

**Activity 6:
Assessment of species diversity,
activity, bat habitats and potential
threats**

In the frame of project:
**"Sustainable bats conservation in the
cross border area"**
1846 BatsConserve

Representing BatMap

/Elena Georgieva/

BatMap

Sofia, 30.07.2019

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The object of **Activity 6: Assessment of species diversity, activity, bat habitats and potential threats** is to make an assessment of species diversity, activity, bat habitats and potential threats and drawn up a Recovery plan and mitigation measures.

Based on the developed database, map materials, as well as the results of the field surveys, the Contractor made an assessment of species diversity, activity, bat habitats and potential threats.

For this reason, the Contractor has developed a spatial model based on the spread of bats, species diversity, habitats, activity and location of threats (e.g. highways, poorly managed forest areas, etc.). The habitat of bats species in good condition and areas where bats are at high risk were clearly identified using this model. The most endangered territories were identified and the places where conservation measures would have the most significant impact on bats and their habitats were identified.

To the assessment of the habitats of bat species in good condition and those at high risk has been added and an assessment of the need to restore significant bat habitats destroyed in the past in the project are and the possibilities for their restoration.

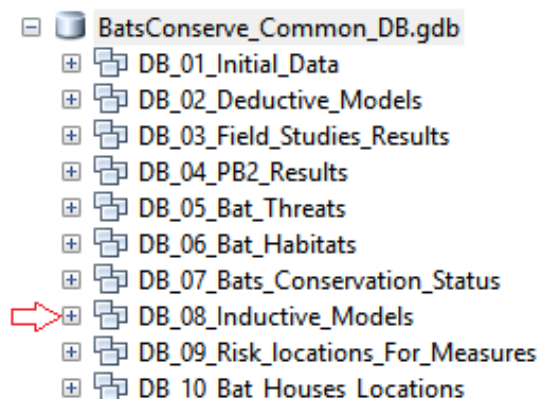
In case that there are identified habitats in need of restoration, a map material, coordinates and a detailed description have been prepared. The description includes both the basis for the assessment and the applicable measures and expected results of the implementation of the measures.

In fulfillment of the activity, the Contractor has also prepared a Plan for recovery and mitigation measures in accordance with the provided activities.

I. Developed spatial model that combines (based on) the spread of bat species, species diversity, habitats, activity and location of threats (e.g. highways, poorly managed forest areas, etc.).

A spatial model has been developed that combines the spread of bats, species diversity, habitats, activity and location of threats (e.g. highways, poorly managed forest areas, etc.) and others.

The developed model is into a separate Data set (DB_08_Inductive_Models) in the Database developed under the project – in format ESRI File Geodatabase (*.gdb). Submitted in **Annex №1**.



During the development of the model, the available information on the bats fauna in the project area is taken into account; the results of the field studies conducted on the project; spatial information on identified threats and factors affecting bat fauna in the project area; information on the habitats of bat species in the project area and others.

The model is made for each bat species found in the project territory during the field surveys or potentially occurring in it.

The habitats of bat species in good condition and areas where bats are at high risk were clearly identified using this model. The most endangered territories were identified and the places where conservation measures would have the most significant impact on bats and their habitats were identified.

II. Assessment of species biodiversity, activity, bat habitats and potential threats

Based on the developed database, map materials, as well as the results of the filed surveys, species diversity, activity, bat habitats and potential threats were assessed.

1. Assessment of species diversity

There were 27 species identified in the surveyed polygons, or almost 70% of the species known so far for Southern Bulgaria and the Aegean part of Greece. The typical composition of bats' communities inhabiting important cave roosts, both on the territory of Bulgaria and on the territory of Greece has been revealed.

1. Greater horseshoe bat (*Rhinolophus ferrumequinum*) - Typical appearance on the Balkan Peninsula without the highest parts of the mountains. Characteristic for karst areas. In the studied area it is one of the most common species. There is a hibernation colony of about 100 individuals in Samara cave, v. Samovila. Single bats (1 – 7) inhabit the karst caves (Maroneia cave, the cave "Folia Drakou", caves around v. Kremen, artificial galleries and as well abandoned military fortification facilities on Greek territory ("Bartisheva fortress", "St. Nikolas fortress", "Kastillo fortress" and „Fortress Pyramidoides") (fig. 1).



Fig. 1. Hibernating Greater horseshoe bat (*Rhinolophus ferrumequinum*) in cave near v. Kremen, Eastern Rhodopes. ©I. Pandurski

2. Lesser horseshoe bat (*Rhinolophus hipposideros*) - Typical specie for the territory of the Balkan Peninsula, found around 1500 m altitude. It mainly uses underground habitats – natural caves and artificial galleries. It is connected with karst regions with rich vegetation. It is often found in settlements. The species is found in the study area in a total of 14 fields almost always along with the Greater horseshoe bat, representing natural karst caves, military bunkers and artificial mine galleries with single individuals. (1-7) (**fig. 2**).



Fig. 2. Hibernating Lesser horseshoe bat (*Rhinolophus hipposideros*) in cave near v. Kremen, Eastern Rhodopes. ©I. Pandurski

3. Mediterranean horseshoe bat (*Rhinolophus euryale*), Blasius' horseshoe bat (*Rhinolophus blasii*), Mehely's horseshoe bat (*Rhinolophus mehelyi*): In study area the three types of horseshoe bats, forms most often mixed colonies (**Fig. 3 and 4**). It was registered a hibernating colony in Samara cave, v. Samovila, numbering around 70 individuals. They are established in Maroneia cave. Manuel's cave near the village of Ribnovo is a breeding roost for the mentioned horseshoe bats. Mediterranean and Blasius' horseshoe bats are registered in the cave "Folia Drakou".



Fig. 3. Mixed colony of hibernating horseshoe bats in Samara cave. ©I. Pandurski



Fig. 4. Part of the mixed colony of hibernating horseshoe bats in Samara cave. ©I. Pandurski

4. Lesser mouse-eared myotis (*Myotis blythii*) and Greater mouse-eared bat (*Myotis myotis*) – Both species often occur together, forming mixed colonies. Their species differentiation on the terrain is often difficult, because of their similar morphological features of the two species. Most habitats are between 100 and 800 m altitude. Yearly, inhabit underground shelters – karst, volcanic and sea caves and mine galleries. Single hibernating individuals, were established in Samara cave, v. Samovila, in old bridge constructions of river Mutnitsa and r. Mesta in Bulgaria, on the Greek territory

– over the water surface of the Potamoy dam, in abandoned military bunkers ("Fortress Pyramidoides"), and a breeding colony from around 100 individuals had occupied the entrance parts of the Maroneia cave in April (**fig. 5**).



Fig. 5. Breeding colony, probably mixed of two species Lesser mouse-eared myotis (*Myotis blythii*) and Greater mouse-eared bat (*Myotis myotis*) in Maroneia cave. ©Y. Yankov

5. Western barbastelle (*Barbastella barbastellus*) - a typical inhabitant of humid and old deciduous, mixed and coniferous forests in the sub-mountainous and mountainous regions of the country (**fig. 6**). The highest is the number roost found in over 500 m altitude.



Fig. 6. Western barbastelle (*Barbastella barbastellus*). ©I. Pandurski

6. Schreiber's bent-winged bat (*Miniopterus schreibersii*) - It is spread throughout the country without the highest parts of the mountains. Most habitats are

between 100 and 600 m altitude. A frequent and numerous inhabitant of the caves in the lower parts of the country, as it forms one of the most numerous bat colonies in Europe, numbering tens of thousands of individuals. Breeding colony of the species of about 1200 individuals was formed in April in the Samara cave in the village of Samovila (**fig. 7**). Permanent inhabitant of the Maroneia cave.



Fig. 7. Breeding colony of Schreiber's bent-winged bat (*Miniopterus schreibersii*) in Samara cave. ©I. Pandurski

7. Long-fingered bat (*Myotis capaccinii*)- It occurs in the whole country, in the mountains up to 1500 m. Extremely cave-dwellers – forming large colonies (up to several thousand individuals). Most habitats are between 100 and 600 m. It is typical inhabitant of karst areas – often in forest landscapes. No significant colonies were found during the current research – a single bat was recorded in the Maroneia cave in September 2018, and in April 2019 – 7 individuals.

8. Geoffroy's bat (*Myotis emarginatus*) - It inhabits karst regions, parklands, without caves areas, and is found in basements of abandoned buildings, churches and houses, old military bunkers and other shelters. It prefers areas with bush and woody vegetation. Most roosts are in low-mountain belt (400-500 m). It is found in Mesta river and in Maroneia cave.

9. Bachstein's myotis (*Myotis bechsteinii*)- Characteristic forest species in beech and mixed forests in the 800-1450 m. The species is known as stationary and does not perform large seasonal migrations. His presence was confirmed in the Manuel's cave near village of Ribnovo, where probably hibernates.

10. Noctule bat (*Nyctalus noctula*) - Common and often species. Forest-dwellers, often settled in tree hollows. Attached to areas with widespread of deciduous and mixed forests, parks, gardens, settlements. It is also found in the mountains above 1200 m. During the study, the Noctule bat was registered relatively rare – single flying individuals were observed in Maroneia and in the valley of the Varbitsa river, the Eastern Rhodopes, around rock niches of Mesta river (September), diluted forests, volcanic niches to water bodies and stone bridges in Eastern Rhodopes (Tihomir village).

11. Lesser noctule (*Nyctalus leisleri*)- Probably occurs in the lower parts of the country, and in the mountains up to 1500 m. It inhabits forest areas with a relatively warm climate. It is registered in October and November along the Mesta river, in the lower stream on the Kazalach river, Dolno Kapinovo village, on Kesibir river (Tihomir village), around rock formations near the village of Tatul, in April on Sap dere river in mixed forest.

12. Greater noctule bat (*Nyctalus lasiopterus*) - A rare, forest species with insufficiently well researched biology. The roosts (summer and winter) are hollows and rock crevices, which sometimes are shared with the Common noctule or species from genus *Pipistrellus*. Established once in the region of Ribnovo village, Western Rhodopes.

13. Grey big-eared bat (*Plecotus austriacus*) - It is mainly found in the lower parts of the country. In the mountains up to 1400 m. Prefers low, open spaces with steppe character, farmlands, river valleys, settlements. He was once found in karst cave near the village of Samovila, Eastern Rhodopes. A larger number of species were registered on Greek territory – in the entrance parts of the bunkers "Bartisheva fortress" – October, "Fortress Pyramidoides" – April, the entrance parts of the "Folia Drakou" – October and Maroneia caves – April.

14. Common pipistrelle (*Pipistrellus pipistrellus*) - One of the most common species of bats in Bulgaria and in the project area. Daily roosts are tree hollows in different semi-enclosed spaces and crevices in man-made buildings. It is also considered for synanthropic species. It hunts over various habitats – open areas with single trees, forest and scrubland facies, very often within the boundaries of the settlements.

15. Soprano pipistrelle (*Pipistrellus pygmaeus*) - Common bat: from the high parts of the mountains to the coastal areas. It inhabits deciduous, coniferous and mixed forests, often found in settlements, gardens, parks, adheres to water areas – lakes, large rivers. It is located in the vicinity of the village of Ribnovo.

16. Natterer's bat (*Myotis nattereri*) - It occurs all over the country in the middle mountain range – usually up to 1500 m altitude, in parks, forests, orchards, often near water bodies and in settlements. They usually fly around 5 m high, between tree crowns and rarely around 15 m above their tops. The species is set once at the entrance of the Maroneia cave (**fig. 8**) during April 2019.



Fig. 8. The entrance of Maroneia cave. ©I. Pandruski

17. Savi's pipistrelle (*Hypsugo savii*) - It inhabits rocky and karst areas, mountain pastures, grassy terrains and valleys, forests regions, open arable lands. The daily and winter roosts of the species are mainly associated with rocky habitats. It is located in the area of the rocky seashore of Maroneia (**fig. 9**).



Fig. 9. Rocky seashore of Maroneia. ©I. Pandurski

18. Nathusius's pipistrelle (*Pipistrellus nathusii*) – Migratory species with pronounced yearly dynamics of their abundance on the territory of the Balkan Peninsula. During the autumn period it is numerous on the Bulgarian Black sea coast when migratory from many thousands of groups of individuals is observed. It occupies tree hollows and sticking to the water. It has located in the region of Ribnovo and above wetlands of Porto Lagos.

19. Kuhl's pipistrelle (*Pipistrellus kuhlii*) – A species characteristic of the southern parts of the Balkan Peninsula. It is closely related to rocky habitats but also has a high degree of synanthropic species. During the survey, it was often found in rocky habitats along the Maroneia coast (**fig. 10**).



Fig. 10. Rock piles, preferred habitat from Kuhl's pipistrelle (*Pipistrellus kuhlii*). ©I. Pandurski

20. Serotine bat (*Eptesicus serotinus*) - Widespread to about 1600 m above the sea level. The species is considered as stationary, but migrations of several tens of kilometers have been observed. Prefer open areas with group of trees as well as rock areas. It is often found in settlements. It is mainly found in the mountainous parts of the studied polygons – the Western Rhodopes in the region of the village of Ribnovo and open pit areas of Bald mountain (Falakro) at altitude of 1900 m.

21. European free-tailed bat (*Tadarida teniotis*) - The habitats of the species are mostly rock areas, high buildings, bridges. It forms small colonies of several dozen individuals. He flies out during dusk, moving far away from the roost and it flies at a height of dozens of meters. His flight is at high altitude – fast. Summer and breeding colonies are in rocks and walls of buildings. It is also active during the late autumn period. The species was found during previous studies near Dolna kula village in the Eastern Rhodopes, Slavyanka mountain and “Borovo” Forestry in Western Rhodopes. Our studies have shown that the species is common in Greek territory (Maroneia and Bald mountain (Falakro) at a height above 2000 m at temperature around 4 degrees (**fig. 11**), the entrance areas of the bunkers zones "Bartisheva fortress" and "Fortress Pyramidoides", rock piles, around groups of old tree hollows along the river and artificial pond near village of Volakas. In Bulgaria, has been found in the valley of Varbitsa river in Eastern Rhodopes, around the rock niches on the right side of Mesta river, near a small dam close to village of Teplen.



Fig. 11. Entrance of a precipice cave *Chionotrypa* under peak *Profitis Ilias* (*Profitis Ilias*), Bald mountain (*Falakro*), where activity of the European free-tailed bat (*Tadarida teniotis*) and Particoloured bat were registered (*Vespertilio murinus*). ©I. Pandurski

22. Particoloured bat (*Vespertilio murinus*) - Migratory species, which is why there is a pronounced seasonal dynamic in its abundance. It inhabits predominantly mountain forests during the summer and during autumn migration it can be found in variety of habitats with an abundant supply of food, even at sea level. The species is common in autumn, as well in the wetlands of Porto Lagos and in the high parts above 1000 m above the sea level in the Western Rhodopes and Bald mountain (*Falakro*).

23. Daubenton's myotis (*Myotis daubentonii*) – Forest species, with its hunting areas mostly large water bodies, along the rivers and lakes, in cultural landscapes. The hunting takes place in small groups or in pairs. Summer roosts are in tree hollows, crevices in buildings. Foraging individuals are recorded above water surface of the Varbitsa river in Eastern Rhodopes.

2. Activity

The activity of established bat species was assessed on the basis of direct observation of the individuals and by the method of registration and analysis of the echolocation and social sounds emitted by them using bat detectors. The main criteria for assessment was the relative share of the number of sounds of each type per unit of time.

1. **Greater horseshoe bat (*Rhinolophus ferrumequinum*)** – The species is present all year round in the project territory. His activity is registered around the entrances of cave-roosts.
2. **Lesser horseshoe bat (*Rhinolophus hipposideros*)** - The species is present all year round in the project territory. His activity is recorded around the entrances of the cave-roosts, often found together with Greater horseshoe bat.
3. **Mediterranean horseshoe bat (*Rhinolophus euryale*), Blasius's horseshoe bat (*Rhinolophus blasii*), Mehely's horseshoe bat (*Rhinolophus mehelyi*)** – All three species are present all year round in the project territory. Particularly high-flying activity was recorded at the entrance of the Maroneia cave in September 2018, as over 90% of the registered echolocation ultrasounds belongs to Blasius's horseshoe bat (*Rhinolophus blasii*).
4. **Lesser mouse-eared myotis (*Myotis blythii*) and Greater mouse-eared bat (*Myotis myotis*)** – because the two species form mixed colonies and have similar biology, their activity is assessed overall. They are found all year round in the project territory. They form breeding colonies with abundance around 100 individuals in cave-roosts. Hibernating individuals have been established severally.
5. **Western barbastelle (*Barbastella barbastellus*)** - The flight activity of this species was registered during autumn period in the region of Ribnovo village, above Mesta river and around water bodies close to Musomishte village.
6. **Schreiber's bent-winged bat (*Miniopterus schreibersii*)** - The species is present all year round in the project territory. It was recorded in the vicinity of the Maroneia cave, as during the autumn period as well in the spring. A significant breeding roost is the Manuel's cave near Ribnovo cave. The species is hunting far from the roosts, as it was registered with relatively high-flying activity over the rocky seashore of Maroneia, lighted port of Agios Charalampos and the valley of the Varbitsa river in the Eastern Rhodopes.

7. **Long-fingered bat (*Myotis capaccinii*)** – The species is rare in the project territory. It is registered during the autumn migration period in the karst area of the Maroneia massif, and also in April in Maroneia cave.
8. **Geoffroy's bat (*Myotis emarginatus*)** - Flight activity of the species was recorded in the area of Maroneia cave in September 2018 and April 2019, during October around rock niches over Mesta river, small ponds Domus dere river near Petrelik river and near bridge constructions above Matnitsa river.
9. **Bechstein's myotis (*Myotis bechsteinii*)** – As a stationary forest species, it does not move far away from its roosts. Flight activity around entrance of the Manuel's cave, Ribnovo village even at an outside temperature around 0°C. The entrance parts of this cave are probably also its winter roost.
10. **Common noctule (*Nyctalus noctula*)** – Migratory species, registered in the project area only with hunting activity.
11. **Lesser noctule (*Nyctalus leisleri*)** - Migratory species, registered in the project area only with hunting activity during autumn period.
12. **Greater noctule bat (*Nyctalus lasiopterus*)** – Rare species in the project territory. Characteristic of the type of echolocation sounds were recorded during autumn period in the region of Ribnovo village, Western Rhodopes.
13. **Grey long-eared bat (*Plecotus austriacus*)** – It is only found in daily roosts. Rare species in the territory. He does not move far away from his shelters.
14. **Common pipistrelle (*Pipistrellus pipistrellus*)** - The species is registered with high hunting activity from the sea level to the high mountainous area of the mountain Falakro: rocky coastal habitats in Maroneia, along the coastal residential areas, the wetlands in Porto Lagos, the valley of the Varbitsa river in Eastern Rhodopes and the high mountain ridges of the Bald mountain (Falakro).
15. **Soprano pipistrelle (*Pipistrellus pygmaeus*)** - With a relatively high-flying activity was recorded in the forest territories of the Western Rhodopes near the village of Ribnovo.

16. **Natterer's bat (*Myotis nattereri*)** – Flight activity has been recorded only during the spring season in the Maroneia area
17. **Savi's pipistrelle (*Hypsugo savii*)** – Hunting flight activity is recorded in rocky habitats on the Maroneia coast.
18. **Nathusius' pipistrelle (*Pipistrellus nathusii*)** – The species is extremely numerous during the autumn migration period in the wetland area along the coast of the White sea coast and the forest areas near Ribnovo village in Western Rhodopes.
19. **Kuhl's pipistrelle (*Pipistrellus kuhlii*)** – Hunting activity was recorded in the autumn period in rocky habitats of the Maroneia coast.
20. **Serotine bat (*Eptesicus serotinus*)** – Activity of the species is recorded mainly in the higher mountain areas of the project territory (1000 – 2000 m above sea level). In Falakro mountain, hunting activity has been established even at a temperature of about 4⁰C
21. **European free-tailed bat (*Tadarida teniotis*)** – The activity of the species is attached to the high mountain and rocky habitats in the valleys of Mesta and Varbitsa rivers and their tributaries. In the mountain Falakro, hunting activity has been established even at a temperature of about 4⁰C.
22. **Particoloured bat (*Vespertilio murinus*)** – Mountain species that during the autumn migration was registered with high activity over the wetlands at Porto Lagos and the forest massifs near the village of Ribnovo in the Western Rhodopes. In the mountain Falakro, hunting activity has been established even at a temperature of about 4⁰C.
23. **Daubenton's myotis (*Myotis daubentonii*)** – High hunting activity was recorded in the valley of Varbitsa river during the autumn period.

3. Bat habitats

Although bats such as flying mammals can move and acquire large areas, they are strictly attached to certain types of roosts – hollows, caves, rock crevices, different man-

made structures, such as attics, basements, etc. Often in these roosts, they form colonies of several individuals up to tens of thousands. Depending on the features of the life cycle, roosts must have strictly defined characteristics such as humidity, temperature, defined size, etc. During the summer there are formed maternity colonies, which most often female individuals are gathered from larger adjacent territories. Winter roosts must also have specific defined characteristics for each species. Change of roosts during the years also makes seasonal migrations – bats can migrate in addition to distances of several tens of kilometers and much more than thousands of kilometers, moving mainly from northern to southern Europe and back. Bats choose areas rich in insects, such as forests, clearings, wet meadows, over water bodies and often street lighting in the villages is also a preferred hunting area, as light can attract a huge number of insects.

Bat's habitats depending on their specific ecological characteristics and the role they have during the various stages of the bats' life cycle; it can be divided into the following main categories:

- ✓ **Underground habitats – Karst and volcanic caves, artificial galleries, mines (fig. 12);**

Within the project there are studied the following underground habitats - karst caves (Maroneia cave – GR 06, Cave "Folia Drakou" – GR04, caves near village of Kremen – BG08, caves near village of Samovila - BG 09, caves in Harman kaya area – BG03, cave "Chionotrypa" – GR02, abandoned galleries for extraction of asbestos – BG04, artificial galleries, as well as abandoned military fortification facilities on Greek territory ("Bartisheva fortress", "St. Nikolas fortress", "Kastillo fortress" and „Fortress Pyramidoides" – GR04).



Fig. 12. Underground habitats in the studied area – caves and artificial galleries

- ✓ **Rocky habitats – rock piles, vertical slopes, rock cavities and crevices (fig. 13);**

Representative rocky habitats have been researched in the following polygons:
GR02, GR05, BG02, BG03, BG01, BG04, BG05, BG07, BG09, BG10.

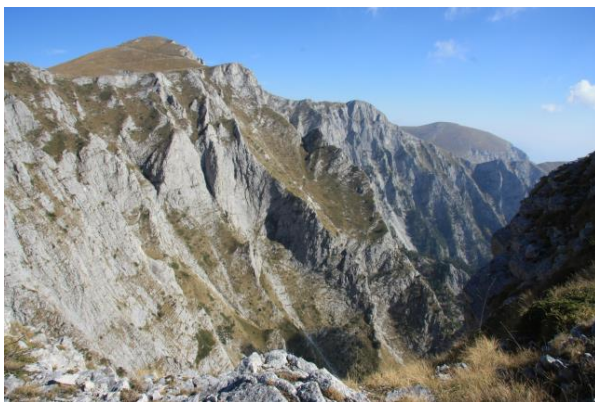




Fig. 13. Representative rocky habitats in the project territory.

- ✓ **Forest habitats - old deciduous, mixed lesser coniferous forests that offer enough shelters (hollows, loose barks) and food supply (fig. 14);**

Representative forest habitats have been researched in the following polygons:
GR02, GR03, GR04, BG02, BG01, BG10, BG04, BG06, BG07, BG08.



Fig. 14. Representative forest ecosystems in the studied area – coniferous forests in polygon GR02 and deciduous in BG04.

- ✓ **Wetlands – because of their high biological potential and rich biodiversity these are some of the most important foraging habitats for bats. Especially significant are these areas during the summer month when thousands of bats hunt above the water surface and are important participants in local food chains. Most individuals, depending on the water areas, live in the**

immediate vicinity or within the limits of those areas. They inhabit tree hollows, residential or industrial buildings, caves and other nearby roosts.

Wetland in the region of Porto Lagos have an extremely important role during the autumn migration of bats, providing a rich food supply (fig. 15).



Fig. 15. Wetlands in the region of Porto Lagos.

- ✓ **Urban areas – here bats spend almost their whole life in man-made shelters, such as attics, basements, joints, shafts, chimneys, ventilation facilities, etc. in villages, towns, resorts and other urbanized areas.**

The habitat is presented in all studied polygons. Especially important for bats are abandoned villages in the polygon BG03 (fig. 16).



*Fig. 16. Abandoned stone house in polygon BG03, a potential habitat for bats of the genera *Myotis*, *Rhinolophus*, *Pipistrellus* and *Plecotus*.*

Depending on the season, bats inhabit different types of roosts:

During the winter all bats inhabit roosts with a permanent temperature of between 2^o to 10^o C. Such conditions are most often found in water caves and flooded mine galleries and, occasionally in the attics and basements of residential buildings.

During the spring and autumn bats can be found in different roosts with a variable or constant temperature (e.g. abandoned or inhabited residential or industrial buildings, underground bunkers, galleries, discharge and ventilation shafts, pipes, chimneys, hollow posts, small and large caves, rock crevices, etc.).

During the summer bats prefer roosts with a higher temperature and this is where they breed. Species which form larger colonies congregate in caves with larger entrances so that in the evening hundreds or even thousands, of bats can fly in or out simultaneously.

4. Potential threats

The potential threats for bats' populations are presented detailed in a separate report of **Activity 3**. In this report has been made concrete expression to these threats for each individual surveyed polygon.

Polygon BG01: Caves in the polygon are often visited uncontrolled for caving, hiking and treasure hunting, resulting to disturbance during the breeding period, expulsion of individuals and high risk of mortality of newborns. Habitat damage due to vandalism (cave formations breakage, fire burning), disturbance during breeding period. It has been identified on the cave entrances overgrowth by ruderal bush vegetation, preventing the free overflight of the roosts. Part of the territory is affected by a fire, destroying potential habitats of forest bats. The terrain is part of the hunting habitat of the bats, and is currently an unregulated landfill, which significantly reduces its suitability.

Polygon BG02: The cave in the polygon is frequently visited uncontrolled for caving, hiking and treasure hunting, resulting to disturbance during the breeding period, expulsion of individuals and high risk of mortality of newborns. Habitat damage due to vandalism (cave formations breakage, treasure hunting). Overgrowth on the entrance with vegetation.

Polygon BG03: The cave is often visited by individual and organized tourists, which is a prerequisite for repelling and disturbance of the bats.

Polygon BG06: The affected area is part of the bats hunting habitat and it is currently an unregulated landfill, which significantly reduces its suitability. Affected territory is used for unregulated mechanical extraction of gravel and sand, which is a factor for the disturbance in the adjacent rock roosts of bats.

Polygon BG08: It has been identified on the cave entrances overgrowth by ruderal bush vegetation, preventing the free overflight of the roosts. The affected area is part of the bats hunting habitat and it is currently an unregulated landfill, which significantly reduces its suitability.

Polygon BG09: All karst caves in the region are visited uncontrolled for caving, hiking and treasure hunting, resulting to disturbance during the breeding period, expulsion of individuals and high risk of mortality of newborns. Habitat damage due to vandalism (cave formations breakage, fire burning).

Polygon BG10: Risk of harvesting a group of old trees and destroying potential habitats of forest bats.

Polygon GR01: Use of chemicals in agriculture as a factor in impoverishment of the food supply.

Polygon GR02: It has been found closing of the entrance to a bunker, inhabited by horseshoe bats with a thick metal door that prevents bats from entering the roost.

Polygon GR04: In the polygon is located a new found cave with active speleological interest, which is a prerequisite for disturbance, expulsion of bats and damage to the roost.

Polygon GR06: It has been observed breakage to the entrance door-grid of the Maroneia cave, which is a prerequisite for unregulated access to the cave and disturbance, expulsion and mortality of individuals, when a breeding colony of the species *Myotis myotis* was registered.

In the six polygons where no real threats to bat populations have been identified their habitats and roosts are in a favorable conservation status.

III. Map material, coordinates and detailed description of habitats in need of restoration.

Using the spatial model developed, the habitats of bat species in good condition and areas where bats are at high risk were clearly identified. The most endangered territories were located and the places where conservation measures would have the most significant impact on bats and their habitats.

On the basis of all available data (literary and obtained during the fieldwork on the project) and the developed Spatial Model of species distribution, reference values of the habitat classes (potentially-favorable, potential and low significance) of bats in the project area were obtained:

Species	Habitat class		
	Potentially-favorable (ha)	Potential (ha)	Low significance (ha)
<i>Barbastella barbastellus</i>	1864	4477	3099
<i>Eptesicus serotinus</i>	6226	25408	180
<i>Hypsugo savii</i>	2771	23112	874
<i>Miniopterus schreibersii</i>	257	28635	69
<i>Myotis aurascens</i>	2334	9640	203
<i>Myotis bechsteinii</i>	1641	4319	3039
<i>Myotis blythii</i>	596	27661	69
<i>Myotis capaccinii</i>	143	10205	0,00
<i>Myotis daubentonii</i>	2042	20343	658
<i>Myotis emarginatus</i>	177	20473	0,00
<i>Myotis myotis</i>	596	27661	69
<i>Myotis nattereri</i>	1641	4319	3039
<i>Nyctalus lasiopterus</i>	811	3346	2748
<i>Nyctalus leisleri</i>	5872	13965	167
<i>Nyctalus noctula</i>	3682	12818	167
<i>Pipistrellus kuhlii</i>	2844	16232	932

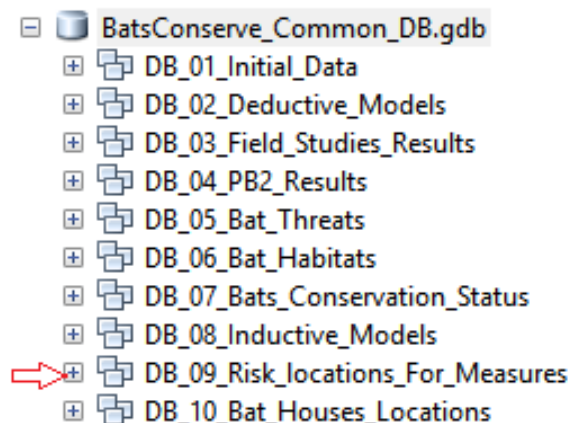
Species	Habitat class		
	Potentially-favorable (ha)	Potential (ha)	Low significance (ha)
<i>Pipistrellus nathusii</i>	1508	21571	69
<i>Pipistrellus pipistrellus</i>	4618	29501	932
<i>Pipistrellus pygmaeus</i>	2515	23297	862
<i>Plecotus austriacus</i>	1760	6566	203
<i>Rhinolophus blasii</i>	85	13274	2409
<i>Rhinolophus euryale</i>	177	13803	0,00
<i>Rhinolophus ferrumequinum</i>	3793	24338	27
<i>Rhinolophus hipposideros</i>	4379	30422	273
<i>Rhinolophus mehelyi</i>	177	13803	0,00
<i>Tadarida teniotis</i>	608	26896	273
<i>Vespertilio murinus</i>	4419	10490	57

Based on the spatial model developed and taking into account the information available and collected under the project, it was estimated that **in the project area there is no need of restoration of destroyed in the past significant habitats for the bat species**. As a result, no map material has been produced with referred habitats in need of restoration.

Although no need of restoration of significant bat habitats destroyed in the past was identified as a result of fieldwork in all 17 polygons in the project area, there were identified as potential threats and factors affecting bat populations (presented in a separate Report under Activity 3) as well as **specific territories and habitats in risk, strongly influenced by human activity in the past and present**. They were assessed for the need to implement the specific recreational and mitigation measures, presented in point „IV. Recovery plan and mitigation measures” from this report.

An identifier has been assigned to each site to which the proposed measures relate (Database object with ID N^o). By the relevant identifier, the specific location of the site can be seen in the attached Database (**Annex N^o1**).

In the Database, in a separate Data set (DB_09_Risk_Locations_For_Measures), the exact location and coordinates of the identified areas where the species are at high risk are presented and conservation measures would have the most significant impact on bats and their habitats. The attribute information provides a detailed description of the identified risk and habitats.



In **Annex № 2** map material is presented showing the exact location and coordinates of the identified areas where the species are at high risk and the application of conservation measures would have the most significant impact on bats and their habitats, as well as the habitats of bat species in good condition. In order to optimize the visualization and interpretation of the information, the map material is presented in *.kmz, format, which enables interactive visualization in conditions of Google Earth.

IV. Recovery plan and mitigation measures

The risk level for bats in each case is determined on a three-point scale: “low”, “medium” and “high”.

For each object to which the proposed measures are related is assigned an identifier (Database object with ID №). By this identifier, the specific location of the object can be seen in the attached Database (**Annex №1**).

In the Database, in a separate Data set (DB_09_Risk_Locations_For_Measures), is presented the exact location and coordinates of the identified risks. The attribute information provides a detailed description of the identified risk and habitats.

The Recovery plan and mitigation measures (**Table №1**) includes the above-mentioned identifier, the description of the risk, the reason for the assessment, the degree of impact of the risk, the conservation (mitigation) measures applicable, their period of application and the expected result of the implementation of the measures.

Table № 1

PLAN for the recovery of bat habitats destroyed in the past, as well as applicable conservation (mitigation) measures to improve the conservation status of populations in identified risk areas

Polygon BG01					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
BG01_01 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	Disturbing during the breeding period	low	Prohibition for entry during the breeding period (1 April - 30 June)	constant	Maintaining the favorable status of the bat populations
BG01_02 <i>The assessment was made on the basis of the available data and</i>	The cave is often visited uncontrolled for the purpose of caving, tourism and	medium	Controlled access and prohibition for entry during the breeding period, periodically	constant	Maintaining the favorable status of the bat populations;

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<p><i>collected data during the implementation of the project</i></p>	<p>treasure hunting, leading to disturbance during the breeding period, the expulsion of individuals and a high risk of newborn's mortality. Habitat damage due to vandalism (breaking cave formations, fire)</p>		<p>cleaning of vegetation on the entrances for the unimpeded flying in and out of bats from the colonies.</p>		
<p>BG01_03</p> <p><i>The assessment was made on the basis of the available data and</i></p>	<p>Overgrowth with ruderal bush vegetation interfering from free</p>	<p>low</p>	<p>Clearing of vegetation</p>	<p>constant</p>	<p>Conservation of habitat qualities</p>

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<i>collected data during the implementation of the project</i>	flying of the roost				
BG01_04 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	Overgrowth with ruderal bush vegetation interfering from free flying of the roost	low	Clearing of vegetation	constant	Conservation of habitat qualities
BG01_05 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	Proximity to a main road is a prerequisite for disturbance. Overgrowth with ruderal vegetation.	low	Clearing of vegetation	constant	Conservation of habitat qualities

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BG01_06 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	Overgrowth with ruderal bush vegetation interfering from free flying of the roost	low	Clearing of vegetation	constant	Conservation of habitat qualities
BG01_07 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	At the entrance of the cave is used as a barn	low	Prohibition for burning fire	constant	Conservation of habitat qualities
BG01_08 <i>The assessment was</i>	Part of the territory is affected by a fire	medium	Control over compliance with	constant	Conservation of habitat qualities

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<i>made on the basis of the available data and collected data during the implementation of the project</i>	that destroyed potential roosts of forests bats		forest fire safety rules		
BG01_09 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	The terrain is part of the hunting area of bats and is currently an unregulated landfill, significantly reducing its suitability	medium	Removal of unregulated landfill and reclamation of the terrain	once	Recovery of the hunting area
BG01_10 <i>The assessment was made on the basis of the available data and</i>	The terrain is part of the hunting area of bats and is currently an unregulated	medium	Removal of unregulated landfill and reclamation of the terrain	once	Recovery of the hunting area

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<i>collected data during the implementation of the project</i>	landfill, significantly reducing its suitability				
Polygon BG02					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
BG02_01 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	The cave is often visited uncontrolled for the purpose of caving, tourism and treasure hunting, leading to disturbance during the breeding period, the expulsion of	medium	Controlled access and prohibition for entry during the breeding period, periodically cleaning of vegetation on the entrances for the unimpeded flying in and out of bats from the colonies	constant	Conservation of habitat qualities

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	<p>individuals and a high risk of newborn's mortality. Habitat damage due to vandalism (breaking cave formations, treasure hunting). Overgrowth on the entrance with vegetation.</p>				
Polygon BG03					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
<i>The assessment was made on the basis of the</i>	The cave is often	low	Guides' awareness of	constant	Reduce the

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<i>available data and collected data during the implementation of the project</i>	visited uncontrolled for the purpose of caving, tourism and treasure hunting, leading to disturbance during the breeding period and expulsion of individuals.		bats habitats		disturbance of the bat assemblage.
<i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	The cave is often visited uncontrolled for the purpose of caving, tourism and treasure hunting, leading to disturbance during	low	Guides' awareness of bats habitats	constant	Reduce the disturbance of the bat assemblage

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	the breeding period and expulsion of individuals.				
BG03_03 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	The cave is often visited uncontrolled for the purpose of caving, tourism and treasure hunting, leading to disturbance during the breeding period and expulsion of individuals.	low	Guides' awareness of bats habitats	constant	Reduce the disturbance of the bat assemblage
Polygon BG06					
Database object with ID № and reason for	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results

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assessment					
<p>BG06_01</p> <p><i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i></p>	<p>The terrain is part of the hunting area of bats and is currently an unregulated landfill, significantly reducing its suitability</p>	<p>medium</p>	<p>Removal of unregulated landfill and reclamation of the terrain</p>	<p>once</p>	<p>Recovery of the hunting area</p>
<p>BG06_02</p> <p><i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i></p>	<p>The terrain is used for unregulated machine extraction of gravel and sand, which is a factor of disturbance in adjacent rocky roosts of bats</p>	<p>low</p>	<p>Prohibition of the activity</p>	<p>once</p>	<p>Reduce the disturbance of the bat assemblage</p>

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Polygon BG08

Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
BG08_01 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	Overgrowth with ruderal bush vegetation interfering from free flying of the roost	low	Clearing of vegetation	Periodically	Conservation of habitat qualities
BG08_02 <i>The assessment was made on the basis of the available data and</i>	Overgrowth with ruderal bush vegetation interfering from free flying of the roost	low	Clearing of vegetation	Periodically	Conservation of habitat qualities

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<i>collected data during the implementation of the project</i>					
BG08_03 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	The terrain is part of the hunting area of bats and is currently an unregulated landfill, significantly reducing its suitability	low	Removal of unregulated landfill and reclamation of the terrain	once	Recovery of the hunting area
Polygon BG09					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
BG09_01	The cave is often visited uncontrolled	medium	Controlled access and prohibition for entry	constant	Maintaining the favorable status of the

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<p><i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i></p>	<p>for the purpose of caving, tourism and treasure hunting, leading to disturbance during the breeding period, the expulsion of individuals and a high risk of newborn's mortality. Habitat damage due to vandalism (breaking cave formations, fire)</p>		<p>during the breeding period, periodically cleaning of vegetation on the entrances for the unimpeded flying in and out of bats from the colonies.</p>		<p>bat populations;</p>
<p>BG09_02 <i>The assessment was</i></p>	<p>The cave is often visited uncontrolled</p>		<p>Controlled access and prohibition for entry</p>	<p>constant</p>	<p>Maintaining the favorable status of the</p>

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<p><i>made on the basis of the available data and collected data during the implementation of the project</i></p>	<p>for the purpose of caving, tourism and treasure hunting, leading to disturbance during the breeding period, the expulsion of individuals and a high risk of newborn's mortality. Habitat damage due to vandalism (breaking cave formations, fire)</p>		<p>during the breeding period, periodically cleaning of vegetation on the entrances for the unimpeded flying in and out of bats from the colonies.</p>		<p>bat populations,</p>
<p>BG09_03 <i>The assessment was</i></p>	<p>Overgrowth with ruderal bush</p>	<p>low</p>	<p>Clearing of vegetation</p>	<p>Periodically</p>	<p>Conservation of habitat qualities</p>

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<i>made on the basis of the available data and collected data during the implementation of the project</i>	vegetation interfering from free flying of the roost				
Polygon BG10					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
BG10_01 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	Risk of harvesting a group of old growth trees and destroying potential roosts for forest bats	low	Preserving the tree group	constant	Protection of potential roosts

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Polygon GR 01					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
GR01_01 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	Use of chemicals in agriculture as a factor for impoverishment of the food base	medium	Control over the use of chemicals in agriculture in accordance with legislation framework	constant	Preserving the favorable conservation status of the bat assemblage
Polygon GR02					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
GR02_01	The entrance of the	medium	Replacement of the	once	Conservation of

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<i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	bunker is closed with a solid metal door, stopping bats from accessing the roost		solid metal door with a lattice, allowing the bats to fly unhindered		habitat qualities
Polygon GR04					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
GR04_01 <i>The assessment was made on the basis of the available data and collected data during the implementation of the</i>	A newly discovered cave with an active speleological interest, which is a prerequisite for disturbance, expulsion of bats and	medium	Awareness of speleologists and limitation of researches during the breeding period (1 April - 30 June)	constant	Conservation of habitat qualities

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<i>project</i>	damage the roost				
Polygon GR06					
Database object with ID № and reason for assessment	Risk description	Level of impact	Conservation measures	Period of application of the measure	Expected results
GR06_01 <i>The assessment was made on the basis of the available data and collected data during the implementation of the project</i>	A breakage of the front door-grille has been observed, which is a prerequisite for unregulated access to the cave and disturbance, expulsion and mortality of individuals,	medium	Installation of a reliable locking mechanism at the entrance	once	Conservation of breeding bat colonies.

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	<p>especially during the breeding period, when a breeding colony of the species <i>Myotis myotis</i> has been registered.</p>				
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Of the 17 polygons studied, in 11 have been identified risks for the bat populations that could be avoided or mitigated by implementing measures to recover the habitat or improve/maintain its condition. In 11 cases, the degree of risk was defined as “medium” and in 15 cases as “low”.

In the six polygons, where are no identified risks for bat populations, their habitats and shelters are in a favorable conservation status.