Conservation Action Plan for the Bats of Transboundary Prespa

(updated version 2025-2030)

M. Radonjić, A. Stojanov, M. Nezaj, L. Nikolov and I. Koutseri

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"PrespaNet Project III:
Biodiversity Conservation
in Transboundary Prespa"

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The present Conservation Action Plan is the result of data analysis carried out in the framework of the project "PrespaNet Project III: Biodiversity Conservation in Transboundary Prespa". The project is implemented by the three PrespaNet partners - Macedonian Ecological Society (MES), Protection and Preservation of Natural Environment in Albania (PPNEA) and Society for the Protection of Prespa (SPP), and is financially supported by the Prespa-Ohrid Nature Trust and the Jensen Charity Foundation.

Report prepared by:

M.Sc. M. Radonjić, Bat expert, Montenegro

M.Sc. A. Stojanov, Bat expert, Macedonian Ecological Society, North Macedonia

M. Nezaj, Junior expert for bats, Protection and Preservation of Natural Environment in Albania

L. Nikolov, GIS specialist, Macedonian Ecological Society, North Macedonia

I. Koutseri, Society for the Protection of Prespa, Greece

Process facilitation and document review by:

Primož Presetnik, univ. dipl. biol., senior bat expert, Slovenia

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ABBREVIATIONS

ALAN:	Artificial Light at Night
ASPBM:	Albanian Society for the Protection of Birds and Mammals
CAP:	Conservation Action Plan
CMS:	Convention on Migratory Species
EEA:	European Environmental Agency
EU	European Union
EUROBATS:	Agreement on the Conservation of Populations of Bats in Europe
IUCN:	International Union for Nature Conservation
MES:	Macedonian Ecological Society
NGO:	Non-governmental organization
NP:	National Park
PA:	Protected Area
PONT:	Prepsa Ohrid Nature Trust
PPCC:	Prespa Park Coordination Committee
PPNEA:	Protection and Preservation of Natural Environment in Albania
SAP:	Strategic Action Programme
SPP:	Society for the Protection of Prespa
TMS:	Transboundary Monitoring System
TPP:	Transboundary Prespa Park
UNDP:	United Nations Development Program
MCWG	Monitoring and Conservation Working Group
WGWM:	Working Group on Water Management

CONTENTS

SUMMARY

This document summarizes the current knowledge on bats and their important roosts in the transboundary Prespa and defines a list of research, monitoring, conservation and communication priorities to ensure their favourable conservation status across national borders. In total, 29 species of bats have been confirmed in the transboundary Prespa area, including some of the most threatened European bat species. Most of them are cave-dwelling species and roost in caves/bunkers/rock crevices along or near the shores of the Prespa Lakes or in the surrounding mountains, but also in several overground objects (attics of churches, abandoned buildings, etc). The knowledge about the forest-dwelling bats is still incomplete and further research is needed. Although the underground and overground structures remain largely well-preserved, several factors continue to threaten bat species and their habitats. These include unauthorized public access that disturbs roosting sites and a general lack of public awareness about the ecological significance of bats. Additionally, insufficient enforcement of existing legal protections presents an ongoing challenge.

In the first part of this document (PART I), we provide background information, including a brief description of the study area, as well as the importance of the bat fauna and their roosts in the transboundary Prespa region. Furthermore, we outline the conservation status and legal protection of bats at both national and international levels.

In the second part (PART II) we describe the threats / limiting factors faced by the bats and their main roosts and we focus on the goals, objectives and recommended actions for their conservation in the area. We first recommend research and survey actions to increase our scientific knowledge and understanding of bats, their roosts and habitats, and the impact of potential tourist or other disturbances in Prespa related to their conservation. We then recommend appropriate conservation management actions based on currently available knowledge and experience. Finally, we provide recommendations to increase public awareness and support for the conservation on bats and their habitats. Bats know no borders and all mentioned actions should be designed and implemented on a transboundary level. The recommendations in the report will require financial support and political will for their successful and sustainable implementation. A large part of the text of the new Conservation Action Plan for Bats 2025 is based on the structure of the previous Action Plan entitled "Status Survey and Conservation Action Plan for the Caves and Cave Bats of Prespa" (Papadatou *et al.* 2012), and the parts that refer to the status of bats in Prespa before 2012 have been adopted from it.

The text of the new CAP 2025 for bats has been further enriched with data and information obtained during the previous PrespaNet project III (2021-2024), as well as with bibliographical resources from 2012 onwards.

PART I.
BACKGROUND INFORMATION

1. INTRODUCTION

Recognized for its extraordinary natural and cultural heritage, the Prespa Lakes Basin remains an important site for nature conservation, biodiversity and sustainable development, both regionally and globally (EU, 2011).

However, Prespa faces catastrophic challenges posed by climate change and biodiversity degradation that threaten the very essence of the local way of life (Schriek and Giannakopoulos, 2017; Trajkoviski and Apostolova, 2024). Within these challenges, however, lies an opportunity to address these issues through close engagement with the remaining and often declining local populations. Building on decades of local engagement, culminating in a decade of cross-border collaboration through our PrespaNet network (Society for the Protection of Prespa (SPP) from Greece, Protection and Preservation of the Natural Environment in Albania (PPNEA) and Macedonian Ecological Society (MES)) is prepared to address these pressing issues.

The overall goal in the PrespaNet III project is to strengthen the conservation and sustainable management of the Prespa region, with a special focus on its protected areas. We aim to achieve this through collaborative efforts, active engagement, information dissemination and ecological restoration, promoting cooperation among transboundary stakeholders and authorities. Building on past achievements, our specific objectives include ecological restoration actions, engaging local communities and stakeholders in habitat restoration, improving ecological connectivity between protected areas, fostering sustainable partnerships with protected area authorities, supporting participatory monitoring and ecological education, advocacy and outreach on behalf of the transboundary Prespa, and identifying and documenting threats to key values of transboundary Prespa, all in the context of understanding and adapting to the climate crisis.

One of the many objectives of the project is to continue the monitoring and conservation of bats and their habitats in the Prespa region through seasonal visits to the most important roosts, field surveys for forest-dwelling bats, mapping of new potential roosts, implementation of concrete conservation measures and communication with the public to raise awareness.

The existing Conservation Plan for Caves and Cave Bats was developed in 2012 (Papadatou *et al.*, 2012) and summarized all available information on bats and their habitats and roosts in the transboundary Prespa region until 2012 (hereafter CAP 2012).

It is recognized that transboundary Prespa supports significant populations of cave-dwelling bats. These bats use a network of limestone caves throughout the region, with movements occurring within and beyond the Prespa watershed. Seasonal shifts in roost sites, influenced by factors such as microclimate, life cycle stages and ecological pressures, demonstrate the complexity of their habitat use.

Despite surveys over the past decade, mostly covering summer, autumn and winter periods, the knowledge of these bats remained incomplete. The previous CAP 2012 identified some caves as important roosts, but the extent of their use and connectivity between sites was

not fully understood. Movement between caves, including sites outside the catchment, highlights the need for a broader perspective on bat conservation in the region.

CAP 2012 shows that bats in Prespa frequently move between different underground sites over the seasons, forming a network of roosts that spans several countries. The lack of physical barriers allows them to move freely, making cross-border conservation efforts essential. To ensure effective conservation, all roosting sites, foraging areas and migration corridors need to be conserved on a transboundary scale. The overall conclusion of CAP 2012 was that more systematic research is needed to fully understand bat ecology, movement patterns and the threats they face to develop comprehensive conservation strategies.

Following the publication of the CAP 2012, many research and conservation activities have been carried out (mostly connected with field surveys, communication campaigns and few conservation measures) in the region in the period 2013-2024, and new data on the status of bats, their habitats and main roosts, as well as on the ongoing threats, have been collected. Therefore, it was planned to use all this new data and update it with the latest information and define appropriate actions, keeping the same goal: to conserve bat roosts and their habitats.

1.1 TRANSBOUNDARY PRESPA PARK

The most prominent feature of the Prespa Lakes watershed is its transboundary character, which is manifested in various ways. This important element of this watershed was the basis for the commitment of the three states to support the protection of the natural and cultural heritage of the basin and its sustainable development, which was officially expressed in the "Declaration on the Creation of the Prespa Park and the Environmental Protection and Sustainable Development of the Prespa Lakes and their Surroundings", signed by the Prime Ministers of Albania, Greece and North Macedonia on February 2, 2000. With this declaration, the entire watershed of the Prespa Lakes was included in the Transboundary Prespa Park (TPP), **the first transboundary protected area in the Balkans**. Based on this Declaration, the Prespa Park Coordination Committee (PPCC) and its Secretariat were established, and important actions to support transboundary cooperation in Prespa were initiated. The TPP includes: the two Prespa National Parks (in Greece and Albania), parts of the Galičica and Pelister National Parks, the Ezerani Nature Park, the Prespa Lake Nature Monument and the Leskodol Landscape Reserve (in North Macedonia), the two Prespa Lakes (partially designated as Wetlands of International Importance under the Ramsar Convention), as well as the remaining areas in the Prespa watershed that are not protected by other conventions or national legislation.

Among other agreements between the three states concerning Prespa, it is important to note the two latest ones: a) the “Joint Statement of the Prime Ministers of the three States sharing the Prespa Lakes watershed” of November 27, 2009 (Pyli, Greece); and b) the Agreement on the Protection and Sustainable Development of the Prespa Park Area, signed by the Ministers of Environment of the three countries and the European Commissioner for the Environment (February 2, 2010). The latter aims to further support transboundary

conservation issues through the development of specific principles and mechanisms of cooperation, including the establishment of the Prespa Park Management Committee (with its Secretariat) and the Working Group on Water Management. The Agreement entered into force in 2019, and its practical implementation will finally begin in 2022, with the proper functioning of the Prespa Park Management Committee (PPMC), together with its associated Working Group on Water Management (WGWM), which focuses on the critical issue of integrated water management.

Transboundary cooperation between the three countries in Prespa has been achieved at various political levels (e.g. PPMC, municipalities), but also at the level of nature conservation, mainly through small-scale projects involving protected area management authorities, local NGOs and experts working in Prespa. In 2015, the Prespa-Ohrid Nature Trust (PONT) was established to support the growing environmental needs of the Prespa-Ohrid region, to respond to the lack of sufficient funding for conservation efforts and to provide long-term sustainable funding for the region's parks and local environmental actors. Since then, many conservation-related projects have been implemented in the basin, including the ongoing PrespaNet III project.

1.2 THE PRESPA LAKES' WATERSHED

The watershed of the Prespa Lakes includes high mountains and valley fields with an elevation lower than 900 m above sea level, of which about 37% is covered by forests (Popovska and Sekovski, 2011). It is in the central-western part of the Balkan Peninsula and is shared by Albania, Greece and North Macedonia (Fig. 1). Geographically, it is divided into two sub-basins: the Greater Prespa Lake (synonyms: Macro Prespa Lake, Liqeni i Prespes, Limni Megali Prespa, Golemo Prespansko Ezero) and Lesser Prespa Lake (synonyms: Micro-Prespa Lake, Liqeni i Prespes, Limni Mikri Prespa or Malo Prespansko Ezero). The largest part of the Greater Prespa Lake watershed is in North Macedonia, while Albania and Greece share a smaller part (Fig. 2). The Lesser Prespa Basin is shared between Greece (about 80% of the basin) and Albania (Fig. 2). The territory of the Prespa Watershed belongs to three local administrative units, one in each of the three countries: the Municipality of Resen - North Macedonia, the Municipalities of Pustec and Devoll, both part of the Korca District - Albania, and the Municipality of Florina - Greece. About 30,000 people live in the Prespa region. The total area of the combined sub-basins and lakes is 1218.1 km^2 (Perennou et al., 2009), but according to Chavkalovski (1997) the total area of the hydrological basin is 1349.2 km^2, of which 1095.3 km^2 belong to the Greater Prespa Lake and 254.0 km2 to the Lesser Prespa Lake.

FIG. 1. BALKAN PENINSULA MAP WITH PRESPA LAKES' WATERSHED INDICATED

1.3 AREA OF INTEREST

This Action Plan covers an area of the Prespa Lakes Watershed, in all 3 sides of the border between Albania, Greece and North Macedonia. As bats are flying animals and may have their roosts outside the Prespa Lakes watershed, although used for foraging, this action does not focus solely on the protected areas or the watershed. We have selected a wider area based on management and ecological criteria. In fact, several caves located on Mt. Galičica in the Ohrid Lake watershed, but very close to the Prespa watershed, were also included in area of interest (Fig. 2). This is because they are likely to be used by bats whose summer or winter roosts are in the Prespa area.

1.4 PHYSICAL FEATURES AND HYDROLOGY

Prespa Lakes (together with Ohrid Lake) are the remnants of the ancient Aegean Sea, which formed millions of years ago (during the Neogene) in valleys created by earthquakes and land movements (Trajkovski and Apostolova, 2024).

The Prespa Lakes are situated on a plain at an altitude of about 850-900 m above sea level, surrounded by high mountain ranges, which form the watershed of the Prespa Lakes. These are: Baba (Pelister, 2601 m) and Varnous (2330 m) to the east of the basin, Plakenska Planina (Stalev Kamen, 1998 m) and Bigla (1656 m) to the north, Galichica (Vir, 2287 m) and Mali Thate / Suva Gora (2284 m) to the west, Ivan (1770 m) and Triklario / Sfika (1750 m) to the south-southeast.

Greater Prespa Lake has a surface area of 253.6 km2 (Perennou *et al.*, 2009) or 273.2 km2 at a water level of 851.83 m above sea level (Chavkalovski, 1997). Its maximum depth is 54 m, its average depth is 18.8 m and the length of its shoreline is 100.1 km. As the water flows down through the limestone into Lake Ohrid near the village of Gorice e Vogel (Vragodupka, Zaver or Zaveri), the water level and the surface of the lake fluctuate annually and through the years. Annual fluctuations range from 0.5 m to 1.75 m, while periodic fluctuations are up to 4.5 m (Chavkalovski, 1997).

The current water level is about 843-845 m a.s.l. Recently, Trajkovski and Apostolova (2024) estimated that the level of Lake Prespa has decreased by about 6 m compared to this water level, with a decreasing trend of 10.9 cm/year (or cca. 10m since the 1950s.). The watershed of the Greater Prespa Lake is characterized by a developed hydrographic network, mainly in its eastern and northern parts, less developed in its western and southern parts.

Lesser Prespa Lake has a surface area of 47.4 km2 (Perennou *et al.*, 2009). It has a maximum depth of 8.4 m, a maximum length of 13 km, and in recent years the water level has been around 853-854 m a.s.l. Since 1975, the water level of Lesser Prespa Lake has remained higher than that of Great Prespa Lake (Hollis and Stevenson, 1997). An alluvial isthmus 4 km long and 100-500 m wide separates the two lakes. The lakes are connected by a small channel on the westernmost part of the isthmus. The outflow of water from the former to the latter is controlled by a system of sluice gates originally built in 1969 on the channel

connecting the two lakes (the first lock was positioned in 1987). This system was restored in 2004 to control the water level of Lesser Prespa Lake (Kazoglou *et al.*, 2010). All these changes began with human interaction with the diversion of the Aigos Germanos torrent from Micro to Macro Prespa Lake (1936), followed by the diversion of the Devolli River (during the 1970s in Albania) to Micro Lake, which initially created an alluvial isthmus (Trajkovski and Apostolova, 2024).

1.5 GEOLOGY

The rock masses belong to the West Macedonian geotectonic unit (Klincarov, 1997), which is divided into five segments. The watershed of Prespa Lake belongs to the Pelister - Shar Mountain segment (Arsovski, 1997). The mountains in the east are composed of silicate rocks (schists, magmatic and volcanic rocks), while the mountains in the north, south and west are mainly carbonaceous (limestone complex). The lowland part of the watershed is composed of a clastic complex of sediments (clay sediments, fluvioglacial residues, alluvial sediments, lake-swamp sediments and proluvial deposits). Due to the porous limestone rocks in the west, there is an underground water flow from the Prespa Lakes to the lower Ohrid Lake, where the water appears as numerous sublacustrine and strong surface springs, such as Drilon in Albania and St. Naum in North Macedonia.

The most important rocks for the formation of the karst forms are the massive Triassic limestones. They are 500 to 550 m thick and are located above the clastic layers of conglomerates and sandstones (Dumurzanov and Ivanovski, 1978). The limestone rocks are usually gray or light gray with distinct cracks. They form the western and southern part of the Prespa Lakes watershed. In addition to the lithological content of the rocks, there are other factors that influence the formation of underwater karst forms (caves), such as tectonics (fault lines and cracks) and changes in climate (especially changes in humidity - rainfall).

1.6 CLIMATIC FEATURES

The climate of the area is under Mediterranean and continental influences and could be characterized as continental-central European. The main climatic modifier is the water mass of the Greater Prespa Lake with its thermodynamic inertia, which influences the entire Prespa watershed. The average annual air temperature was 10.2°C in 1931-1960 and 9.6°C in 1961-1987. According to more recent data (1991-1995), the average air temperature in the north of the lower part of the watershed was 9.5°C (Resen meteorological station) and 10.8°C in the east (Pretor meteorological station) (Ristevski *et al.*, 1997). The warmest month is July, with an average monthly temperature of 19.2°C, and the coldest is January, with an average temperature of 0.2°C (Lazarevski, 1993). The earliest freezing temperatures occur in October and the latest in May. The average duration of frost is 167 days. Precipitation is under the influence of the Mediterranean pluviometric regime. Precipitation occurs mainly in late fall and winter, while the least amount of rainfall is recorded in July and August. The

average precipitation in 1961-1991 was 730 mm/m^2. In the lower parts of Prespa, precipitation is between 600 and 700 mm, in the mountain belt it increases to 800-900 mm, and in the high mountain belt it is up to 1000 mm (it can reach 1400 mm in the wettest years) (Ristevski, 2000). Prespa is characterized by a unique regime of local winds, conditioned mainly by the water mass of the Greater Prespa Lake and by the unequal warming of the air above the lake surface and above the ground.

The Intergovernmental Panel on Climate Change (IPCC) 2022 report states that temperatures in the Mediterranean are rising 20% faster than the global average, with regional temperatures already 1.5°C above pre-industrial levels. This accelerated warming will have a significant impact on water bodies such as Lake Prespa, with reduced precipitation and increased evaporation, potentially leading to the complete drying of the lake (Trajkovski and Apostolova, 2024). Recent climate scenarios used to calculate the progression of Prespa's water loss showed that Prespa Lake would dry up in 50 to 80 years under the worst and best scenarios (Trajkovski and Apostolova, 2024).

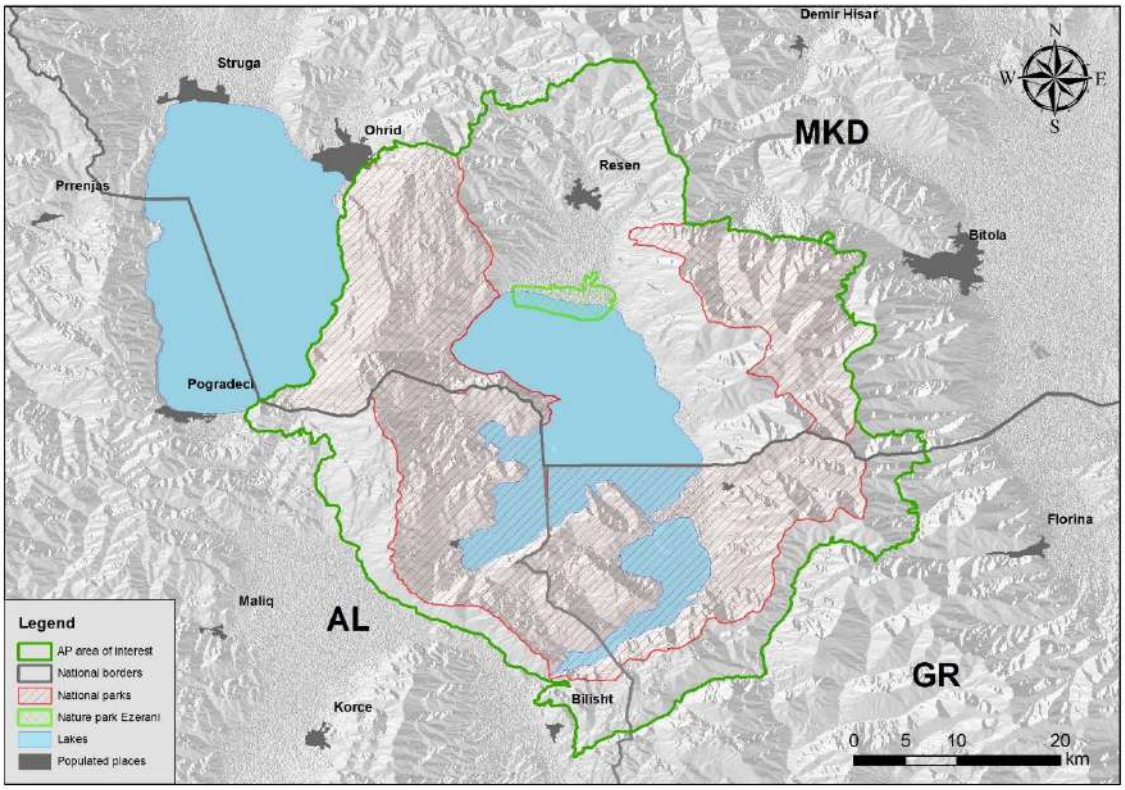


FIG. 2 THE PRESPA LAKES' WATERSHED AND REVIEW OF ALL PROTECTED AREAS

2. NATURAL VALUES OF TRANSBOUNDARY PRESPA PARK

2.1. GENERAL DESCRIPTION (OF BIODIVERSITY VALUES)

The area is known for its unique geomorphology, rich biodiversity and ecological importance. The lakes and their surrounding watersheds serve as vital habitats for rare, endemic and globally threatened species of flora and fauna. Key biological resources include over 260 bird species, including over 140 nesting and over 90 migratory species, making the area an important nesting and stopover site (Catsadorakis 1997; DEKONS-EMA 2009; Catsadorakis et al. 2013, 2021). The site is of international importance for globally threatened bird species such as the Dalmatian Pelican *Pelecanus crispus* and the Great White Pelican *Pelecanus onocrotalus* - (Ramsar, 2024).

Lake Prespa hosts 26 fish taxa (13 native), including 8 endemics (local or south-east European endemics), which represents high endemism - 89% in fish (Trajchevski *et al.*, 2020). There is also 37.5% endemism in mollusks - marking it as a distinct biogeographical region (Albrecht *et al.*, 2012). This ancient lake also supports diverse wildlife, including around 60 species of mammals (Catsadorakis and Bousbouras, 2010; Papadatou *et al.*, 2011), 11 species of amphibians, 21 species of reptiles, and more than 1,500 species of plants and algae (SAP, 2012).

The ecosystem also includes significant natural landforms such as forests, subalpine grasslands, heaths, and caves (Papadatou *et al.*, 2011), some of which host thousands of bats (Treni, Cherna, and Bimbilova caves).

2.2. LAW TOOLS FOR PRESPA BIODIVERSITY PROTECTION

Macro and Micro Prespa Lakes and their watersheds are regulated and protected by several national and international legal instruments. In Albania and Greece, the entire Prespa watershed is covered by a single protected area in the form of a national park. In North Macedonia, however, the Prespa watershed is much larger and includes, in whole or in part, two national parks, one Nature Park and one Monument of nature. In addition, the Prespa Lakes are recognized as a Wetland of International Importance under the Ramsar Convention. The Greek part is designated as a Natura 2000 site (EEA, 2023).

Albania

The Prespa National Park on the Albanian side was established in 1999 and is a key site for biodiversity conservation, with a special focus on bat species. It includes the Treni Cave, a natural monument of high importance (IUCN Category III) and a significant cultural heritage site.

The Prespa Ramsar site (site No. 2151, covering 15,119 hectares), which was designated in June 2013 under the Ramsar Convention (1971), which Albania ratified in 1996, is also part of the Prespa National Park – AL encompassing parts of the watershed.

Albanian environmental legislation is largely aligned with EU standards and reflects key principles of EU environmental law. This modern legislative framework has been developed with international expertise and ensures compliance with Albania's obligations under global environmental conventions and agreements, but there are still issues with law enforcement.

Key legislation on protected areas and biodiversity includes:

- Law No. 81/2017 "For Protected Areas" and its amendments, which establish the framework of the proclamation, management and sustainable use of protected areas[1];
- Law No. 9587, dated 20.7.2006 "For the Protection of Biodiversity" and its amendments, which aims to protect biological diversity, regulate its sustainable use, ensure the operation of a network to protect habitats, take action to ensure a favourable status for habitats and fauna species and to incorporate the socio-economic needs;
- Law No. 10 006, dated 23.10.2008 "For the Protection of Wild Fauna" and its amendments, which aims to protect, manage, and control wildlife, to preserve species, their populations, the habitats in which they live, their migration routes, as well as ensure their requirements for food, shelter and reproduction.

Greece

The Prespa National Park and adjacent areas in Greece, fall under multiple layers of protection, both national and international. At the national level, a large part of the area was designated as a "Prespa National Forest" in 1974 (Presidential Decree 46/1974), initially encompassing Lesser Prespa lake and an old-growth juniper stand as a "core" areas, and surrounding agricultural land, grasslands, and forests as a "peripheral zone", but excluding the northern-eastern mountainous area (Mt. Varnous), offering several prohibitions, but no real tools for the protection and conservation of the ecosystem. In 2009, a Joint Ministerial Decision (46508/2009) revised the spatial and legal framework of Prespa National Park, delineating zones with the inclusion of management provisions. Importantly, this reconfiguration incorporated areas already designated under the Natura 2000 network, aligning it more closely with the European Union's environmental legislation.

Presidential Decree 67/1981 "On the protection on native flora and fauna" (Greek legislation), lists protected species of flora and fauna, including several bat species (see Table 3).

Prespa National Park includes three Natura 2000 sites that protect a variety of habitats and species of Community interest. In 1999, **GR1340001 – Ethnikos Drymos Prespon**, was designated as a Special Protection Area (SPA) under the Birds Directive (2009/147/EC), and

[1] However, the latest amendment with the Law No. 21/2024, has provoked many reactions within nature conservation community in the country.

GR1340002 – Limni Mikri Prespa, both as a Special Protection Area (SPA) and a Site of Community Importance (SCI) under the Birds (2009/147/EC) and Habitats (92/43/EEC) Directives, respectively. Additionally, **GR1340003 – Ori Varnounta** was designated as an SCI in 2001. The SPA sites primarily focus on avian conservation, while the SCIs emphasize on key habitats, and supported species, including bats of conservation concern (see Table 1 below for a list on bat species under Annex II and Annex IV of the Habitats Directive).

Additionally, the area was designated as a "landscape of exceptional beauty" (Ministerial Decree 23211/1747/1975). This national recognition was later reinforced in 2002 by its designation as a protected landscape under the European Landscape Convention (ELC), with site code LC-01. The ELC status emphasizes the preservation, management, and planning of the area's diverse landscape features - including wetlands, forests, and mountainous zones—that are vital for biodiversity.

Greece ratified the Ramsar Convention in 1974 and designated Lesser Prespa Lake as a wetland of international importance in August 1975 (site No. 60, covering 5,078 ha).

North Macedonia

In North Macedonia, the watershed of Lake Prespa is protected by the:

- The institutional framework of the Galičica National Park, established in 1958;
- Institutional Framework of Pelister National Park, established in 1948;
- Institutional Framework of Ezerani Nature Park, established in 2012 (previously proclaimed as Strict Nature Reserve in 1996);
- Institutional Framework of Prespa Lake Monument of Nature, established in 2011.

Prespa Lake Monument of Nature and Ezerani Nature Park are also part of the Prespa Lake Ramsar Site (Site No. 726, 18,920 ha), designated in June 1995 under the Ramsar Convention (1971), which was ratified by North Macedonia in 1991.

The main law regulating protected areas and biodiversity conservation is the Nature Protection Law (Official Gazette of the Republic of Macedonia, No. 67/04). The Nature Protection Law has transposed most of the EU legislation with all directives and regulations, as well as obligations arising from relevant ratified international agreements. The Law regulates the protection of nature through the protection of biological and regional diversity and the protection of natural heritage both inside and outside protected areas.

There are also two strategic documents relevant to biodiversity conservation:

- National Biodiversity Strategy and Action Plan (2018-2023), which is aligned with the objectives of the Convention on Biological Diversity and the EU Biodiversity Strategy.
- National Strategy for Nature Protection (2017-2027), which includes appropriate measures and activities for the protection and sustainable management of the environment, as well as measures arising from the obligations of international documents (conventions and agreements) ratified by North Macedonia in the field of environmental protection and relevant EU legislation.

3. THE IMPORTANCE OF BATS IN EUROPE: WHY BATS MATTER

Bats are an important part of European biodiversity and are the only mammals capable of true flight (Burgin *et al.*, 2018). They represent more than 20% of all mammal species worldwide, with 47 species found in Europe, each contributing to the health and balance of ecosystems (Russo, 2023). The diversity of European bats is evident in the wide range of habitats they occupy. Although there is a marked north-south gradient in Europe, both in terms of species numbers and individual bats (Fig. 3), bat species can be found using habitats across the continent (Barova and Streit, 2018).

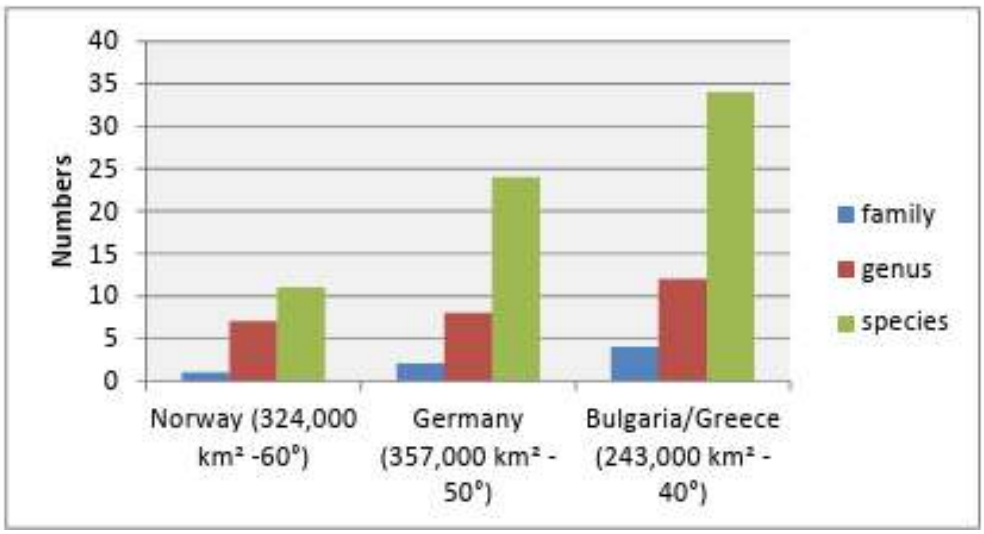


FIG. 3. NORTH-SOUTH GRADIEN OF FAMILIES, GENUSES AND SPECIES OF THE BATS IN EUROPE (BAROVA AND STREIT, 2018)

Bats are of high conservation concern throughout Europe. They are considered one of the most threatened species in Europe due to constant disturbance, intensive agriculture, loss of habitat and roosting sites (Terry and Temple, 2007).

The European Red List shows that almost half of the bat species are categorized as near threatened, vulnerable or endangered (NT, VU or EN), and the other half is considered that they are not currently at significant risk (or there is not enough data on their status; Fig.4).

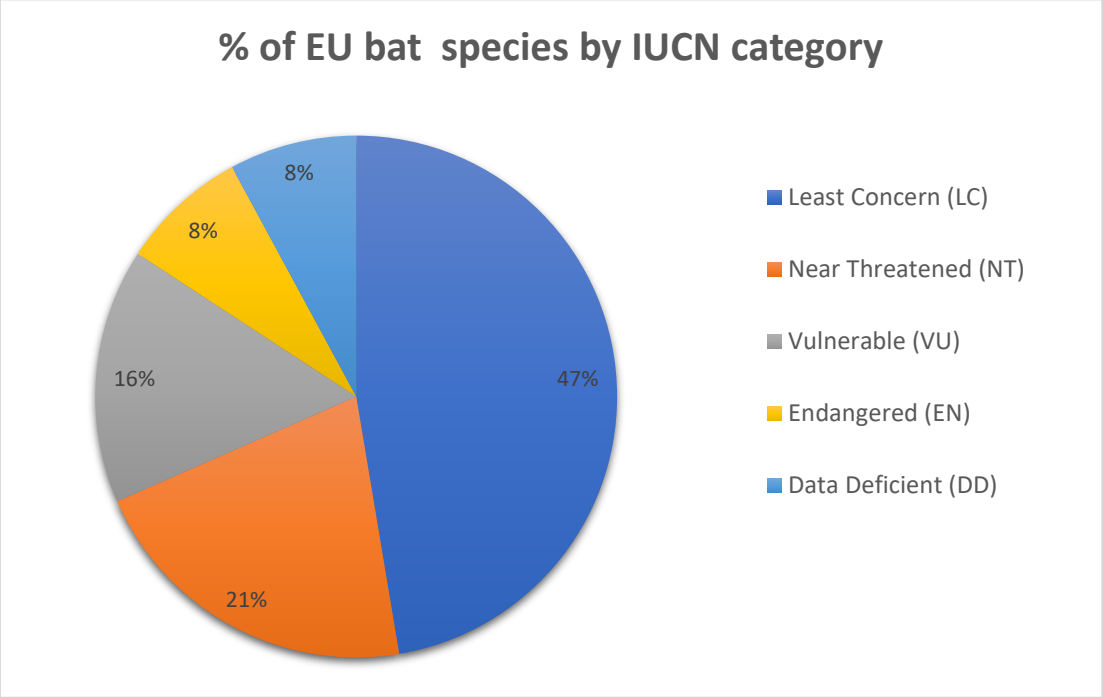


FIG.4. PERCENTAGE OF BAT SPECIES (40 SPECIES ARE INCLUDED) IN EACH IUCN CATEGORY IN EUROPE BASED ON TERRY AND TEMPLE (2007).

This high conservation concern for bats encompasses several legal documents (international conventions and agreement, as well for EU member state The Habitats Directive (Council Directive 92/43/EEC) described in chapter 3.3.

As Greece is part of the EU, a (multi) species action plan (SAP) applies to all bat species found in the EU and should be followed (Barova & Streit, 2018). This plan supports the development of national and local action plans, as well as the implementation of conservation measures. It provides baseline data on the status of bat species in the EU, science-based recommendations for their conservation, and a common framework for different stakeholders.

A National Action Plan for 10 cave-dwelling bat species was developed (Georgiakakis and Kafkaletou-Dietz, 2022) and adopted under a Joint Ministerial Decision (83436/2165) in 2024. This action plan outlines comprehensive action categorized into four main areas:

Protection and conservation measures include roosting site management actions, such as installing bat-friendly fences, improving cave microclimates, managing surrounding vegetation, and restoring entrances of mines and old buildings used by bats, albeit specifying measures for highly visited caves in Greece, proposing feasibility studies for the rest. Under colony management measures, improvements to old buildings and other structures, holding refuges are improved, including buildings in Prespa, referring to action for >300 individuals; *Rhinolophus ferrumequinum, R. hipposideros.*

Policy Measures focus on updating legal frameworks and integrating bat protection into environmental legislation. Legal protection is proposed through defining protection zones,

such as the establishment of "cave micro-reserves" to legally protect significant bat habitats, as predicted under Law 3937/2011.

3.1 ECOLOGICAL ROLE AND ECONOMICAL IMPORTANCE OF BATS

European bats thrive in diverse habitats, including forests, urban and semi-urban areas, and wetlands. They use a variety of roosting sites such as caves, tree hollows, attics, cracks in buildings, and abandoned structures like hotels or factories. Some species form colonies in trees, while others depend on natural or artificial underground shelters for mating, hibernation, and raising young.

Bats forage across diverse landscapes, including urban areas, forests, pastures, rivers, and coastlines, relying on networks like tree lines, hedgerows and riverbanks for navigation (Dietz *et al*., 2009).

Bats (as top predators) are key indicators of environmental health, reflecting the state of biodiversity and habitat management. However, few of the European species can be found in all these habitats, showing the high specialization of these animals. Opportunistic species like *Pipistrellus pipistrellus* or *P. kuhlii* can adapt to varied conditions, while others, such as *Myotis bechsteinii* and *Nyctalus lasiopterus*, require well-preserved habitats (Dietz *et al*., 2009).

In Europe, by feeding mostly on insects and other invertebrates (the exception is the Egyptian fruit bat), bats play a critical role in pest control. They act as natural insecticides (Puig-Montserrat *et al*., 2020) consuming pests that threaten crops (e.g. Aizpurua *et al*., 2018) and forests (e.g. Garin *et al*., 2019) and help maintain ecological balance.

For example, *Rhinolophus euryale* feeds on moths and flies (Goiti, 2004), while *Myotis emarginatus* targets spiders and harvestmen (Bauerova, 1986), and in the guano of *Miniopterus schreibersii are* identified >200 species, 44 of which are known to cause agricultural damage (Aizpurua *et al*., 2018). Pest species were detected in 94% of the analysed samples.

3.2 ADAPTATIONS AND CHALLENGES IN LIFE CYCLE OF BATS

Bats display remarkable adaptability in their behaviour and physiology. Bats to survive harsh winters without insects, migrate and hibernate.

Species like *Pipistrellus nathusii*, *Nyctalus noctula*, *Nyctalus lasiopterus* (Fig.5), migrate thousands of kilometres to adapt to seasonal changes (Hutterer *et al*., 2005).

Hibernation is one of the two most sensitive periods in the life of a bat. To survive insect-poor winters, bats hibernate in caves, crevices, and underground man-made structures. Disturbances during this period can deplete their energy reserves and lead to mortality.

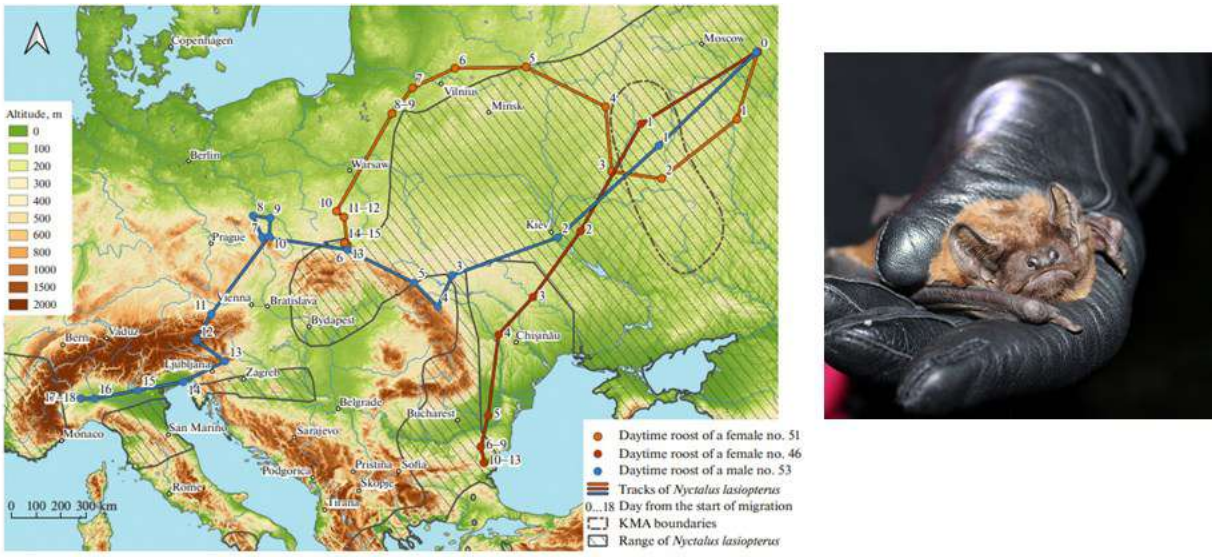


Fig. 1. Autumn migration flights of three greater noctule bat tagged with GPS-GSM trackers. Numbers indicate the location of each individual, corresponding to the days of migration from its start date. The range of the greater noctule bat is given according to [9], the boundaries of the Kursk magnetic anomaly (KMA) according to [10].

FIG. 5. AUTUMN MIGRATION OF *NYCTALUS LASIOPTERUS* (VESENKOV *ET AL.* 2023); PHOTO OF BAT: WILDLIFE MONTENEGRO.

Another sensitive period in the annual bat cycle is the period of maternity colonies (Fig. 6). From May to August, hundreds of young are being raised in bat colonies. Disturbances during this critical period can disrupt adult bats, resulting in potential mortality of juveniles due to the lack of flight ability.

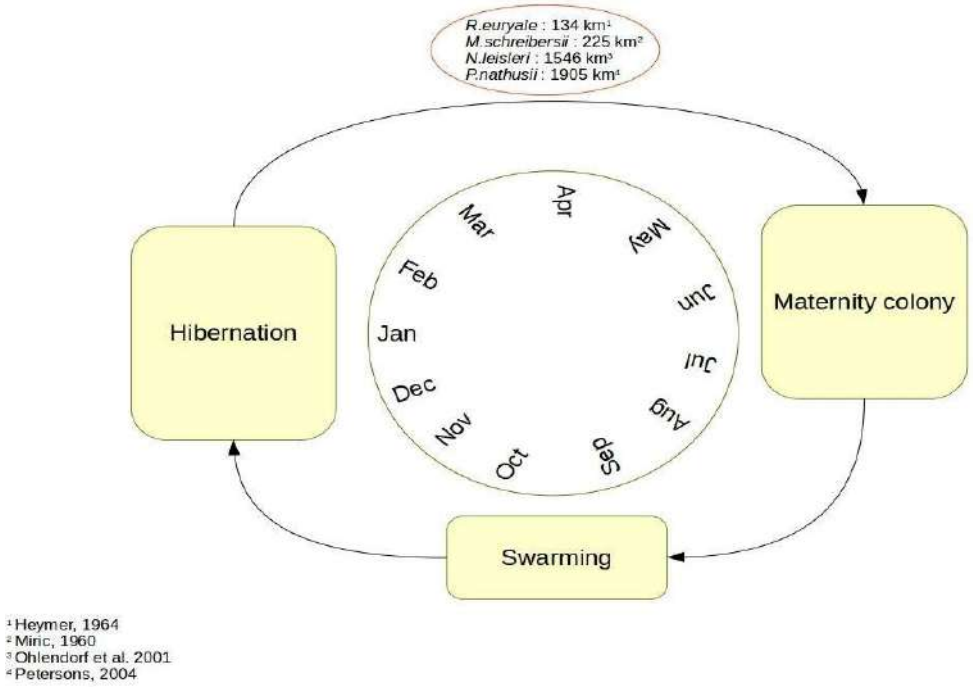


FIG. 6. YEAR CYCLE OF EUROPEAN BATS, AND MAXIMUM MIGRATION DISTANCES FOR SELECTED SPECIES (THÉOU AND ĐUROVIĆ, 2015).

The diversity of bat species is also reflected in their use of echolocation. Almost all European bats are insectivorous and rely on echolocation to navigate and hunt (the only exception is the Egyptian fruit bat), with techniques varying by species, habitat, and purpose. Echolocation is a biological sound (sonar) system where bats emit ultrasonic sound waves (most of this sound range is not hearable by humans) and interpret the returning echoes to perceive their surroundings. Advanced technologies now enable the identification of some bat species through recorded calls (Fig. 7). European bats can be grouped into four main echolocation categories (Barataud, 2014):

- *Rhinolophus* species (FM/CF/FM, 75–118 kHz)
- *Nyctalus* species (QFC, 13–23 kHz)
- Mixed species like *Pipistrellus* spp. (QFC and FM, 9–57 kHz)
- *Myotis* spp. and others (Abrupt FM, 25–90 kHz)

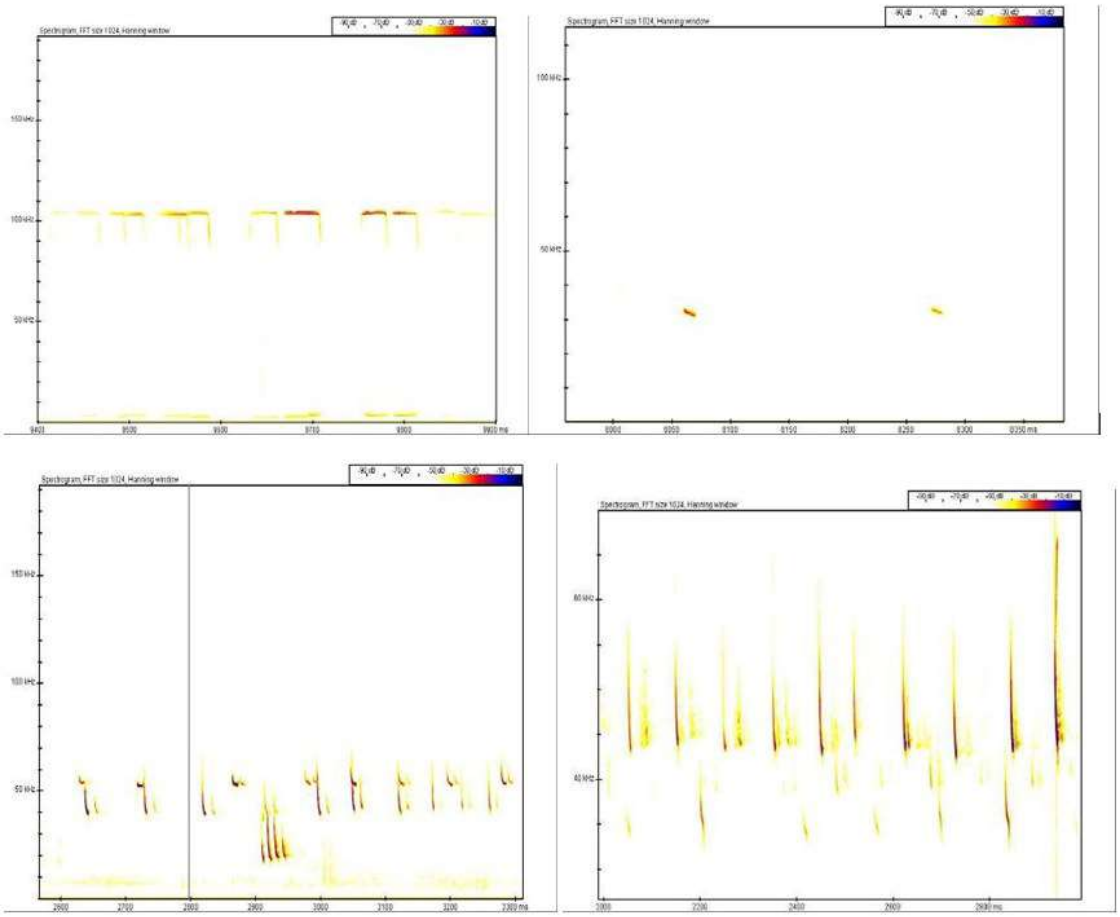


FIG. 7. EXAMPLE OF SONOGRAM FOR THE 4 DIFFERENT GROUPS (THÉOU AND ĐUROVIĆ 2015).

The ecological roles, adaptability, and diversity of bats highlight their importance to biodiversity and human well-being. By conserving bats, we protect critical ecosystem services, such as natural pest control and habitat health, and ensure the preservation of these remarkable mammals for future generations.

3.3 THREATS AND CONSERVATION CONSIDERATIONS

Reflecting the broader trend of European biodiversity loss, bat populations in Europe have dramatically declined over the past 60 years. Some species, such as horseshoe bats (*Rhinolophus* spp.), have disappeared or suffered severe reductions in central Europe. This decline (firstly recorded in France, on horseshoe bats) is primarily attributed to the post - World War II increase in pesticide use in agriculture (Brosset, 1988), along with habitat destruction caused by urbanization, the expansion of intensive agriculture, and the extraction of building materials.

- Several EUROBATS guidelines address specific conservation issues, including:
- Protecting and managing underground sites for bats (Mitchell-Jones *et al.*, 2007)
- Protection of overground roosts for bats (Marnell and Presetnik, 2010)
- Guidelines for Surveillance and Monitoring of European Bats Guidelines for Surveillance and Monitoring of European Bats (Battersby, 2010)
- Guidelines for consideration of bats in wind farm projects *Revision 2014* (Rodrigues *et al.* 2015)
- Guidelines for consideration of bats in lighting projects (Voigt *et al.*,2018)
- Guidance on the conservation and management of critical feeding areas and commuting routes for bats (Kyheröinen *et al.*, 2019)
- Guidelines for bats, insulation and lining materials (Jahelková et. al, 2024)
- Guidance on the consideration of bats in traffic infrastructure projects (Matthews *et al.* 2024)

In a more limited but notable context, bat research itself has sometimes negatively impacted populations. Disturbances during hibernation and the use of inadequate ringing or capture protocols have led to unintended harm in certain countries.

3.4 INTERNATIONAL LEGAL ACTS SUPPORTING BAT CONSERVATION

Since the 1990s, several international conventions have been established to protect biodiversity and the environment, with two key agreements directly supporting bat conservation in Europe:

Bern Convention

The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) is a legally binding international treaty aimed at protecting wildlife in Europe and its natural habitats while fostering cooperation among countries. It also ensures that conservation efforts are integrated into broader policy decisions, recognizing the ecological, cultural, and economic value of biodiversity.

Albania (1999), North Macedonia (1999), and Greece (1983) have ratified the Convention and committed themselves to implementing its provisions. With over 50 signatory countries in Europe and Africa, the Convention has led to the establishment of a network of protected areas that ensure the conservation of key species and habitats.

A key part of this effort is the Natura 2000 network, which focuses on protecting species and habitats of European importance.

Bonn Convention

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), also known as the Bonn Convention, is a United Nations treaty established in 1979 to protect migratory species throughout their range. It promotes international cooperation among countries, NGOs and other stakeholders to ensure the survival of these species and their habitats.

Albania (2001), North Macedonia (1999) and Greece (1983) have ratified the Convention, committing themselves to coordinated conservation action for migratory wildlife. CMS plays an important role in aligning national policies with global conservation efforts to ensure long-term sustainability.

Species that require or would significantly benefit from international cooperation are listed in Appendix II of the Convention. This includes all the bat species found in Prespa (Table 3). The Bonn Convention encourages range states (countries where these species occur) to enter into regional or global agreements to enhance their conservation.

EUROBATS Agreement

This Agreement, ratified by Albania (2001) and North Macedonia (1999), was made under the Convention on Migratory Species (Bonn Convention) and requires Parties to:

- Identify and protect important sites for bats, including shelters and foraging areas, from damage or disturbance.
- Cooperate to increase knowledge and understanding of bats, both nationally and internationally.

This new Conservation Action Plan for bats is in line with the objectives of EUROBATS to increase national expertise, improve biological data and strengthen conservation efforts in Albania and North Macedonia.

EU Habitat Directive and Natura 2000 Network

Although not yet members of the EU, Albania and North Macedonia are actively aligning their national legislation with the EU Habitat Directive as part of their commitment to environmental conservation and future integration into the EU framework and therefore on the creation of the Natura 2000 sites network in a near future. EU Habitats Directive (92/43/EEC) identifies species of Community interest, such as the following:

(i) endangered, except those species whose natural range is marginal in that territory, and which are not endangered or vulnerable in the western Palaearctic region; or
(ii) vulnerable, i.e. believed likely to move into the endangered category in the near future if the causal factors continue operating;
(iii) rare, i.e. with small populations that are not at present endangered or vulnerable but are at risk. The species are located within restricted geographical areas or are thinly scattered over a more extensive range; or
(iv) endemic and requiring particular attention because of the specific nature of their habitat and/or the potential impact of their exploitation on their habitat and/or the potential impact of their exploitation on their conservation status.

From this definition, species have been classified in three different annexes (II, IV and V), attached to the Directive. All the species listed in Annex II and IV must be strictly protected in their natural range.

Prohibited activities under Article 12 of the Habitat Directive include:

(a) all forms of deliberate capture or killing of specimens of these species in the wild;
(b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration;
(c) deliberate destruction or taking of eggs from the wild;
(d) deterioration or destruction of breeding sites or resting places.

In addition, the species listed in the Annex II of the Directive require the designation of Special Areas of Conservation, which are part of the European Natura 2000 network (Table 1).

Greece, as a third country sharing the Prespa Lakes ecosystem and as a member of the EU, has already applied the EU Habitats Directive at national level and has the status of a non-party range state to the EUROBATS Agreement. In addition, the Greek side of the Prespa region has been designated as a Natura 2000 site due to the presence of 25 Natura 2000 habitats and 131 species, including the Bechstein's bat (*Myotis bechsteinii*) (EEA, 2023).

TABLE 1: SPECIES OF BATS PROTECTED BY EU HABITAT DIRECTIVE (* - PRESENT IN TRANSBOUNDARY PRESPA REGION)

ANNEX II *ANIMAL AND PLANT SPECIES OF COMMUNITY INTEREST WHOSE CONSERVATION REQUIRES THE* *DESIGNATION OF SPECIAL AREAS OF CONSERVATION*	*ANNEX IV* *ANIMAL AND PLANT SPECIES OF COMMUNITY INTEREST IN* *NEED OF STRICT PROTECTION*
1. *Rhinolophus blasii**	All species
2. *Rhinolophus euryale**	
3. *Rhinolophus ferrumequinum**	
4. *Rhinolophus hipposideros**	
5. *Rhinolophus mehelyi*	
6. *Barbastella barbastellus**	
7. *Miniopterus schreibersii**	
8. *Myotis bechsteinii**	
9. *Myotis blythii**	
10. *Myotis capaccinii**	
11. *Myotis dasycneme*	
12. *Myotis emarginatus**	
13. *Myotis myotis**	
14. *Rousettus aegyptiacus*	

4 BATS IN TRANSBOUNDARY PRESPA PARK

4.1 REVIEW OF BAT RESEARCH AND CONSERVATION ACTIVITIES TRANSBOUNDARY PRESPA PARK

4.1.1 ALBANIA

a. Overview until AP 2012 (Papadatou *et al.*, 2011 and Papadatou *et al.*, 2012)

The first study on bats in the Albanian part of Prespa was conducted in May 1991 by Czech researchers (Chytil and Vlašin 1994). Their most important discovery was a large colony of about 10000 individuals of *Myotis capaccinii* in the Treni Cave, the largest known colony of the species in Europe at the time. In April 1995, a joint expedition of Slovak, Czech and Albanian researchers was organized in the Prespa area and other important sites in Albania (Uhrin *et al.* 1996). This survey resulted in new records on bat species in the Albanian part of Prespa, raising the number of known bat species to nine (*Rhinolophus ferrumequinum*, *R. blasii*, *R. hipposideros*, *Eptesicus serotinus*, *Myotis myotis*, *M. capaccinii*, *M. daubentonii*, *Hypsugo savii* and *Miniopterus schreibersii*). Of these, in that time, seven of them were in Treni Cave, thus making it the most important known underground roost in this side of Prespa, and one of the most important caves in Albania. However, the researchers counted only 1000 *M. capaccinii* during this visit. In 2008, the Treni Cave was surveyed as a part of a project conducted by the Albanian Society for the Protection of Birds and Mammals (ASPBM). During this period, the cave was fully explored by speleologists. During (2009-2011) the Treni Cave was studied by the French and local researchers and naturalists in cooperation with the SPP, adding new species to the list (*R. euryale, Tadarida teniotis* and *Plecotus sp.*). Within the framework of this project, the rocky shore of the Greater Prespa Lake was explored and new roosts, including some important caves for bats, were discovered.

Probably the most important cave on the Albanian side of Prespa is Treni Cave, which is used throughout the year by large summer colonies, swarming/mating bats, hibernating populations and bats that simply use it as an autumn shelter (Table 2). It is one of the most important known hibernacula in the area (along with Bimbilova and Samotska dupka caves in MK). In summer, the cave hosts several thousand breeding bats of *Myotis capaccinii* and males of *Miniopterus schreibersii*. Other species, such as *Myotis myotis*, may also breed in the cave. In the fall, several hundred mostly male *Mi. schreibersii* roost in the cave, while another eight species use the cave as a shelter and/or swarming and/or mating site (Table 2). In winter, several hundred *M. capaccinii* hibernate in the cave, while only a few bats of other species (*R. ferrumequinum*, *R. hipposideros*, *E. serotinus*, *M. daubentonii, M. blythii, Pl. spp*[2], and *H. savii).*

2 Later determined as Pl. austriacus, Pl. kolombatovici (Théou et al., 2015)

Previous CAP 2012 noted that Zaveri (also known as Zavir), Gollomboç, Petralia, Kosornik, Zaroshka, and Golema Dupka (Kallamas) caves (Fig. 3) also appeared to be important for bats, but their significance should be further investigated as they are not used all year round. The amount of bat droppings on the floor and urine stains on the walls and ceiling suggests that they are relatively heavily used by bats, probably during spring and summer. This has been confirmed for at least one small cave near the village of Gollomboç, where *M. daubentonii*, *M. capaccinii*, *E. serotinus* and *H. savii* were found in 1995 (Uhrin *et al.* 1996). Only a few *R. hipposideros* were found in the fall and winter. Based on the amount of bat droppings and urine stains, it has been estimated that Zaroshka Cave hosts colonies of more than 1000 bats in spring and summer (Bego, 2011). Zavir (also knowns as Zaveri) Cave was used by more than 1000 bats in autumn 2011.

Some of the other shallower caves along the lake shore have some bat droppings on the floor, suggesting their use by only a few bats as night or satellite roosts, and are therefore not described further here. Finally, the Pigeon Cave (Peshtera na gulabite) on Mali Grad Island was found to be used by a few thousand *Mi. schreibersii* in the fall of 2008 (W. Fremuth pers. com.), suggesting that the cave may only be used as a hibernaculum in the fall and perhaps in the spring (Table 2). The amount of bat droppings and urine stains on the ceiling suggests a long-term use by bats.

b. Overview since CAP 2012 (Théou *et al.*, 2015; Benda *et al.*, 2019)

Théou *et al.* (2015) provided new data on bat populations in the Albanian side of Prespa National Park, highlighting the importance of continued monitoring to improve knowledge of the ecological significance of the Prespa area. Their study expanded the number of recorded bat species in the area to 15 by adding *Plecotus austriacus*, *P. kolombatovici*, and *Tadarida teniotis* to the species list. The research, based on surveys conducted between 2012 and 2015, documented 45 bat roosts and confirmed the presence of over 5,000 individuals, reinforcing the crucial role of Prespa National Park for bat diversity and conservation in Albania and the southwestern Balkans. The comprehensive study by Benda *et al.* (2019) significantly advanced the understanding of bat diversity in Albania, including the Prespa region. They provided detailed distribution maps and ecological insights, highlighting the importance of the Prespa region as an important habitat for different bat species.

c. Preparatory actions for of AP (2025)

Within the framework of PrespaNet Project (2021-2024), several research expeditions have been carried out, which have improved the knowledge of the presence, number and distribution of bat species. In 2021, a specimen of *M. bechsteinii* was identified for the first time in the Albanian Prespa Basin (Théou, 2021). The most recent bat survey in 2023-24 provided data for 13 bat species from 33 sites, also discovering significant new colonies of *Mi. schreibersii*, *M. capaccinii*, *R. hipposideros*, *R. ferrumequinum*, and medium-sized Rhinolophus spp. (Nezaj & Bego, 2025). In addition to confirming the importance of several underground refuges such as Treni Cave, Zaveri Cave and other caves along the Great Prespa Lake, efforts have also been made for the forest-dwelling species. All the data

collected after 2011 were used for the revision of this CAP. Additionally, in the framework of this PrespaNet Project, some concrete conservation measures were taken by creating the first comprehensive management plan for one of the most important bat roosts in the whole trans-boundary Prespa (Bego, 2022).

4.1.2 GREECE

a. Overview till CAP 2012 (Papadatou et al., 2012)

The foundational on bats in Prespa, Greece, began more than a decade ago with the first CAP 2012 and focused on site surveys, monitoring, and bat-specific studies. The fieldwork involved trapping techniques and echolocation call recordings, mainly in lowland areas and cliffs near the lake shore, with limited exploration of upland areas such as forests, alpine meadows and mountain ridges.

The Bat Research Action (1995-2010) established a strong foundation for understanding bat diversity in the Greek Prespa region. Surveys focused on lake shore habitats and upland areas, resulting in a significant increase in known species from 8 in 1995 to 26 in 2010 (Catsadorakis and Kollaros, 1986; Helversen and Weid, 1990; Catsadorakis, 1995; Helversen, 2007 pers. com.; Grémillet *et al.*, 2010; Galand *et al.*, 2010; Papadatou *et al.*, 2011).

Tcherna Cave is perhaps the most important among caves on the Greek side of Prespa. It is used by bats for breeding in summer and for swarming, mating and generally as a shelter in autumn. In summer, the cave hosts important breeding mixed-species colonies of *R. euryale*, *R. ferrumequinum*, *M. capaccinii*, *M. emarginatus* and a male colony of *Mi. schreibersii* (Table 1). Male *H. savii* have also been found in summer near the cave entrance, probably roosting in rock crevices. Summer colonies comprise several thousand individuals. The large piles of droppings on the cave floor and the large stains on the ceiling are evidence of long-term bat use. The number of bats appears to have fluctuated over the years, suggesting that they move between a few different underground sites, probably forming a network, like the behaviour reported for *M. capaccinii* in Thrace, Greece (Papadatou *et al.* 2008, 2009). This is not surprising considering the number of known underground sites suitable for roosting throughout the Prespa area (Fig. 3 and Table 1). In the fall, several hundred males *Mi. schreibersii* can still be found in the cave, and other species may also roost in the cave in smaller numbers. The cave is also used by bats as a swarming/mating roost or simply as a night shelter. Thus, it is used by at least 10 bat species (Table 2). In winter, the cave is used by only a few bats (*R. ferrumequinum* and *R. hipposideros*).

The **cave at Cape Roti** is used by important breeding colonies of *M. capaccinii* and *M. daubentonii* (Table 2). *M. emarginatus* may also breed in the cave, but confirmation of this requires further investigation. It has not been possible to estimate the approximate size of the colonies because they roost in a dome high up in the ceiling, 10 m away from the ground, half hidden by rocks and smaller groups roost inside deep crevices. Nevertheless, there are at least several hundred and up to a several thousand individuals in summer. In autumn, the large maternity colonies have dispersed, and a few hundred individuals remain mostly inside rock crevices in the cave.

Psarades Cave (the "flea" cave in Papadatou *et al.* 2011) on the rocky shore near Cape Roti and opposite the village of Psarades (Fig. 3) showed signs of past, probably heavy, use (stains on the walls and ceiling and quantities of bat droppings mixed with the soil). It has not been used by large numbers of bats: only a few *R. ferrumequinum* were found in the fall of 2011.The lack of bat use, especially in summer, may be related to the large number of fleas in the cave and/or to the lowering of the water level of the lake since the 1970s, which may have altered the microclimate of the cave.

A significant part of the other, mostly shallow caves present along the shore of the Greek Greater Prespa Lake (Petrochilou *et al.* 1977) have been explored by X. Grémillet and colleagues up to the Albanian border (Padadatou *et al.*, 2011). No large bat colonies were found only small colonies or single roosting individuals.

Only a few *R. ferrumequinum* use the cave in summer. However, more than 700 individuals of *R. euryale* and *R. blasii* roost in the cave in spring and autumn, probably using it as a transitional site between their summer and winter quarters (Table 2). The cave may not be a typical hibernation site, but in February 2011 the site was used by a small number of medium-sized rhinolophids that were not in deep torpor.

Kokkalis' and **Zachariadis' Caves** are used by only a few *R. hipposideros* or *R. ferrumequinum* individuals during daytime. At night, however, they are used by many bats: Kokkalis' Cave is an important roost. Many bats also visit the site as a night roost in summer and probably autumn. A total of 11 species have been recorded using this site (Table 2). Zachariadis' Cave is not suitable for swarming and is rather used as a night roost in summer and autumn by several species including *R. euryale*, *R. blasii*, *Plecotus species* and possibly *M. emarginatus* (Table 2).

b. Overview since CAP 2012

Recent efforts in the Prespa region have focused on reducing light pollution and protecting biodiversity, especially bats. The Society for the Protection of Prespa (SPP) implemented a project under the Interreg IPA CBC program "Greece - Albania 2014-2020", co-funded by EU and national funds. The main actions undertaken were

1. Installation of photovoltaic systems in public buildings and pumping stations;
2. Replacing traditional public lighting with energy-efficient, environmentally friendly LED lighting.

These measures aimed to reduce artificial light at night (ALAN), especially in the sensitive Prespa Lakes area, to improve the protection of fauna, including bats (Brajanoska *et al.*, 2017). The 2018 and 2020 survey showed that the current streetlights do not meet ecological standards and contribute to light pollution, especially in the PA (Uhrin *et al.*, 2020). Efforts were made to replace some lights by 2020, but most municipal streetlights remained unchanged, resulting in no significant impact on bat activity. However, high light spill from unshielded luminaires increases skyglow, potentially creating barriers for bats and their prey.

3. Artificial lighting attracts nocturnal insects, creating "light traps" that disrupt natural feeding patterns. To reduce light pollution, Uhrin *et al.* (2020) suggested replacing fixtures with downward facing lights to minimize skyglow, reducing the number of streetlights, maintaining dark zones to support nocturnal wildlife, lowering streetlight poles, and using long-wavelength, low-impact bulbs. A bat survey was conducted from 2018 to 2020 (Uhrin *et al.*, 2020).

This survey confirmed the high bat diversity of the area, with 22 bat forms (20 species) recorded, including three species new to Greece: *Nyctalus lasiopterus*, *Barbastella barbastellus*, and *Eptesicus nilssonii*, although at least the latter needs further verification. Some important cave bat roosts previously recognized by Papadatou *et al.* (2011) were also surveyed, and no changes in roost status were detected.

The study also highlighted the importance of old buildings such as churches and ruins as bat roosts, which should be considered in future monitoring efforts.

Georgiakakis *et al.* (2023), in their study on the bats of Greece, acknowledge the survey conducted in the Prespa region and highlight the importance of rock crevices and semi-flooded caves on the Greek side of Prespa as important bat habitats. In addition, Georgiakakis emphasizes the need for transboundary cooperation between Albania, Greece and North Macedonia to enhance conservation efforts and further develop strategies for the protection of bat species in this region.

4.1.3 NORTH MACEDONIA

a. Overview till CAP 2012 (Papadatou et al, 2011; Papadatou et al., 2012)

Research on these bats began in the 1920s, then stopped, and research efforts have only recently begun again. Most of the existing data relate to cave-dwelling species, while there is almost no data on tree-dwelling or other species. In the late 80s and 90s, several attempts were made to sample caves, ponds and springs using mist nets, but no results were obtained because bats were not caught in the nets. According to the research of Boris Kryštufek (1992) and unpublished material, at least 19 species of bats have been identified not only in Galičica NP, but in the entire Prespa area.

According to CAP 2012 three important caves for bats on this side of the Prespa watershed have been identified: **Leskoečka peštera**, **Samotska Dupka** and **Bimbilova peštera.**

Samotska Dupka is the longest known cave in Galičica NP. Although not in (but very near) the Prespa watershed, it has been included here because bats are highly mobile species, and it may be used in winter by bats whose summer quarters are in Prespa. The cave was used by over 80 hibernating bats from three species (*R. hipposideros*, *M. blythii*, *M. myotis*) in winter 2011 (O. Avramoski, pers. comm.) and by almost 30 bats from four species (*R. hipposideros*, *R. ferrumequinum*, *M. blythii*, *M. myotis*) in October 2011 (unpublished data) (Table 2). It is the most important known hibernaculum for *R. hipposideros* in the entire Prespa area (almost 40 individuals counted in winter 2011; O. Avramoski, pers. comm.). The cave is cold and provides good conditions for hibernation. The relatively small amount of bat droppings and the lack of large urine stains on the walls combined with the low temperature of the cave

suggest that the site is not used by large numbers of bats at other times of the year; however, the annual use of the cave remains to be investigated. A grille-door at the cave's entrance (Fig.8) placed in 2005 to prohibit uncontrolled public access has not been designed according to standards that allow free access to bats such as those provided by EUROBATS (Mitchell-Jones *et al.*, 2007). AP 2012 suggested the gate should be replaced by a "bat-friendly" grille-door that may allow access to more bat species in the cave.

FIG. 8. THE GRILLE-DOOR AT THE ENTRANCE OF SAMOTSKA DUPKA CAVE (PHOTO: ALEKSANDAR STOJANOV 2023)

Cave **Leskoečka peštera** (Leskoec cave) is used by all four *Rhinolophus* species present in the Prespa area. *M. blythii* has also been found in the cave (Kryštufek *et al.* 1992), but it appears to be an important cave primarily for medium sized Rhinolophids (*R. euryale* and *R. blasii*) at least in the autumn months, since it is used by at least 500 bats for roosting and most probably mating; (comparable to Mikrolimni cave in Greece, see Table 2). In winter 2011, a few medium sized Rhinolophids and *R. hipposideros* were found torpid in the cave. A few *R. hipposideros* use the cave throughout the year and a few *R. ferrumequinum* have been found in summer. In the frame of the project "Protection of cave ecosystems and endangered plant and animal species in the National Park Galičica from the negative effects of climate change", implemented by the Research Society Ursus Speleos from Skopje and the Red Cross of Ohrid, and supported by Prespa-Ohrid Nature Trust (PONT), a bat-friendly gate was installed at the entrance of the cave in 2023 (Fig. 9).This intervention aims to prevent unauthorized access while ensuring safe passage for bats, contributing to the long-term preservation of the cave's vulnerable ecosystem.

FIG. 9. A BAT FRIENDLY GATE ON LESKOEČKA PEŠTERA CAVE SET UP IN MARCH 2023 (PHOTO: EXPLORING SOCIETY URSUS SPELEOS)

Bimbilova Peštera (Bimbilova Cave) was discovered only in June 2010. It is used by many thousands of bats in summer and autumn, whereas several thousand hibernate in the cave, making it one of the most important known hibernacula in the entire Prespa. Although breeding has not been confirmed according to the data from the CAP 2012. In that period not been confirmed, the cave hosts large bat colonies from at least two species (*M. capaccinii* and *Mi. schreibersii*) throughout the year (Table 2). Torpid *R. ferrumequinum* have also been observed in winter.

Zandana Cave may be relatively important for bats. Three *Rhinolophus hipposideros* and a moderate amount of dry bat droppings have been found in the cave in autumn suggesting that the cave may be used at other times of year by more bats.

These efforts provided the baseline for further research and conservation, contributing significantly to the understanding and protection of bat populations in Transboundary Prespa Park.

b. Overview since CAP 2012

Several publications have contributed to the knowledge of bat fauna in the Lake Great Prespa region. Micevski *et al.* (2014) conducted general bat surveys, primarily using bat detectors, and recorded 12 species in the area, providing a valuable baseline for further studies. Presetnik (2015) carried out a more targeted spring survey, revisiting important roosts previously identified by Papadatou *et al.* (2011) and confirming the presence of 14

bat species. This study also provided the first unquestionable evidence of *Vespertilio murinus* in the area. In addition, Presetnik (2015, 2020) documented further details of significant bat roosts and foraging areas. Gojznikar (2016) contributed with specific observations on the dynamics of *Rhinolophus euryale* in Leskoečka peštera, providing insights into seasonal population changes. The studies mentioned above have significantly improved the understanding of bat species distribution and ecology in the Greater Prespa Lake (MK) region.

c. Preparatory actions for updating of AP (2025)

Recently, more intensive and systematic survey and monitoring was done within the PrespaNet project (2021-2024) and the project Protection of cave ecosystems and endangered plant and animal species in the Galičica NP from the negative effects of climate change (2022-ongoing). Many data on bat presence and distribution were collected throughout the Macedonian side of Prespa. Seasonal surveys to determinate the status of the bat population and the seasonal use by bats were done in the priority caves Samotska Dupka, Bimbilova Peštera and Leskoečka Peštera. A new cave, Klarova Propast (2023), was discovered with about 50 individuals of *R. hipposideros* at the beginning of spring, indicating that it might represent second important hibernaculum for the species in this area. Additional two caves, Svinska Strna and Vojla, were surveyed during summer period, resulting with observation of two individuals of *R. hipposideros* and a single individual of *R. euryale*, respectively. A larger mixed maternity colony of *R. ferrumequinum*, *R. euryale* and *M. emarginatus* was discovered in the abandoned hotel Evropa, representing the first confirmed data on reproduction for these species in Prespa (150-200 individuals). One species from the *M. mystacinus* species complex new for the area, *M. davidii,* was mist-netted near Oteševo village, however this finding is based only on morphology and needs further confirmation with field work and genetic analysis. For the first time for this area *M. brandtii* was also registered at the same place in 2023. Considering their revised distribution in Albania (Benda et al., 2019; Uhrin et al., 2020), their presence is quite possible.

TABLE 2. KEY NATURAL UNDERGROUND SITES IN THE PRESPA LAKES WATERSHED, BAT SPECIES, ANNUAL FUNCTION AND APPROXIMATE COLONY SIZE. PSARADES CAVE (GREECE), AND CAVES NEAR GOLLOMBOÇ AND ZAROSHKA (ALBANIA) AND ZANDANA (NORTH MACEDONIA) ARE NOT INCLUDED IN THE TABLE (SEE TEXT FOR DETAILS). SAMOTSKA DUPKA, SVINSKA STRNA AND VOILA CAVES ARE IN OHRID LAKE WATERSHED BUT VERY NEAR PRESPA (FIG. 2).

Country	Cave	Location and description	*R. blasii*	*R. euryale*	*R. hipposideros*	*R. ferrumequinum*	*Mi. schreibersii*	*M. capaccinii*	*M. emarginatus*	*M. blythii*	*M. myotis*	*M. daubentonii*	*H. savii*	*P. pipistrellus*	*P. nathusii*	*Pl. austriacus*	*Plecotus sp.*	*Pl. kolombatovici*	*Pl. auritus*	*E. serotinus*	Annual use	Colonies size
Greece	Tcherna	Partly lacustrine cave in the south of the Lake Greater Prespa, west of Psarades village	x	x	-	x	x	x	x	-	-	x	x	x	x						Summer breeding; autumn Shelter, mating & swarming. male only *Mi. schreibersii* colony	Several thousand in summer; several hundred in autumn; unknown number swarming
	Cape Roti	Lacustrine cave on the tip of Cape Roti, in the south of the Lake Greater Prespa, west of Psarades village	-	-	-	-	-	x	x	-	-	x									Summer breeding, autumn Shelter	Several hundred (autumn) up to a few thousand (summer)
	Mikrolimni	Warm cave on the east coast of the Lake Lesser Prespa, near Mikrolimni village	x	x	-	-	-	-	-	-	-										Spring and autumn shelter; winter use	> 700 individuals
	Kokkalis'	Cave with historical importance in the west of Lesser Prespa Lake, near the village of Vrondero surrounded by oak forest	x	x	x	x	x	x	-	x	x		x	x		x					Night roost; autumn swarming	Tens up to a few hundred bats
	Zachariadis'	Cave with historical importance in the southwest of Lake Lesser Prespa, near the village of Pyli surrounded by oak forest	x	x	x	x	-	-	x	-	x						x				Summer roosting; night roost; autumn mating	Some tens of bats

Country	Cave	Location and description	*R. blasii*	*R. euryale*	*R. hipposideros*	*R. ferrumequinum*	*Mi. schreibersii*	*M. capaccinii*	*M. emarginatus*	*M. blythii*	*M. myotis*	*M. daubentonii*	*H. savii*	*P. pipistrellus*	*P. nathusii*	*Pl. austriacus*	*Plecotus sp.*	*Pl. kolombatovici*	*Pl. auritus*	*E. serotinus*	Annual use	Colonies size
Albania	Treni	Cave in the southern tip of Lake Lesser Prespa, near reedbeds and the Treni village	x	x	x	x	x	x	-	x	x	x	x					x	x	x	Summer breeding; autumn shelter, mating & swarming; male only *Mi. schreibersii* colony; *M. capaccinii* hibernation	Several thousand in summer; several hundred in autumn and winter; unknown number swarming >2500 individuals
	Mali Grad	Dry cave on the eastern shore of Mali Grad Island, Lake Lesser Prespa	-	-	-	-	x	-	-	-	-										Autumn and probably spring shelter	> 2000 individuals
	Zaveri cave	Zaveri Cavity is located on the western shore of Lake Prespa, at the intersection of two tectonic faults.Natural monument.	-	x	x	x	-	x	-	-	-										Summer breeding (*R. ferrumequinum* , *M. capaccinii*) Hibernation (*R. euryale, R. hipposideros*, *R. ferrumequinum*)	>1700 in summer > 250 in winter
North Macedonia	Bimbilova peštera	Cave on Golem Grad Island, Lake Greater Prespa	-	-	-	x	x	x	-	-	-										Summer breeding; autumn shelter, mating & swarming; male only *M. schreibersii* colony; hibernation	> 10 000 in summer; > 7000 in autumn; > 3000 in winter
	Samotska Dupka	Cave to the west of the Mountain Hut Asan Gura surrounded by beech forest	-	-	x	x	-	-	-	x	x										Hibernation; autumn use	Tens of individuals in autumn > 80 individuals in winter
	Leskoečka peštera	Dry and warm cave in the northwest of Lake Greater Prespa, near Leskoec village surrounded by oak forest	x	x	x	x	-	-	-	x -	-										Autumn and probably spring shelter	> 500 individuals
	Svinska Strna	Dry cave located on the ridge Asan Djura at 1485 m altitude.	-	-	x	-	-	-	-	-	-										Unknown	2 individuals in mid-June

Country	Cave	Location and description	*R. blasii*	*R. euryale*	*R. hipposideros*	*R. ferrumequinum*	*Mi. schreibersii*	*M. capaccinii*	*M. emarginatus*	*M. blythii*	*M. myotis*	*M. daubentonii*	*H. savii*	*P. pipistrellus*	*P. nathusii*	*Pl. austriacus*	*Plecotus sp.*	*Pl. kolombatovici*	*Pl. auritus*	*E. serotinus*	Annual use	Colonies size
	Vojla	Dry cave located 250m eastern of the road Ohrid-Suvo Pole, towards v.Konjsko, surrounded by hazel trees.	-	x	-	-	-	-	-	-	-										Unknown	1 individuals in mid-June
	Klarova Propast	Pit located on Prespa side of Galičica NP, in the locality Ceremušana.	-	-	x	-	-	-	-	-	-										Possible hibernation	~50 individuals

4.2 CONSERVATION AND PROTECTION STATUS OF BATS

In Table 3 we present the conservation and protection status of bat species found in the Prespa region. First, the table presents the conservation status of bats according to the IUCN Red List of European Mammals (Terry and Temple, 2007), followed by the local conservation assessment, if available. 5 of the bat species present in Prespa are classified as VU, 6 as NT and 18 as LC in the European assessment.

In the next part of the table are presented bat legal protections. Details on the international conservation and protection legal acts are described in chapter 3.3, and details on local legislation are explained in the following subchapters.

4.2.1 ALBANIA

Bats and their roosts are protected by Albanian legislation. There are several laws and regulations that guarantee the protection of all bat species present in the country (e.g: Biodiversity Protection Law, Protected Areas Law, Wildlife Protection Law, Environmental Protection Law, etc.). There is an existing but outdated red list of species, Order No. 1280, dated 20/11/2013 "On the approval of the Red List of Albanian Fauna and Flora", which includes 13 out of 32 bat species present in the country (Théou and Bego, 2018). Apart from being more than 10 years old, this list doesn't contain data on all bats present in Albania, which is why only one species has a "vulnerable" conservation status (*R. euryale*). The main challenge, however, remains law enforcement. This problem can be partly attributed to the limited effectiveness of the Protected Areas Managers and Environmental Inspectors, who are the competent authorities responsible for the enforcement and implementation of laws and regulations. An example of this could be seen in the overlapping of responsibilities between the authorities responsible for nature conservation and those responsible for cultural heritage, as the Treni Cave is both a natural and cultural monument, which can slow down the implementation of conservation measures.

4.2.2 GREECE

In the Greek Red Data Book of Threatened Animals (Legakis and Maragkou, 2009), approximately one quarter of the bat species in Greece are classified as Least Concern (LC), while one third are Data Deficient (DD) due to insufficient data. More specifically, of the 25 bat species assessed in Greece, 8 species (32%) are DD, 1 species (4%) is Endangered (EN), 6 species (24%) are LC, 7 species (28%) are NT, and 3 species (12%) are Vulnerable (VU). In addition, ten species (60%) are listed in Annex II of the Habitats Directive and all are listed in Annex IV (Table 3).

4.2.3 NORTH MACEDONIA

In accordance with the Nature Protection Act, Article 35 (Official Gazette of the Republic of Macedonia, No. 67/2004), the following species of cave-dwelling bats found in Prespa are proclaimed as protected species: *Miniopterus schreibersii*, *Myotis capaccinii*, *Rhinolophus blasii* and *R. euryale* (Lists for the designation of strictly protected and protected species, Official Gazette RM 139/2011).

TABLE 3. BAT SPECIES IN THE PRESPA WATERSHED, THEIR CONSERVATION AND LEGAL PROTECTION STATUS. (GR – GREECE, AL – ALBANIA, MK – NORTH MACEDONIA, P – PROTECTED)

Scientific name	English name	Conservation status				Protection status					
		EUROPE[3]	National			International			National		
		IUCN red list category 2007	AL Red List 2013[4]	GR Red Book 2009[5]	MK (no national red book/list that includes bats)	Bern[6] (AL, GR, MK)	Bonn[7] & EUROBATS[X8] (AL, MK)	HD[9](GR)	AL[10]	GR PD[11]	MK[12]

[3] European Commission, Directorate-General for Environment, Terry, A., Temple, H. (2007) *The status and distribution of European mammals*. Publications Office.

IUCN threat status: VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient

[4] Théou and Bego (2018).

[5] Georgiakakis *et al.* (2023)

[6] Convention on the Conservation of European Wildlife and Natural Habitats, Bern 1979

Annex II: Strictly protected fauna species; Annex III: Protected fauna species

[7] Convention on the Conservation of Migratory Species of Wild Animals (CMS), Bonn 1979.

Appendix II: Migratory species conserved through Agreements

[8]Agreement on the Conservation of Populations of European Bats. Eurobats. United Nations Environment Programme/Eurobats. 4 December 1991.

[9] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)

Annex II: Animal and plant species of community interest whose conservation requires the designation of special areas of conservation.

Annex IV: Animal and plant species of community interest in need of strict protection

[10] Law No. 81/2017 "For Protected Areas" and its amendments; Law No. 9587, dated 20.7.2006 "For the Protection of Biodiversity" and its amendments

[11] Presidential Decree 67/1981 "On the protection on native flora and fauna" (Greek legislation)

[12] Lists for designation of strictly protected and protected species, Official Gazette of RM 139/2011

Scientific name	English name	Conservation status				Protection status					
Rhinolophus ferrumequinum	Greater horseshoe bat	NT	LR cd	LC	/	II	II	II, IV	P	P	
R. hipposideros	Lesser horseshoe bat	NT	LR nt	LC	/	II	II	II, IV		P	
R. euryale	Mediterranean horseshoe bat	VU	VU	NT	/	II	II	II, IV		P	P
R. blasii	Blasius' horseshoe bat	VU	LR nt	NT	/	II	II	II, IV		P	P
Myotis blythii	Lesser mouse-eared bat	NT	DD	LC	/	II	II	II, IV	P	P	
M. myotis	Greater mouse-eared bat	LC	/	NT	/	II	II	II, IV	P	P	
M. bechsteinii	Bechstein's Myotis	VU	DD	NT	/	II	II	II, IV		P	
M. nattereri	Natterer's Bat	LC	DD	NT	/	II	II	IV		P	
M. emarginatus	Geoffroy's Bat	LC	DD	NT	/	II	II	II, IV		P	
M. davidii/ M. mystacinus	Steppe /Whiskered Bat	LC/LC	/	DD/-[13]	/	II	II	IV		P	
M. brandtii	Brandt's Myotis	LC	/	DD	/	II	II	IV		/	
M. daubentonii	Daubenton's bat	LC	/	VU	/	II	II	IV		P	
M. capaccinii	Long-fingered bat	VU	/	NT	/	II	II	II, IV	P	P	P

[13] Probably all older data referred to *Myotis mystacinus* belong to *M. davidi* based on recent molecular genetic analyses. See further Georgiakakis *et al.* 2023

Scientific name	English name	Conservation status				Protection status					
Vespertilio murinus	Particoloured Bat	LC	DD	DD	/	II	II	IV		P	
Eptesicus serotinus	Serotine bat	LC	/	LC	/	II	II	IV		P	
Hypsugo savii	Savi's Pipistrelle	LC	/	LC	/	II	II	IV		P	
Pipistrellus pipistrellus	Common Pipistrelle	LC	/	DD	/	III	II	IV		P	
P. pygmaeus	Soprano Pipistrelle	LC	/	DD	/	II	II	IV		/	
P. nathusii	Nathusius's pipistrelle	LC		DD	/	II	II	IV		P	
P. kuhlii	Kuhl's Pipistrelle	LC		LC	/	II	II	IV		P	
Nyctalus noctula	Noctule bat	LC	DD	DD	/	II	II	IV		P	
N. leisleri	Lesser Noctule	LC	DD	LC	/	II	II	IV		P	
Barbastella barbastellus	Western Barbastelle	VU	/	EN	/	II	II	II, IV		/	
Plecotus auritus	Brown Big-eared Bat	LC	DD	VU	/	II	II	IV		P	
Pl. austriacus	Grey Big-eared Bat	LC	DD	DD	/	II	II	IV		P	
Pl. macrobullaris	Mountain Long-eared Bat	NT	/	VU	/	II	II	IV		/	
Pl. kolombatovici	Mediterranean Long-eared Bat	NT	/	DD	/	II	II	IV		/	
Miniopterus schreibersii	Schreiber's bent-winged	NT	LR nt	NT	/	II	II	II, IV		P	P
Tadarida teniotis	European Free-tailed Bat	LC	/	LC	/	II	II	IV		P	

4.3 CONSERVATION AND PROTECTION STATUS OF CAVES AS THE MOST PERMANENT BAT SHELTERS

Caves are also considered an important habitat under the Bern Convention (Resolution No. 4, 1996: 65. Caves), and underground bat sites are the subject of the first EUROBATS guidelines (Mitchell-Jones *et al.*, 2007) as they provide permanent roosts for these animals.

Caves that are not open to the public are included as important habitats under Annex I of the Habitats Directive (code: 8310).

According to CAP 2012, underground sites in Prespa generally have a favorable conservation status. This is probably due to their location within the boundaries of protected areas (i.e. national parks).

Several national legal documents provide regulations for the protection of caves in the individual countries of the Prespa Region, which are presented in the following subchapters.

In general, all caves in Prespa fall within the boundaries of national parks (Galičica NP in North Macedonia and Prespa National Parks in Greece and Albania). Thus, their protection in all three countries is the responsibility of the PA authorities. The protection of caves as natural monuments (category III of IUCN) in Albania, (previous responsibility of PAs in Albania, see further in chapter 4.21) is an additional reason to protect caves and their surroundings. In Greece, the management of caves is generally the responsibility of the Department of Paleoanthropology and Speleology of the Ministry of Culture and Tourism.

NOTE: The physical description of the most important cave in the Transborder Prespa Park is given in Appendix I.

4.3.1 ALBANIA

Several laws and bylaws are related to the conservation of caves in Albania:

- DCM No. 80, dated 18.02.1999 – Concerning the designation of Prespa as a "National Park" and of Pogradeci as a "Protected Landscape and Water Scape."
- Order No. 1280, dated 20.11.2013 – "On the Approval of the Red List of Albanian Fauna and Flora."
- Law No. 81/2017 – "For Protected Areas" and its amendments (Caves as Natural Monument).
- DCM No. 303, dated 10.5.2019 – "On the Approval of the revised and updated list of natural monuments in Albania (Treni Cave)."
- DCM No. 414, dated 19.6.2019 – "On Regulations, Criteria and Procedures for the Use of Caves for Touristic Purposes."

4.3.2 GREECE

The Habitats Directive (92/43/EEC) is the most important legal document on caves protection used on a national level. Caves may also be protected by respective articles in *laws 1650/86* and *3937/2011* through Common Ministerial Decisions and Presidential Decrees.

4.3.3 NORTH MACEDONIA

Protection of cave habitats (article 64) and speleological sites (articles 122-126) is regulated by the *Law on Nature Protection* (Official Gazette of RM 67/04). In accordance with Article 123 line 4 of the Law, a Regulation describing the measures and activities for protection of speleological objects has been adopted.

4.4 DISTRIBUTION MAPS OF BAT SPECIES IN TRANSBOUNDARY PRESPA PARK AND VICINITY

To date, based on published data and data collected through the project (The Prespa Project - Biodiversity Conservation in Transboundary Prespa), **29** bat species have been recorded so far, including those that were reported but need further confirmation by morphological or molecular methods (Table 4).

However, based on the data collected in the Prespa project and published scientific data, future research is needed to confirm and collect new bat species in the TPP.

TABLE 4. LIST OF REGISTERED BAT SPECIES IN TRANSBOUNDARY PRESPA PARK IN ALL THREE COUNTRIES. (SIGN ☑ DESCRIBES NEW REGISTERED SPECIES IN THE AREA SINCE CAP 2012; * - NEEDS FURTHER CONFIRMATION BY MORPHOLOGICAL (*E. NILSSONII*) AND/OR MOLECULAR METHODS (*M. MYSTACINUS* S.STR. AND *M. DAVIDII* (LATER ALSO REPORTED AS *M. MYSTACINUS* F. *BULGARICUS* OR *M. AURASCENS*))

No.	Species	Albania[14]	Greece [15]	N. Macedonia [16]
1	*Rhinolophus ferrumequinum*	✓	✓	✓
2	*Rhinolophus hipposideros*	✓	✓	✓
3	*Rhinolophus euryale*	✓	✓	✓
4	*Rhinolophus blasii*	✓	✓	✓
5	*Myotis myotis*	✓	✓	✓
6	*Myotis blythii*	☑	✓	✓
7	*Myotis bechsteinii*	☑	✓	—
8	*Myotis nattereri*	—	✓	—
9	*Myotis emarginatus*	☑	✓	☑
10	*M. mystacinus* / Myotis davidii **	✓	✓	✓
11	*Myotis brandtii*	—	✓	☑
12	*Myotis daubentonii*	✓	✓	✓
13	*Myotis capaccinii*	✓	✓	✓
14	*Vespertilio murinus*	☑	✓[17]	✓
15	*Eptesicus serotinus*	✓	✓	✓
16	*Hypsugo savii*	✓	✓	✓
17	*Pipistrellus pipistrellus*	☑	✓	✓
18	*Pipistrellus pygmaeus*	—	✓	✓
19	*Pipistrellus nathusii*	☑	✓	☑
20	*Pipistrellus kuhlii*	✓	✓	✓
21	*Nyctalus noctula*	☑	✓	☑
22	*Nyctalus leisleri*	☑	✓	✓
23	*Barbastella barbastellus*	—	☑	—
24	*Plecotus auritus*	—	✓	✓
25	*Plecotus austriacus*	☑	✓	—
26	*Plecotus kolombatovici*	☑	—	—
27	*Plecotus macrobullaris*	—	✓	☑
28	*Miniopterus schreibersii*	✓	✓	✓
29	*Tadarida teniotis*	✓	✓	✓

[14] Théou and Bego, 2018; Benda *et al.* 2019; Théou 2021, Nezaj & Bego 2025)

[15] Papadatou *et al.*, 2011; Uhrin *et al.*, 2020; Georgiakakis *et al.*, 2023

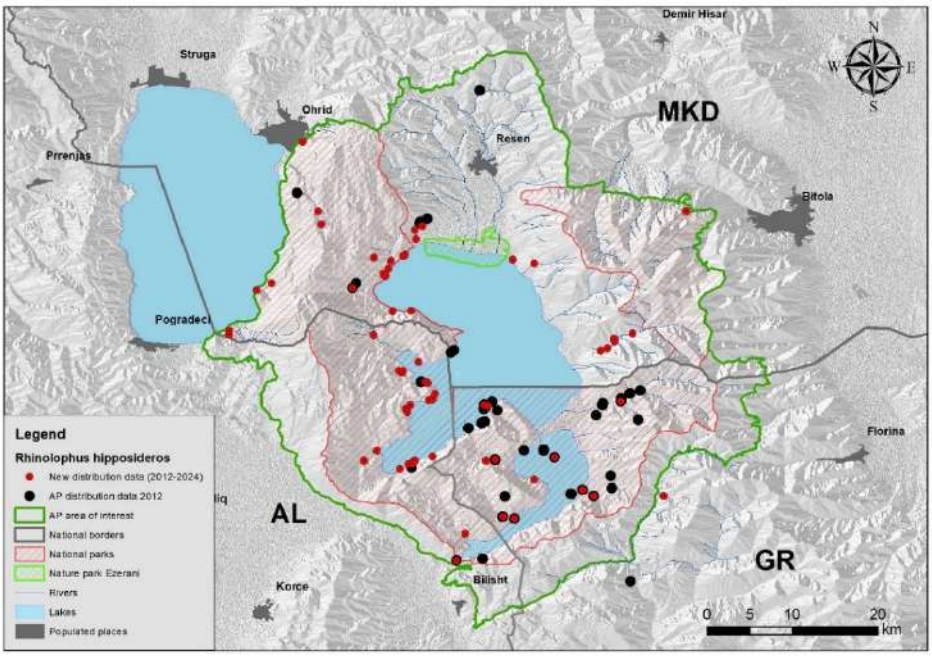
[16] Micevski et al., 2014; Presetnik 2015; Gojznikar 2016; Gičevski et al. 2025; unpublished project data

The new species for Trasboundary Prespa Park was registered in Albanian side (10), followed by Macedonia (4) and Greece (3), since the CAP 2012. Reviewing all published papers and grey literature, taking into account the need for further confirmation by morphological *(E. nilssonii and N. lasiopterus*) and/or molecular methods (*M. mystacinus* s.str. and *M. davidii* (later also reported as *M. mystacinus* f. *bulgaricus* or *M. aurascens* this area inhabits least 29 species so far. The most species were registered in Greece (28), followed by North Macedonia (24) and Albania 23 species.

Species are briefly described in Papadatou *et al.* (2011) and we do not repeat the text. However, in order to visualize the known sites of these species in TPP we are here presenting data from previous CAP 2012 and additionally all data published from 2012 on and collected in the frame of the Prespa Project in the period 2021-2024:

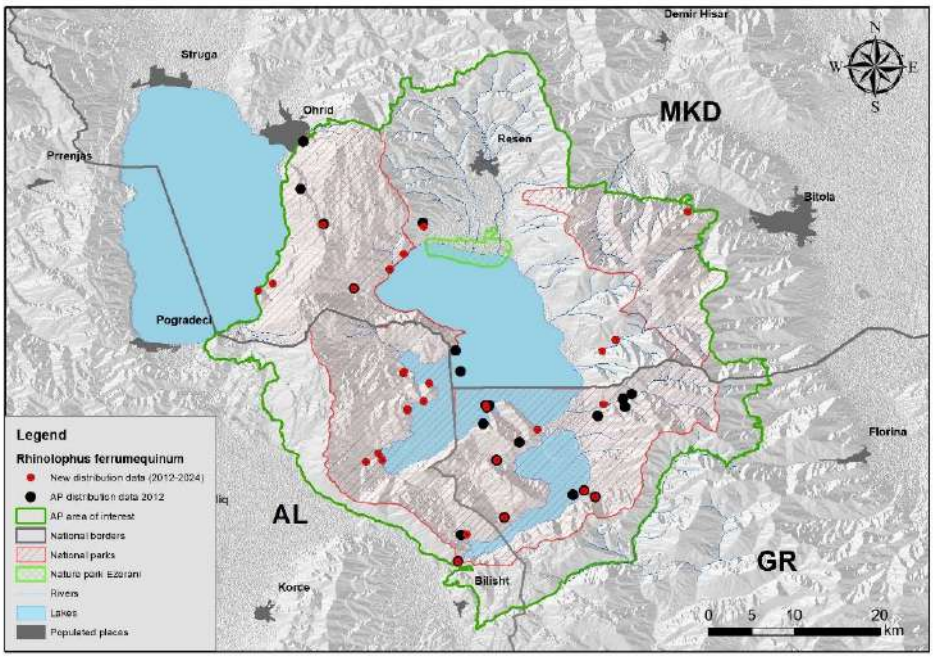
1. Rhinolophus hipposideros

The species is common and widespread throughout Prespa.



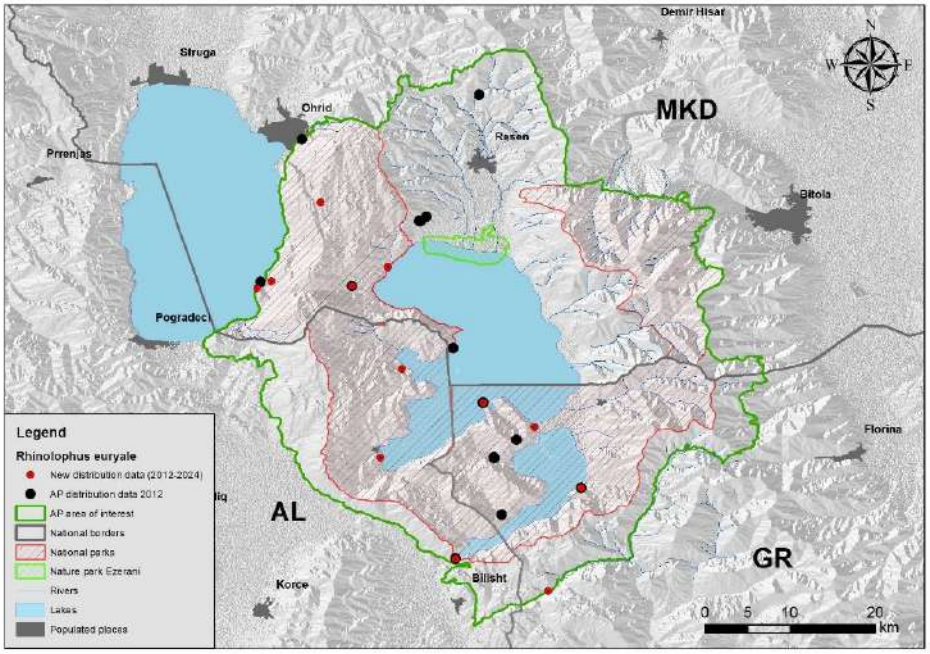
2. *Rhinolophus ferrumequinum*

The species is common and widespread throughout Prespa. Further research is needed on the Macedonian side, on the eastern parts of Greater Prespa Lake.



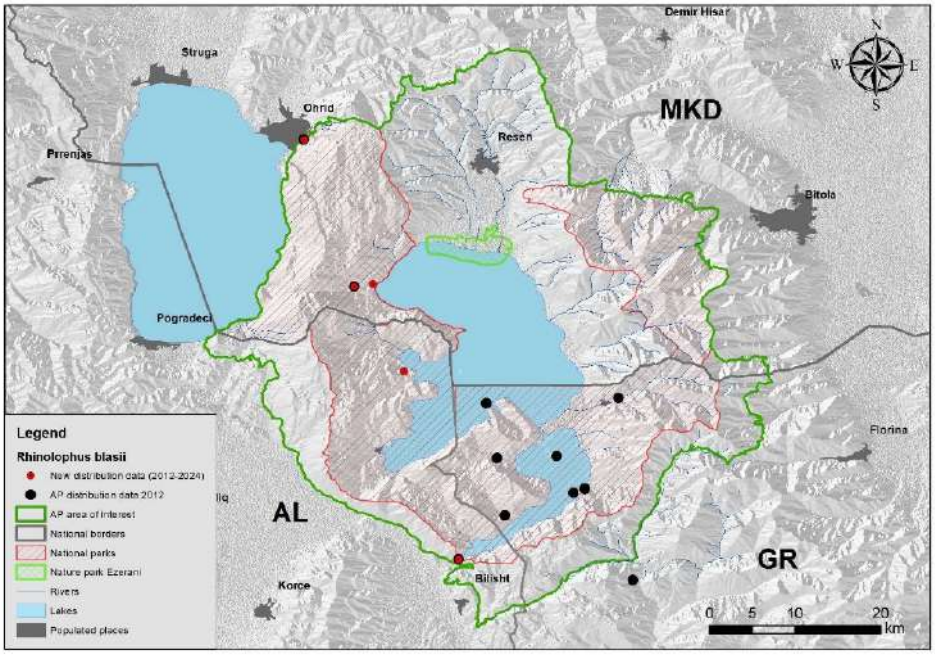
3. *Rhinolophus euryale*

The species is probably common with many records throughout Prespa. Further research is needed on the Macedonian side, on the eastern parts of Greater Prespa Lake.



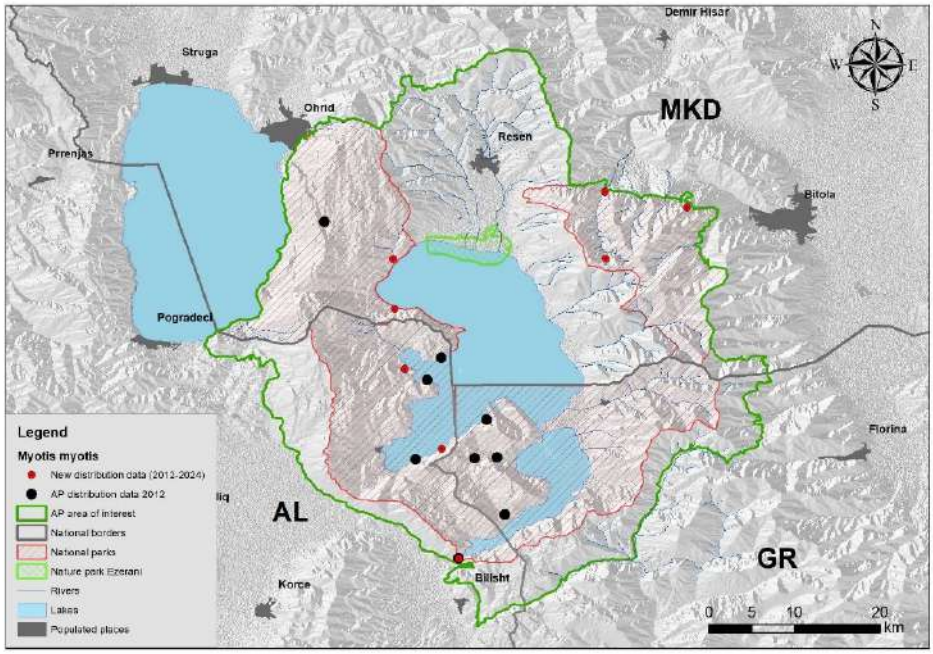
4. *Rhinolophus blasii*

The species is mainly found in many of the caves in Prespa Lakes' watershed, with most records being on Greek side.



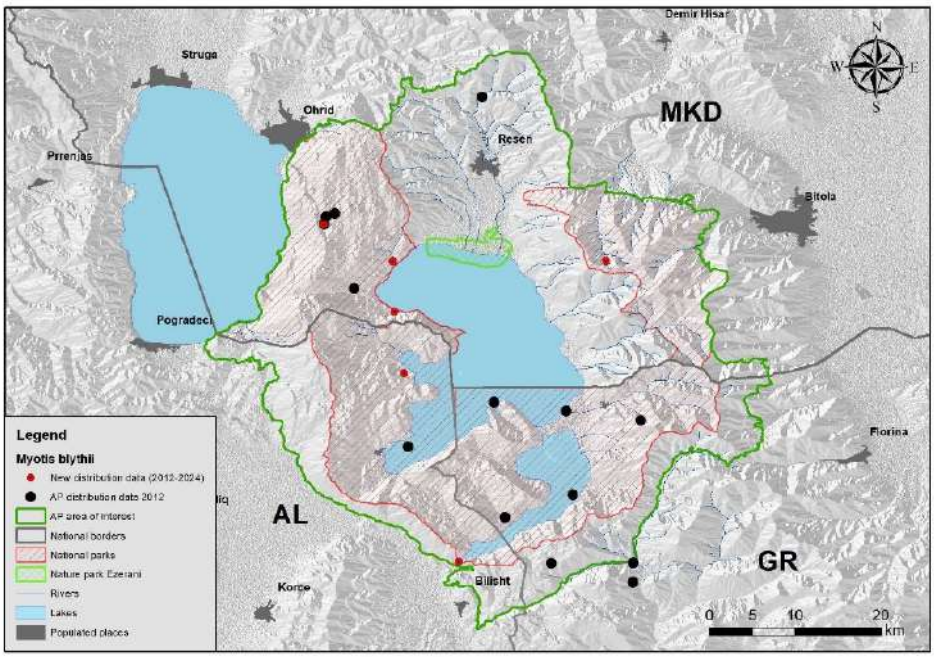
5. *Myotis myotis*

The species is probably a common species in Prespa area, however, further research on its distribution is needed in all three countries.



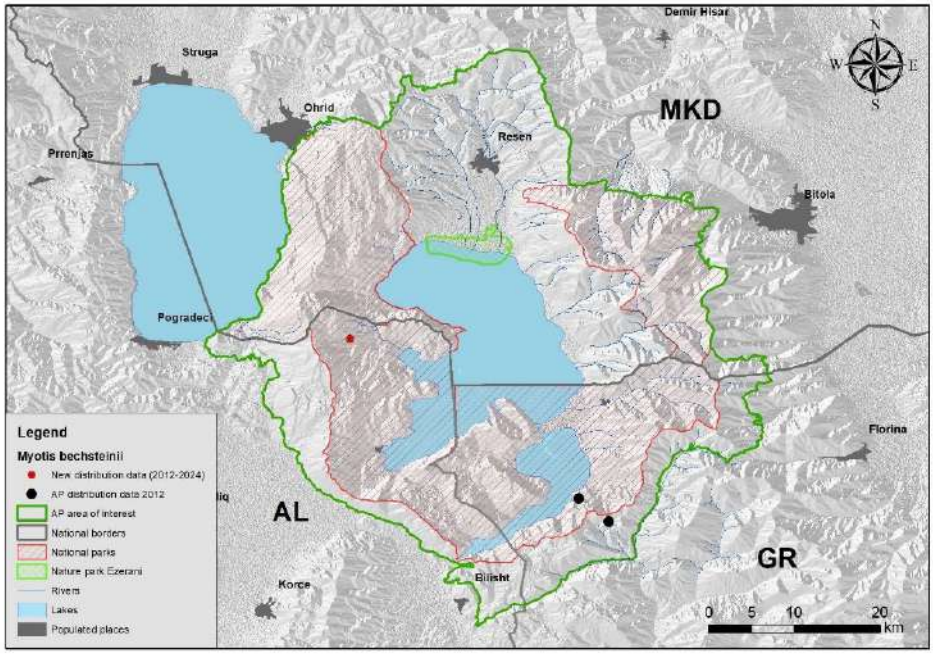
6. *Myotis blythii*

The species is probably common in Prespa area, however, further research needed in some parts on Macedonian and Albanian side.



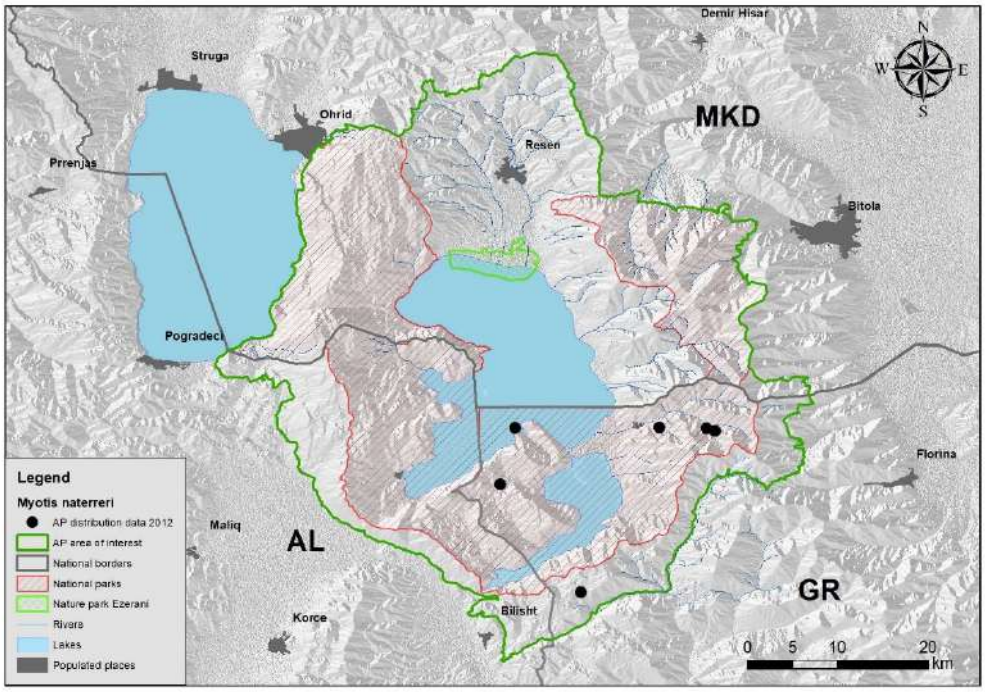
7. *Myotis bechsteinii*

There are only 3 records of the species for the entire Prespa area, and further research is needed.



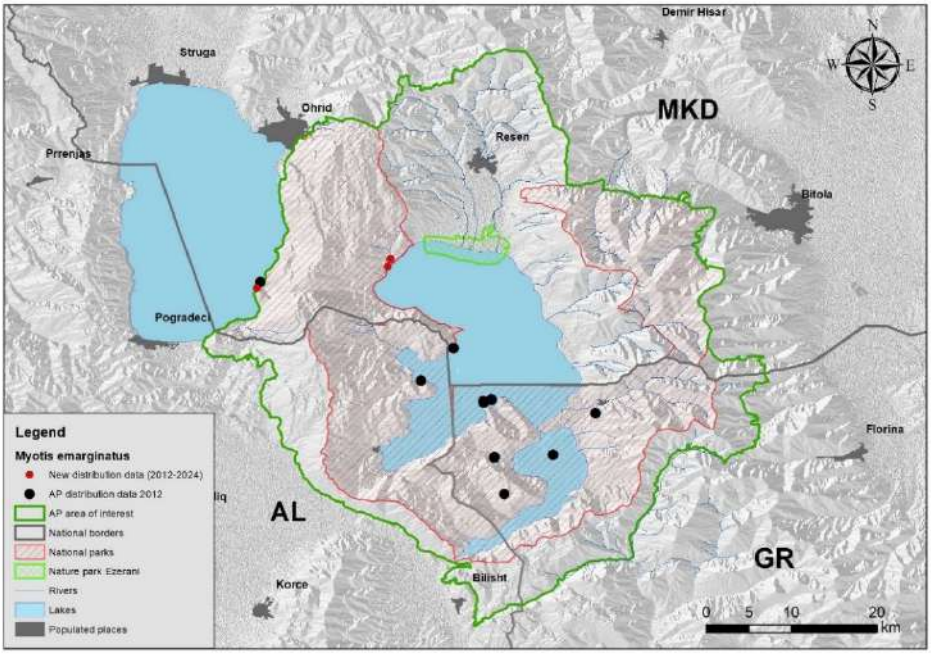
8. *Myotis nattereri*

The species is probably commonly recorded on the Greek side of Prespa, with no records on Albanian and Macedonian side.



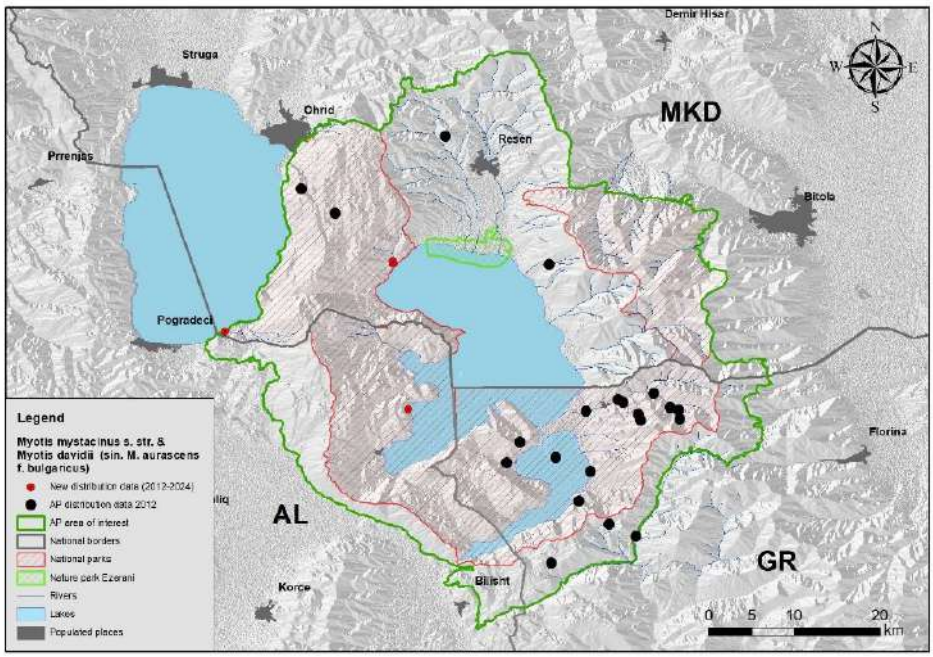
9. *Myotis emarginatus*

The species has limited distribution in Prespa, mainly along the lakeshore.



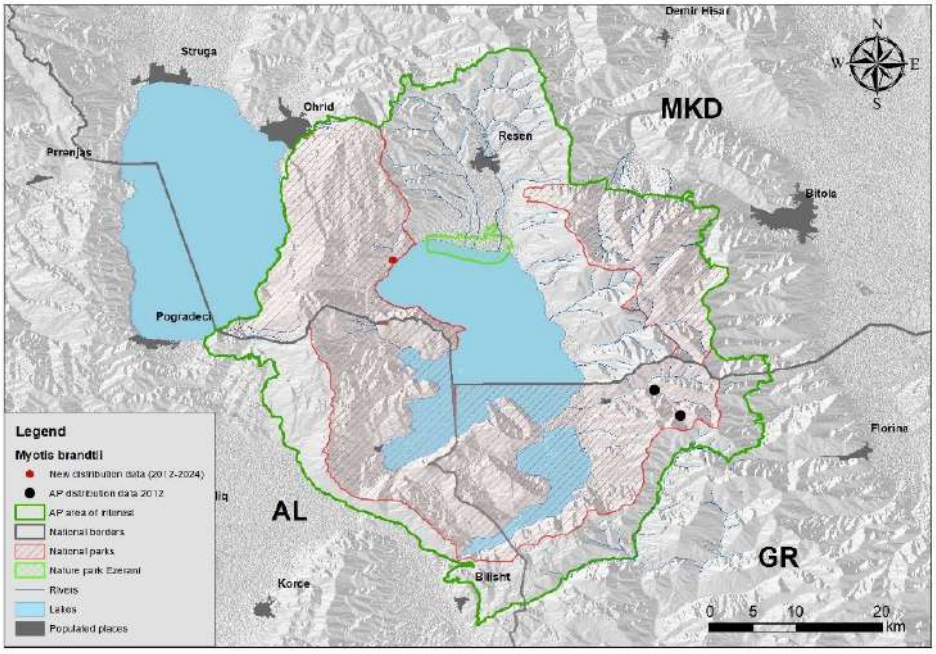
10. *Myotis mystacinus* s. str. & *Myotis davidii* (*sin. M. aurascens, M. mystacinus* f. *bulgaricus*)

This species complex is widespread on the Greek side of Prespa. On the Macedonian side, however, the species has only been recorded in a few localities, and on the Albanian side there are no records so far. Therefore, further research is needed in these countries, especially in Albania. However, all sites should be re-surveyed, and bats measured (see Benda *et al.*, 2012; Milchram *et al.*, 2023) and tissues collected for molecular analysis to determine which or both species are present.



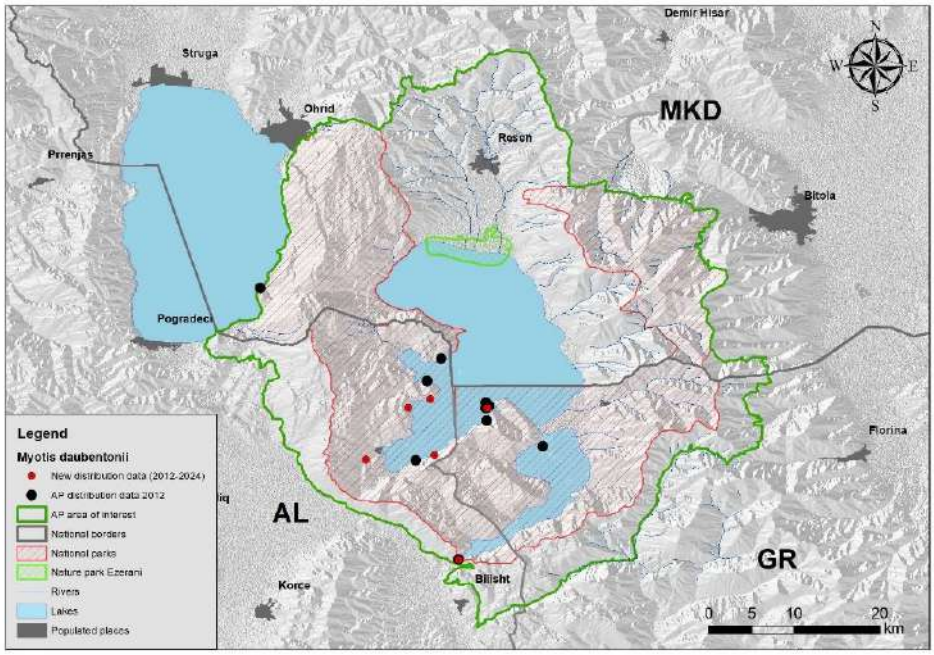
11. *Myotis brandtii*

There are only 3 records of the species for the entire Prespa area, and further research is needed.



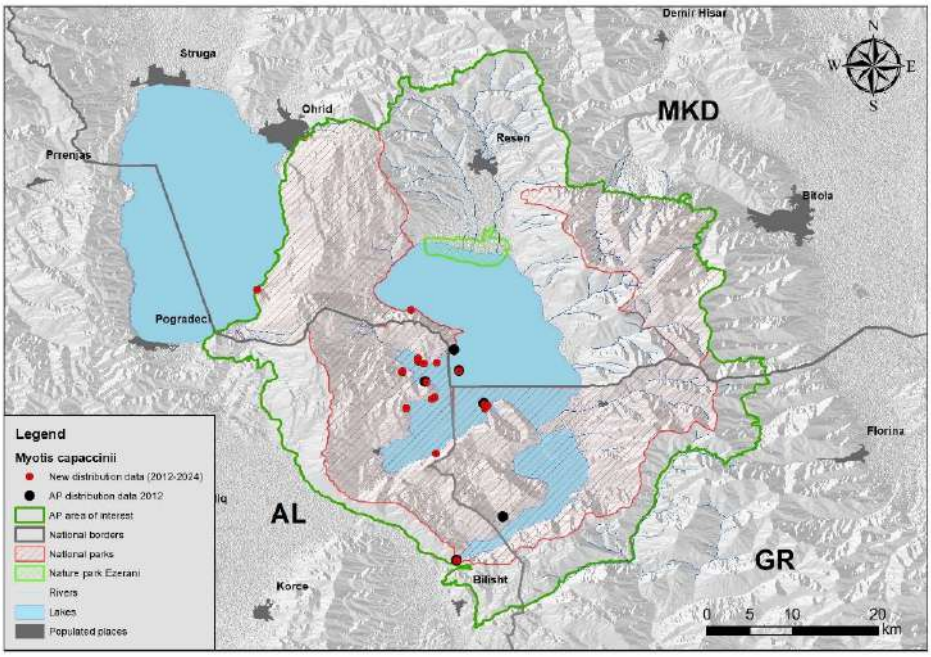
12. *Myotis daubentonii*

The species has a limited distribution in the Prespa area, mainly along the lakeshore. Further research in needed in all three countries, especially in North Macedonia.



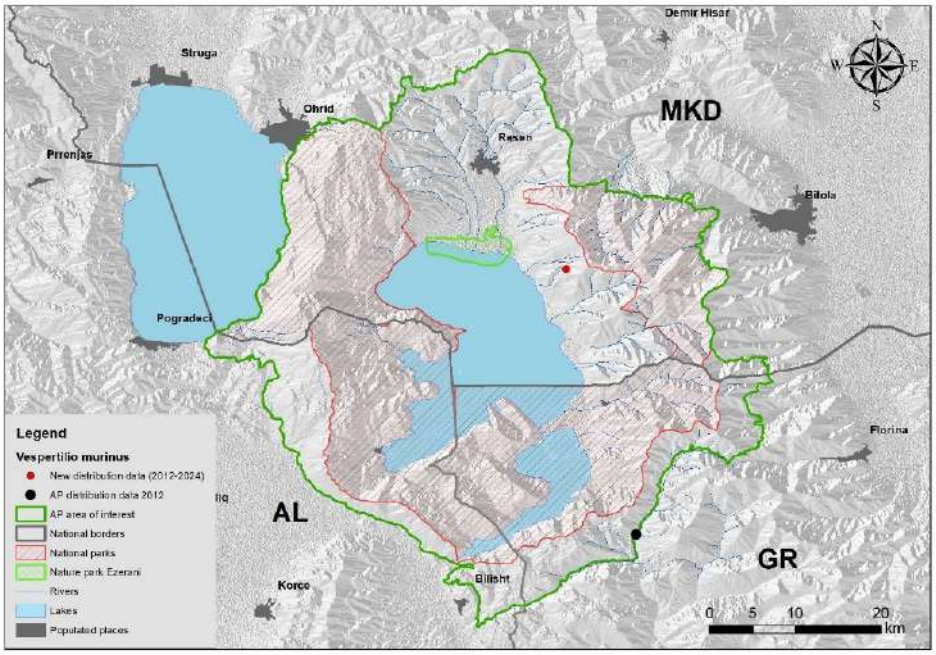
13. *Myotis capaccinii*

A lot of new sites have been discovered on Albania sites (2012-2024), nevertheless the species has limited distribution in Prespa area, mainly in caves along the lakeshore. Further research is needed in all three countries.



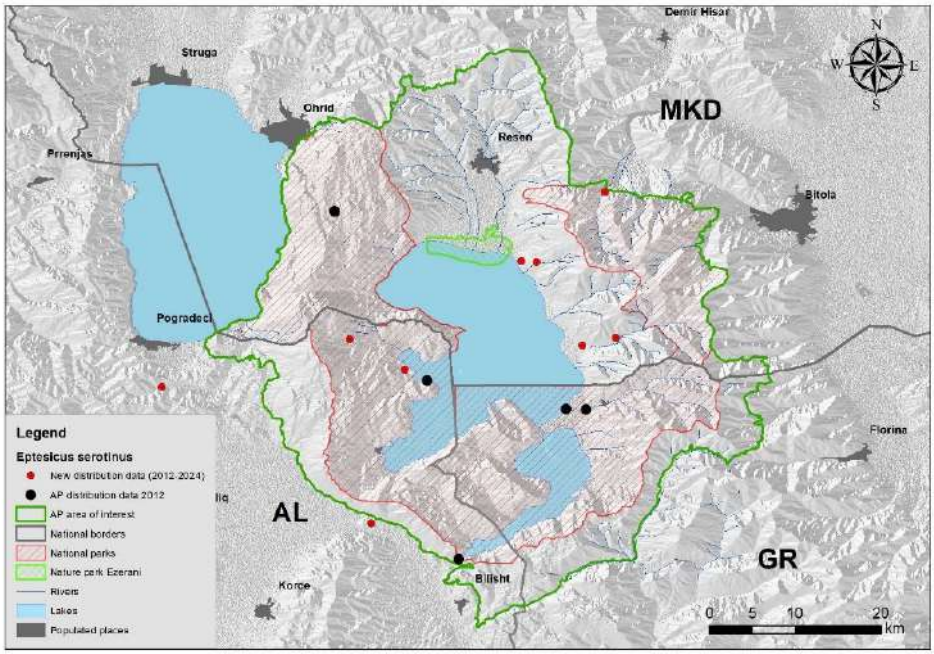
14. *Vespertilio murinus*

This species has probably limited distribution with only 2 records so far entire Prespa watershed.



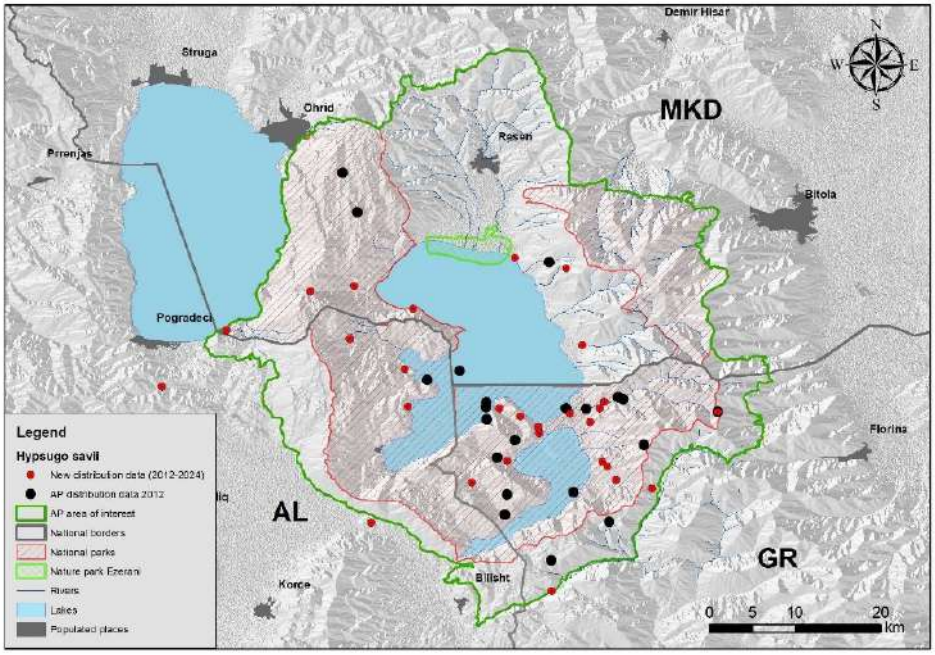
15. *Eptesicus serotinus*

The species has a scattered distribution throughout the Prespa watershed, however further research on its distribution is needed.



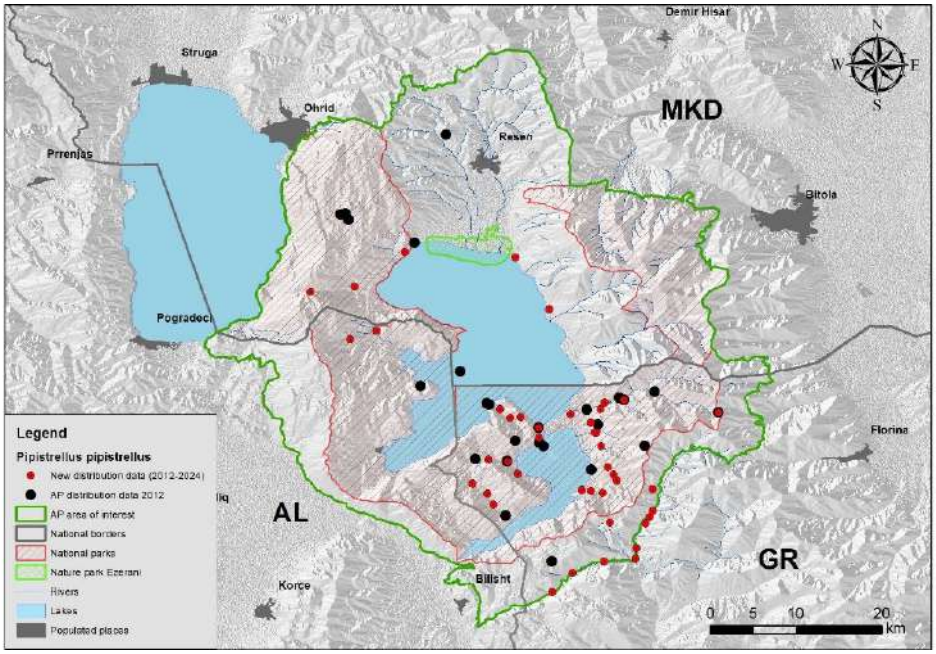
16. *Hypsugo savii*

Common species throughout the Prespa watershed, especially on the Greek side, which is a consequence of focused surveys with bat detectors.



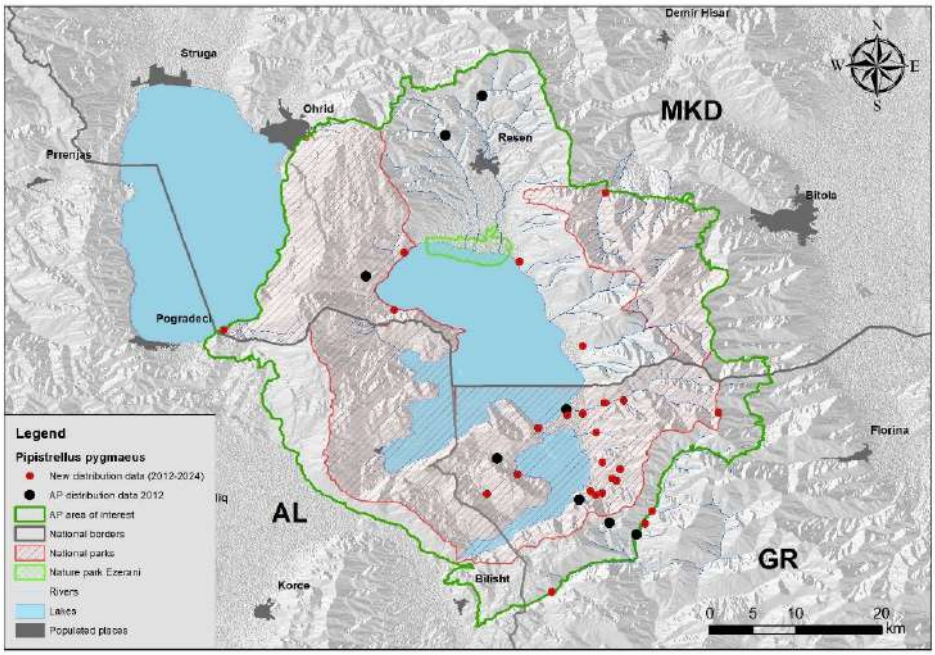
17. *Pipistrellus pipistrellus*

Common species throughout the Prespa watershed, however map clearly shows focused survey effort with bat detectors in Greece.



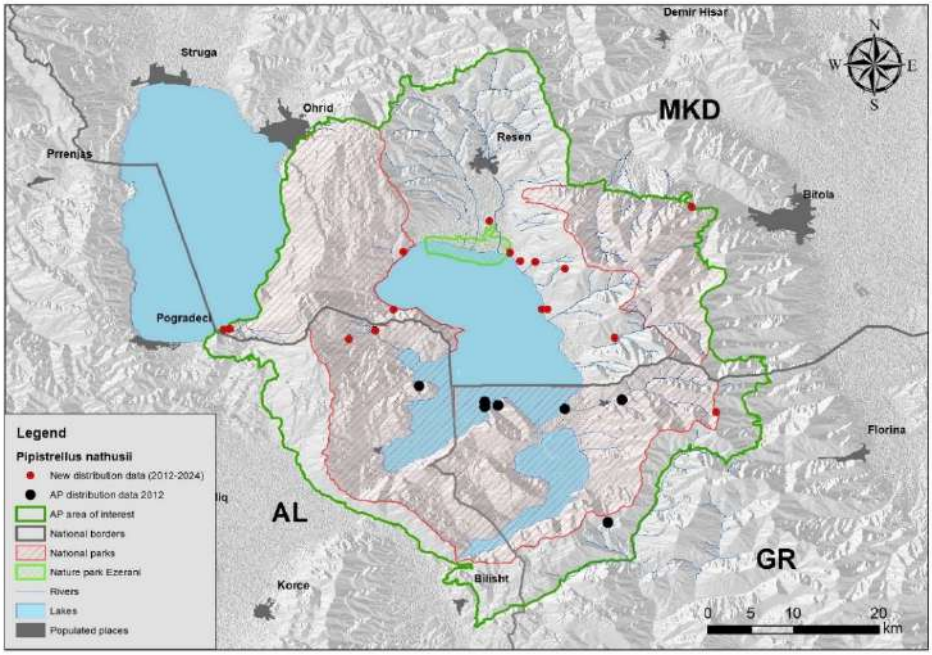
18. *Pipistrellus pygmaeus*

Common species on the Greek and Macedonian side of Prespa. Also, here map clearly shows the focused survey effort with bat detectors in Greece. Further research is needed in Albania and North Macedonia.



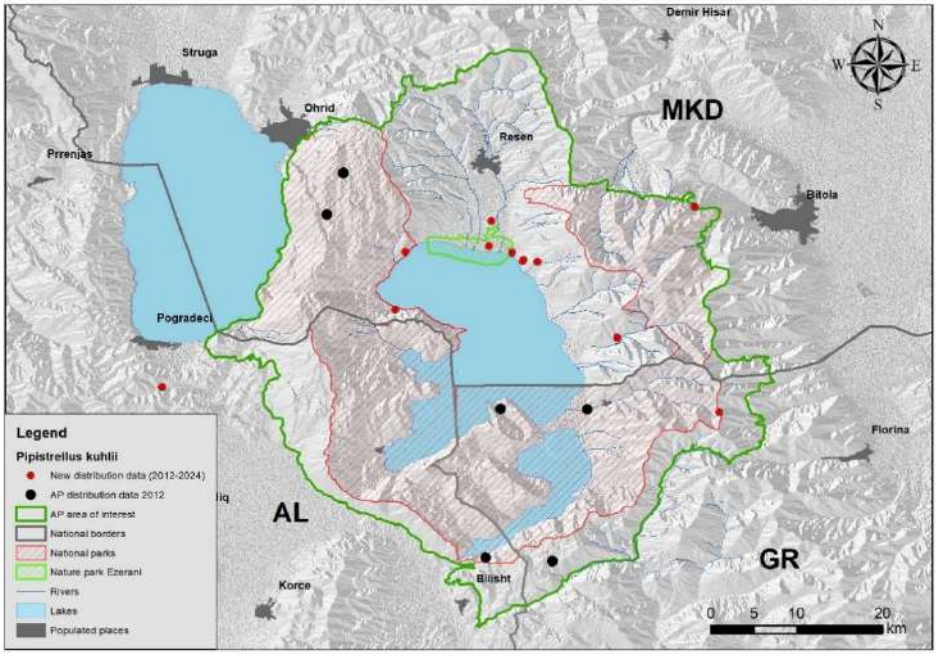
19. *Pipistrellus nathusii*

Common species throughout Prespa watershed.



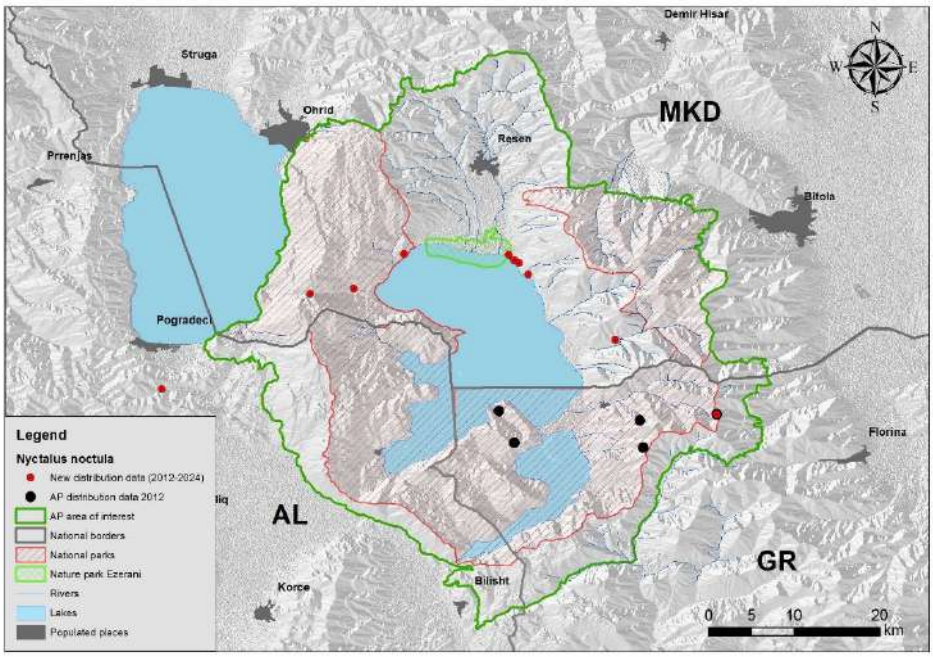
20. *Pipistrellus kuhlii*

Common species throughout the Prespa watershed.



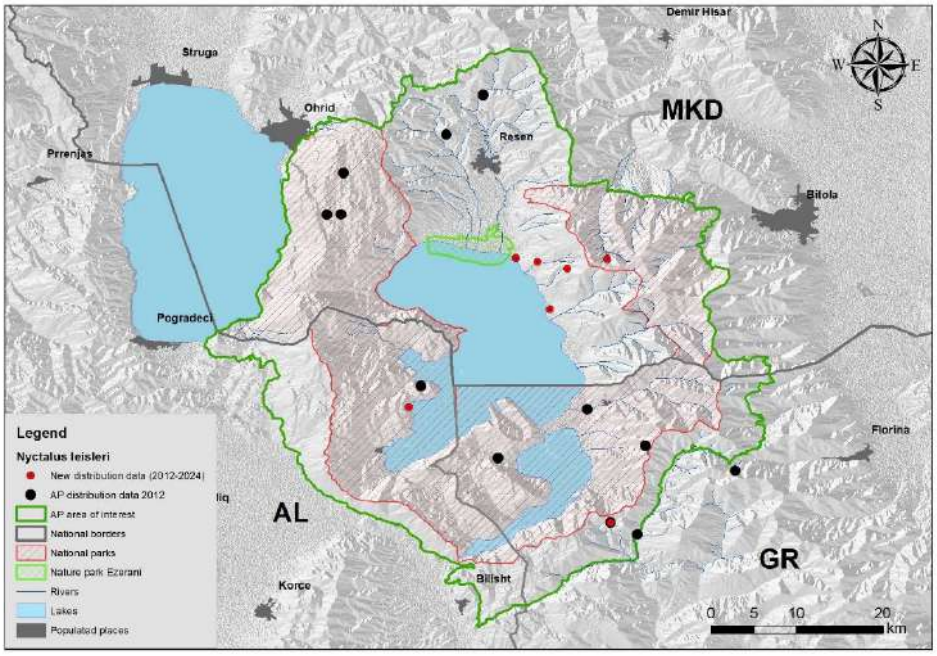
21. *Nyctalus noctula*

Commonly found species on Greek and Macedonian side of Prespa. Further research needed in Albania.



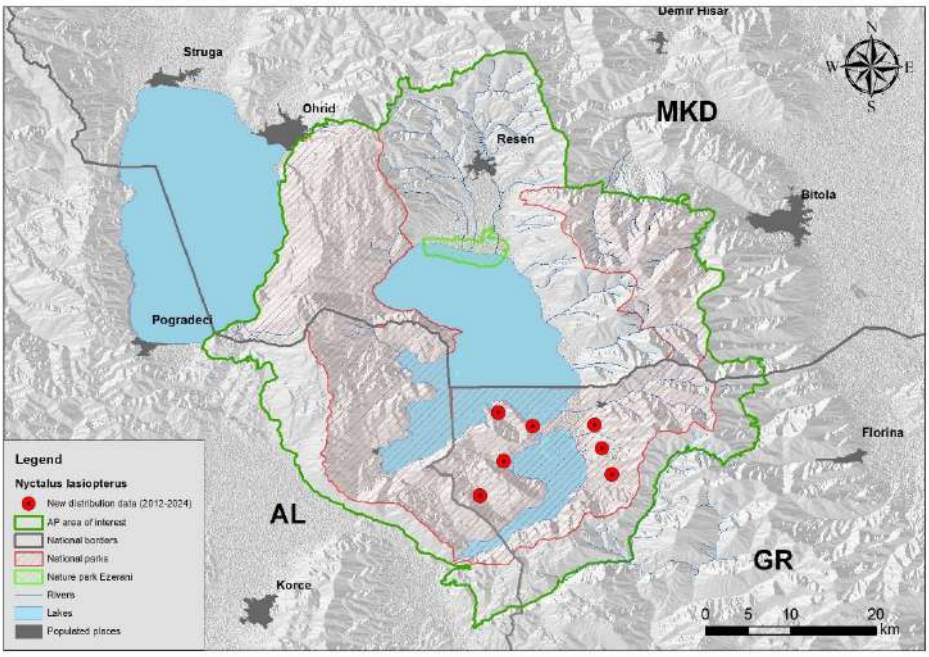
22. *Nyctalus leisleri*

Common species throughout Prespa watershed.



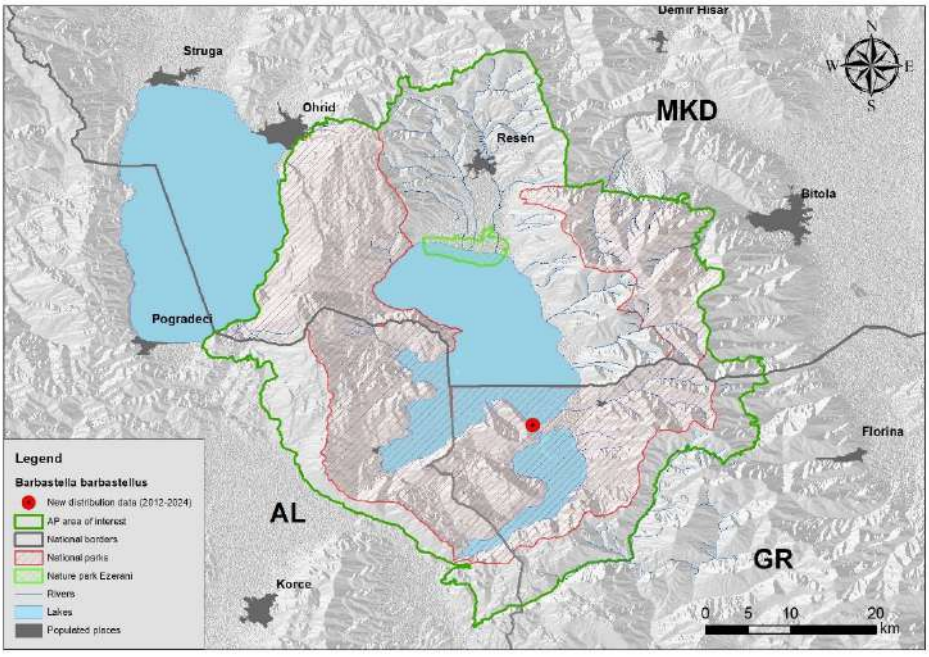
23. *Nyctalus lasiopterus*

The species have been recorded only on the Greek side of Prespa. However, this is based on acoustic evidence only (Uhrin *et al.*, 2020) and further research should focus on confirming presence by observation or capture of an animal. Therefore, we omit *N. lasiopterus* from the TPP species list.



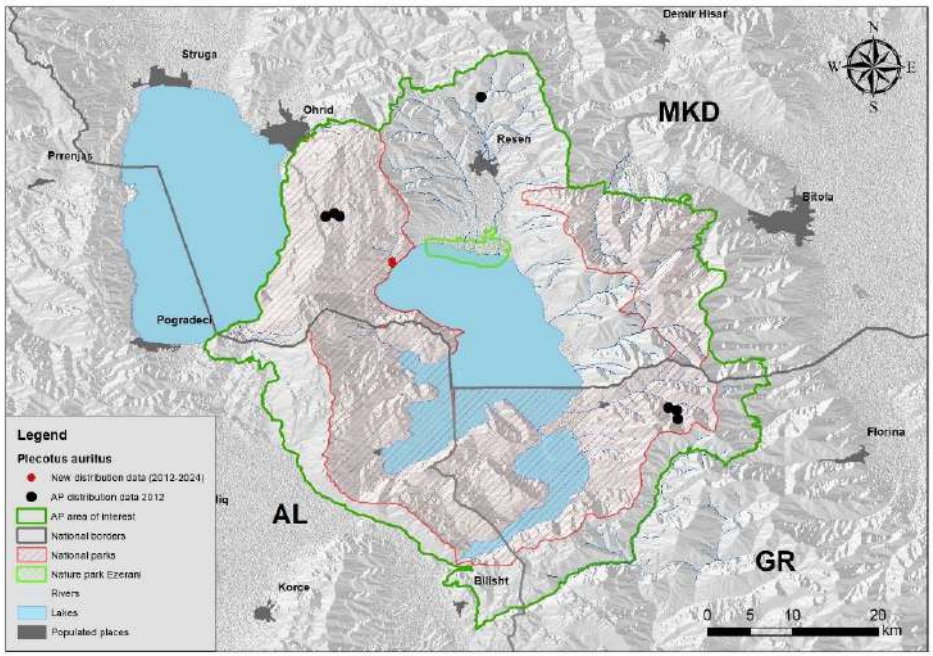
24. *Barbastella barbastellus*

The species have been recorded only at one location on the Greek side of Prespa.



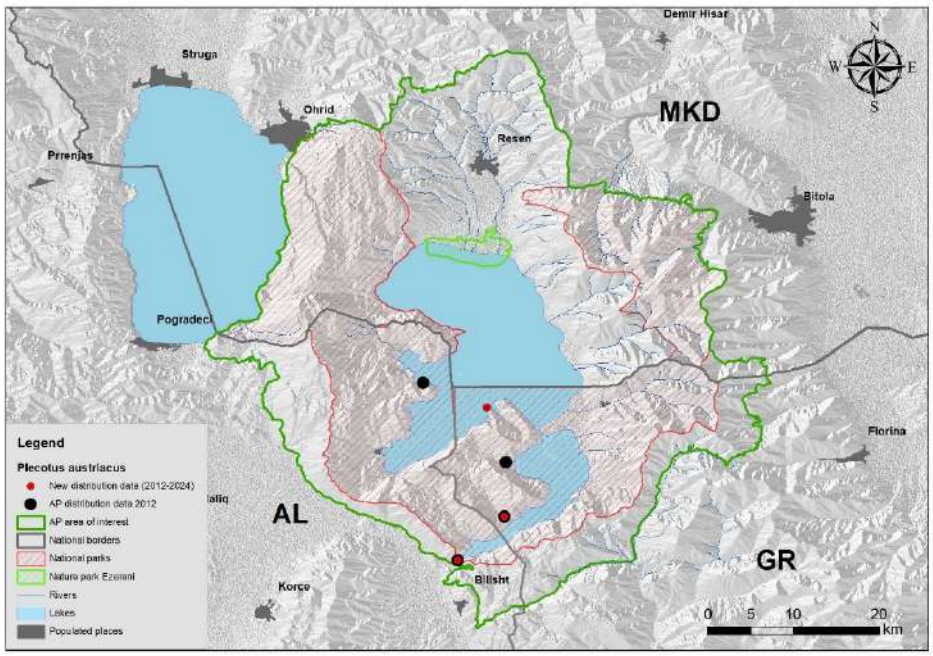
25. *Plecotus auritus*

The species has a limited distribution and has been recorded only in a few locations in the Greek and Macedonian part of Prespa.



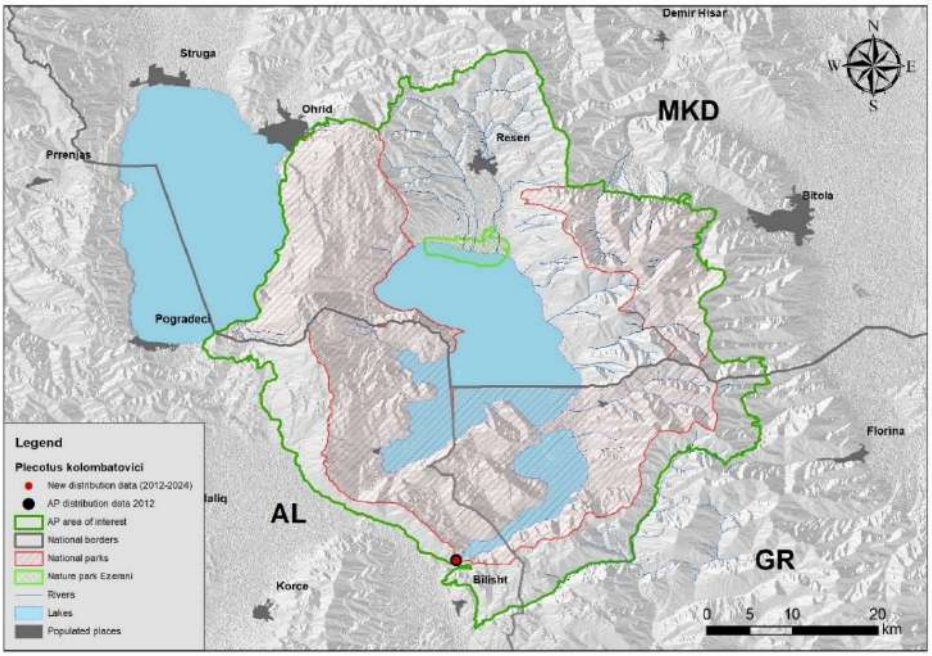
26. *Plecotus austriacus*

The species has a limited distribution and has been recorded only in a few locations in the Greek and Albanian part of Prespa.



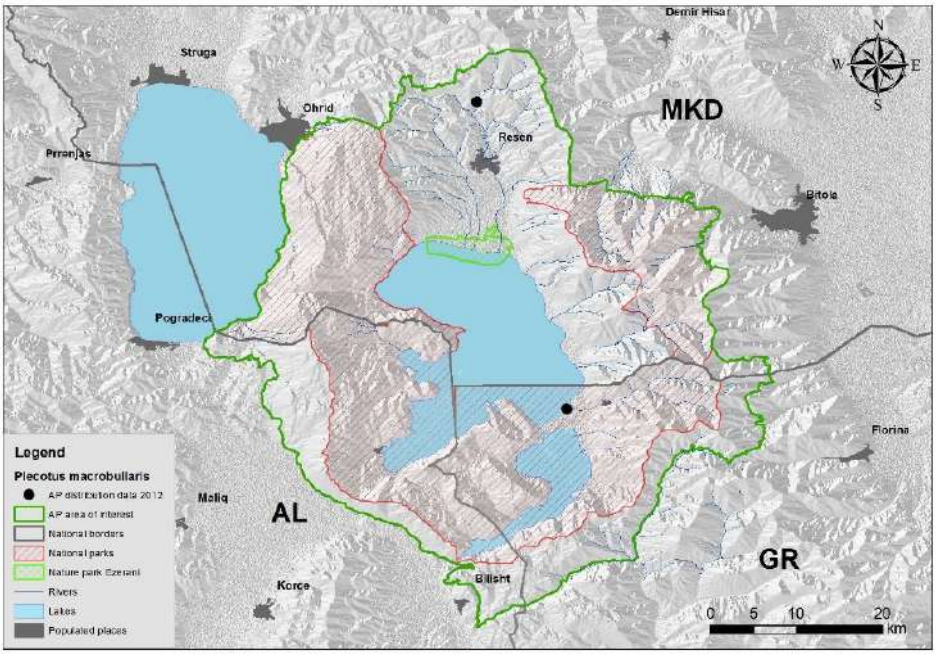
27. *Plecotus kolombatovici*

The species has been recorded only at one location in Albanian part of Prespa.



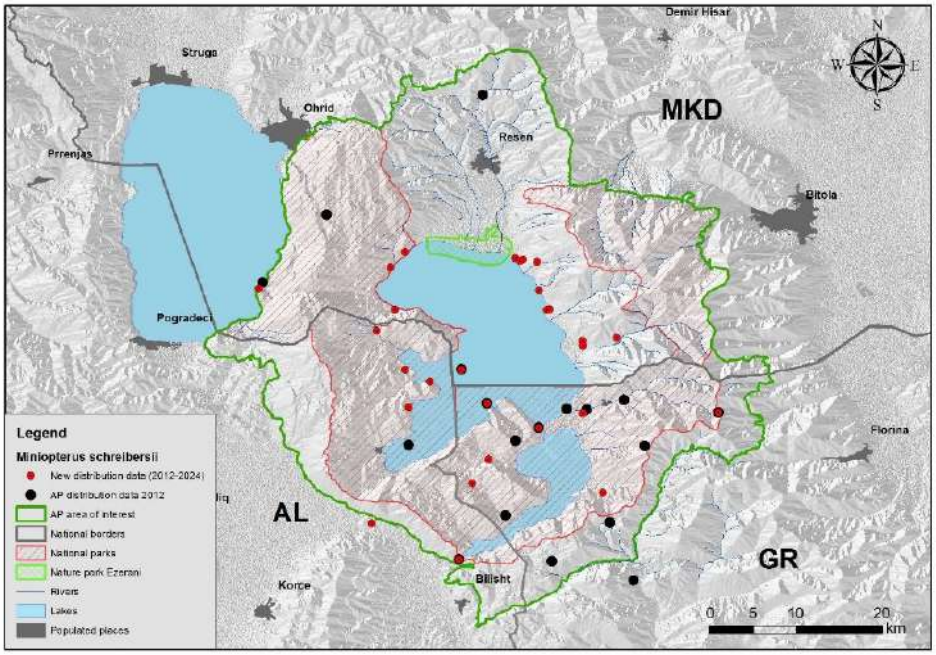
28. *Plecotus macrobullaris*

The species has limited distribution and has been recorded only on two locations in entire Prespa watershed.



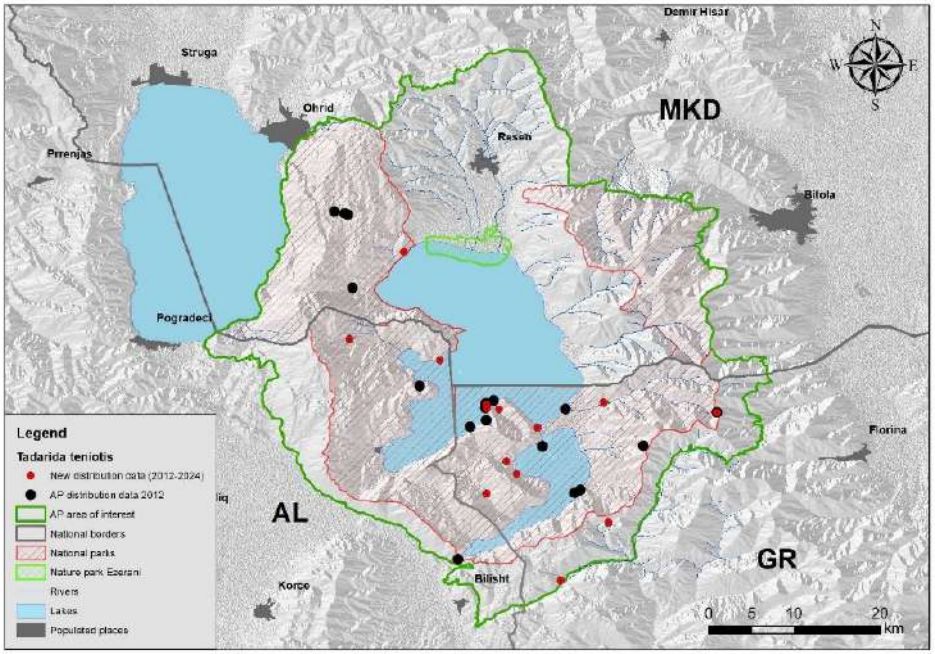
29. *Miniopterus schreibersii*

Common species throughout the Prespa watershed.



30. *Tadarida teniotis*

Common species throughout Prespa watershed.



5. TRANSBOUNDARY MONITORING SYSTEM (TMS)

The Transboundary Prespa Park is a ground for transboundary cooperation on the conservation of bats. The basis for such cooperation is established through the document: The Conservation Action Plan for the Bats of Prespa (Papadatou *et al.*, 2011) on which all attempts to improve and develop transboundary monitoring schemes are based.

Based on this first step of transboundary cooperation in bat monitoring, a number of monitoring activities for cave-dwelling bats were considered important for the future (Papadatou, Grémillet & Kazoglou, 2010; Papadatou et al, 2011), and this has been continued through various initiatives, which reviles the need to improve the CAP 2012 in the way to consider, besides cave-dwelling species, also other bat species and their habitats (commuting and feeding areas, but also feeding habitats).

According to the CAP 2012 it was agreed that the development of the TMS for the Transboundary Prespa Park should be realistic, inexpensive and applicable followed by scientifically based and practical methods of monitoring bats. However, the resources needed to implement such monitoring have not yet been secured or defined; therefore, it is very likely that its implementation in the near future will involve the collection of relatively simple data (i.e. not requiring highly skilled personnel or complex methods and equipment) based on common methodologies and field protocols for the three sides of Prespa, to be implemented by well-trained local people. In addition, bat monitoring should require resources comparable to those allocated to other thematic areas and elements of the TMS, such as midwinter bird counts, which do not require large amounts of funding.

Transboundary Monitoring Protocol

One of the most important results of the PrespaNet project (2021-2024) is the Transboundary Monitoring Protocols, which represents a unified monitoring protocols for bats in the Prespa area (Théou and Stojanov, 2021). This protocol is focused on underground and forest habitats and bat species using them, but it is very useful to consider it in other situations in the field. The full transboundary protocols are presented in ANNEX III and IV.

Additionally, during the preparation of this document, we agree that we will create a simple field monitoring forms for two methods inspired and designed based on the field monitoring formularies of the Slovenian state bat monitoring program (Presetnik *et al.*, 2023) as supporting documents which will enhance the monitoring activities on the field. Examples of these protocols are attached in the ANNEX II.

PART II. CONSERVATION ISSUES AND RECOMMENDATIONS

6. THREATS AND LIMITING FACTORS

Based on the knowledge and experience of bat experts and stakeholders from the Prespa Transboundary Park, the following 7 main threats have been identified (see below). They are mainly concentrated around caves, which are the most important roosts identified so far in the area. Some caves are easily accessible to the public and show signs of uncontrolled visits, which can damage them in various ways (e.g. burning of garbage inside, taking of cave jewellery, visiting in sensitive periods for bat species, etc.). Caves of archaeological interest may become a particular target, such as Treni Cave (AL), where archaeological findings date back to prehistoric times (CAP 2012; Bego, 2022). Based on CAP 2012, 3 important underground roosts used by bat colonies during all or most of the year are identified: **Treni (AL), Tcherna (GR) and Bimbilova (MK) caves.** These 3 caves should have very controlled access. Before implementing physical restrictions, it is important to assess the number of tourists visiting these caves. In addition, physical measures alone will not ensure long-term conservation without a clear plan for their maintenance and a strategy to compensate local communities for any new restrictions. Balancing conservation with community interests is imperative for these caves.

Breeding and hibernating bat colonies are particularly sensitive to disturbance from uncontrolled visitation: mothers may drop and abandon their young if disturbed, and hibernating bats may be awakened and consume their expensive fat reserves without being able to replenish them, increasing the likelihood of death.

1. Disturbance and/or damage caused by uncontrolled and unauthorized public access

Signs of uncontrolled visits have been identified so far (Table 5):

a. **Waste disposal problems**. In the Treni and Kosornik caves in Albania and in the Samotska Dupka cave in North Macedonia, garbage such as cans, plastic bags, clothes, etc. has been recorded. The cause of this problem is the low awareness of the local population about the importance and values of caves and the mismanagement of urban waste, as waste is sometimes burned directly in the caves (Bego, 2022).

b. **Disturbance by fishermen/hunters**. Previous conservation plan from 2012, which shot cartridges in Tcherna Cave, revealed that hunters shoot animals in or near the site (probably birds from inside the cave) and use the cave as a shelter during bad weather; it is also noted that several groups of fishermen who fish in Small Prespa Lake, including near the channel at Treni Cave, use the cave as a shelter during bad weather, sometimes lighting fires at its entrance, which poses a direct threat to the bats inside (Bego, 2022).

c. **Summer shelter for animals**. In the previous CAP 2012, it was indicated that Treni Cave, the caves near Gollomboç and Golema Dupka may be frequently used by shepherds during the summer to shelter their animals (large flocks of sheep and goats). Shepherds sometimes even light fires in the caves. This is especially true for the Treni Cave, where shepherds are the most important group of users of this underground object. Due to the fact that the outside watering place for cattle is not in operation, the shepherds are directed to the water resources of the cave (Bego, 2022).

d. **Other uncontrolled activities**. *Uncontrolled and unauthorized* visits by humans may even involve rituals: in February 2011, the iron gate at the entrance to Treni Cave (Kazoglou *et al.* 2010, WAMP *et al.* 2011) was forced open and objects such as a mirror and candles were found inside the cave. The gate has been forced open several times in the past and has even been removed by people to be sold as scrap metal. There has been no such incident recently.

   Inappropriate gates at cave entrances can also be described as uncontrolled activity: Gates at cave entrances that are unsuitable for bats can prevent their free access to these sites, as some species react negatively to the presence of gates (Mitchell-Jones *et al.*, 2007). The gate at the entrance of Samotska Dupka Cave, installed in 2005 to control public visits, is not specifically designed for bats and most likely does not allow many bats, and probably other bat species, to roost in the cave.

e. **Degradation of speleothems in Samotska Dupka Cave** This cave is the richest in speleothems in Prespa and the most endangered in this respect. The most vulnerable speleothems are the travertine pools and the cave pearls found in them. They are formed on the floor of the main cave chamber and can be walked on by visitors. A small part of the cave wall is damaged by graffiti.

   Importance: high

2. Human pressure in the surroundings of the caves

As noted in the 2012 CAP, the threats to which attention should be paid are changes in the immediate surroundings of caves (with reference to Mikrilimni and Kakkalis caves in Greece), such as the removal of vegetation near cave entrances, which can disrupt bat use and alter hydrological conditions. Deforestation was also mentioned as a threat, which can negatively affect karst ecosystems by increasing erosion, altering water chemistry, and degrading cave formations. In addition, past quarrying activities have caused significant disturbance, particularly to Treni Cave, through noise, dust pollution, and structural damage. These threats emphasize the need for careful environmental management to protect cave habitats and their ecological functions.

Regarding this chapter, on the 1st Participatory Workshop "Revision of the Bat Action Plan for Prespa" held on 20-21 November 2024 - Hotel Tino, Ohrid, we concluded that there is not enough evidence of negative effects of deforestation in the surroundings of caves compared to the period from CAP 2012, but it has to be taken into consideration through the monitoring of possible threats in the future. Similarly, it is concluded that two quarries that were identified as a threat to Treni Cave (AL), are still stopped, but the monitoring of this activity is very welcome. Also, no intensity or any threat in the changes in the immediate surroundings of the Mikrilimni and Kakkalis caves in Greece, has been noticed since CAP 2012.

However new threat arose in subchapter:

a. Changing the configuration of the immediate surroundings

Recently, as part of a church restoration project (2020-2024), artificial lighting was installed on Maligrad Island, including areas near previously known bat roosts. However, since the

island is not visited at night, these lights serve no real purpose other than to create a constant disturbance for bats. During the PrespaNet III project survey, no bats were recorded in the area, suggesting that changes in the environment may have affected their activity (Nezaj & Bego 2025, Unpublished). However, further surveys are needed to confirm the extent of this impact, assess the severity of the threat, and determine appropriate conservation measures. The island, despite being a core area of the park, is also being used as a camping site.

Importance: high

3. Lack of scientific data on caves and cave-dwelling bats, as well as invertebrate fauna

Caves in Prespa are not fully explored. Locals may know the geographical location of other caves and pits. Further detailed speleological research is needed. Almost nothing is known about the invertebrate fauna of the currently known caves.

Importance: medium

4. Lack of enforcement of legislation

Basic legal frameworks for the conservation and/or protection of caves and cave fauna exist in all three countries of the Prespa region. Lack of enforcement of legislation is the main threat to be addressed in this Action Plan.

Importance: medium

5. Lack of capacity in NPs regarding cave research and conservation

Most of the National Park staff are not well informed about the importance of caves and cave fauna, nor do they have the necessary skills and knowledge for practical survey of caves and cave fauna.

Importance: medium

6. Low public awareness (prejudice about bats)

Public ignorance of the ecological role and importance of caves and bats can lead to a lack of respect and interest in their protection.

Importance: medium

7. Cave tourism

Recently, it has been concluded that the main threats to Treni Cave (AL) include uncontrolled tourist visits, noise and light disturbances, and some structural modifications, all of which disturb bats during critical hibernation and breeding periods. As a result of these disturbances, Treni Cave is no longer being used as a nursery (Bego, 2022) and very low number of bats (only 80 specimens of *M. capaccinii* & *Rhinolophus spp.*) have been registered during the winter season (Nezaj & Bego, 2025)

There have been no changes in the medium tourist use of the two historic caves in Greece, Kokkalis and Zachariadis, which are managed sustainably by local authorities, compared to 2012. Papadatou *et al.* (2011) noted that only a few individuals of *R. hipposideros* and *R. ferrumequinum* use these caves during the day, but at night, many bat species use them as night roosts. Additionally, Kokkalis Cave is recognized as a swarming roost. However, increased tourism could alter the caves' structure and microclimate, potentially making them less suitable for bats. Cave tourism has already been identified as a serious threat to some important bat caves in northern Greece (e.g., Paragamian *et al.* 2004).

There were plans in the past for Samotska Dupka cave (MK) to be visited by tourists. The lights that were placed at that time in the cave are not suitable and may destroy the cave if they come into use (they are currently out of use). If the cave is ever used to attract visitors in future, particular care should be taken with regards to the type and the use of lights, the time and season of visits as well as the number of visitors and other details (see conservation recommendations below). The cave is primarily used as a hibernaculum and as mentioned earlier, accidental disturbance of hibernating bats may increase their probability of death.

Importance: high (Albania) / medium (Greece & N. Macedonia)

TABLE 5. MAIN THREATS, ISSUES AND LIMITING FACTORS IN BAT CONSERVATION IN TPP.

DISTURBANCE AND/OR DAMAGE CAUSED BY UNCONTROLLED AND UNAUTHORISED PUBLIC ACCESS			
Issue	**Details**	**Examples/Locations**	**Importance**
Waste disposal problems	Low public awareness leads to garbage disposal in caves, causing environmental harm, by lighting up that garbage.	Treni and Kosornik caves in the past, but recently (2021-2024) Shueci Tunnels (Al), Samotska Dupka (MK)	High
Disturbance by hunters	Hunters shoot near or inside caves, disturbing bats and potentially damaging cave structures through rock collapse.	Tcherna Cave (GR) shot cartridges found	Medium
Domestic stock shelter	Caves used as summer shelters by shepherds with herds, occasionally lighting fires, disturbing cave ecology.	Treni Cave, caves near Gollomboç (AL), Golema Dupka (MK)	High

DISTURBANCE AND/OR DAMAGE CAUSED BY UNCONTROLLED AND UNAUTHORISED PUBLIC ACCESS			
Issue	**Details**	**Examples/Locations**	**Importance**
Uncontrolled activities and vandalism	Unauthorized visitors perform rituals, often forcing open gates and leaving objects inside caves. Gates are sometimes removed for scrap metal.	Treni Cave (AL) gate repeatedly forced open; mirror and candles found in 2011)	Medium
Unsuitable cave entrance gates	Improperly designed gates restrict bat access and limit roosting opportunities.	Samotska Dupka Cave (MK) not bat-friendly gate installed in 2005	High
Degradation of speleothems	Visitors damage sensitive speleothems like travertine pools and cave pearls by stepping on them; graffiti damages cave walls.	Samotska Dupka Cave (MK) is the richest in speleothems in Prespa region	High

2. HUMAN PRESSURE IN CAVES' SURROUNDINGS			
Issue	**Details**	**Examples/Locations**	**Importance**
Changing configuration of surroundings	Artificial lights installed on Maligrad Island disturb bats by altering their habitat, even though the island is not visited at night. No bats were recorded during the PrespaNet III project survey (2021-2024), suggesting a negative impact, but further research is needed to confirm the extent of the threat.	Caves in Maligrad Island (AL)	High

3. LACK OF SCIENTIFIC DATA			
Issue	**Details**	**Examples/Locations**	**Importance**
Insufficient data on caves and cave-dwelling fauna	Limited exploration of caves and minimal data on invertebrate fauna. Locals may know additional sites, but comprehensive scientific studies are lacking.	All caves in the Prespa region	Medium
4. LACK OF ENFORCEMENT OF LEGISLATION			
Inadequate legal enforcement	Although legal frameworks exist, enforcement is weak, reducing effectiveness in conservation efforts for caves and fauna.	Prespa region (all three countries)	Medium

5. LIMITED CAPACITY IN NATIONAL PARKS			
Lack of skills and knowledge for cave research	National Park staff lack necessary skills and knowledge for surveying and protecting cave ecosystems.	National Parks in the Prespa Region	Medium
6. LOW PUBLIC AWARENESS			
Public prejudice and lack of awareness	Public ignorance and prejudice against bats can lead to indifference or disrespect towards cave and bat conservation.	General issue in Prespa Region	Medium
7. CAVE TOURISM			
Negative impact of tourism on caves	Mild tourism in Kokkalis' and Zachariadis' caves has had little impact, but heavy use or unsuitable lighting (e.g., Samotska Dupka Cave) could cause damage. Treni Cave has already been impacted by uncontrolled visits and disturbances.	Historic caves in Greece (Kokkalis', Zachariadis'), Samotska Dupka Cave, Treni Cave	Medium (Greece & N. Macedonia)/High (Albania)

7. ACTION PLAN

7.1 ANALYSIS OF IMPLEMENTATION OF CAP 2012

Most of the activities assessed (2 fully implemented, 9 largely implemented, and 14 partially implemented) since the first CAP 2012 was prepared were mostly related to improving knowledge of bats and their underground sites and developing capacity in other PAs to conserve these species and their main roosts (Table 6). Only 3% of the CAP 2012 recommendations are fully implemented. Mostly and partially or partially implemented activities represent 32% and non-implemented activities represent 65% of CAP 2012 (Fig. 10).

TABLE 6. STATUS OF IMPLEMENTED ACTIVITIES FROM CAP 2012

Recommendation in AP 2012	Implementation	Notes on implemented actions
1. Recommended actions to increase knowledge of the specific threats		
1.1.1 Development of survey protocol (survey caves avoiding disturbance to bats) for surveying impacts of specific threats	Some parts	A transboundary protocol for underground sites and cave-dwelling bats monitoring developed in 2021, but not specifically for the threats.
1.1.2 Training NP wardens to survey caves in terms of threats	Some parts	Several trainings/workshops organized for inspection of underground roosting sites, including threat observation and reporting.
2. Recommended actions to increase knowledge and understanding of caves and bats		
2.1.1 Identify new caves that may be important to bat species	Some parts	One new cave discovered in MK part
2.1.2 Assessment of the annual/seasonal function of the new caves if used by the bats	Some parts	Spring and summer visits done in the new cave.
2.2.1 Investigation of known caves on a seasonal basis	Major part	Most caves in MK and some in AL part.
2.2.2 Updating and completing the current knowledge	Major part	Data of number of species, number of individuals and

Recommendation in AP 2012	Implementation	Notes on implemented actions
		seasonal use updated in MK and AL part.
2.2.3 Assessment of the caves' annual function through these seasonal surveys.	Some parts	Annual function assessed for 3 caves in MK part.
2.3.1 Prioritise caves used by large colonies such as Bimbilova, Tcherna and Treni, as well as others that may be identified as important	Major part	Bimbilova and Treni caves prioritized and seasonally visited.
2.3.2 Development of common survey protocol across the 3 countries	Full	Transboundary monitoring protocols for caves and cave-dwelling bats and for forest bats prepared.
2.3.3 Seasonal survey of the sites	Major part	Seasonal surveys done for selected priority caves in MK and AL.
2.3.4 Assessment of the natural fluctuations and population trends of colonies roosting in caves	Some parts	Only for 3 caves in MK.
2.3.5 Provide baseline data against which ongoing presence of bat species can be monitored in subsequent assessments	Major part	For most caves in MK and AL.
2.4.1 Development of common survey and monitoring schemes, methodologies and protocols across the three countries	Full	Transboundary monitoring protocols for caves and cave-dwelling bats and for forest bats prepared.
2.4.2 Organize regular meetings among bat experts, local NGOs and scientists from the management bodies of the NPs	Some parts	Meetings organized only opportunistically in MK and AL.
2.6.2 Develop a centralised system of data management in the TPP (transboundary data base)	Some parts	Common and simple excel database developed.
3. Recommended conservation actions to ensure the favourable conservation status and long-term survival of cave bat populations and their cave roosts in Prespa Region		

Recommendation in AP 2012	Implementation	Notes on implemented actions
3.3.1 Survey the surroundings of the caves during the monitoring	Major part	Only caves in MK and AL.
4. ***Recommended actions to enforce legislation to ensure the favourable conservation status and long-term survival of cave bat populations and their cave roosts in Prespa Region***		
4.1.2 Promote and include caves in management plans and local conservation strategies	Major part	Most caves included in the management plans of the PAs. Management plan for Treni Cave prepared in AL.
5. ***Recommended actions to develop NPs' staff capacity with regard to cave research surveys and conservation***		
5.1.1 Organize local and transboundary meetings, presentations and discussions with experts and local NGOs	Some parts	Meetings organized only opportunistically in MK and AL.
5.2.1 Permanently equip local scientists and wardens of the NPs with the appropriate skills for the monitoring of cave roosts	Some parts	Only in Galičica NP.
5.2.2 Organise training sessions and courses in practical survey and monitoring in the field as well as data management	Major parts	Several trainings organized for NP staff in MK and AL.
5.2.3 Produce guidelines and specific protocols	Major part	Transboundary monitoring protocols prepared for cave-dwelling and forest bats.
5.3.1 Include provision of appropriate equipment in NPs budget	Some parts	Only in Galičica NP.
6. *Recommended actions to develop sustainable eco-tourism considering the ecological needs of cave fauna*		
6.1.2 Define protocols of the visits by qualified personnel based on the EIA study	Some parts	Only common protocol for caves visits defined.
7. ***Recommended actions to increase public awareness on the function and importance of caves as well***		

Recommendation in AP 2012	Implementation	Notes on implemented actions
the ecological role and significance of cave-dwelling bats and invertebrates		
7.1.1 Produce and disseminate leaflets and other information material	Some parts	General leaflet on bats produced in MK.
7.1.2 Organize educational campaigns/programmes	Some parts	Educational modules for caves and bats developed for kindergartens and primary schools in Galičica NP, MK; Events for celebrating International Bat Night and Bat Appreciation Day organized in MK and AL.

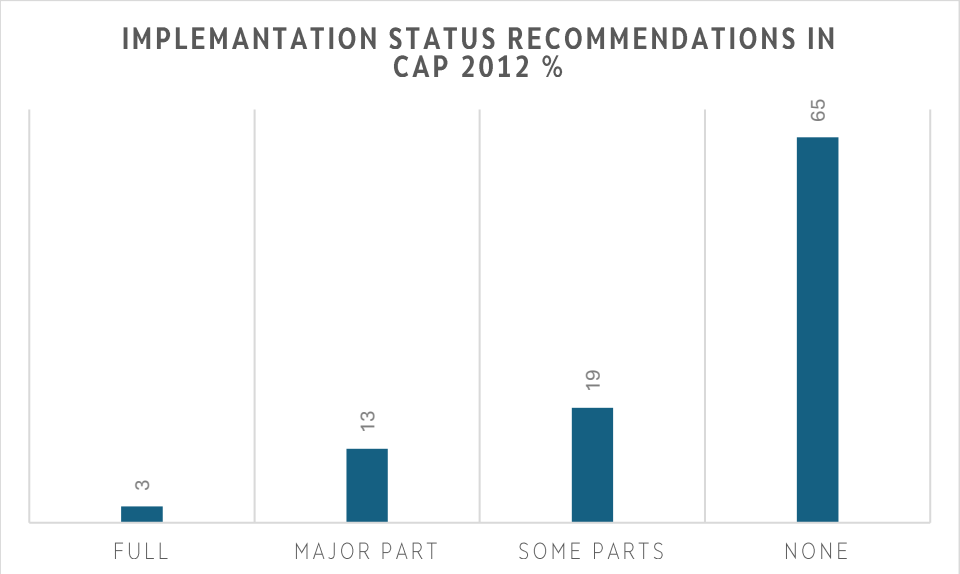


FIGURE 10. STATUS OF IMPLEMENTATION RECOMMENDATIONS FROM CAP 2012 IN %.

7.2 OVERARCHING GOAL OF REFRESHED AND UPDATED VERSION CAP 2025

The overall objective of this updated Action Plan is ***to ensure the sustainable, long-term conservation of important bat roosts and the habitats they use for foraging and transboundary movements in the Prespa Watershed***. To achieve this goal, the objectives, targets and recommended actions are defined in response to the identified threats and limiting factors (which hampered the implementation of the previous AP) and are organized around three pillars, all of which are essential for conservation and interrelated:

1. Improving knowledge;
2. Protection and conservation actions;
3. Public awareness.

More than one axis may be involved in the same objective. The recommendations concern all three countries sharing the Prespa Lakes basin. Actions should ideally be designed and implemented at a transboundary level, with the cooperation of scientists, local governments, national park management bodies (Galičica National Park, Prespa National Parks in Greece and in Albania), the Society for the Protection of Prespa (SPP), the Ezerani protected area and other local NGOs, under the umbrella of the Transboundary Prespa Park.

General recommendation

Conservation projects should be community-based and be implemented with the participation of local people at both the planning and execution stages, ensuring that the benefits are made available to local people where applicable. Raising public awareness plays a significant role in resolving any misunderstandings and in shedding light on the importance of the ecological role of caves and bats and the need to protect and preserve them.

Some general recommendations applicable to all axes described in detail in the subsequent chapters are the following:

- Establish working groups on bats and appoint a coordinator in each country;
- Organize regular contacts, exchange of information/findings from bat surveys, and meetings;
- Plan and implement joint monitoring and research efforts based on commonly agreed protocols and methodologies (Use transboundary monitoring protocol attached as Anexx II & III);
- Use the already established collaboration of experts in the three countries as a model for transboundary conservation and monitoring work in the Transboundary Prespa Park;
- Train staff involved in bats conservation and monitoring by experts already acquainted with the area;
- Encourage collaboration with foreign scientists and experts, by organising or providing opportunity for meetings, field surveys, exploration camps, and participations of different park personal and local inhabitants.

7.3 DETAILED ACTION PLAN

This CAP is prepared for a 5-year period of implementation. In order to reach the overall objective mentioned above, 7 main aims were identified to:

1. Improve knowledge of specific threats.

2. Increase knowledge and understanding of bat species, their roosts and habitats.
3. Develop and test appropriate conservation measures to ensure the favorable conservation status and long-term survival of bat populations and their roosts, beginning with the conservation of cave roosts.
4. Improve enforcement of nature conservation laws.
5. Develop capacity in PAs and NGOs for bat research surveys and conservation.
6. Develop sustainable ecotourism that respects the ecological needs of cave fauna.
7. Increase public awareness of the ecological role and importance of bats.

To achieve these goals, 17 objectives and 60 recommended actions were developed through a participatory process involving cave and bat experts from all three countries and external consultants. With very few exceptions, all objectives and recommended actions concern all three countries sharing the Prespa Lakes watershed.

The main goals, objectives and actions identified are categorized according to the three pillars principle (explained above). Therefore, in the following sections of this chapter, the goals, objectives and proposed actions (or recommendations) of the Conservation Action Plan are classified into three thematic groups: 1) Research and Survey Recommendations; 2) Conservation Recommendations; and 3) Public Awareness Recommendations.

7.3.1 RESEARCH AND SURVEY RECOMMENDATIONS

This section focuses on the first axis. Research and survey recommendations are linked to conservation because they provide the knowledge necessary for regionally adapted conservation management plans and for the targeted use of resources.

Actions should be organized and implemented by the relevant protected area (PA) management bodies in collaboration with local PA experts, local NGOs (e.g. SPP) and external collaborators, including bat experts and speleologists.

Aim 1: To increase knowledge of the specific threats to bats and their habitats in the Transboundary Prespa Park to design appropriate conservation measures and priorities.

Objective 1.1 *To closely survey impacts of specific threats (uncontrolled visits, change in configuration of surroundings) to better assess their importance for bat roosts and their habitats; to identify potential new threats.* To fulfil this objective, the following actions were defined:

- Define the exact needs and develop a survey protocol with the help of experts in collaboration with the PA authorities.
- Train NP wardens to survey caves for threats
- Survey bat roosts and their habitats using a common monitoring protocol.
- Start measuring the number of visitors in the most important caves using light data loggers (e.g. https://datalogger.shop/dataloggers/light.html).
- Exchange information and reports between Pas

- Systematically monitor and report any signs of large-scale infrastructural development activities in
- Forsee action against threats where necessary

Aim 2: To increase knowledge and understanding of bat species, their roosts and habitats to design appropriate conservation measures and priorities.

Objective 2.1 To perform speleological research in the Transboundary Prespa Park. To fulfil this objective, the following actions were defined:

- Identify new caves that may be important to bat species
- Seasonally assess these caves to determine their annual function if used by the bats should be carried out by trained bat workers. Assess the annual function of the caves (maternity, mating, satellite, transient, night roost, hibernation, fall shelter, male only roost) through these seasonal surveys. Timing and frequency of surveys are key to determining roost function

Objective 2.2 *To conduct transboundary monitoring on the most important underground bat roosts* Transboundary Prespa Park. To fulfil this objective, the following actions were defined:

- Seasonally do monitoring of important underground sites to update and complete current knowledge in order to improve bat trends. Prioritize caves used by large colonies such as Bimbilova, Tcherna and Treni, as well as others that may be identified as important.
- Include other known caves if judged necessary by experts
- Survey sites seasonally, if judged necessary by the experts (e.g. twice per season in the first year to minimize disturbance, then once per season in the following 3 years, etc.).

Objective 2.3 *To survey and monitor the annual use of overground known and potential roosting sites and to assess the bat population status on a long-term basis.* To fulfil this objective, the following actions were defined:

- Use a joint survey protocol across the 3 countries(Annex II &III)
- Monitoring known important roosts (hotel Evropa, churches, abandoned houses, etc.)
- Survey potential overground roosts
- Assessment of the natural fluctuations and population trends of colonies in overground roosts
- In the Greek part of Prespa, actions may be combined with the national survey and monitoring scheme (inset this where needed)

Objective 2.4 *To identify the most important bat forest habitats*:

- Conduct echolocation and mist netting surveys to identify species and possible roosts in forest habitats.
- Opportunistic surveys of old trees/forests to identify potential roosts.
- Identify and map key habitats using GIS tools.

Objective 2.5 *To generally promote and implement established monitoring protocols of bat surveys and monitoring on a transboundary level.* To fulfil this objective, the following actions were defined:

- Implement common survey and monitoring schemes, methodologies and protocols across the three countries so that results are comparable (see Annex II&III)
- Organize regular meetings between bat experts, local NGOs and scientists from the management bodies of the protected areas.
- Update protocols every few years (period to be decided based on experience)
- Ensure the translation of key documents, protocols, and guidelines from English into Greek, Albanian, and Macedonian to support effective implementation and understanding across all participating countries.

7.3.2 CONSERVATION RECOMMENDATIONS

This section deals with the second pillar: Improving knowledge and understanding of bat species, their roosts and habitats. We recommend conservation management actions based on currently available knowledge and experience. The results of these actions should be monitored, and conservation recommendations should be adapted to the results of monitoring, research and surveys. Conservation management actions will help to stabilize or increase populations of endangered species and improve their conservation status at the local level. The protection of important underground and overground roosts is a key action to achieve a favorable conservation status for bats, especially given the fact that bats are very faithful to these roosts and use a network of roosts.

Actions should be organized and implemented by the management bodies of the PAs involved, in collaboration with local scientists from the NPs, local NGOs (e.g. SPP) and external collaborators, including bat experts and speleologists.

Aim 3: To develop appropriate conservation measures to ensure the favorable conservation status and long-term survival of bat populations and their roosts in the Transboundary Prespa Park

Objective 3.1 *To apply immediate measures at bat underground roosts where disturbance and damage is detected.* To fulfil this objective, the following actions were defined:

- Remove the vertical rails of the current gate and build a bat-friendly gate. (Samotska Dupka cave), according to EUROBATS standards
- Keep the entrances unblocked if necessary
- Remove installed wires and other infrastructure/objects in the caves (e.g. Samotska Dupka cave)
- Remove graffiti from the walls with a steel brush (Ford and Williams, 2007) (Samotska Dupka cave)
- Remove garbage from Kosornik, Treni, important bunkers designated as bat roosts in the Prespa region.
- Install bat-friendly gates/fences at Treni (following the recommendations of the latest management plan - Bego, 2022), but be very careful with the fence model, as *M. schreibersii* only tolerates certain ones (Mitchell-Jones, 2007).
- Rehabilitate and maintain the existing water storage facilities "lera" to discourage the shepherds of Treni village from using the lake as a water supply for their livestock and the Treni cave as a shelter for sheep and goats.

Objective 3.2 *To apply immediate measures at bat overground roosts where disturbance and damage is detected.* To fulfil this objective, the following actions were defined:

- Maintain overground roosting sites following the EUROBATS guideline (Protection of overground roosts for bats, 3rd edition; Marnel and Presetnik, 2012)
- Consider the installation of bat boxes where necessary as mitigation measures in degraded habitats, thus demonstrating the importance of EIA procedures to mitigate habitat loss. Bat boxes should be installed in suitable locations based on species requirements, including factors such as temperature, orientation, surrounding foraging areas and the materials from which they are made (Jankowska-Jarek *et al.*, 2023). Monitoring their use can further demonstrate the effectiveness of EIAs and promote conservation awareness.

Objective 3.3 *To ensure the maintenance of the important bat feeding habitats and commuting and migratory corridors.*

- Maintain and enhance key habitat features (as recommended in the EUROBATS *Guidance on the Conservation and Management of Critical Feeding Areas and Commuting Routes for Bats*) such as hedgerows, extensively managed pastures, parks, ponds, old orchards, and elements that ensure high landscape connectivity, including tree lines and steppingstones (Kyheröinen et al., 2019).
- Promote traditional orchards.
- Monitor the impact of pesticide use on bats; reduce pesticide use; inform policy makers.
s
- Encourage, promote and support extensive agriculture, traditional practices and organic farming.
- Develop the breeding of local cattle breeds for reed management in Small Prespa.

Aim 4: Enforce legislation to ensure the favorable conservation status and long-term survival of bat population in Prespa Region

Objective 4.1 *To promote the enforcement of national and international legislation for the protection of bat populations on a local level.* To fulfil this objective, the following actions were defined:

- Encourage actions to ensure that bat roosts and their habitats receive the fullest possible legislative protection (e.g. nominate Treni, Tcherna and Bimbilova caves as caves of the National importance in EUROBATS)
- Promote and streamline AP activities for bat conservation in management plans and local conservation strategies of PAs prepared under national and international policies and legislation (e.g. the Habitats Directive)
- Promote the enforcement of the legislation in all three countries through the establishment of the TPP Authority and other active relevant organizations.

Aim 5: Develop capacity in PAs and NGOs with regards to bat research surveys and conservation

Objective 5.1 *To educate the National Park authorities and management bodies as well as the local governments with regards to the function, ecological role and importance of bat populations in the Prespa region.* To fulfil this objective, the following actions were defined:

- Organize local and transboundary meetings, workshops, presentations and discussions with experts and local NGOs

Objective 5.2 *To train experts, volunteers and wardens in the PAs in census techniques to take over the survey and monitor important bat roosts.* To fulfil this objective, the following actions were defined:

- Permanently equip local experts and NP wardens with the appropriate skills to monitor important bat roosts.
- Organize training sessions and courses in practical field survey and monitoring, and data management.

Aim 6: Develop sustainable eco-tourism considering the ecological needs of cave fauna

Of all the caves examined in this document, only Kokkalis, Zachariadis (Greece) and Samotska Dupka (North Macedonia) may be opened to the public. All other caves host bat colonies all or most of the year, and therefore visits should be very controlled (e.g. controlled observation of the evening bat colony as a tourist attraction). In any case, most of the caves in Prespa do not present particularly important cave speleothems. The Psarades cave cannot be opened to the public due to the presence of large numbers of fleas. In particular:

- In Albania - Treni Cave - in general, mild tourist development should be allowed in the first part of the cave up to the gate.

- In Greece - the mild tourist development of the two historical caves, Zachariadis and Kokkalis, should remain as it is.
- In North Macedonia - in general, the tourist exploitation of the cave should be mild, as for the Kokkalis and Zachariadis caves in the Greek part of Prespa and should be done under a strict protocol that will be developed following an Environmental Impact Assessment (EIA) study that will include a study of the annual use of the cave by bats.

Details for the management of the potential tourist development of these three caves are elaborated in the following objectives and actions:

Objective 6.1 *To define the protocol of visits to Samotska Dupka Cave in case it opens for tourism.* To fulfil this objective, the following actions were defined:

- An EIA study is a prerequisite before any work is done and the cave is opened to the public. The EIA should include a study of the annual use of the cave by bats, if this has not already been done; we already know that visitors should not be allowed from October to March, since the cave is one of the most important known hibernacula in Prespa and the bats start to gather in the cave at least from the end of August and September and onwards.
- Special care should be taken by following the strict protocol defined by the EIA.

Objective 6.2 *To maintain the mild tourist development of Kokkalis and Zachariadis caves.* These caves are open to the public. Because of their historical importance and because they are not used by breeding or hibernating bat colonies, they may continue to be used as such. In order to fulfil this objective, the following measures have been defined:

- Promote and ensure sustainable tourism
- Developing protocols for public visits (e.g. installing light loggers to count the number of visits)

Objective 6.3 *To maintain the sustainable tourist development of Treni Cave. This is the most important bar roost in the Prespa region, and all activities should be controlled and implemented in a sustainable way. To fulfil this objective, the following actions were defined:*

- Employ permanent staff by the municipality of Devoll to act as interpreters at the fenced entrance of Treni Cave (once the fence is built and installed).
- Impose a "no entry" regime for the public and visitors and other unauthorized people inside the Treni Cave (once the fence is in place).

Important point: Any restoration or protection works (e.g. placement of gates at entrances, etc.) should be implemented when the bats are absent from the sites and under the supervision and advice of bat experts. For example, work in Samotska Dupka Cave should not take place in late autumn and winter.

7.3.3 PUBLIC AWARENESS

This section is concerned with the third pillar: raising public awareness and capacity building.

Aim 7: Increase public awareness about the ecological role and significance of bats. Increasing public support for the ecology and behaviour of bats through the dissemination of information to the public will reduce the threats to their survival.

Objective 7.1 *To produce and diffuse information to the public: local communities and visitors.* To fulfil this objective, the following actions were defined:

- Produce and distribute brochures and other informational materials
- Organizing educational campaigns/programs
- Place information boards in the information centers of the PAs
- Place information boards outside caves open to the public
- Promote the importance and ecological role of bats through the websites of relevant organizations/institutions and social media.
- For Treni Cave and its surroundings, use the recently developed management plan (Bego, 2022), which explains in detail how to communicate with local people about bat ecology to protect their population and the most important roost in the Prespa region (e.g: Establishment of an information center on the bats of Prespa in the village of Treni or Zagradec).

Objective 7.2 To inform and establish agreements with municipalities and authorities responsible for the tourist development of caves on a local level. To fulfil this objective, the following actions were defined:

- Encourage municipalities and relevant authorities, in cooperation with the management bodies of national parks, to maintain a soft tourist development of caves open to the public, leaving it to the PAs to decide (e.g. "open door day" of caves for the local community, guiding small groups with head/hand lumps, controlled observation of evening bat emergencies, etc.).

A review of all actions together with responsible institutions/organizations and priority for implementation is presented in Table 7.

TABLE 7. RECOMMENDED ACTION PLAN FOR CAVES AND CAVE BATS IN TRANSBOUNDARY PRESPA PARK

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
RESEARCH AND SURVEY RECOMMENDATIONS	Human pressure in the surroundings of the caves	**1. Increase knowledge of the specific threats**	*1.1 To closely survey impacts of specific threats; to identify new threats*	1.1.1 Development of survey protocol (survey caves avoiding disturbance to bats) for surveying impacts of specific threats	Bat and invertebrate experts, speleologists	ST	2
				1.1.2 Training PA wardens to survey caves in terms of threats	Bat and invertebrate experts, speleologists	ST	2
				1.1.3 Exchanging information and reports among PAs	PAs	LT	3
				1.1.4. Start with measuring the number of visitors in the most important caves, by light dataloggers (e.g. https://datalogger.shop/dataloggers/light.html)	PAs	LT	3

[18] ST=Short term action (up to 1 year); MT= Medium term action (1-3 years); LT=Long term action (3-5 years)

[19] 1=Immediate action; 2=Action in the frame of this Action Plan; 3=Action to start in the frame of this Action Plan

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
				1.1.5 To systematically monitor and report any signs of large-scale infrastructural development activities in and around the protected area	PAs	LT	3
				1.1.6 Acting against threats where appropriate	PAs in cooperation with the relevant experts	LT	3
	Lack of scientific data on caves and cave-dwelling bats, as well as invertebrate fauna	**2. Increase knowledge and understanding of bat species, their roosts and habitats**	*2.1 To perform speleological research in the wider area of the Prespa watershed*	2.1.1 Identify new caves that may be important to bat species	Bat and invertebrate experts, speleologists in collaboration with NPs staff and local NGOs	MT	2

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
				2.1.2 Assessment of the annual/seasonal function of the new caves if used by the bats	Bat experts	MT	3
			2.2 To conduct transboundary monitoring on most important underground bat roosts in Prespa Lake watershed	2.2.1 Monitoring important underground sites on a seasonal basis to update and complete the current knowledge in function of improve trends of bats (**priority are Bimbilova, Treni and Tcherna Caves**)	Bat experts and trained PAs staff; local NGOs	LT	3
				2.2.2 Include monitoring of other known caves if judged necessary by experts	Bat experts and trained PAs staff; local NGOs	LT	3
				2.2.3 Assessment of the caves' annual function through these seasonal surveys.	Bat experts and trained NPs staff; local NGOs	LT	3
			2.3 To survey and monitoring the annual use of overground known and potential roosting sites and to assess the bat population status on a long-term basis.	2.3.1 Prioritise monitoring of known known important overground roosting sites and that may be identified as important	Bat experts	ST	3
				2.3.3 Seasonal surveys of the sites to update and complete the current knowledge in function of improve trends of bats	Bat experts and trained PAs staff; local NGOs	LT	3

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
				2.3.4 Assessment of the natural fluctuations and population trends of colonies roosting in overground roosts	Bat experts	LT	3
			2.4 To identify the most important bat forest habitats	2.4.1 Development of common survey and monitoring schemes for, acoustic and mist-nett method to identify species and possible roosts in the forest habitats	TPP, NPs, local NGOs and relevant experts	ST	1
				2.4.2 Organize opportunistic surveys of old trees/forest to identify possible roosts	PAs forest service	LT	3
				2.4.3 Identify the most important habitats by using GIS tools	Bat experts, local NGOs and PAs	LT	3
			2.5 To generally promote and implementing established monitoring protocols of bat surveys and monitoring on a transboundary level.	2.5.1 Implement common survey and monitoring schemes, methodologies and protocols across the three countries so that results are comparable	TPP, PAs, local NGOs and relevant experts	ST	1
				2.5.2 Organize regular meetings among bat experts, local NGOs and experts from the management bodies of the NPs	PAs, NGOs	LT	1

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
				2.5.3 Update of the protocols every few years (period to be decided upon experience)	Bat experts, local NGOs and PAs	LT	3
CONSERVATION RECOMMENDATIONS	Disturbance and/or damage caused by uncontrolled and unauthorised public access	**3. To develop appropriate conservation measures to ensure the favorable conservation status and long-term survival of bat populations and their roosts in Prespa region**	*3.1 To apply immediate measures at bat underground roosts where disturbance and damage is detected.*	3.1.1 Remove the vertical rails of the current gate and build a bat-friendly gate. (Samotska dupka cave), according to EUROBATS standards	NP Galichica	ST	1
				3.1.3 Remove the currently installed and disused lights and other infrastructure in the cave; remove graffiti (Samotska Dupka Cave)	NP Galichica	ST	1
				3.1.4 Remove garbage from Mečkina Dupka, Kosornik, Treni, Shuec, important bunkers designated as bat roosts in the Prespa Region.	PAs in Albania and N. Macedonia	ST	2
				3.1.5 Installed bat friendly gates on Treni (followed recommendations from the recent Management plan – Bego, 2022) according to EUROBATS standards	Prespa Park AL	ST	1
				3.1.6 Rehabilitate (and maintain) the existing water storage utilities "lera" to discourage shepherds of Treni village to use the lake as	Prespa Park AL	LT	2

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
				water supply for their livestock and Treni cave as a shelter for sheep and goats.			
			3.2 To apply immediate measures at bat overground roosts where disturbance and damage is detected	3.2.1 Maintain overground roosting sites following the EUROBATS guideline (Protection of overground roosts for bats, 3rd edition; Marnel and Presetnik (2012)	TPP, PAs, local NGOs and relevant experts	LT	2
				3.2.2 Consider setting up bat boxes where needed as compensation measures in devastated habitats	TPP, PAs, local NGOs and relevant experts	LT	2
			3.3 To ensure the maintenance of the important bat feeding habitats and commuting and migratory corridors.	3.3.1 Promote traditional orchards.	TPP, PAs, local NGOs	MT	2
				3.3.2 Monitor the impact of pesticide use on bats; reduce pesticide use; inform policymakers.	Universities	LT	3
				3.3.3 Encourage, promote and support extensive agricultural and traditional practices, and organic cultivations.	TPP, PAs, local NGOs	MT	3
	Lack of enforcement of legislation	**4. Enforce legislation to ensure the favourable conservation**	*4.1 To promote the enforcement of national and international legislation for the protection of bat*	4.1.1 Encourage actions to ensure that bat roosts and their habitats receive the fullest possible legislative protection (e.g. Nominate Treni, Tcherna and Bimbilova caves as caves of National importance in EUROBATS)	PAs, TPP, EUROBATS initiative	LT	2

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
		status and long-term survival of bat population in Prespa Region	*population in Prespa Region*	4.1.2 Promote and streamline AP activities for bat conservation in management plans and local conservation strategies of PAs drawn up under national and international policies and legislation (e.g. the Habitats Directive)	PAs authority	MT	3
				4.1.3 Promote the enforcement of the legislation in all three countries	TPP authority	MT	2
	Lack of capacity in NPs in regard to cave research and conservation	**5. Develop PAs and NGOs capacity with regards to bat research surveys and conservation**	*5.1 To educate the National Park authorities and management bodies as well as the local governments with regards to the function, ecological role and importance of bat populations in the Prespa region.*	5.1.1 Organize local and transboundary meetings, workshops, presentations and discussions with experts and local NGOs	NPs authorities and local NGOs	LT	1
			5.2 To train experts, volunteers and wardens in the PAs in census techniques to take over the survey and monitor important bat roosts	5.2.1 Permanently equip local experts and wardens of the NPs with the appropriate tools for the monitoring of the important bat roosts	Experts/ NPs/ local NGOS	LT	3
				5.2.2 Organise training sessions and courses in practical survey and monitoring in the field as well as data management	Experts/ NPs/ local NGOS	LT	3

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
	Cave tourism	**6. Develop sustainable eco-tourism considering the ecological needs of cave fauna**	*6.1 To define the protocol of visits in Samotska Dupka Cave in case it opens for tourism*	6.1.1 Conduct Environmental Impact Assessment (EIA) study as a prior condition to any works and opening of the cave to the public	NP Galichica	LT	3
				6.1.2 Define protocols of the visits by qualified personnel based on the EIA study	NP Galichica	LT	3
			6.2 To maintain the mild tourist development of Kokkalis' and Zachariadis' caves (only GR)	6.2.1 Promote and ensure mild tourist exploitation	NPs and local relevant authorities	MT	1
				6.2.2 Develop protocols of public visits	NP and local relevant authorities	ST	1
			6.3 To maintain the sustainable tourist development of Treni Cave.	6.3.1 Employ a permanent staff as an interpreter at the fenced entrance of Treni cave	NP and local relevant authorities	MT	1
				6.3.2 Impose a "No entry regime" to the visitors inside the Treni cave	NP and local relevant authorities	MT	1
Raising public awareness and capacity building recommendations	Low public awareness (prejudice against bats)	**7. Increase awareness about the ecological role and significance of bats**	*7.1 To produce and diffuse information for the public: local communities and visitors*	7.1.1 Produce and disseminate leaflets and other information material	Local NGOs and PAs	ST	2
				7.1.2 Organize educational campaigns/programs	Local NGOs and PAs	MT	2
				7.1.3 Place information panels in information centres of the NPs	Local NGOs and PAs	ST	1

	Threats	Aims	Objectives	Actions	Implementation	Timeframe[18]	Prioritization[19]
				7.1.4 Place outdoor information panels at caves limited to the public	Local NGOs and PAs	ST	1
				7.1.5 Create webpage as part of the websites of the NPs and promote it through social media as well	PAs	MT	1
				7.1.6 For Treni cave and its surroundings use recently developed Management plan which is in details explains how to communicate with locals about bat ecology	PAs, NGOs, local authorities	LT	1
			7.2 To inform and establish agreements with municipalities and authorities responsible for the tourist development of caves on a local level	7.2.1 Encourage municipalities and relevant authorities to maintain a mild tourist development of caves open to the public (for example "Open door day" of caves for local community, guiding small groups with head/hand lumps, controlled observation of bat evening emergencies, et.)	NPs authorities/ Local NGOs	LT	2

7.4 RECOMMENDED PRIORITY ACTIONS

From the Action Plan given in Table 7, two priority conservation actions that need to be applied immediately by the responsible management authorities, were selected by the expert team. In the following text they are elaborated in more detail.

Action 3.1.1 Remove the vertical rails of the current gate and build a bat-friendly gate. (Samotska Dupka cave), according to EUROBATS standards.

The gate at the entrance of the Samotska Dupka Cave, installed in 2005 to control public visits, is not specifically designed for bats and most likely does not allow many bats to enter the cave (at least in winter). The gate should be replaced by a "bat friendly" gate according to EUROBATS standards, which may allow more bats and probably more species to enter the cave. According to EUROBATS recommendations, the grille should have horizontal bars of appropriate design and construction for the site. One of the most important grill variables is the spacing between the bars. The recommended air gap is 130-150 mm between the bars (or more depending on the type) and 450-750 mm between the vertical supports. The grill door should be well secured but allow safe access to authorized persons. It is recommended that the grill be securely fixed to solid rock and be installed in such a way that it does not obstruct the flow of air into the site. The grill door should be inspected regularly and serviced as necessary.

Time scale: Short term

Prioritization: Immediate action

Approximate costs: 1.200 €

Priority action(s)	Short description	Budget	Stakeholders	Leader(s) / potential implementers	Monitoring	Indicators
Replacing the current gate in Samotska Dupka Cave entrance by a grille-door built according to the EUROBATS standards	The gate placed at the entrance of Samotska Dupka Cave is not designed particularly for bats and most possibly does not allow many bats to roost in the cave. The gate should be replaced by a “bat-friendly” grille-door according to EUROBATS standards.	1.200 €	Local authority, NGOs	NP Galičica	Bat experts with trained NP stuff	Replaced grille-door according to EUROBATS standards

Action 3.1.5 Install bat friendly gate on Treni (followed recommendations from the recent Management plan – Bego, 2022) according to EUROBATS standards

A grill-door installed of the cave allowing bats to freely emerge from and enter the cave without being disturbed by the human presence was recently damaged and cut-off. Thus, there is an urgent need to replace it with a new door of long-lasting material according to the EUROBATS standards. It is recommended to use toughened steel for the most vulnerable parts of the grill. The grill-door should be well secured but should allow access to authorized persons. It is recommended that the door should be securely fitted into solid rock and must be fitted on a way that it does not obstruct the air flow into the site. It should be inspected regularly and maintained when necessary.

Time scale: Short term

Prioritization: Immediate action

Approximate costs: 1.200 €

Priority action(s)	Short description	Budget	Stakeholders	Leader(s)/potential implementers	Monitoring	Indicators
Installed bat friendly gates on Treni (followed recommendations from the recent Management plan – Bego, 2022) according to EUROBATS standards	As the previously installed grill door at the entrance of the cave was cut off, there is urgent need to replace it with new one made of long-lasting material according to EUROBATS standards.	1.200 €	Local authority, NGOs	Prespa Park AL	Bat experts	Installed grill-door according to the EUROBATS standards

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ANNEX

ANNEX I

UNDERGROUND SITES IN THE PRESPA LAKES WATERSHED

I.1 CAVES

Scientific information about caves in the Prespa lakes watershed is generally limited. Here we present data on selected caves based on their importance primarily with regards to their bat fauna. However, a number of other caves in the area (e.g. Petrochilou et al. 1977, Manakovik et al. 1993; Nedelko 2000) are important underground habitats and should also be subject to protection; these are not thoroughly elaborated in this document.

FIG. 1. THE DISTRIBUTION OF IMPORTANT CAVES FOR BATS IN PRESPA (PAPADATOU ET AL. 2012)

Most caves in Prespa are simple and relatively small, while they have few or no speleothems. To date, several key sites have been identified, hosting up to 10 species of bats depending on the season. These caves are used by breeding colonies, as night roosts, for autumn swarming and mating, as stop-over (transitional) sites, possibly as satellite sites, as autumn shelters and for hibernation. Their distribution in Prespa is shown in Fig 1. Cave bat fauna described by country below. The importance of Prespa caves as habitats is further stressed by providing data about invertebrate fauna. The description of the physical features of some caves is not given due to lack of data (Psarades Cave), but these are mentioned in the description of the bat fauna.

I.1.1 Caves in Albania

Treni Cave – located on the southwest of the Lesser Prespa Lake (Fig. 1), near the village of Treni. It stretches southeast and has two entrances. The first entrance is larger and is 7 m wide and 3 m high. The second is 1 m wide and 1 m high. There is a large cave chamber (hall or gallery) 20 m long and 12 m wide which is located 9 m after the entrance. The floor is uneven because of the fallen blocks from the ceiling and the soil structure. Moving south-west, and then south-east, there is another cave expansion 43.2 m long, 5-16 m wide and 2-4 m high. Its floor is also covered with fallen blocks of rock. The highest inclination is at the south-east part of the hall because of the sedimented clay and guano. On the west part of the chamber there is another channel, 67 m long, which connects the first and the second cave chambers. Its width is between 2-8 m, and its height 3-5 m.

Fig. 2 Entrance of Treni Cave (photo: PPNEA 2021)

Twenty meters from the second chamber the channel is under water which is 0.6 m at its deepest point. At one point, in the northwest, the channel is dry due to fallen rocks and guano. The water inside the cave probably shares the same origin as the water from the Lesser Prespa Lake. In the cave, there is another channel stretching out of the first cave chamber southwards and then towards south-east. Its length is 65 m, width 1-8 m and height 1.5-2 m. Part of this channel (40 m long) is also flooded. The water depth here is approximately 0.2 m. The total length of the Treni Cave channels is 250 m. In the past, when the water level of the lake was higher, cave chambers and channels were flooded, allowing the formation of a few speleothems.

A drawing of the cave is shown in Annex II.

FIG. 3 MIXED COLONY OF *MI. SCHREIBERSII*, *M. CAPACCINII* AND *RHINOLOPHUS SPP.* IN TRENI CAVE (PHOTO: MELITJAN NEZAJ, 2023)

Zaveri Cave – located between the villages of Gollomboç and Goricë e Vogël (Fig. 4). Water runs from Greater Prespa Lake downwards into Ohrid Lake through this cave and under Galičica Mountain. The cave is 30 m long and 10 m wide. In period of the creation the first CAP 2012, the most of the cave was flooded with water. During Nezaj & Bego visit in 2025 it was noticed that there is no more visible water inside it. The floor is steep and slippery, as well as covered with unstable rocks. Fluctuations of the water level of the lake are reflected on the traces left on the cave walls. Local people say that there was a time when the lower water level of the lake was due to water flowing into the cave and therefore a small dam was constructed to prevent massive water flows. A drawing of the cave is shown in Annex II.

FIG. 4 PHOTO FROM INSIDE ZAVERI CAVE (PHOTO: MELITJAN NEZAJ, 2023)

Petralia Cave – located near the cave chapel St. Blashtojna on the east coast of the Greater Prespa Lake (Fig. 5), vicinity of Gollomboç village. It has a chamber and two channels. The chamber is 21 m long, 8.6 m wide and has a maximum height of 10 m; it is in northwest direction. The floor is covered with rock blocks. The first channel is 10 m long and less than 1 m high. The second is oriented towards the northwest in the first 20 m, then its orientation changes towards the south for 36 m. This channel is narrow, and its highest point is 2 m. There is a small crack at its end which goes through the rock with the opening a few metres away from the main cave entrance. Petralia Cave is a fossil cave, formed by tectonic abrasion (especially the first channel) and karst erosion. When the water level of the Greater Prespa Lake is higher, part of the longest channel floods with water forming small lakes in its central part. There are almost no cave ornaments because it was under water in the past and because the roof has largely collapsed. These days, speleothems can only be seen in places where cracks are intersecting. Speleothems are represented by small stalactites and draperies.

FIG. 5 THE ENTRANCE OF PETRALIA CAVE (PHOTO: B. GICHEVSKI)

Kosornik cave - located on the eastern shore of the Greater Prespa Lake, near Gollomboç village (Fig. 6). The entrance is opposite Golem Grad Island. The cave channel is simple and oriented

towards the northwest. Its length is 40 m and its width ranges between 1 and 3 m. The highest point near its entrance is 5 m lowering down to 1.5 m at its end. The floor is covered with rocks, especially in the middle and at the end. At the end of the channel there is a chimney which is approx. 3-4 m high. Kosornik Cave is poor in speleothems, mainly because most of the roof has collapsed. Corrosion and the tectonic structure of the terrain have influenced the formation of the cave, while abrasion had important impacts at its entrance.

A drawing of the cave is presented in the Annex II.

FIG. 6 THE ENTRANCE OF THE KOSORNIK CAVE (PHOTO: B. GICHEVSKI) - PAPADATOU *ET AL.*, 2012.

Cave of Doves *(Peshtera na gulabite)* – A small cave on Mali Grad Island (Fig. 7) about 5 m from the lake. The cave floor is covered with large rocks; therefore, it is not possible to estimate its height. The lake waves had a lot of impact on its formation a process like the formation of rock shelters.

FIG. 7 PICTURE FROM INSIDE CAVE OF DOVES (PHOTO: MELITJAN NEZAJ, 2023)

Zmio Cave - Located in the eastern shore of the Great Prespa Lake between Pustec and Gollomboç, this cave has a very difficult access, if not reached by a boat.

FIG. 8 INSIDE ZMIO CAVE (MELITJAN NEZAJ, 2023)

The cave entrance is about 20m from the lake and has one main chamber with a height of about 4 m and a diameter of 15-20m. During Nezaj & Bego (2025) spring visit a mixed colony of 769 specimens of *Mi. schreibersii* and a few unidentified specimens of middle-sized *Rhinolophus* were observed. In early August, a small colony of 20 specimens belonging to *Rh. hipposideros* was observed. This cave seems also to be an important hibernating site, with 89 specimens of *Rhinolophus* species counted in January 2024. During this research campaign, this cave turned out to be the most important (surpassing also Treni Cave) in terms of bat species present inside or nearby the entrance, with 8 species identified

Golema Dupka (Bego, 2011) - This cave is comparatively large, with an entrance that is approx. 10 m high and 25 m wide. "Golema dupka" is the name given to it by the locals and means "big or large cave". The cave is located on the southern shore of Kallamas Peninsula, close to the border with North Macedonia, facing south towards Golem Grad Island (Fig. 1). The cave has two main galleries. The left-hand side gallery is deeper and more suitable for bats. It is some 50 m deep but after that it gets narrower and difficult to explore.

Zaroshka Cave (Bego, 2011) – situated on the southwest coast of the Greater Prespa Lake (Fig. 1). This is the largest and deepest of about 5 shallow caves along this part of the lake shore and the only one that appears to host important bat colonies, at least for some time during the year. It has a narrow entrance and continues for approx. 10 m, after which it widens up in a gallery which is approx. 1-2.5 m wide, 10 m long and 1.7-2 m high. The cave continues further with a very narrow gallery.

I.1.2 CAVES IN GREECE

General issues - In 1977, Petrochilou *et al.* identified and described 15 shallow or deeper caves along the rocky shore of Greater Prespa. In 1963, both lakes had approximately the same level, but the level of Greater Prespa has been generally decreasing since then (Hollis & Stevenson 1997). By the end of December 2010, the level of Greater Prespa was 844.70 m a.s.l. (SPP, unpublished data), being about 5 m lower compared to the lake level in 1977 when A. Petrochilou and colleagues published their report (Petrochilou *et al.* 1977). The situation for the caves must therefore have been very different at that time, with some lacustrine caves currently having dried out and other, new caves having been revealed. Indeed, the 1977 the description of some caves does not fit with the current situation; for example, the location and description of a cave called "Roti" in Petrochilou *et al.* (1977) fits that of the Psarades Cave (Fig. 1) which is now a dry cave approx. 4 m above the level of the lake. On the other hand, the lacustrine cave on the tip of Cape Roti (Fig. 1) was presumably covered by water at the time, as it is not reported by Petrochilou *et al.* (1977). Because of these differences and because not all of them are important to bats, we do not include their description by Petrochilou and colleagues here. We do not provide a description of Psarades Cave because it is infested with fleas and therefore difficult to explore.

Zachariadis *and* ***Kokkalis*** *caves* - These caves have great historical value related to the Greek civil war in the late 1940s and hence an effort for mild tourist development has been made by the local authorities. Kokkalis Cave is also known as the Civil War Hospital Cave. They are located in the northwest and the southwest of the Lesser Prespa Lake respectively (Fig. 1). Kokkalis Cave is approx. 1120 m a.s.l. and comprises a very large chamber. Zachariadis is a small cave approx. 1050 m a.s.l. They are both surrounded by oak forests.

Tcherna Cave – located on the south coast of the Greater Prespa Lake, near the village of Psarades (Fig. 9). It was semi-lacustrine in 1977 (Tcherna II, Petrochilou *et al.* 1977). There are two main channels (A and B) and one chamber. At approximately 10 m from the entrance of the cave, channels A and B are divided. Channel A is a crack 1.5-3 m wide and 3 m high. In its first 7 m it has western orientation, and in the next 10 m it gets a southern direction. Here it is divided in three smaller channels: one with western and two with southern directions. The bottom of the channel with a western direction goes out to the lake and is flooded with water. The middle channel has a larger inclination because of the fallen rocks, ending with a layer of rockslide that ends into the Prespa Lake. The total length of channel A is 44 m. Cave channel B is a narrow crack with a southeastern orientation. Its length is 27 m, width 1-3 m and height around 2 m. This channel is lowered towards an interior of a carbonate mass. The chamber is a special speleological object divided by a primary rock from channels A and B. The entrance of this chamber is 14 m wide and 5-6 m high. It is divided by a rock block that forms two entrances. The chamber orientation is eastward. The bottom is covered by wide rock blocks which have fallen from the ceiling. Because of these blocks, the slope is high and it is impossible to measure the exact height; however, it is approximately 5 m. The total length of the chamber is 37 m and it is 8 m wide. A drawing of the cave is shown in the Annex I.

FIG. 9 INSIDE TCHERNA CAVE (SLAVCHO HRISTOVSKI, 2011)

Cape Roti Cave – located on the tip of Cape Roti (hence the name), near Psarades village (Fig. 1). The entrance and the first part of the cave are only accessible by boat. In the past the cave was entirely under water (Petrochilou *et al.* 1977), which is also suggested by the shells on the cave floor. It is a simple cave stretching along a rock crack and expanded through the process of karst erosion and abrasion. Its length is approx. 50 m and width 3-6 m. Its height is approx. 10 m near the entrance lowering down to 3 m towards the inside of the cave. The cave floor is slightly slanted towards the lake and in parts it is covered by rocky material fallen from the cave ceiling. Speleothems are represented by small stalactites, stalagmites and cave columns. A drawing of the cave is presented in the Annex I.

Mikrolimni Cave - situated east of Mikrolimni village at 860 m a.s.l. (Fig. 1). It was explored and mapped by K. Paragamian and G. Katsadorakis in 1991 (Paragamian 1992). The entrance is 4 m wide and 1 m high and ¾ of it are blocked by large stones and rocks. Behind the entrance there is a small chamber 3 m long and 6 m wide. After 6 m downwards, there is the main chamber of the cave which has a maximum length of 10 m, a maximum width of 17 m and a maximum height of 3 m. Its total length is 20 m and its deepest point is 9 m below the entrance level. In the northern part of the cave there is water with a maximum depth of 0.5 m. This water is at approximately the same level as the water table of the Lesser Prespa Lake and it appears that it follows its fluctuations: the water appears to flood half of the chamber for parts of the year, since its level rises by up to 1 m. A drawing of the cave is presented in Annex II.

I.1.3 CAVES IN NORTH MACEDONIA

Samotska Dupka Cave – is located to the west of Mountain Hut "Asan Gjura", in the watershed of Lake Ohrid but very near Prespa watershed (Fig. 10). Preliminary data about the cave are found in Manakovik (1990) and Manakovik *et al.* (1993).

FIG. 10 INSIDE SAMOTSKA DUPKA CAVE (PHOTO: ALEKSANDAR STOJANOV, 2023)

It is a long channel with a general southwest-northeast direction. The channel is meander-like, frequently changing direction. Its average width is approx. 2 m and height approx. 10 m. In the middle there are three smaller side channels. The first is on the right side of the main channel and it is oriented towards the east. It is 8 m long, 0.5 m wide and 2 m high. The second is on the left side of the main channel and it is oriented to the northwest. It is 11 m long, 0.6 m wide and 1.5 m high. The last channel is on the right side of the main channel with a length of 2 m and a width of 2 m. The total length of the main chamber is 224 m. Cave Samotska Dupka is perhaps the richest in speleothems compared to the rest of the known caves in Prespa. These include stalactites, drainage watersheds, corals, cave pearls and travertine basins. Their colour is mostly white, yellow and red. Especially interesting are the cave pearls which are settled in travertine basins. During the wet period of the year, when water leaks through the cracks, the cave pearls are still active (speleothems are generally active when water drops through the cracks). During the dry period of the year, most of the speleothems lose their shine. A drawing of the cave is shown in the Annex II.

***Leskoec Cave* (Leskoečka peštera)** – Preliminary data about the cave are found in Tochkovski (1970) and Manakovik *et al.* (1993). The cave is located near Leskoec village (Fig. 11). The entrance is at the bottom of a rocky section at 1070 m a.s.l. and it is small (1.4 m wide and 1.3 m high). From the entrance, there is a narrow channel with a length of 14.5 m, 1-1.5 m width and 1.3-3 m height. Its orientation is towards the east, then north-east. This channel leads to the first cave chamber which has a length of 10 m, its widest point is 5.5 m and its highest point is approximately 3 m. Here there is an entrance through a small crack to a second cave hall with a length of 2.5 m and a width of 7.5 m. Beyond the second hall, there is another cave chamber in a southern direction which is 10 m long and 4 m wide and high. The bottom of the cave chamber is covered with soil and small rock blocks, while there is a high amount of guano (see bat fauna below). Speleothems are poorly represented. They occur only where there are large cracks and include basins and small stalactites. Cave

Leskoec (Leskoečka) is a typical example of a cave in which an underground river flowed in the past. The underground river flow had a meandering character (Manakovik *et al.,* 1993). A drawing of the cave is presented in the Annex I.

FIG. 10 INSIDE LESKOEC CAVE (PHOTO: ALEKSANDAR STOJANOV, 2022)

Zandana Cave - A small cave in the southwest of Greater Prespa Lake close to the border with Albania, at a locality called "Zandana". It is approx. 10 m long, relatively dry and has a few cave ornaments. The entrance is orientated to the southeast.

Bimbilova Cave – This cave is located on Golem Grad Island in the Greater Prespa Lake. The entrance is 3 m wide and 1.5 m high. First there is a channel, 10 m long and 1-2 m wide. There is then a cave chamber 30 m long, 15 m wide and 15 m high. There are rocky blocks on its floor, dividing the chamber in two parts. At the end of the southeast part of the chamber there is a small lake (10 m long, 5 m wide and 3 m deep). The origin of the water in the cave lake is from the Greater Prespa Lake since they are both connected via underground cracks. The total length of Bimbilova Cave is 50 m. This cave is poor in speleothems, represented only by few stalactites and cave basins. The formation of the cave was conditioned by the rain water and lake waters. Because the cave is formed from limestone plates, which are set vertically, rain water can easily breach through the inside of the carbonate mass and dissolve it. In addition, the mechanical and chemical erosion of the cave was facilitated through the fluctuations of the Greater Prespa Lake water level, expanding the cracks at the bottom of the cave. A drawing of the cave is presented in the Annex I.

I.2 ROCK SHELTERS

Rock shelters can be found in limestone and other rock types where streams have undercut their banks at bends, or where there has been abrasion by blowing sand. They are small, and day light illuminates them to their end. Most of the rock shelters in Prespa are located along the coasts of the two lakes, while a few others can be found away from the coasts. Many rock shelters near or at the shorelines of Greater and Lesser Prespa Lakes have been used as hermitages and some have chapels constructed in them. Overall, 10 cave chapels have been recorded (Angelichin-Zhura 2006).

ANNEX II

DRAWINGS AND BAT MONITORING FORMS FOR MOST IMPORTANT CAVES IN TRANSBOUNDARY PRESPA

We present drawings of the most important caves in Prespa watershed with the example of Monitoring formulary for bat species in underground sites. The field monitoring forms were designed based on the field monitoring forms of the Slovenian state bat monitoring programme (Presetnik *et al.* 2023)[20] and if this for is used in the forms this should be noted.

[20] Presetnik, P., A. Zamolo, S. Grgurevič & A. Šalamun, 2023. *Monitoring populacij izbranih ciljnih vrst netopirjev v letih 2021–2023.* Končno poročilo. Center za kartografijo favne in flore, Miklavž na Dravskem polju. 212 str., digitalne priloge. [Naročnik: Ministrstvo za naravne vire in prostor, Ljubljana].

Monitoring form for bats in underground habitats in Transboundary Prespa

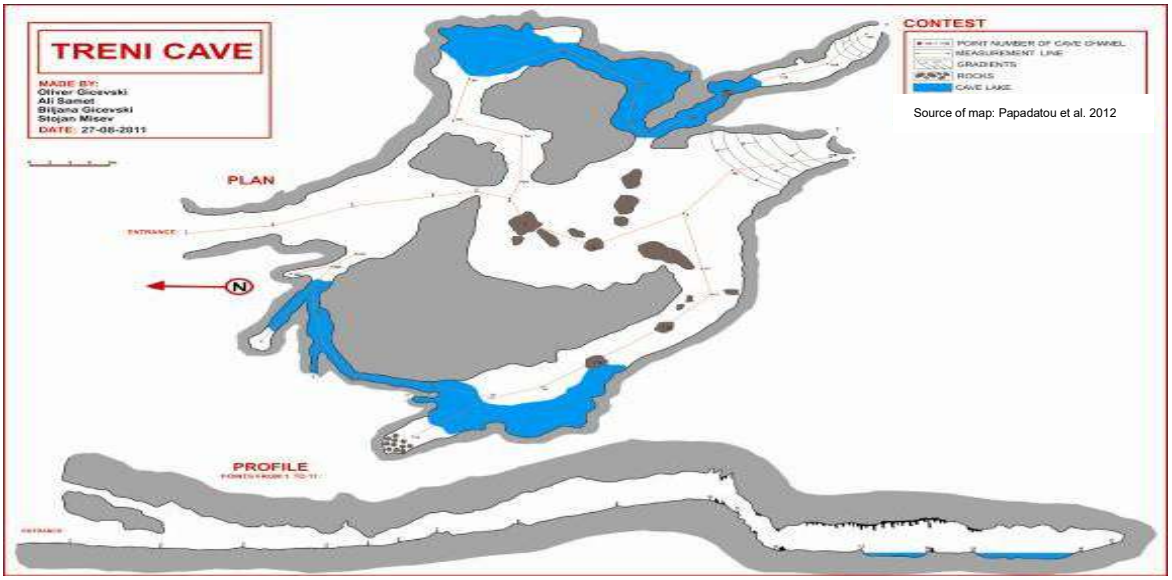
CAVE: TRENI (AL01)	N: 40.67250 E: 20.98750

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, ultrasound bat detector, a camera with a good zoom, tripod and waterproof boots.

Date:	**Observer:**



Species	**No. of individuals**								**Method of determination**
	unisex	**adult**	**♂ adult**	**♀ adult**	**with young**	**carcasses**	**osteo material**	**other**	
Rhinolophus blasii									
Rhinolophus euryale									
Rhinolophus ferrumequinum									
Rhinolophus hipposideros									
Myotis capaccinii									
Myotis myotis									
Miniopterus schreibersii									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

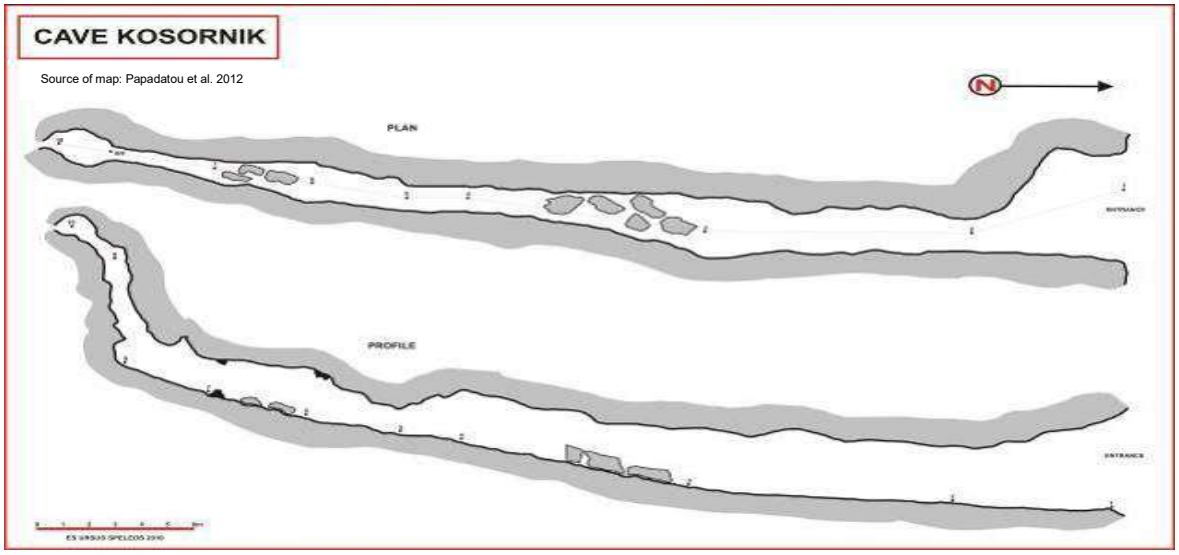
CAVE: KOSORNIK (AL02) | N: 40.84220 E: 20.96206

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, a camera with a good zoom and tripod.

Date: | **Observer:**



Species	No. of individuals								Method of determination
	unisex	adult	♂ adult	♀ adult	with young	carcasses	osteo material	other	
Rhinolophus hipposideros									
Rhinolophus ferrumequinum									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

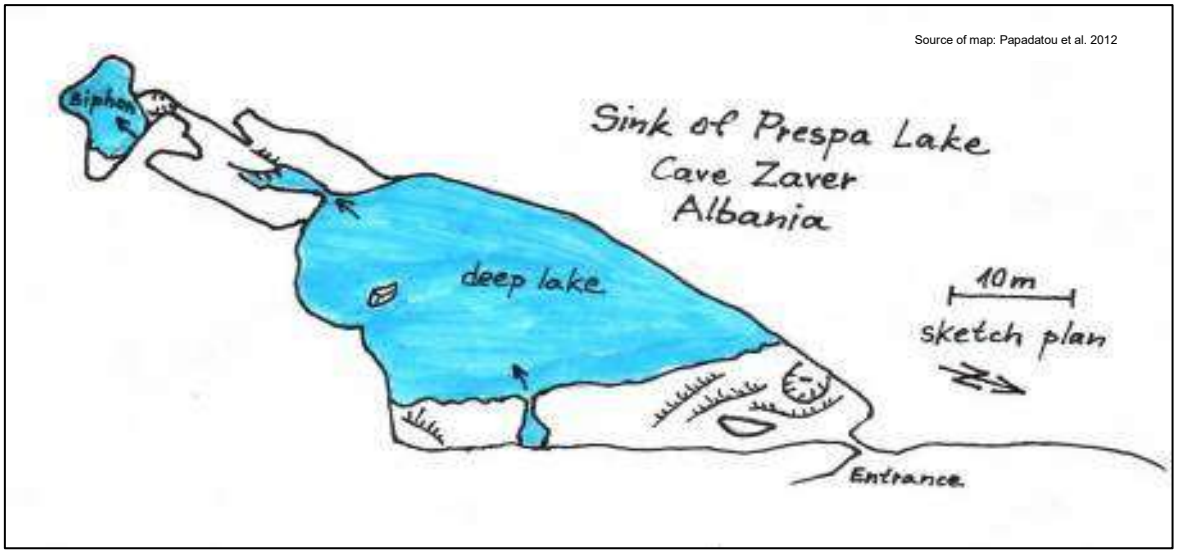
CAVE: ZAVERI (AL03) | N: 40.87006 E: 20.92970

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, a camera with a good zoom, tripod and waterproof boots. Cave inspection should be conducted in good weather (as there is less fog).

Date: | **Observer:**



Species	No. of individuals								Method of determination
	unisex	adult	♂ adult	♀ adult	with young	carcasses	osteo material	other	
Rhinolophus ferrumequinum									
Myotis capaccinii									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

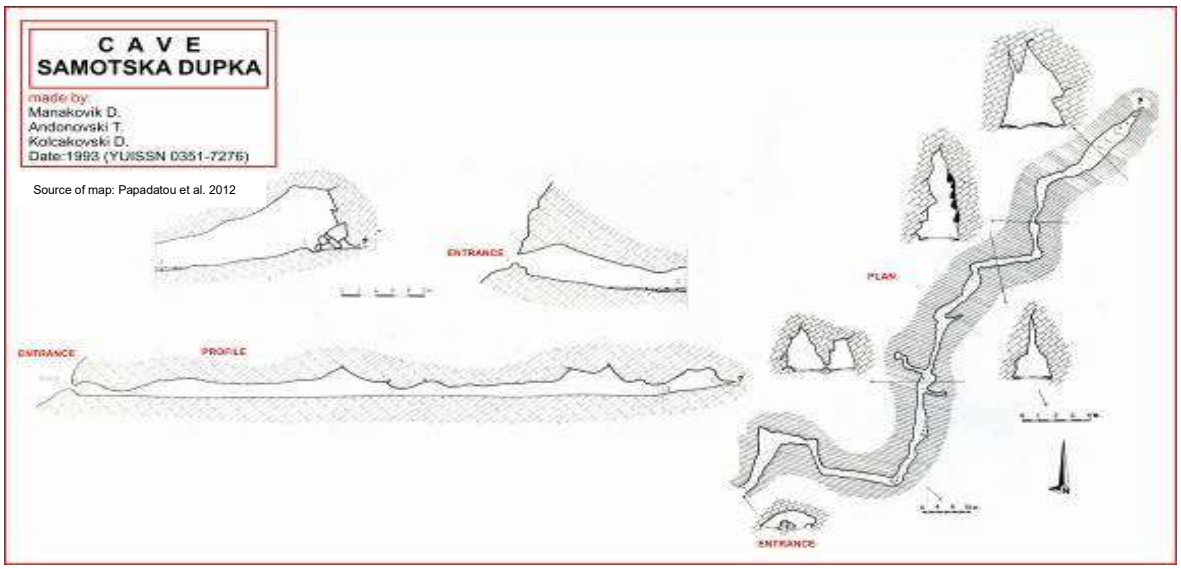
CAVE: SAMOTSKA DUPKA (MK01)	N: 41.02662 E: 20.84614

Address of managing body:

Address of manager/key holder:

Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, a camera with a good zoom. Cave inspection should be conducted in good weather (as the road to the cave can be impassable). Contact manager for keys to open the gate.

Date:	**Observer:**



Species	No. of individuals								Method of determination
	unisex	adult	♂ adult	♀ adult	with young	carcasses	osteo material	other	
Rhinolophus ferrumequinum									
Rhinolophus hipposideros									
Myotis blythii									
Myotis myotis									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

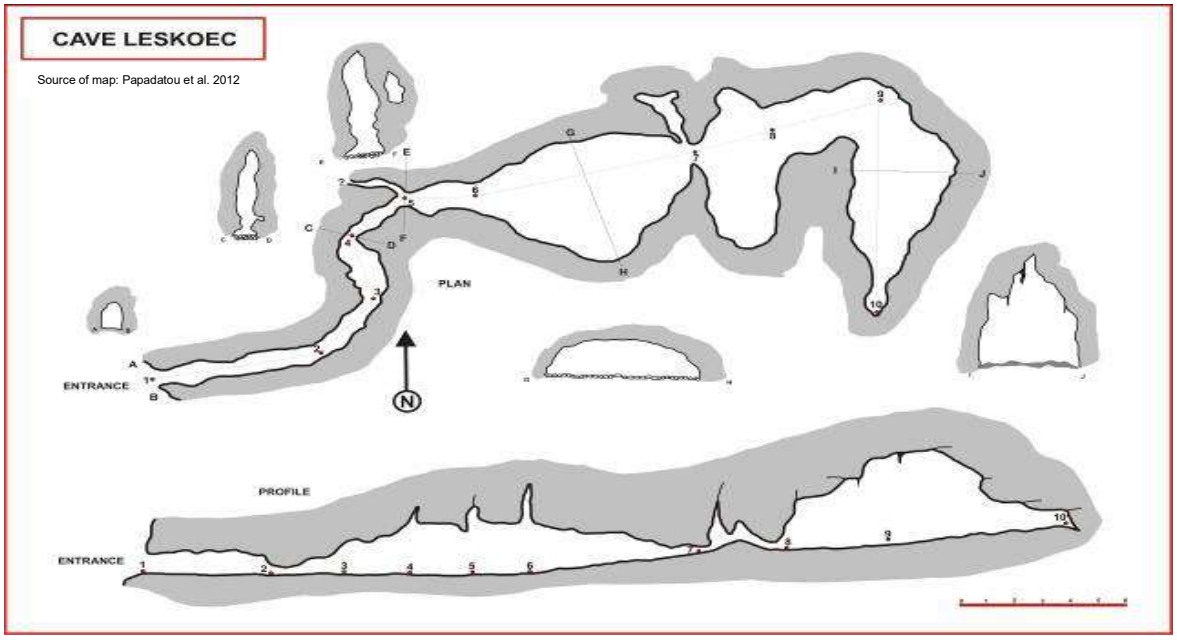
CAVE: LESKOEC (MK02) | N: 40.97907 E: 20.91559

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, a camera with a good zoom, ultrasound bat detector. Contact responsible managing body for key to open the entrance gate.

Date:	**Observer:**



Species	No. of individuals								Method of determination
	unisex	adult	♂ adult	♀ adult	with young	carcasses	osteo material	other	
Rhinolophus blasii									
Rhinolophus euryale									
Rhinolophus ferrumequinum									
Rhinolophus hipposideros									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

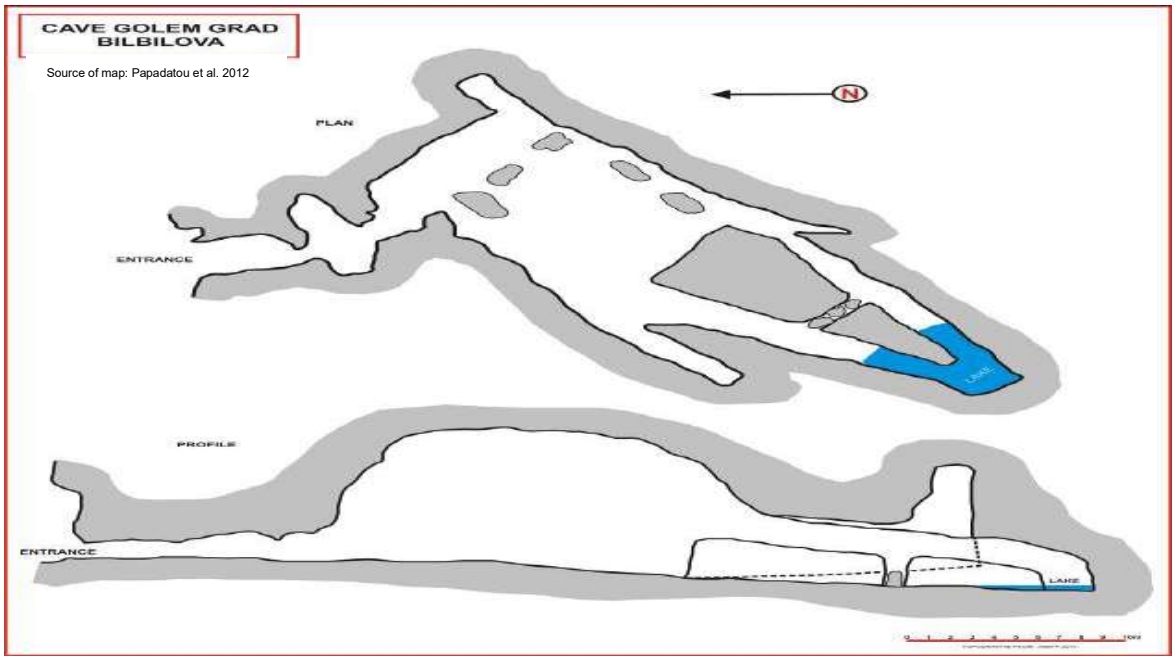
CAVE: BIMBILOVA (MK03)	N: 40.87171 E: 20.98975

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, a camera with a good zoom, life vests and waterproof boots. Cave inspection should be conducted in good weather as it is accessible only by boat.

Date:	**Observer:**



Species	**No. of individuals**								**Method of determination**
	unisex	**adult**	**♂ adult**	**♀ adult**	**with young**	**carcasses**	**osteo material**	**other**	
Rhinolophus ferrumequinum									
Myotis capaccinii									
Miniopterus schreibersii									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

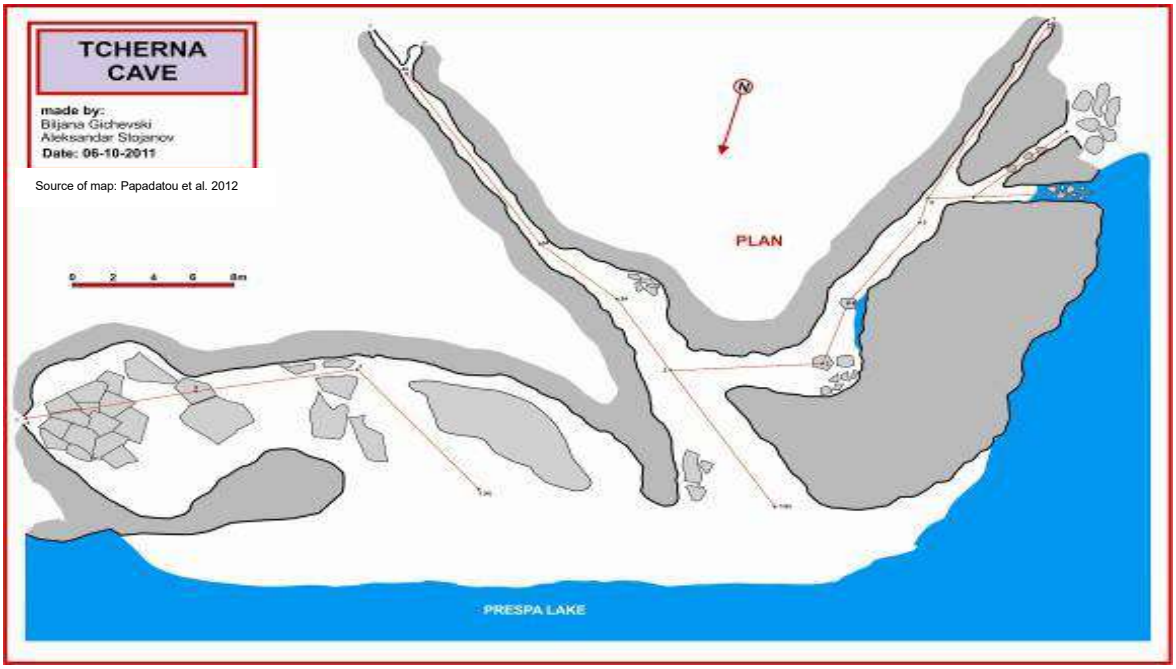
CAVE: TCHERNA (GR01)	X: 40.83618 Y: 21.01623

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, a camera with a good zoom, life vests and waterproof boots. Cave inspection should be conducted in good weather as it is accessible only by boat.

Date:	**Observer:**



Species	No. of individuals								Method of determination
	unisex	adult	♂ adult	♀ adult	with young	carcasses	osteo material	other	
Rhinolophus blasii									
Rhinolophus euryale									
Rhinolophus ferrumequinum									
Myotis capaccinii									
Myotis daubentonii									
Myotis emarginatus									
Myotis myotis									
Miniopterus schreibersii									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

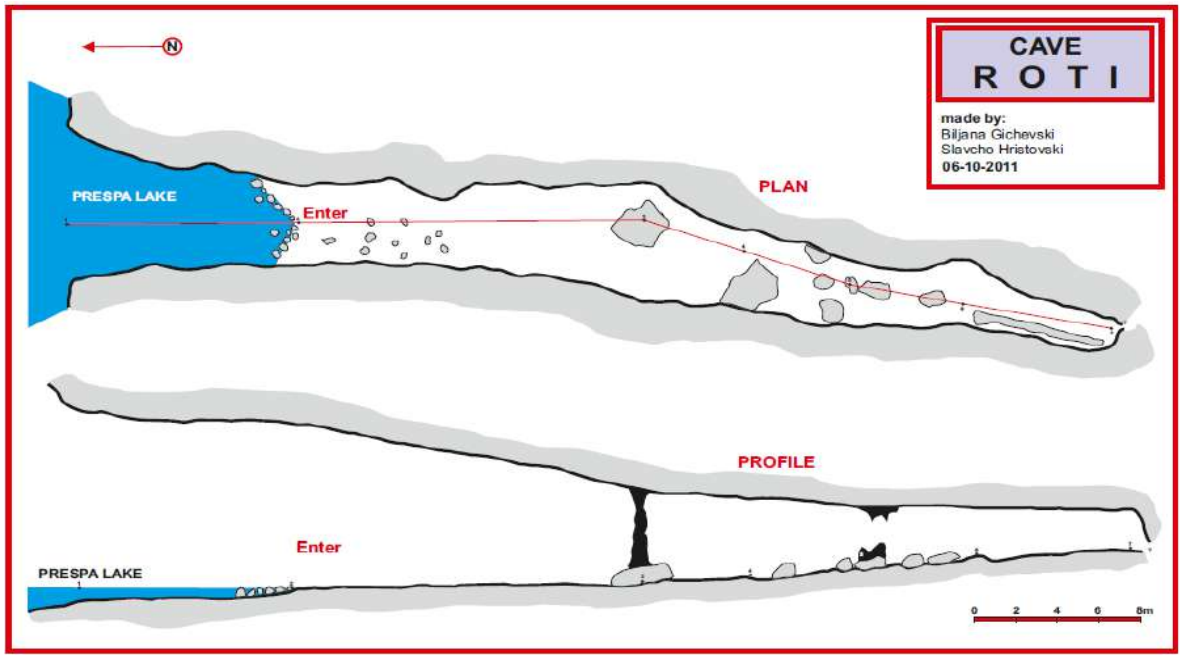
CAVE: ROTI (GR02)	N: 40.81670 E: 21.01380

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, a camera with a good zoom, life vests and waterproof boots. Cave inspection should be conducted in good weather as it is accessible only by boat.

Date:	**Observer:**



Species	No. of individuals								Method of determination
	unisex	adult	♂ adult	♀ adult	with young	carcasses	osteo material	other	
Myotis capaccinii*									
Myotis daubentonii*									
Myotis emarginatus**									

Method of determination

1. Bones

Source of map: Papadatou et al. 2012

3. Ultrasound detector

4. Measurement of live individuals

5. Measurement of dead individuals

6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

Monitoring form for bats in underground habitats in Transboundary Prespa

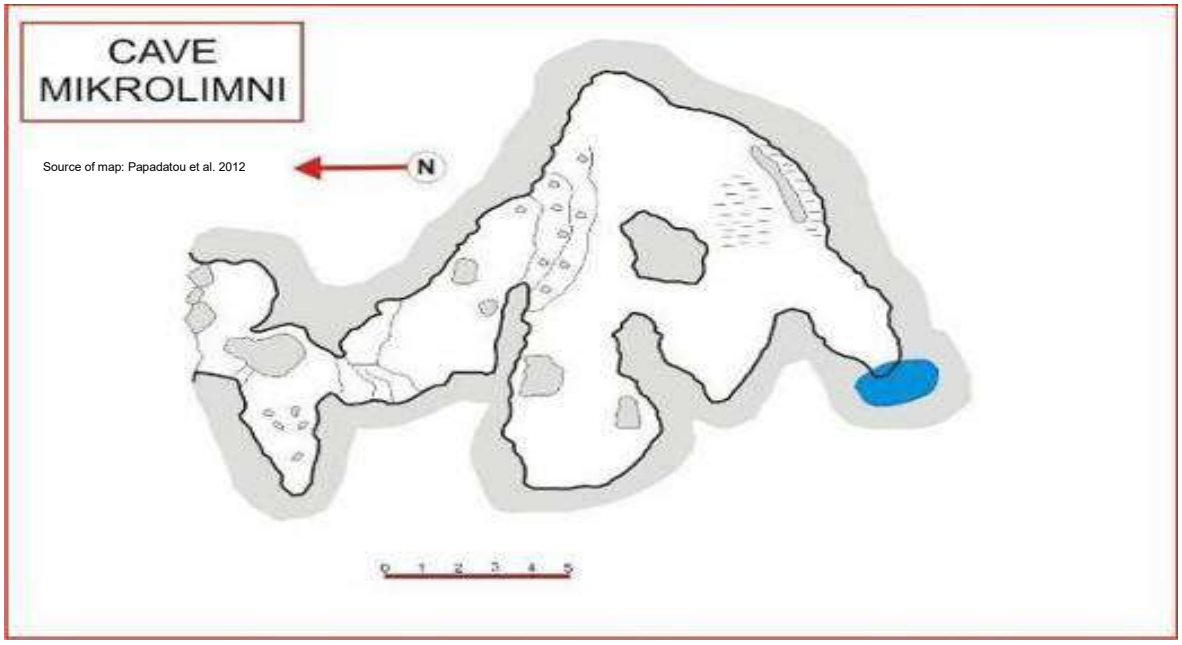
CAVE: MIKROLIMNI (GR03)	X: 40.672500 Y: 20.987500

Address of managing body:

Address of manager/key holder:

Safety and Equipment: Ensure safety; personal equipment includes mandatory powerful head torch (including spare ones), helmet, binoculars/telescope, a camera with a good zoom, tripod.

Date:	**Observer:**



Species	No. of individuals								Method of determination
	unisex	adult	♂ adult	♀ adult	with young	carcasses	osteo material	other	
Rhinolophus blasii									
Rhinolophus euryale									

Method of determination

1. Bones
2. Observation
3. Ultrasound detector
4. Measurement of live individuals
5. Measurement of dead individuals
6. Other

Notes: (Work and research in the cave, surroundings of the cave, bats, observed threats and changes of the area)	**Presence of other animals:** (Owl droppings, other feces etc.)

ANNEX III

TRANSBOUNDARY PROTOCOL FOR CAVE-DWELLING BAT SPECIES MONITORING

Visiting potential and known underground roosts used by bats requires the respect of a strict protocol and a pre-field preparation. Bats can use roosts presenting risks for humans, as abandoned buildings, bunkers or caves. Any persons that may be part of field expeditions must be aware about it, and be ready to anticipate any situations and react properly if needed.

I Before the field work - Preparation

1.1 Participants' safety

The first point of this protocol is the safety of the participants, near and inside all the visited locations. All the needed equipment (Tab. 1) must be functional and checked before any expedition. In order to reduce possible issues, it is proposed to always realise expeditions with a **minimum of two persons.** However, it is also better to realise these expeditions with a **maximum of four persons**, in order to reduce as much as possible the disturbance of bats, but also of the whole ecosystem within these stations, especially caves (cave's dwellers and geological jewel).

As a general idea, it is always better to inform persons which are not part of the monitoring team (such as protected areas staff or colleagues) about the daily plan and expected timeframe of the monitoring plan. This will give the possibility to organise first aid support in case of major issues.

TABLE 1: SAFETY EQUIPMENT NEEDED TO MONITOR UNDERGROUND SITES

Needed equipment :	
Security	- 1 head-lamp per person. - Additional batteries and spare light - 1 helmet per person - At least one phone fully charged per group - Bottles of water (1L per person) - Dried fruits - Basic first aid kit - If visiting a cave, a full equipment for speleologist must be carried within the group

1.2 Location's safety

1.2.1 Habitat and species

The underground sites visited can host an important biodiversity, in addition to bat species. This includes potential protected species and endemic species extremely sensitive to disturbance such as light, noise, destruction of the habitat but also chemical changes in the composition of the air (increase of CO2, etc.) or the water.

In order to avoid at the maximum such disturbances, it is highly recommended to limit at the maximum the time inside **and near by** underground sites, as well as not to leave anything inside these sites (waste, etc.). If a dumpsite is observed inside the underground site, it is recommended to collect data on this pollution (pictures) and collect as much as possible of waste.

1.2.2 Diseases

* SARS-CoV-2 (COVID 19)

While finalising this unified monitoring protocols document, the research on the SARS-CoV-2 (COVID 19) is still on-going, and many points are not yet answered by science. However, since June 2020, the IUCN (SSC Bat Specialist Group) formulated several recommendations for bat workers to avoid potential human-bat transmission of the virus (Fig. 1).

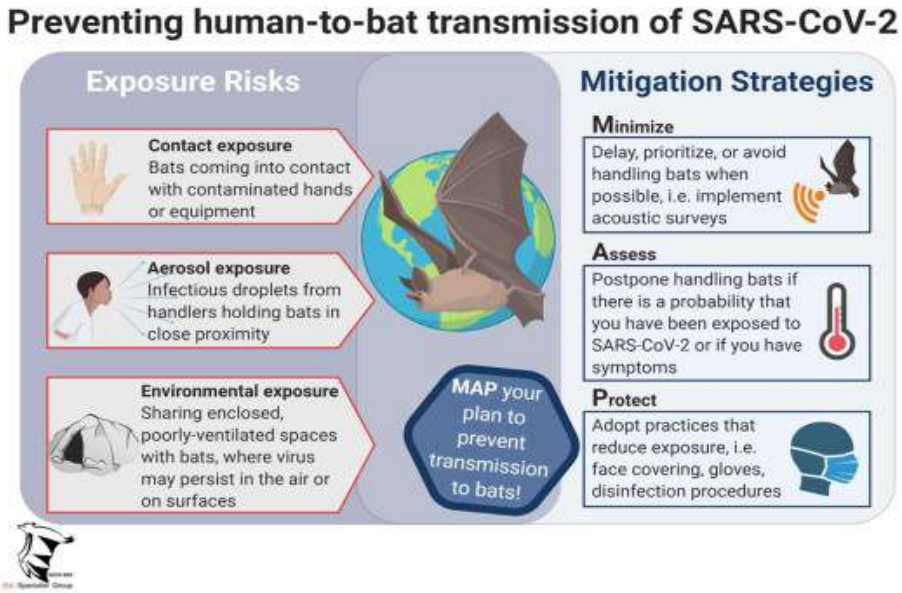


FIGURE 1: PREVENTING HUMAN-TO-BAT TRANSMISSION OF SARS-COV-2 (IUCN SSC)

Considering the high risk that could represent a human-bat transmission of the virus to local and international bat populations, these recommendations should be strictly implemented in the Prespa area.

1.2.3 Geological aspects

In addition to their biological values, many underground sites are of high geological interest and are protected as such. It is therefore extremely important to not negatively impact

these locations on a geological point of view. This includes the importance of not walking over geological features such as stalagmites, be careful not to destroy ***stalactites when walking inside and not resting on unstable geological features.***

1.2.4 Archaeological aspects

Underground sites represent also targeted environment for archaeological studies and conservation work. It is therefore extremely important to not manipulate any potential archaeological items when monitoring. In case of potential interesting items observed, it is recommend to take pictures and share them with the authorities in charge in the country. This collaboration is important, as it is giving an opportunity of exchanges between different stakeholders (ecologists & archaeologists) which could lead to a better integration of the different stakeholders' needs and benefit to the general conservation of the habitat and species.

II On the field – Data collection

This monitoring protocol aims to collect information concerning the roost (coordinates, type) and on the use done by bats (presence of bats, indicators, species, number of specimens). Also, collecting information about bats, an assessment of the situation should be done in order to identify possible threats on the site or on the chiropters.

In order to be able to implement the protocol on the field, the following equipment is needed, in addition to the safety equipment (Tab. 2)

TABLE 2: MONITORING EQUIPMENT NEEDED TO MONITOR UNDERGROUND SITES

Needed equipment:	
Monitoring protocol	- GPS - Additional hand-lamp needed for identification of bats - Camera - Gloves - Plastic boxes for bones collection - Block note - Bat detector (if available) - Mist-nets equipment, if needed - Measurement equipment (Calliper, etc.) - Key of identification of European Bats (i.e C.Dietz, 2009)

2.1 Site visits

As previously mentioned, the monitoring team entering the underground sites should be composed by at least 2 members and a maximum of 4 members. More members could be accepted only in specific situations, especially when the underground site visited is extremely large.

Specimens that are directly observed by the monitoring team should be included to the notebook at the moment of the observation, including their number, species identification and potential additional information (cluster, hibernation, juvenile, etc.).

When important colonies are identified (generally in spring or in winter), or when identification is not sure, a picture can be taken in order to allow a more efficient counting and identification on computer, and also to avoid disturbing the animals.

Once monitoring the site, potential threats on bats but also on the habitat should be listed. These threats can be listed as follow:

- Modification of habitat (removal of geological features, increase/decrease of the location entrance, construction inside and/or outside the site, etc.)
- Destruction of habitat
- Past and/or on-going disturbance of cave dwelling species (fire, bat specimen collection, human activities inside the underground site and/or near the entrance, etc.)
- Destruction of species (fire, dead animal, etc.)

2.2 Use of bat detector

The use of a bat detector inside an underground site can support the identification of species. This can be the case for specimens flying inside the site, for specimens located in some inaccessible parts or specimens that cannot be determined only visually (especially middle sized Rhinolophus). It is recommended to use the bat detector with a X10 time expansion and record for a long period, in order to collect the maximum of information from the echolocation calls (such as social calls). The records should be done in different parts of the site, in order to increase the chances to clearly identify all the species using the site during the monitoring.

2.3 Use of Mist-nets

Mist-nets could be installed in front underground sites' entrances to catch bats, and to obtain more information concerning specimens using the sites monitored. It is important to underline that the mist-netting sessions must be realised during periods when bats are less sensitive to disturbance (**not during maternity period**), and following a visit inside the site to identify the number of specimens and species actually using the cave. If the number of specimens observed inside the cave is too high, it is better to not proceed with the use of mist-nets, as the number of caught bats in a short period of time will strongly stress the bats staying in the nets for too long, and potentially destroy the monitoring equipment (mist-nets). Mist net should be installed only if an experienced expert is part of the monitoring team.

2.4 Collection of bones and indicators

When monitoring underground sites, it is important to search for potential indicators of bat presence during the year. This includes potential carcass of dead bats, bat bones (Fig. 2), chiropterolite (part of the cave that change color due to the past presence of bats) (Fig. 3), guano but also remains of prey, such as wings of butterflies, dragonflies or exoskeleton of various insects. Such indicators should be collected, if possible, or taken in pictures, in order to be identified during the post-field work stage.

The quantity and type of guano recorded in the monitored sites can shed a light on the use of such habitats by bats during the year (Fig.3). If fresh guano is observed, it means that bats have been using recently the site (last 1 or 2 months), while if dried guano is recorded, the bats used it several months ago, and might use again soon the site following a yearly cycle. Also, the presence of large wings of butterfly and dragonfly could suggest the use by large bat species (Rhinolophus sp. or *Myotis myotis/blythii*)

FIGURE 2: SKULLS OF MYOTIS MYOTIS

FIGURE 3: CHIROPTEROLITE AND GUANO IN A CAVE

III After the fieldwork – Analyse & Database

3.1 Counting with picture

To realise the counting, a grid can be added to the picture taken on the field, using the GIMP free-software (Fig.4). The number of specimen per square is manually counted in several squares, and an average of specimens per square is obtained. Then, all the squares full of bats can be counted, and the number of squares be multiplied by the average of bats per square. The remaining bats are counted manually and added to the total amount.

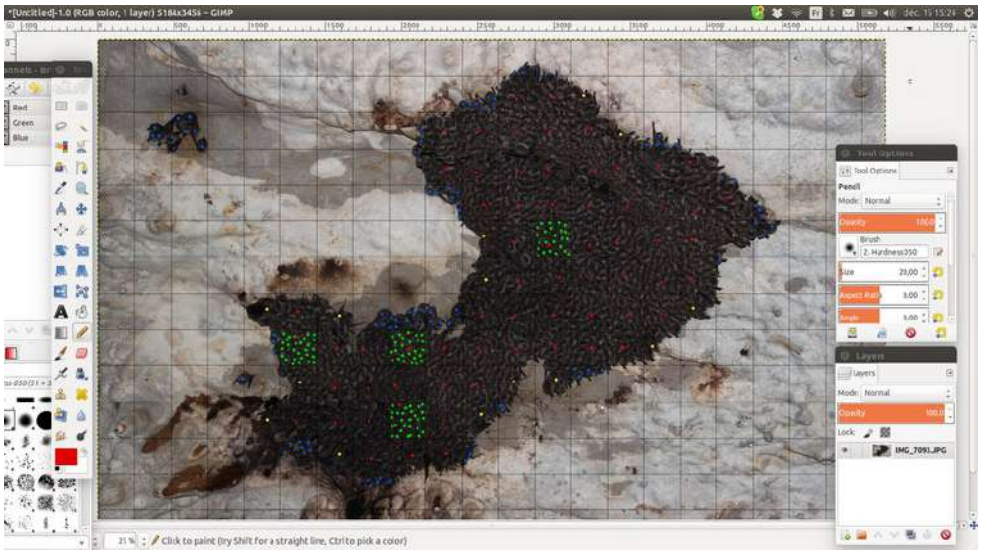


FIGURE 4: A COLONY COUNTED ON COMPUTER

3.2 Analyse of bat echolocation calls

Echolocation calls recorded inside the underground site should be analysed using a specific software for the bat echolocation calls, such as BatSound from Petterson. The frequency of the calls, the potential presence of social calls, as well as the duration of the calls can allow the identification of a family of bats and often the species.

The identification of bat echolocation calls require some experience for the identification of species and should not be considered as a unique solution for the identification of all the species using the Prespa area. Many species are very difficult to identified only by bat detector, and require the implementation of others methodologies for a clear identification (capture, DNA analyses, etc.)

3.3 Identification of bat carcass, bones and preys

The identification of bat carcass is generally easy, especially if the specimen is recently dead. The specimen can be easily fully measured and if needed in the case of cryptic species, DNA material can be extracted.

Also, with the use of specific measurement, it is possible to identify bat family but also species from bat some bat bones collected inside the underground sites. Skulls should especially be targeted, as they often allow a good species identification.

If collected from the site, the sample should be left at the competent authorities after identification (Museum of Natural History, Faculty of biology).

3.4 Addition of data into the unified database

After analysis of all the data collected, the digital database should be updated. It is proposed to have two files using the same template (see part C): one for the Albanian side, and one for the Macedonian side. Both files can be merge at the end of the activity, in order to give the overview of the transboundary cooperation implemented during the project.

ANNEX IV

TRANSBOUNDARY PROTOCOL FOR FOREST-DWELLING BATS SPECIES MONITORING

The implementation of a monitoring protocol targeting bat forest dwelling species requires the respect of a strict protocol and a pre-field preparation. The monitoring protocol is presenting risks for humans, especially due to the location of potential roosts and the fact that monitoring should be done in remote areas during night. Any persons that may be part of field expeditions must be aware about it, and be ready to anticipate any situations and react properly if needed.

I Before the field work - Preparation

1.1 Participants' safety

The first point of this protocol is the safety of the participants, before, during and after the implementation of the monitoring protocol. All the needed equipment (Tab. 3) must be functional and checked before any expedition. In order to reduce possible issues, it is proposed to always realise expeditions with a **minimum of two persons.** There is no limit for the monitoring team size.

As general idea, it is always better to inform persons which are not part of the monitoring team (such as protected areas staff or colleagues) about the daily plan and expected timeframe of the monitoring plan. This will give the possibility to organise first aid support in case of major issues.

TABLE 3: SAFETY EQUIPMENT NEEDED TO MONITOR FOREST DWELLING SPECIES

Needed equipment:	
Security	- 1 head-lamp per person. - Additional batteries - 1 helmet per person, if checking for potential roosts in trees - At least one phone fully charged per group - Bottles of water (1L per person) - Dried fruits

1.2 Location's safety

1.2.1 Habitat and species

The sites selected for implementing the protocol can host an important biodiversity, in addition to bat species. It is therefore important to reduce at the maximum potential disturbances, from the place of parking selected (not to damage potential interesting habitat/species), the use of light or the accidental catch of non targeted animals. It is

important to not leave anything on site after the monitoring (waste, etc.). If a dumpsite is observed on site, it is recommended to collect data on this pollution (pictures) and collect as much as possible of waste.

1.2.2 Diseases

* SARS-CoV-2 (COVID 19)

While finalising this unified monitoring protocols document, the research on the SARS-CoV-2 (COVID 19) is still on-going, and many points are not yet answered by science. However, since June 2020, the IUCN (SSC Bat Specialist Group) formulated several recommendations for bat workers to avoid potential human-bat transmission of the virus (Fig. 1).

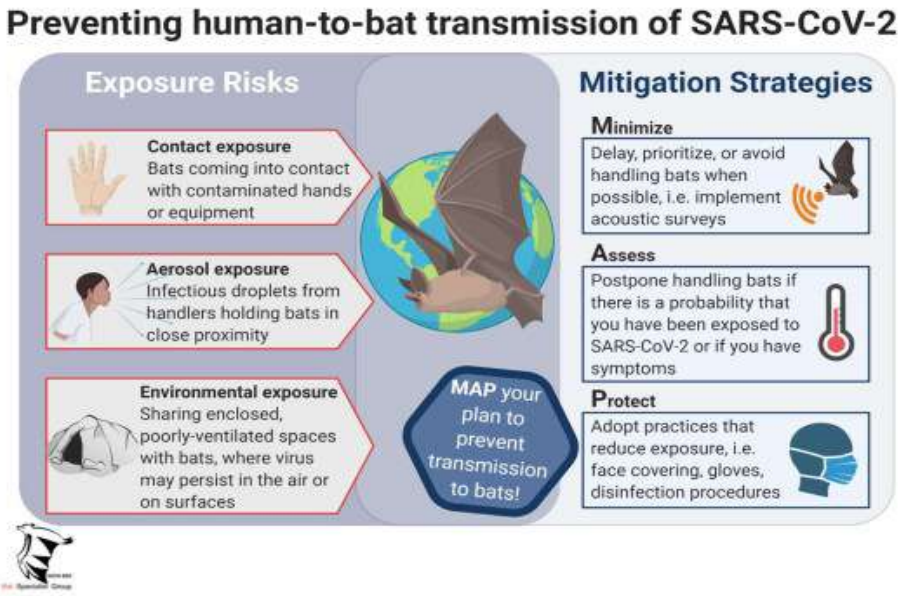


FIGURE 1: PREVENTING HUMAN-TO-BAT TRANSMISSION OF SARS-COV-2 (IUCN SSC)

Considering the high risk that could represent a human-bat transmission of the virus to local and international bat populations, these recommendations should be strictly implemented in the Prespa area.

1.2.3 Private properties

In case of private properties near by the monitoring site, it is important to make sure the access is kept open (road, tracks, etc.). In case, owners of the properties could be informed before the implementation of the activity, if possible by the protected areas staff.

II On the field – Data collection

This monitoring protocol aims to collect information concerning potential roosts (coordinates) and on the use of the area done by bats (presence of bats, indicators, species, number of specimens). Also, collecting information about bats, an assessment of the situation should be done in order to identify possible threats on the site or on the chiropters.

In order to be able to implement the protocol on the field, the following equipment is needed, in addition to the safety equipment (Tab. 4).

TABLE 4: MONITORING EQUIPMENT NEEDED TO MONITOR FOREST DWELLING SPECIES

Needed equipment:	
Monitoring protocol	- GPS - Additional hand lamp needed for identification of bats - Camera - Gloves - Block note - Bat detector (passive & active) - Ladder (if possible) - Mist-nets equipment, if needed - Measurement equipment (Calliper, etc.) - Key of identification of European Bats (i.e C.Dietz, 2009)

2.1 Site visits during day time

As previously mentioned, the monitoring team visiting the sites should be composed by at least 2 members.

2.1.1 Search of roost

The first step is the search of potential tree used as roost by bats. Such trees are generally old and present some holes where bats can hide. However, bats can also hide in other part of the tree, and a general inspection of trees should be done. This step could be supported by the deployment of telemetry protocol in the future. Considering the extremely high amount of work that this protocol require, it is recommended to target only characteristic trees, including isolated trees near agricultural plots.

2.1.2 Bat Boxes

Following the installation of bat boxes in the forest areas of the project, these boxes will have to be monitored at least once per season. This can be made thanks to an appropriate

scale, hand lamp and camera. If a bat box is known to be used by bats but the number of specimen cannot be exactly counted, it is recommended to count the bats at sunset, when the animals are leaving the roost. The entrance of the box can be lighten, and if needed, a video camera can be used to ease the counting later on, in case of large amount of specimen.

Specimens that are directly observed by the monitoring team should be included to the note book at the moment of the observation, including their number, species identification and potential additional information (juvenile, etc.).

When important colonies are identified, or when identification is not sure, a picture can be taken in order to allow a more efficient counting and identification on a computer, and also to avoid disturbing the animals.

Once monitoring sites during the day, potential threats on bats but also on the habitat should be listed. These threats can be listed as follow:

- Modification of habitat (fire, dumpsite, tracks etc.)
- Destruction of habitat (fire, illegal logging, etc.)
- Destruction of species (for trees / bat boxes known to be used by bats)

2.2 Use of bat detector

2.2.1 Passive bat detection

In the frame of this project, it is foreseen to install two passive bat detectors in each country in order to collect information regarding bat using forest areas. These passive bat detectors should be installed in areas identified as potentially important for bats.

It is proposed to run at least one recording sessions of five days during each season (excluding winter) and for at least two sectors. The bat detectors should be installed thanks to a scale at an appropriate height on a tree, and removed after five complete nights of recording. It is recommended to install each time the two bat detectors in the same targeted sector, in order to improve the coverage of the monitoring. Once the data collected on a computer and batteries changed, the two bat detectors could be installed in another sector.

2.2.2 Active bat detection

In addition to the passive bat detection, it is proposed if possible to use active bat detection in the areas where mist-netting sessions are implemented. This will increase the coverage of forest area covered by echolocation recording as well as support the identification of potential species using the targeted area but not caught by mist nets. It is recommended to use the bat detector with a X10 time expansion and record for a long period, in order to collect the maximum of information from the echolocation calls (such as social calls). The

records should be done in different parts of the site, in order to increase the chances to clearly identify all the species using the site during the monitoring.

2.3 Use of Mist-nets

The use of mist-nets inside forest areas is very important to understand the use of these habitats by bats, and to record species that cannot be clearly identified by echolocation recording.

In order to increase the chance of catching as many species and specimen possible, it is recommended to carefully select the locations:

- near water pond / reservoir / river / stream
- near car path if the forest is old enough around
- inside potential “tunnel” created by the vegetation

If during the maternity period, a pregnant female and/or a female with a juvenile is caught, it is extremely important to release it as fast as possible. The identification of the species should be the only data to be taken from such specimen, as the stress could lead to the rapid death of the female and/or the juvenile (especially for Rhinolophus sp.)

Mist net should be installed only if an experienced expert is part of the monitoring team.

III After the fieldwork – Analyse & Database

3.1 Analyse of bat echolocation calls

Echolocation calls recorded should be analysed using a specific software for the bat echolocation calls, such as BatSound from Petterson. The frequency of the calls, the potential presence of social calls, as well as the duration of the calls can allow the identification of a family of bats and often the species.

The identification of bat echolocation calls require some experience for the identification of species and should not be considered as a unique solution for the identification of all the species using the Prespa area. Many species are very difficult to identified only by bat detector, and require the implementation of others methodologies for a clear identification (capture, DNA analyses, etc.).

3.2 Addition of data into the unified database

After the analysis of all the data collected, the digital database should be updated. It is proposed to have two files using the same template (see part C): one for the Albanian side, and one for the Macedonian side. Both files can be merge at the end of the activity, in order to give the overview of the transboundary cooperation implemented during the project.

ANNEX V

DATA SHEET FOR MONITORING PROTOCOLS

I. Field work data sheet

Country: _____ Date: _____

Monitoring Team: _____

Name of Station	Lat	Long	Type	Metho_Obs	Species	Number	Comments