting concession was granted for the entire area. Zone C1 is divided into two sub-zones C1.1 and C1.2.

• Sub-zone C1.1 represents the settlement of Čvaljina with a total surface of 9.45 ha, located in the extreme northern part of the protected area.

• Sub-zone C1.2 represents an agrozone in the area of the settlement of Čvaljina with the surface of 493.86 ha. In the area around the river Trebišnjica, the first agrozone (I-IV land capability class) is represented, the most valuable agricultural land in the area. Agrozone II (V and VI land capability class) with a smaller surface coverage is located near the settlement of Čvaljina, and in the eastern part of the wider area it includes settlements, while in other parts of this zone there is agrozone III (VII and VIII land capability class).

Zone C2 with a surface of 231.54 ha is located in the wider area of the settlement of Zavala and includes three sub-zones marked as C2.1, C2.2 and C2.3.

• Sub-zone C2.1 is represented by the settlement of Zavala located near the cave, and the settlement of Češljari in the extreme southwest of the wider scope of Zavala, with a total surface of 12.63 ha, located in the northern, that is, the central part of the protected area.

• Sub-zone C2.2 represents an agrozone in the area of the settlement of Zavala with a surface of 157.36 ha. Around the river Trebišnjica agrozone I is represented (I-IV land capability class), agrozone II (V and VI land capability class) is located near the settlement of Zavala, while in other parts of the settlement there is agrozone III (VII and VIII land capability class).

• Sub-zone C2.3 indicates the purpose of catering and tourist complexes planned for the development of tourist activities and facilities. The total area of this sub-zone is 61.55 ha, and it is located in the western part of the wider Zavala settlement, more precisely in the vicinity of the Češljari settlement.

Zone C3 with a surface of 105.60 ha is located within the settlement of Belenići, and it is represented by two sub-zones C3.1 and C3.2.

• Sub-zone C3.1 represents the locality of the settlement Belenići with a total surface of 5.20 ha, located in the eastern part of the protected area.

• Sub-zone C3.2 represents an agrozone in the wider area of Belenići settlement with a surface of 100.40 ha. The populated part of Belenići is dominated by the agrozone II (V and VI land capability classes), while the agrozone III (VII and VIII land capability class) is represented in smaller parts around the agrozone II.

Zone C4 with a surface of 39.28 ha is located within the settlement of Kijev Do and includes two sub-zones C4.1 and C4.2.

• Sub-zone C4.1 represents the site of the settlement of Kijev Do with a total surface of 4.60 ha, located in the south-eastern part of the protected area.

• Sub-zone C4.2 represents an agrozone in the wider area of the settlement of Kijev Do, with a surface of 34.68 ha. The agrozone includes a narrow belt along the settlement of Kijev Do, which is dominated by the agrozone II (V and VI land capability classes), while the agrozone III (VII and VIII rating category) is represented in smaller parts in the extreme south of the settlement of Kijev Do.

Zone C5, with a surface of 33.35 ha, is located within the range of Golubinac settlement, and it is divided into two sub-zones, namely C5.1 and C5.2.

• Sub-zone C5.1 represents the locality of Golubinac settlement with a total surface of 1.90 ha, located in the central part of the protected area.

• Sub-zone C5.2 represents an agrozone in the area of the wider scope of Golubinac settlement with a surface of 31.45 ha. Agrozone III (VII and VIII rating category) is represented in smaller parts just around the settlement of Golubinac.

Zone C6 with a surface of 262.86 ha is located within the settlement of Orahov Do, with the second and third agrozones, and the tourist zone, based on which it is divided into three sub-zones marked as C6.1, C6.2 and C6.3.

• Sub-zone C6.1 represents the locality of the settlement Orahov Do with a total surface of 5.11 ha, located in the western part of the protected area.

• Sub-zone C6.2 represents an agrozone in the area of the wider scope of the settlements of Orahov Do, with a total surface of 68.95 ha. The agrozone includes a narrow belt along the settlement of Orahov Do, dominated by the agrozone II (V and VI land capability classes) located south of the settlement of Orahov Do, while the agrozone III (VII and VIII land capability classes) is represented in smaller parts in the far north of the settlement.

• Sub-zone C6.3 indicates the purpose of catering and tourist complexes planned for the development of tourist activities and facilities. The total surface of this sub-zone is 188.80 ha, and it extends through the central part of the wider scope of the settlement of Orahov Do.

Values of the zone of use (Zone C)

Zone C also includes constructed settlements: Čvaljina, Zavala, Budim Do, Češljari, Orahov Do, Golubinac, Belenići and Kijev Do. The zone of use consists of the following units: **C1, C2, C3, C4, C5 and C6** with the corresponding sub-zones.

The main values of the third protected zone are made of:

- a) development of tourist complexes (C2.3 and C6.3)
- b) tourist activities (catering, accommodation) all zones and subzones C
- c) agricultural areas of different land capability classes, organic food production all zones and subzones C
- d) ambient values of the space all zones and subzones C.

Permitted activities in the third protected zone

In the third protected zone (zone C) permitted activities include:

- a) scientific research activities,
- b) educational activities,
- c) felling of trees in accordance with applicable regulations, and with prior obtaining of the consent and approval in accordance with the law.
- d) physical and spiritual recreation,
- e) hunting in accordance with the approved hunting management plan,
- f) establishment of infrastructure in a form that will be integrated into the ecological-spatial element
- g) extensive pasturing,

- h) mowing,
- i) traditional agricultural activities,
- j) construction of educational centres,
- k) construction of new and maintenance of existing road infrastructure,
- l) construction of tourist infrastructure that must be integrated with the surroundings, construction of accompanying tourist facilities and holiday homes,
- m) development of handicrafts and small economy in the function of tourism,
- n) agricultural production and production of healthy food without the use of pesticides,
- a) construction of residential buildings for the domicile population,
- b) improvement of infrastructure for recreation (trim trails, cycle paths, etc.)

Consents and permits must be obtained for permitted activities.

PROHIBITION MEASURES - Prohibited activities in the third protected zone (C)

In the third protected zone (Zone of use, zone C) protection measures are aimed at preserving environmental values, traditional values and use of space, and they are related to:

- a) prohibition of deforestation, except deforestation in accordance with the forest management plan,
- b) ban on hunting that is contrary to the hunting management plan,

c) ban on the collection of medicinal plants except with the special approval of the manager of the protected area,

d) ban on the collection of specimens of flora and fauna, in particular endemic, endangered and protected species,

e) ban on introduction of invasive species,

f) prohibition to perform construction activities in the zones of existing water sources and springs,

g) prohibition of construction that is not integrated with the surroundings,

h) prohibition of the use of chemical agents in agriculture, except those permitted by the state institutions.

PROTECTION ZONE IV (D) - Transitional protection zone (D)

The fourth protected zone (Transition Zone, Zone D), with the surface of 2,655.54 ha, is the largest zone in the scope of the protected area, which extends to cadastral municipality Čvaljina, cadastral municipality Zavala, cadastral municipality Belenići, cadastral municipality Grmljani, cadastral municipality Gorogaše, cadastral municipality Kijev Do, cadastral municipality Golubinac, cadastral municipality Orahov Do, excluding the previously described strict protection zones, active protection zones and zones of use. This zone is represented mainly by forest land which covers 2,549.33 ha, while a smaller share includes infrastructure facilities such as substations, transmission lines, roads and planned tourist facilities with a surface of 106.21 ha.

Transition zone values (D zone)

The fourth protected zone (transition zone, Zone D) is represented by predominantly forest land (D1), while a smaller share is covered by infrastructure facilities such as substations, transmission lines, roads (D2). The main values of the fourth protected zone include:

- a) forest ecosystems, that is, coppice forests, as well as non-reproductive forest areas, and forest areas suitable for collection of non-timber forest material and recreation (D1)
- b) maintaining the integrity of the area and other zones
- c) ambient values of the space of all zones and subzones D
- d) supporting infrastructure (D2).

Permitted activities in the fourth protected zone

In the fourth protected zone (zone D) the permitted activities include:

c) scientific research activities,

- d) educational activities,
- e) all types of tourist activities,
- f) felling of trees in accordance with applicable regulations, and with prior obtaining of the consent and approval in accordance with the law.
- g) hunting in accordance with the approved hunting management plan,
- h) establishment of infrastructure in a form that will be integrated into the ecological-spatial element
- i) extensive pasturing,
- j) mowing,
- k) traditional agricultural activities,
- l) construction of educational centres,
- m) construction of new and maintenance of existing transport infrastructure,
- n) construction of tourist infrastructure that must be integrated with the surroundings, construction of accompanying tourist facilities and holiday homes
- o) development of handicrafts and small economy that is in the function of tourism,
- p) agricultural production and production of healthy food without the use of pesticides,
- q) improvement of infrastructure for recreation (trim trails, cycle paths, etc.)
- r) construction of residential buildings for the domicile population,
- s) construction of parking spaces for visitors,
- t) construction of all other infrastructure facilities in accordance with the purpose of this space,
- u) construction of residential buildings for the domicile population.

Consents and permits must be obtained for permitted activities.

PROHIBITION MEASURES - Prohibited activities in the fourth protected zone (D)

(1) In the fourth protected zone (Transition zone, zone D), protection measures are aimed at preserving the entire protected area with the unprotected area in the surroundings, and the practice of sustainable development of the local community.

(2) Zone D protection measures are aimed at:

- a) prohibition of deforestation, except deforestation in accordance with the forest management plan,
- b) a ban on hunting that is contrary to the hunting management plan,
- c) prohibition of construction that is not harmonized with the spatial planning documentation.

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