



**Preliminary Design and ESIA for
the Matesevo - Andijevica
alignment for the purposes of the
ESIA study Environmental Survey:
Mammals (including Bats)**

Client: HILL INTERNATIONAL N.V.

Beneficiary:

Ministry of Transport and Maritime
Affairs,
Montenegro

Consultant: SMART STUDIO

Expert: MSc Marina Radonjić
Gavra Vukovića bb
81000 Podgorica

(DRAFT)

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Executive summary

Mammals. In the project area, no detailed and systematic research has been done on any group of mammals. In the past, the mammal species presence was mostly concluded based on the natural and other environmental characteristics of the area. The zone where the Matešev-Andrijević section is planned, consists of a forest-meadow complex ecosystems. Beech forests are dominant, while at higher altitudes they alternate with coniferous ones. According to the Management Plan of the Komovi Regional Park, that area offering habitat for **33** mammal species, of which **8** are nationally and/or internationally protected. The territory of the Komovi Regional Park places with its northern side with the construction scope of the Matešev-Andrijević section. In addition to the status of a regional park, Komovi is also recognized as an IPA area (plant area of international importance).

So far, within the project area, 3 photo-traps were placed in ecologically attractive places, abandoned buildings were inspected, bats were caught by using mist nets, as well as transects of ultrasonic detection of the bat activities was also conducted.

Preliminary research indicates that the sites of Han Drndarski and the confluence of the Crnja and Drcka rivers are sensitive areas where the high activity of mammal fauna has been recorded. The maternity colonies of *Rhinolophus hipposideros* (Lesser horseshoe bat) and *Barbastella barbastellus* (Barbastelle bat) were registered at these localities. Both species are marked as "Near threatened" (NT), according to IUCN (International Union for Conservation of Nature) criteria for the Mediterranean. As for their conservation status, they are protected both nationally and internationally (Eurobats agreement, EU Habitat directive, Berne Convention).

River Drcka and its streams are recognised also as an important ecosystem due to otter (*Lutra lutra*) presence. This species is also a nationally and internationally protected species (EU Habitat Directive, Berne Convention) and according to the IUCN for the Mediterranean, it is marked as "Near threatened" (NT) also.

An inspection of the abandoned buildings, a particular building that continues to the Post Office at the Matešev-Andrijević intersection is used by at least 4 bat species during the warmer period of the year.

Several sites where high-grade degradation was observed were also recorded, e.g. Batal and Čuke localities due to intensive deforestation.

By this biodiversity survey location Han Drndarski showed the highest point of mammal diversity together with river junction of Pecka stream to Drcka river.

According to the results, the plan and manner of construction of the section Matešev-Andrijević should be considered concerning the described sensitive zones to mitigate the negative impact on the species habitat and shelters.

Considering the protection status of all species, three locations should be of high importance: **Confluence of Pecka river in Dricka river, Han Drndarski (including Crnja river), Krgovići** locations.

The type of planned road construction in the sense that most of the roadway would be in bridges and tunnels is already a mitigating fact due to the animal corridors.

Taking into account the geography of the area, vegetation, registered sensitive zones, the following general mitigation measures should be taken into account when it comes to Mateševu – Andrijevica alignment :

- Road construction activities in places important for bats should be exclusively performed by daylight, as noise and artificial lights may significantly disturb their activities;
- Whenever possible, the existing flight paths / corridors , as well as landscape elements that define them, should be preserved, and special measures should be taken in places where the road obstructs them to enable safe “transit” of bats/other mammal species – for example, green viaducts, passes below the road or green bridge, etc.
- When it is not possible to preserve the safety of the existing flight paths and migration routes for bats, it is not possible to provide safe “crossing” for bats at the places where the road interrupts these corridors, it is necessary to develop a system of measures, which must include the following:
 1. Inhibiting bats from crossing the road at unsafe places – for example, by bright light, removal of vegetation, etc.;
 2. Redirection of flight paths toward the closest safe crossing – for example, by reshaping the linear landscape elements;
 3. Enabling an appropriate safe crossing at the closest possible location – for example, green viaducts, appropriate passes below the road or green bridge, etc.
- Avoid any removal of trees and shrub vegetation that is not in direct function of project realization;
- Artificial lights should be projected in such a way to disrupt the life activities of bats as little as possible, except when it is proposed by the measures in the function of decreasing the possibility of bat fatalities.
- Planned culverts should be adapted to otter ecology.
- Site compounds and storage or waste dumping facilities should be located away from potential otter habitat.

Contents

INTRODUCTION.....	4
MATERIAL AND METHODS.....	6
BATS	6
OTHER MAMMALS	7
RESULTS	8
BATS	8
TYPE AND STATUS DESCRIPTION OF HABITATS AND POPULATIONS OF RECORDED SPECIES	13
HABITAT AND FUNCTIONAL ELEMENTS OF REGISTERED BAT SPECIES IN THE SCOPE OF THE PROJECT AREA.....	34
MEASURES FOR MITIGATION, REDUCTION AND ELIMINATION OF NEGATIVE IMPACTS.....	37
PROPOSED MITIGATION MEASURES.....	39
CONCLUSION ON MITIGATION MEASURES.....	42
OTHER MAMMAL SPECIES	40
TYPE AND STATUS DESCRIPTION OF HABITATS AND POPULATIONS OF RECORDED SPECIES	43
MITIGATION MEASURES FOR REDUCTION AND ELIMINATION OF NEGATIVE IMPACTS.....	47
PROPOSED MITIGATION MEASURES.....	47
CONCLUSION ON MITIGATION MEASURES.....	50
REFERENCES	53
Appendix I	55
Appendix II	60
Appendix III	64
Appendix IV	69

INTRODUCTION

Purpose of the document. Hill-IPF Consortium has been assigned by WBIF/IPF7 the preparation of the Preliminary Design and ESIA for the Matesevo - Andrijevisa alignment for the purposes of the ESIA study and according to ToR, Hill-IPF is seeking to enhance biodiversity baseline in terms of mammals (bats included). The locations for the surveys was 500m left and right from the road alignment provided. Special accent was put on the protected areas that have been identified in the project area, these being: (a) officially nominated candidate Emerald site “Lim river” (identified as Important Plants Area (IPA) site as well) and (b) Regional Park Komovi

It should be pointed out that the highway corridor intersects with the northern part of the Emerald site “Lim river”, whereas certain parts of the highway corridor are close to the northern border of Regional Park Komovi such as the Drcka valley (in the area of Batal) and the area in front of Han Drndarski (before Tresnjevik). The results of the field survey are recorded and assessed separately for the parts of the survey that are adjacent or within the concerned protected areas. We used GPS for all recordings of species which allowed us to propose more site-specific impacts and mitigation measures. The measurements provided all the necessary information on the bat fauna and other mammal fauna in the indicated area and support the Environmental and Social Impact Assessment. This report includes environment survey results, an indication of the most sensitive zones followed with proper mitigation measures. The Report is split into two parts. One is dedicated to bats and the other to the mammal species.

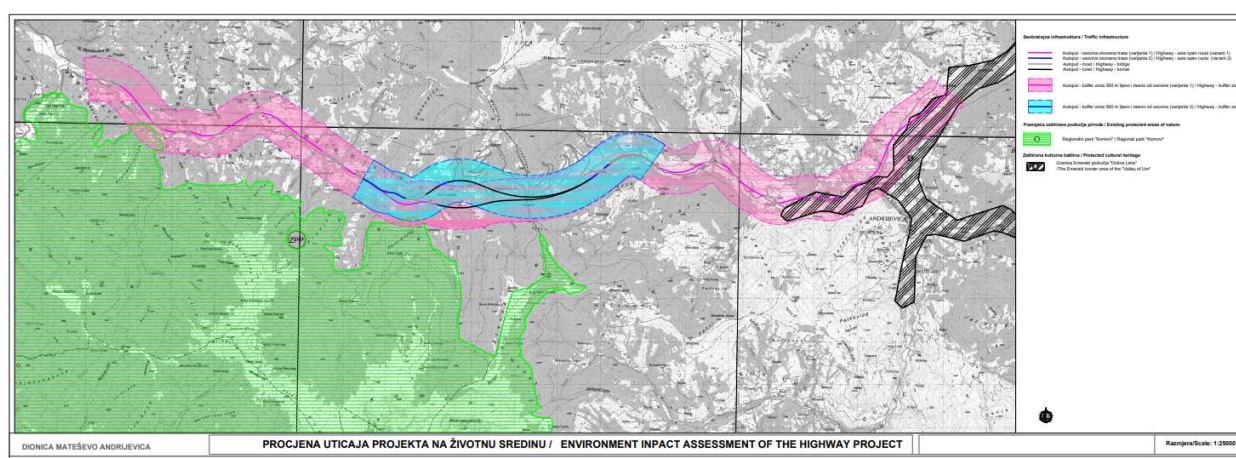


Figure 1. Scope of the roadway project Mateševo-Andrijevisa

Mammals in the project scope. In the project roadway scope, no detailed and systematic research has been done on any group of mammals. In the past, the mammal species presence was mostly concluded based on the natural and other environmental characteristics of the area. The zone where the Mateševo-Andrijevisa section is planned, consists of a forest-meadow complex ecosystems. Beech forests are dominant, while at higher altitudes they alternate with coniferous ones. According to the Management Plan of the Komovi Regional Park, that area offering habitat for **33** mammal species, of which **8** are nationally and/or internationally protected. The territory of the Komovi Regional Park places with its northern side with the construction scope of the Mateševo-Andrijevisa section. Due to the presence of

diverse habitats, such as forests, aquatic habitats (springs, rivers and ponds), grasslands and rocks, the area, provides shelter for a variety of mammal fauna. However, very little is known about this group of animals in this area. According to scarce but relevant data the presence of international protected big mammals (bear and wolf) it is expected and nationally and/or internationally protected, the most characteristic typical aquatic representative of mammals, otter (*Lutra lutra*) and species from the group of bats (*Chiroptera*) as well.

Bats and roads. Planning of road infrastructure must be viewed from a broader perspective, as it may have multifold impacts on bats living in the vicinity of a proposed construction project. The road might break the continuity of present habitats, or even destroy the habitats or their functional elements for the populations of bats (roosts, flight paths, hunting areas and migration routes) at the site or in the region. Bats are especially at risk of being negatively affected by roads. Road infrastructures can affect bats directly due to vehicle collisions, destruction of roost sites, habitat loss and degradation, light and noise disturbance. Indirectly, roads may act as barriers those fragment populations and increase the extinction risk for the populations. All European bat species are of conservation concern. Bats (*Chiroptera*) are globally endangered animals that have the international protection of UNEP through the Convention on Migratory Species (CMS) and the Agreement on the Protection of European Bat Populations (EUROBATS, 1991). By disturbing their natural habitats, bat populations are declining daily. These are the only mammals that can fly actively, they are indicators of a preserved environment and they are natural regulators of the number of nocturnal insects (especially mosquitoes). Montenegro is one of the least researched countries when it comes to bats and very limited data on them has been published. A similar situation can be projected in the Project Area. However, there is scientific proof that bats are road victims in Montenegro too. All bats in Montenegro (32 species) are protected by law and are on the List of protected rare and endangered species (Official Gazette 76/06).

Other mammals and roads. It is scientifically proved that road infrastructure can disturb movement patterns of big and middle-size mammal species, cut their territories and increase roadkill, which leads toward decreasing of many populations from a long-term perspective. Mammal population densities declined with their proximity to infrastructure. Mammals seemed to avoid infrastructure in open areas over larger distances compared to forested areas, which might be linked to the reduced visibility of the infrastructure in forested areas. From our experience, the most vulnerable animals in this project scope, when it comes to other mammals are fox, stone marten, badger, European polecat, but also bear and wolf, but there are evidences for the otter road kills.

Restrictions in the research

Due to the global pandemic caused by the Corona virus, we had to adjust the surveys with proposed lockdowns in the country. However, our knowledge about the area and its biodiversity were an advantage in this situation.

MATERIAL AND METHODS

Taxonomic group:	Consultant:	Expert:	Engage period:	Research area
Bats(<i>Chiroptera</i>) and other mammal species	SMART STUDIO	Marina Radonjić	2020	Mateševo-Andrijeva

Location: Mateševo- Andrijeva section

Scope of work: Bats and other mammals survey

BATS

Field survey included two seasons (summer and autumn) and the whole area that might be affected by the road construction project, including all the project alternatives. The most adequate combination of methods and appropriate intensity of research depended on the ecological characteristics of the area that may be affected by the project, as well as on the composition of potentially present species and their ecological functions in that area.

Necessary methods for field research were:

- Searching for and inspection roosts and colonies;
- Ultrasound audio-detection with a hand-held detector (with the time expansion system), in combination with visual detection, using car transects in the stop point every 300m.

An additional method was included:

- Capturing with mist nets in the hunting areas and along the flight paths, with the goal of precise Identification of species that may not be reliably identified by using ultrasound signals alone (Fig.2)



Figure 2. Mist-nettin on Drcka river

OTHER MAMMALS

Field survey included the opportunistic setting of photo traps (Fig.3) on the areas based on expert opinions. The photo traps were at least 4 weeks on the field to be sure that all the expected mammals have been registered. Four (3) photo traps were set up in 3 UTM squares size 10x10 km².



Figure 3. Inspection of potential bat roost



Figure 4. Photo-trap set up in the project area near Pecka river

RESULTS

BATS

By this biodiversity survey, 13 species of bats were registered (Table 1). Three (3) species are identified as species of high importance: *Rhinolophus hipposideros* (Lesser Horseshoe Bat), *Barbastella barbastellus* (Western Barbastelle) and *Myotis myotis* (Great Mouse-eared Bat). Very possibly, due to habitat diversity it is the presence of several more species is expected: *Myotis capaccinii* (Long-fingered Bat), *Myotis mystacinus* (Whiskered Myotis), *Pipistrellus nathusii* (Nathusius's pipistrelle).

Table 1: Overview of bat species in the project cope, with conservation status at the international and national level (legend: + - species protected by the national law (Official Gazette of the Republic of Montenegro No. 76/06); HD - Habitats Directive; Bern - Bern Convention-Convention on the Conservation of European Wildlife) species and natural habitats; Bonn - Bonn Convention - Convention on the Conservation of Migratory Animal Species (Eurobats - One of the agreements under the auspices of the Bonn Convention); CITES – Convention on International Trade in Species of Wild Flora and Fauna)¹.

¹ No23.te: Species protected by national legislation are species that are rare or sparse at the national level and need protection for their trend to increase at the national level. The Berne Convention protects those species whose habitats are of great importance for wildlife conservation, ie. habitats of species recognized in the annexes to the Convention to preserve migration routes (corridors), all in the function of preserving the free movement of genes, while the Bonn Convention protects those migratory species whose conservation depends on cross-border cooperation. The CITES Convention controls the international trade (international trade) of endangered animals recognized by the CITES list.

No.	Latin name	Montenegrin name	English name	National laws	IUCN	BERN	BONN	EU HABITAT DIRECTIVE	EUROBATS
1.	<i>Barbastella barbastellus</i> (Schreber, 1774)	Širokouhi slijepi miš	Western Barbastelle	+	N T	Appendix II	+	Annex II	+
2.	<i>Eptesicus serotinus</i> Schreber, 1774	Kasni slijepi mišić	Serotine bat	+	L C		+		+
3.	<i>Hypsugo savii</i> Bonaparte, 1837	Savijev slijepi mišić	Savi's Pipistrelle	+	L C	Appendix II	+		+
4.	<i>Myotis alcathoe</i> von Helversen & Heller, 2001	Alkatoin večernjak	Alcathoe Whiskered Bat	+	D D	Appendix II	+		+
5.	<i>Myotis brandtii</i> (Eversmann, 1845)	Brandtov večernjak	Brandt's Myotis	+	L C	Appendix II	+		+
6.	<i>Myotis daubentonii</i> (Kuhl, 1817)	Vodeni večernjak	Daubenton's Myotis	+	L C	Appendix II	+		+
7.	<i>Myotis myotis</i> (Kuhl, 1817)	Veliki mišouhi večernjak	Great Mouse-eared Bat	+	L C	Appendix II	+	Annex II	+
8.	<i>Nyctalus leisleri</i> (Kuhl, 1817)	Šumski noćnik	Lesser Noctule	+	L C	Appendix II	+		+
9.	<i>Nyctalus noctula</i> (Schreber, 1774)	Obični noćnik	Noctule	+	L C	Appendix II	+		+
10.	<i>Pipistrellus pipistrellus</i> (Schreber, 1774)	Mali slijepi mišić	Common Pipistrelle	+	L C	Appendix III	+		+
11.	<i>Pipistrellus pygmaeus</i> (Leach, 1825)	Patuljasti slijepi mišić	Soprano Pipistrelle	+	L C	Appendix II	+		+
12.	<i>Pipistrellus kuhlii</i> (Kuhl, 1817)	Bjelorubi slijepi mišić	Kuhl's Pipistrelle	+	L C	Appendix II	+		+
13.	<i>Rhinolophus hipposideros</i> (Bechstein, 1800)	Mali potkovičar	Lesser Horseshoe Bat	+	N T	Appendix II	+	Annex II	+

Species protected by national legislation (Official Gazette of the Republic of Montenegro No. 76/06) are species that are rare or sparse at the national level and need protection for their trend to increase at the national level.

The Bern Convention protects species whose habitats are of great importance for the preservation of wildlife, ie. habitats of species recognized in the Annexes to the Convention to preserve migration routes (corridors), all in the function of preserving the free movement of genes.

Eurobats is an Agreement on the protection of European bat populations, entered into force in 1994, and currently has 32 member states, including Montenegro since 2011. It is one of the agreements under the authority of the Bonn Convention, the Convention on the Conservation of Migratory Species of Wild Animals (CMS), which aims to ensure the active protection of endangered migratory animal species throughout their range. The Eurobats Agreement protects all 52 species of bats that occur in Europe, through legislation, education, implementation of protection measures and international cooperation between States Parties, but also those that have not yet acceded to the Agreement.

The main objective of the EU Habitat Directive is to establish protected areas within the community to maintain both the distribution and the richness of endangered species and habitats, both terrestrial and marine.

The following report provides detailed descriptions and maps, for species protected by national legislation (Official Gazette of the Republic of Montenegro No. 76/06) and those listed in the Habitats Directive in Annexes II and IV.

TYPE AND STATUS DESCRIPTION OF HABITATS AND POPULATIONS OF RECORDED SPECIES²

1. *Barbastella barbastellus* (Schreber, 1774); Širokouhi slijepi miš; Western Barbastelle

Species data quality

Until recently (2014) almost nothing was known about this species, but more frequent use of bat detectors and the use of "invisible mist nets" in projects that support the survey of rare species of bats for better identification of Natura 2000 sites in Montenegro, distribution of this species has spread to both the alpine and mediterranean biogeographical regions. So far, the only place where the reproduction of this species has been recorded is in the canyon of the river Tara in the NP "Durmitor". During this field survey, reproduction of this species was recorded at the Bare Kraljske site, at the river junction of Crnja river into Drcka river.

² The segment on species report shows the status of the species population within the project (from a national and local perspective). For each species, a general overview of the quality of available data was given, as well as general ecological habitat characteristics. Montenegro does not have a Red Book of mammals and assessments of species status (abundance, presence, and trend) are based on published papers, expert opinion with use of the conservation species status based on the IUCN for the Mediterranean. In addition, an estimate of the number of each registered species was given, for each location. If this information was not available, descriptions as a very common, common, rare and very rare species were used. If the species is described as common or very common at the national level or there is a relative population size at the national level, then local estimates are given in percentages (%). When there are no estimates of population size, only the presence of the species is stated.

Ecological characteristics for species

The species prefers exclusively cave wooded areas and areas with shrubby vegetation. The composition of tree species does not play as much a role in the preference of habitats of this species, as the structural abundance of different age groups and the bordering structure of trees. They inhabit various types of shelters, spaces under the bark of trees, cracks in trees, buildings, caves, cracks in the rocks, etc.

Habitat description of registered locations where the species was present (Fig.5):

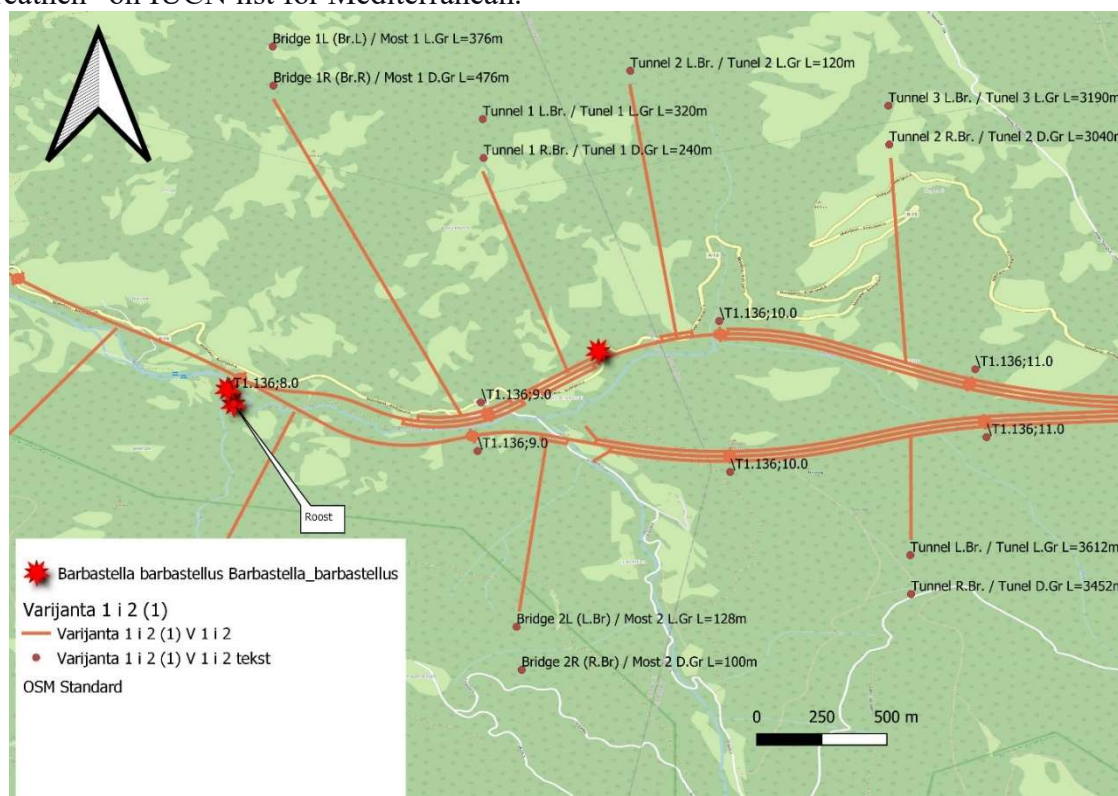
Habitats	Locations
Broad-leaved forest	Han Drndarski ³
Transitional woodland shrub	

Population estimate

In the location Bare kraljske 2 females with the cubs (4 individuals) and 2 contacts were made (with bat detector). Due to the lack of data, only the presence of the species at these locations can be confirmed with the note that this species use this habitats for reproduction. The contacts were registered in the habitat described as land principally Broad-leaved forest and roost was found in the traditional wooden house at the junction of Crnja River in the Drcka River in the habitat described as Transitional woodland shrub.

Global location assessment

Even the species has not been sufficiently researched in Montenegro at the national level, global significance of the location is high since this is highly endangered species describes as “Near threaten” on IUCN list for Mediterranean.



³ Bold locations showing overlapping species records with planned roadway

Figure 5. Records of *Barbastella barbastellus* in the Project scope

The described habitats above are overlapping with the planned road scope. This species is very endangered and its habitats should be preserved, especially since the reproduction in these places is confirmed. Species is relatively highflying type of bats which means that the most impact on this species would be during construction of the road. Removal of composition of mature and less mature trees in these places, increase habitat loss for this endangered species.

2. *Eptesicus serotinus* Schreber, 1774; Kasni slijepi mišić; Serotine bat

Species data quality

Not many confirmed locations are known. However, its presence is confirmed for both biogeographical regions in Montenegro.

Ecological habitat characteristics of species

It is mainly crevice dwelling species, roosting in the crevices under roofs, bridges or rocks. Hunting over lowland wooded agricultural landscapes, hay meadows, parklands and semi-arid habitats. Often found in towns and villages.

Distribution in Montenegro

It can be concluded that this species is present in both biogeographical regions. The size of the population is unknown.

Ecological habitat characteristics of species

It is mainly crevice dwelling species, roosting in the crevices under roofs, bridges or rocks. Hunting over lowland wooded agricultural landscapes, hay meadows, parklands and semi-arid habitats. Often found in towns and villages.

Distribution in Montenegro

It can be concluded that this species is present in both biogeographical regions. The size of the population is unknown.

Habitat description of registered locations where the species was present (Fig.6):

Habitats	Locations
Broad-leaved forest	Han Drndarski
Transitional woodland shrub	
Mixed forest	

Population estimate

Due to the lack of data, only the presence of the species at these locations can be confirmed.

Global location assessment

As the species is not sufficiently researched at the national level, we believe that the habitat is important for the conservation of the species.

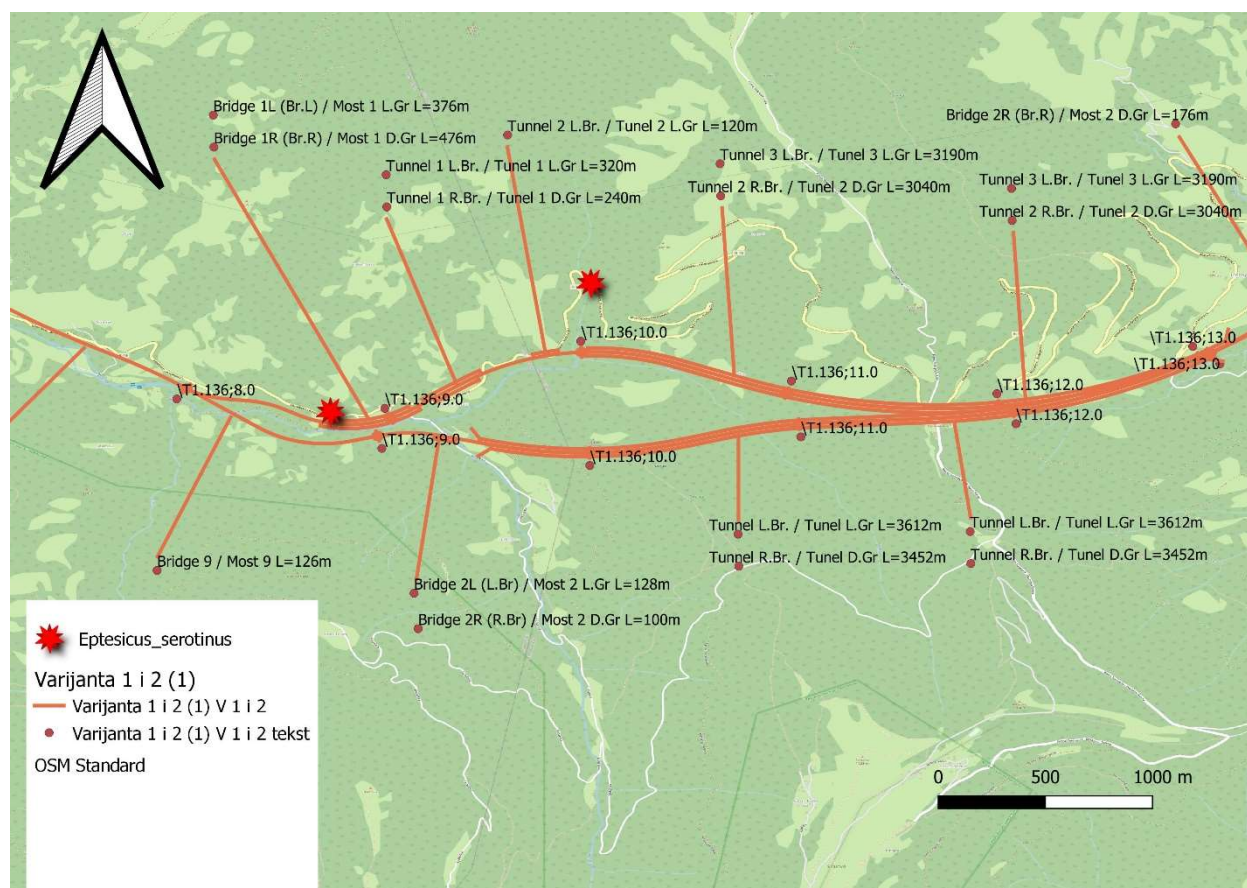


Figure 6. Records of *Eptesicus serotinus* in the Project scope

3. *Hypsugo savii Bonaparte, 1837; Savijev slijepi mišić; Savi's Pipistrelle*

Species data quality

Based on former research, this species is probably widespread in our country and present in both biogeographical regions. Its presence is registered from the coast itself until 1750m above sea level.

Ecological habitat characteristics of species

Mountain pastures and surrounding water bodies. It is often present around human settlements as well.

Distribution in Montenegro

It can be concluded that this species is present in both biogeographical regions. The size of the population is unknown.

Habitat description of registered locations where the species was present (Fig.7):

Habitats	Locations
Broad-leaved forest	Krgovići
Transitional woodland shrub	
Mixed forest	

Population estimate

Due to the lack of data, only the presence of the species at these locations can be confirmed.

Global location assessment

As the species is not sufficiently researched at the national level, we believe that the habitat is important for the conservation of the species.

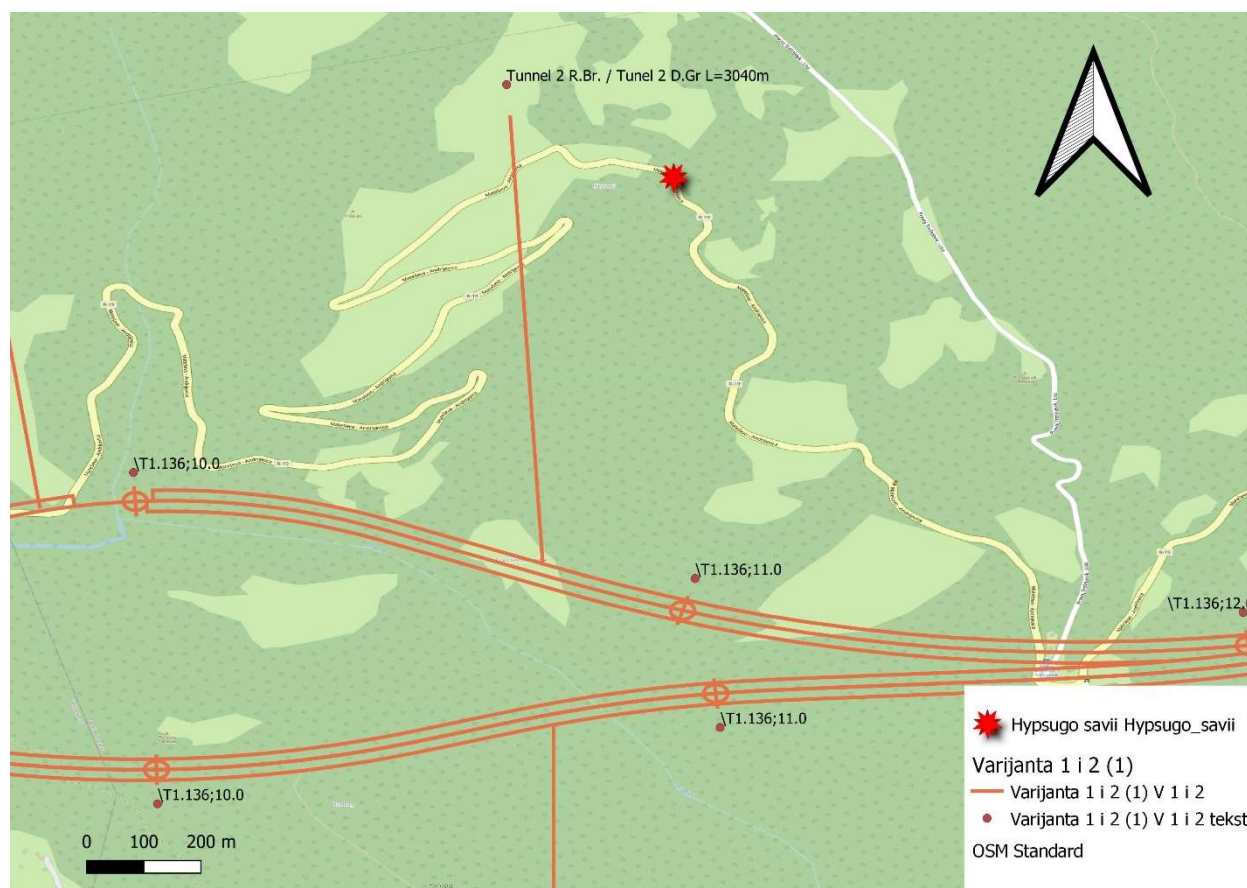


Figure 7. Records of *Hypsugo savii* in the project scope.

4. **Myotis alcathoe von Helversen & Heller, 2001; Alkatoin večernjak;**

Species data quality

There are only 3 records (including finding in this implemented filed survey) in Montenegro. Species is not very well researched even on European level.

Ecological habitat characteristics of species

Dense and humid mixed forests often near water or in small ravines with streams. Roost mainly in trees.

Distribution in Montenegro

It is assumed that this species can be present in both biogeographical regions.

Habitat description of registered locations where the species was present (Fig. 8):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Mateševo

Population estimate

Species present.

Global location assessment

Species is not very well researched and every individual is significant even on global level.

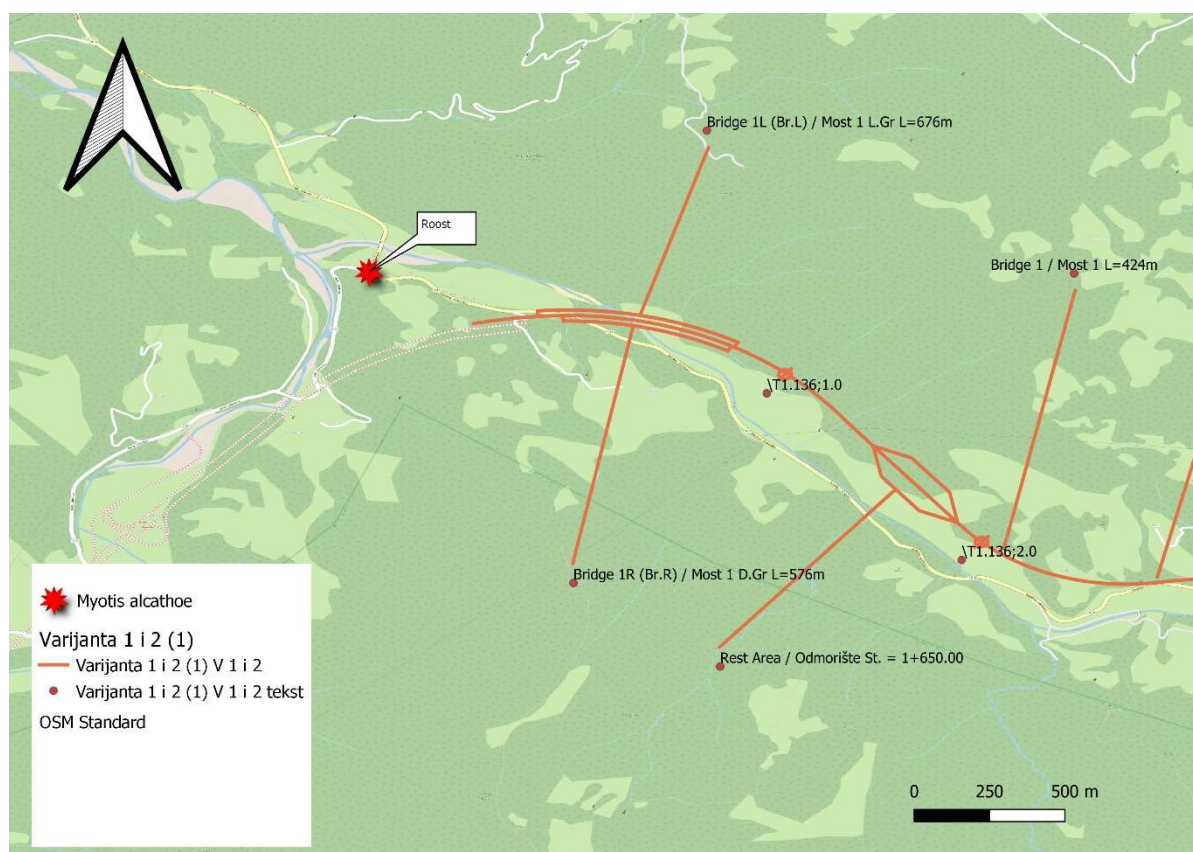


Figure 6. Records of *Myotis alcatheae* in the Project scope

The species was found in Mateševo in abandoned building which provides shelter for many bat species as registered by this survey. This building is in the scope of the planned road.

5. *Myotis brandtii* (Eversmann, 1845); Brandtov večernjak; Brandt's Myotis

Species data quality

There are only 3 records (including finding in this implemented field survey) in Montenegro. According to this data, species is present only in alpine biogeographical region. Species is not very well researched in Montenegro.

Ecological habitat characteristics of species

Usually it could be found in mixed and broad leaf forests often close to the water. Summer roosts in crevices in buildings, tree holes and bat boxes. Hibernates in caves, mines and other underground places.

Distribution in Montenegro

It is assumed that this species can be present just in alpine biogeographical region.

Habitat description of registered locations where the species was present (Fig. 9):

Habitats	Locations
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**Land principally occupied by agriculture, Mateševo
with significant areas of natural vegetation**

Population estimate

Species present.

Global location assessment

Species is not very well researched and every individual is significant even on global level.

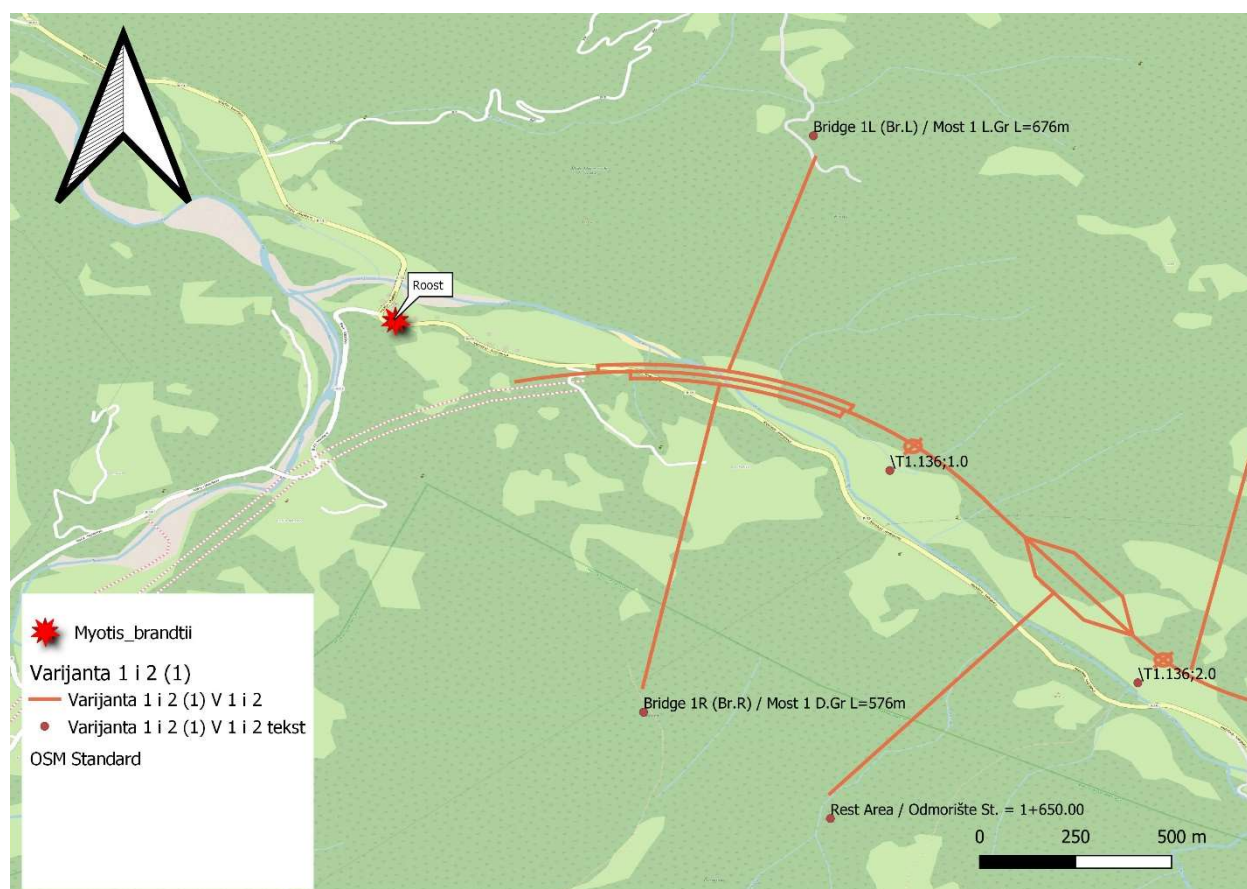


Figure 9. Record of *Myotis brandtii* at the project scope.

The species was found in Mateševo in abandoned building which provides shelter for many bat species as registered by this survey. This building is in the scope of the planned road

6. *Myotis daubentonii* (Kuhl, 1817); vodeni večernjak; Daubenton's bat

Species data quality

According to previous literature data, this species is widespread in Montenegro, although most of the known population so far is in the alpine biogeographical region of the country. So far, the only known important reproductive nucleus of this species has been registered in the alpine biogeographical region (NP Biograska Gora). By spreading knowledge about the

distribution of this and its sister species, these species likely live in sympathies and further research is needed to delineate their distributions and thus define the most important habitats. We also had phonetic groups of *M. daubentonii* / *capaccinii* in the project area, however, using the methods of inspection of the objects, we registered only *M. daubentonii* species and in the continuation, I present data on phonetic groups as data on the distribution of *M. daubentonii* species.

Ecological characteristic of species

The species is closely related to deciduous and mixed forest ecosystems that have water bodies nearby. Summer colonies are mostly in tree crevices, while males are solitary in trees or rock crevices. The species can be found in Montenegro from 0 to 1700 m above sea level.

Distribution in Montenegro

According to the available literature, the species is more widespread in the alpine biogeographical region than in the mediterranean. However, more and more data point to the fact that these two species live in sympatry throughout Montenegro. Due to the ignorance of the status of this species, it is very difficult to give population estimates.

Habitat description of registered locations where the species was present (Fig. 10):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Mateševo, river junction of Kraštica River in Lim River
Broad-leaved forest	
Transitional woodland shrub	Han Drndarski
Mixed forest	

Population estimate

Species present in the area.

Global location assessment

As the size of the population is unknown at the national level and the smallest percentage (%) is important from a global perspective.

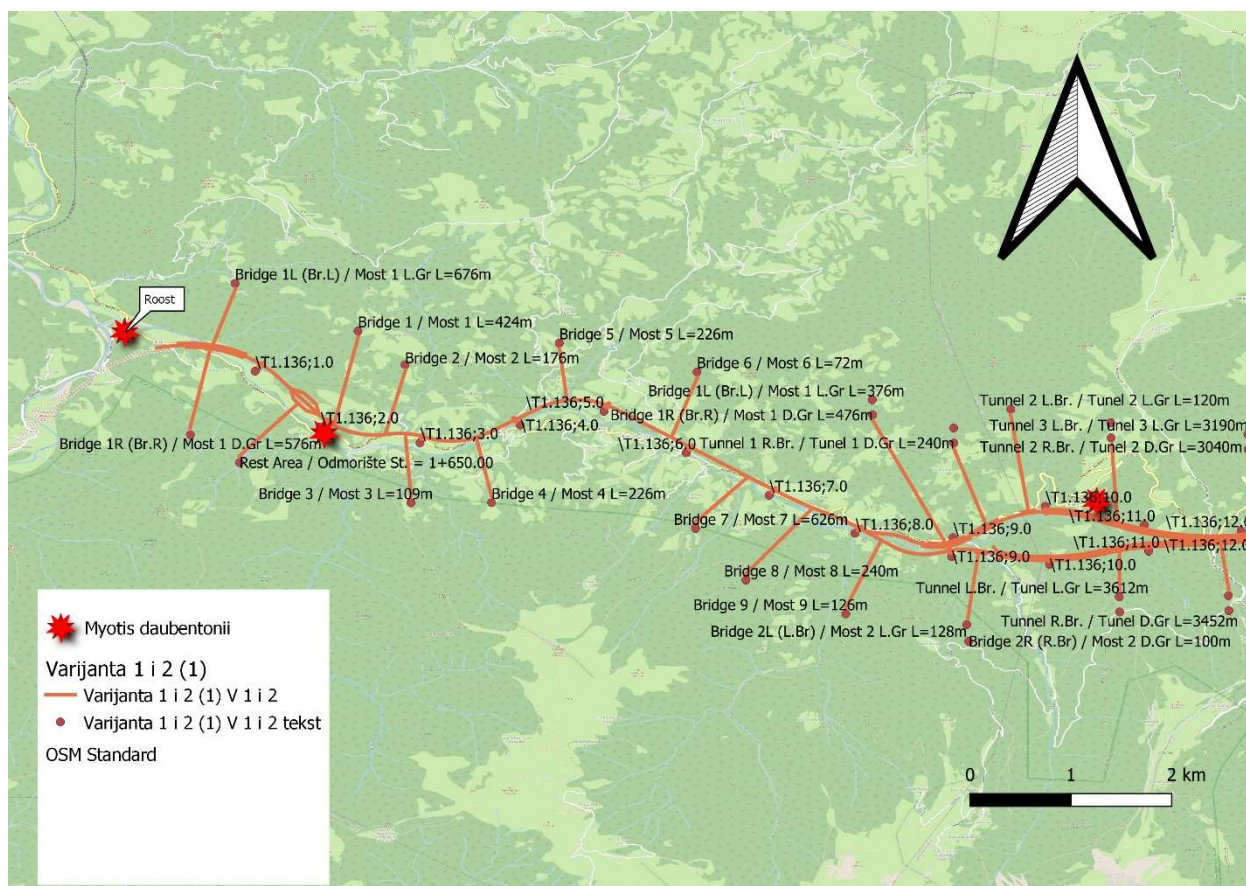


Figure 10. Records of *Myotis daubentonii* (in Mateševo) and *Myotis daubentonii/capaccinii* fonetic group

Additional information on the sister species that is less likely to be present in the project area:

***Myotis capaccinii* (Bonaparte, 1837); dugoprsti večernjak; Long-fingered Bat.**

Species data quality

According to previous literature data, this species is quite common in caves in the Mediterranean region and near water surfaces. Until recently, the only known important habitat of this species in the alpine biogeographical region was the Vilina pećina Cave in Nikšić. By disseminating knowledge about the distribution of this species and its sister species, these species likely live in sympatry and further research is needed to delineate their distributions, thus better defining the most important habitats of the long-fingered bat as a “Natura” species.

Ecological characteristic of species

The species is closely related to cave ecosystems and quality karst waters from 0 to 1000 m above sea level. Relatively well-preserved ecosystems and the application of good agriculture practices still ensure the preserved habitats of this species in Montenegro. They hunt above smaller rivers and other smaller bodies of water, but they have also been recorded hunting along the coast.

Distribution in Montenegro

According to the available literature data, the species is more widespread in the Mediterranean biogeographical region along the coastal area of Montenegro and the Skadar Lake basin.

However, with the existence of a large colony in the municipality of Nikšić, a more accurate estimate of the population would be that 15% of the known population is concentrated in the north and 85% in the Mediterranean biogeographical region, with the northern part of Montenegro much scarcer. For this reason, this estimate does not represent a real numerical value.

7. *Myotis myotis* (Borkhausen, 1797); veliki mišouhi večernjak; Greater Mouse-eared Myotis

Species data quality

There is very limited data on this species, and an estimate of population size can not be concluded. The only possible reproductive center of this species is in the village of Vranjina in cave Golubija, in the national park "Skadar Lake". However, literature data show that this species is mostly concentrated in the northern parts of the country. According to available data and data from neighboring countries, it should be considered widespread, but more detailed research is needed to confirm this.

Ecological characteristics for species

This species is mainly present up to 800 m above sea level in lowland and mountainous areas, although in warmer regions they can be found higher (e.g. in Montenegro up to 1700 m above sea level). Colonies of this species prefer caves as shelters, but it is not excluded that smaller colonies can also occur in cracks in trees. The colonies are mostly around very wooded habitats made up of deciduous and mixed middle-aged forests. They prefer wooded habitats with open pastures and mountain meadows that are mowed in the nearness. During feeding, they spend 98% of their time in the forest.

Distribution in Montenegro

This species is also present in the mediterranean and alpine biogeographical region. Little is known for its more detailed distribution. Size of national population unknown.

Habitat description of registered locations where the species was present (Fig. 11):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Bare kraljske
Broad-leaved forest	
Transitional woodland shrub	Han Drndarski and Krgovići
Mixed forest	

Population estimate

Species present in the area.

Global location assessment

As the size of the population is unknown at the national level and the smallest percentage (%) is important from a global perspective since the species is Natura 2000 species and these habitats are very important for its ecology.

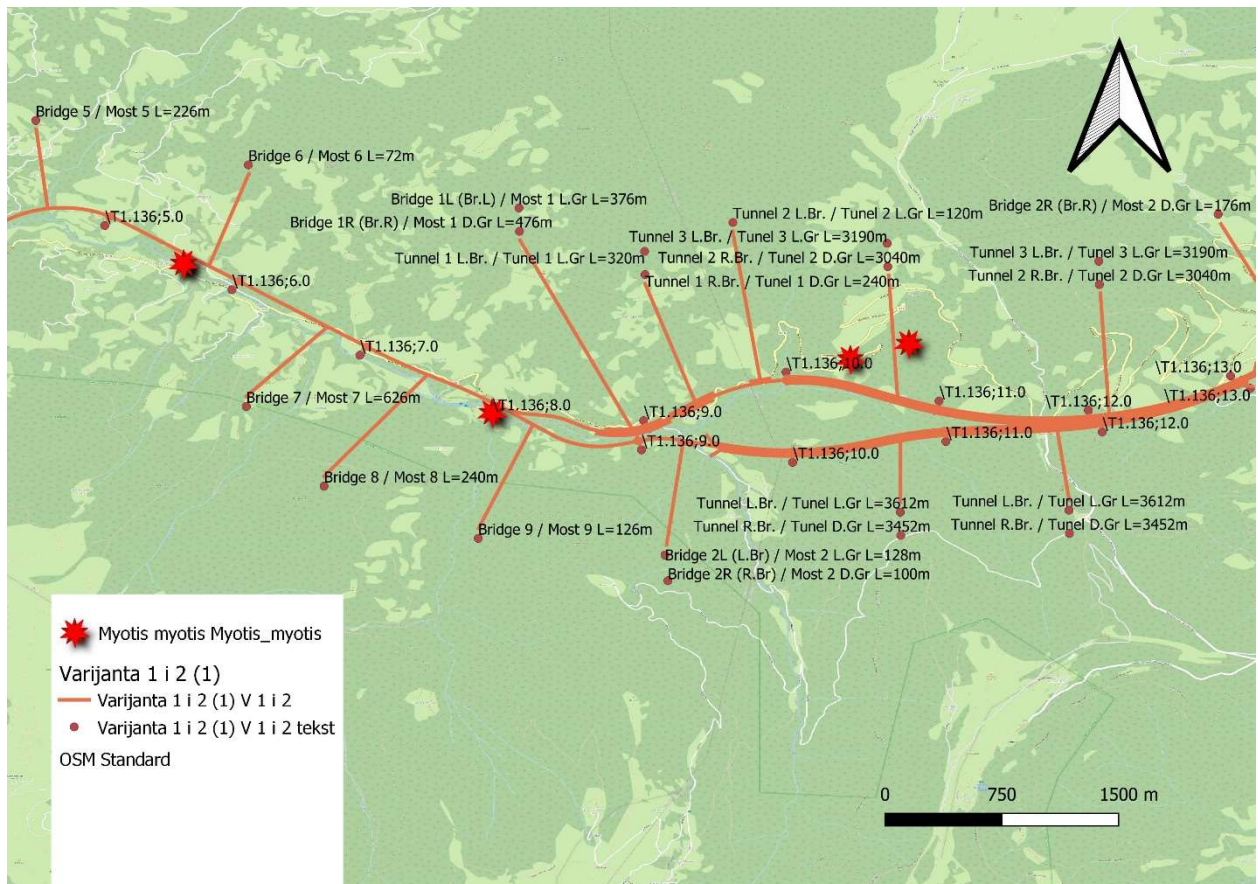


Figure 11. Registered fonetic group *Myotis myotis/oxygnathus* represented as *Myotis myotis* presence in the project scope.

Population estimate

Species present in the area.

Global location assessment

As the size of the population is unknown at the national level and the smallest percentage (%) is important from a global perspective.

Population estimate

Species present in the area.

Global location assessment

As the size of the population is unknown at the national level and the smallest percentage (%) is important from a global perspective.

8. *Nyctalus leisleri* (Schreber, 1774); mali noćnik; Lesser Noctule.

Species data quality

In Montenegro, the noctule bat is a widespread species, from 0 to 1800 m above sea level. Although so, there is still no data on the most significant shelters of this species as well as data on population size at the state level.

Ecological characteristics of species

The noctule bat is mostly a forest species, although in many countries it has adapted to the urban environment. Maternity colonies are in cracks in trees, while during the winter they are mostly in cracks in rocks or buildings (buildings, bridges, etc.). They feed in open areas and prefer wetlands or water bodies near these open areas.

Distribution in Montenegro

This species is also present in the mediterranean and alpine biogeographical region. Little is known for its more detailed distribution. Size of national population unknown.

Habitat description of registered locations where the species was present (Fig. 12):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Han Drndarski
Broad-leaved forest	
Transitional woodland shrub	
Mixed forest	

Population estimate

Species present in the area.

Global location assessment

As the size of the population is unknown at the national level and the smallest percentage (%) is important from a global perspective.

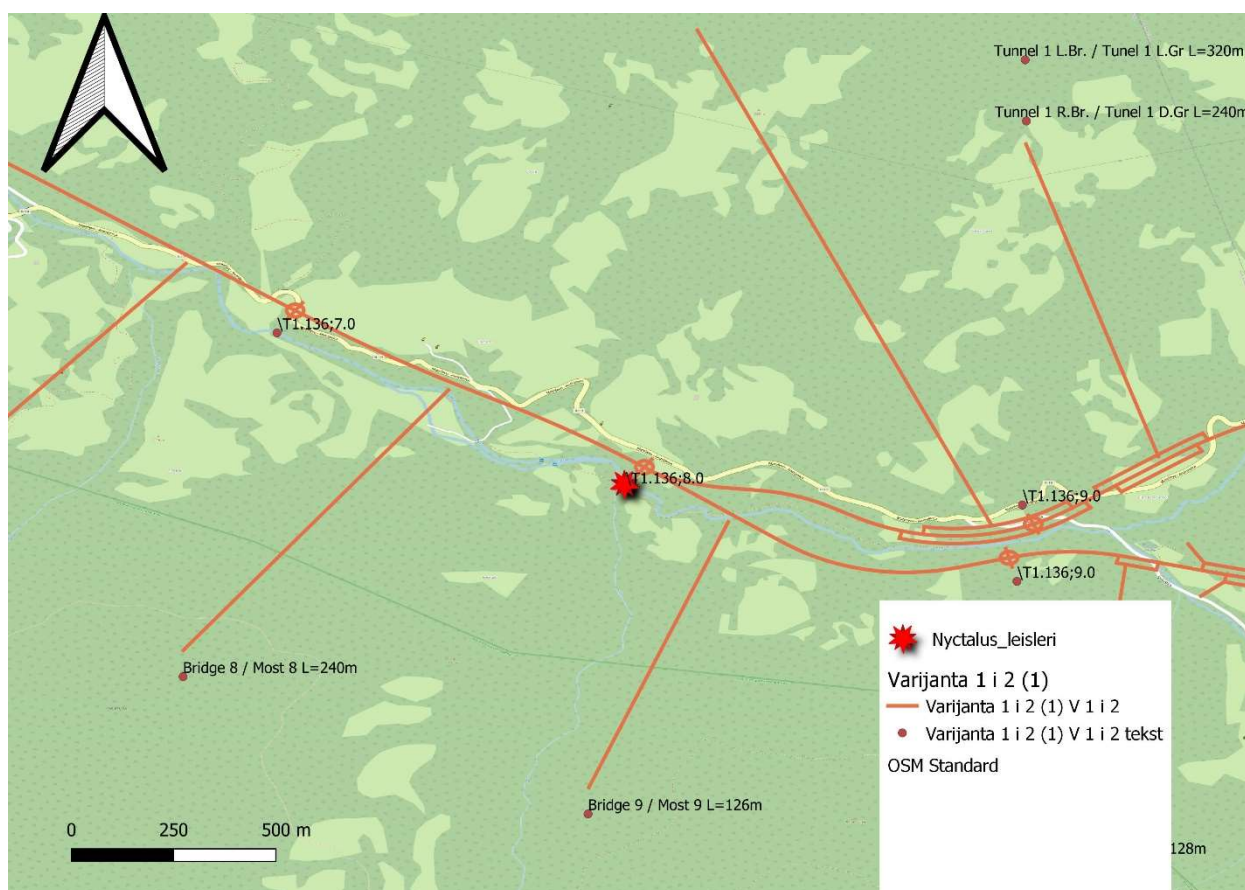


Figure 12. Registered *Nyctalus leisleri* in the project scope.

9. *Nyctalus noctula* (Schreber, 1774); obični noćnik; Noctule bat

Species data quality

In Montenegro, the noctule bat is a widespread species, from 0 to 1800 m above sea level. Although so, there is still no data on the most significant shelters of this species as well as data on population size at the state level.

Ecological characteristics of species

The noctule bat is mostly a forest species, although in many countries it has adapted to the urban environment. Maternity colonies are inhabited by cracks in trees, while during the winter they are mostly in cracks in rocks or buildings (buildings, bridges, etc.). They feed in open areas and prefer wetlands or water bodies near these open areas.

Habitat description of registered locations where the species was present (Fig. 13):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Mateševo, Bare kraljske, Han Drndarski, river junction of Krašnica river to lim river, Semi urban area of Andrijevice Municipality
Transitional woodland shrub	Han Drndarski
Mixed forest	

Population estimate

Species present. Due to the lack of sufficient information, the species can only be estimated to be present in this area.

Global location assessment

As the status of the species is unknown in Montenegro, the smallest percentage is considered important from the global aspect.

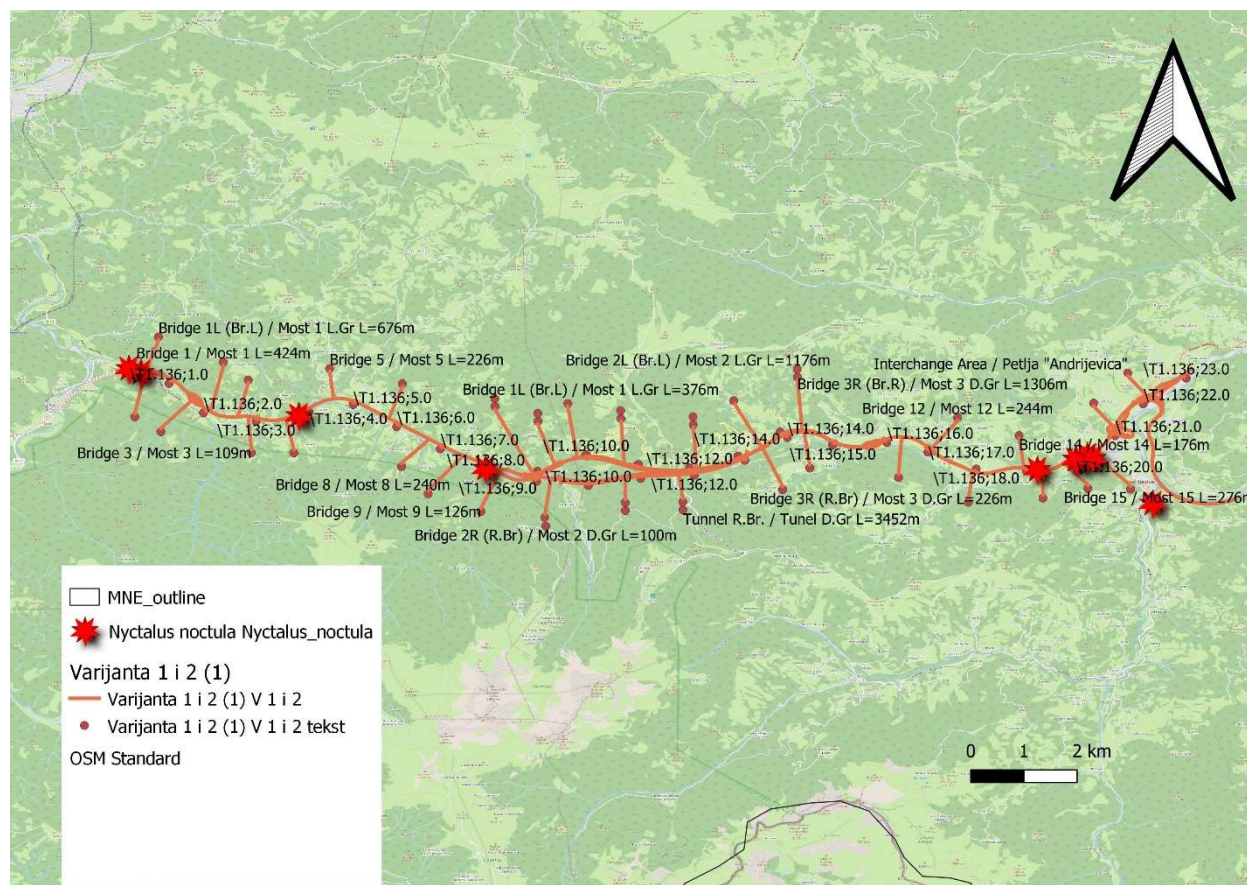


Figure 13. Registered *Nyctalus noctula* at the project scope

10. *Pipistrellus pipistrellus* (Schreber, 1774); Mali slijepi mišić; Common Pipistrelle

Species data quality

The common pipistrelle is a typical species in Montenegro, present in both biogeographical regions, although almost nothing is known about the more important shelters. In our country, it is represented from the coast to 1700m above sea level.

Ecological characteristic for species

The species prefers wooded areas near riverbeds and wetland habitats. It can also inhabit urban areas. Maternity and hibernation habitats are mainly in buildings or trees.

Distribution in Montenegro

It can be concluded that this species is present in both biogeographical regions. Significant shelters are still unknown.

Habitat description of registered locations where the species was present (Fig. 14):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Mateševo, Bare kraljske, Han Drndarski, Trešnjevik, Gnjili potok, river junction of Krašnica river to lim river, Semi urban area of Andrijevisa Municipality
Transitional woodland shrub	
Mixed forest	Han Drndarski, Krgovići
Broad-leaved forest	

Population estimate

This species is present in the project area.

Global location assessment

As the size of the population is unknown at the national level and the smallest percentage (%) is important from a global perspective.

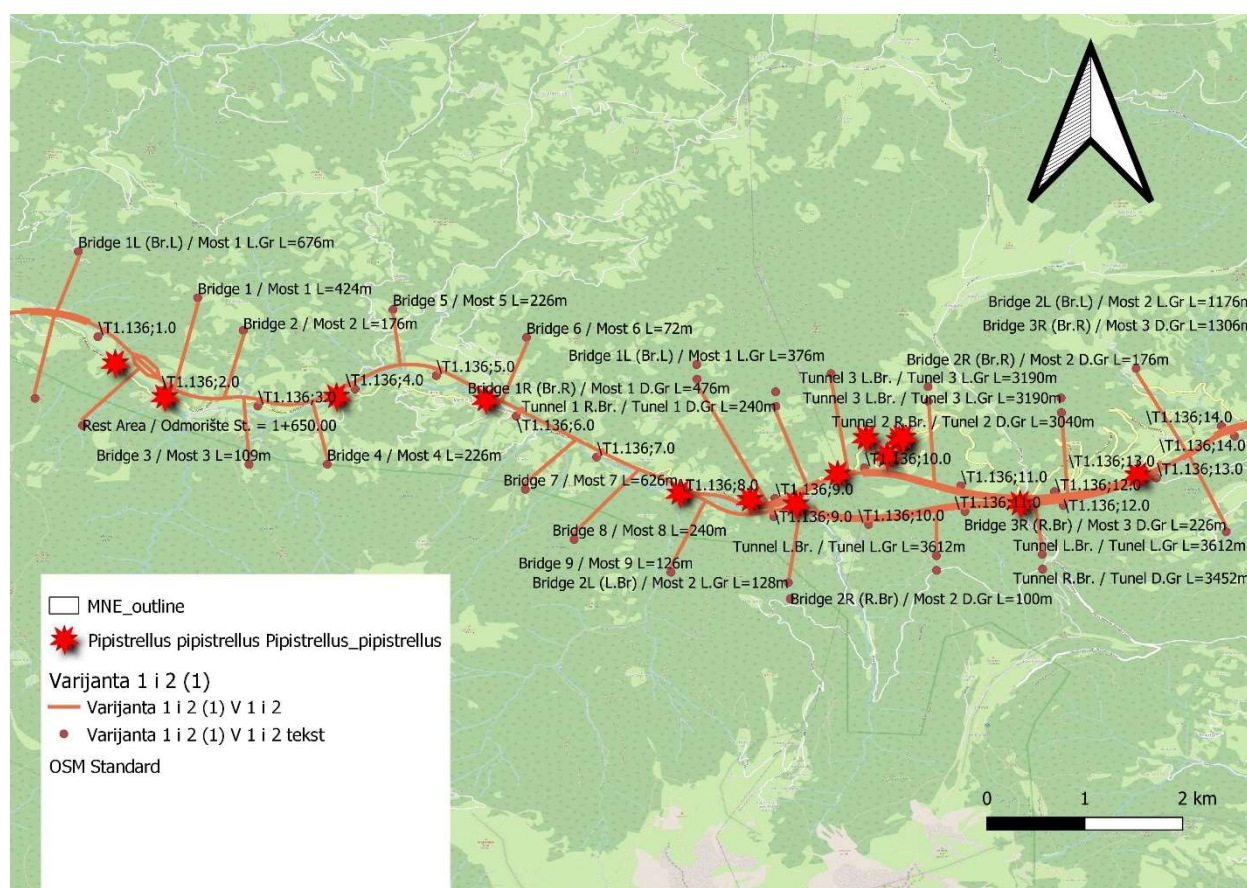


Figure 14. Records of *Pipistrellus pipistrellus* in the project area.

11. *Pipistrellus pygmaeus* (Leach, 1825); patuljsti slijepi mišić; Soprano Pipistrelle

Species data quality

Soprano pipistrelle is a common species in Montenegro, present in both biogeographical regions, although almost nothing is known about the more important shelters. In our country, it is represented from the coast to 1600m above sea level.

Ecological characteristics of habitat for species

The species prefers wooded areas near stagnant waters.

Distribution in Montenegro

This species can be concluded to be present in both biogeographical regions. The only potential maternity shelter in Montenegro was registered at the bus station in Sutomore in 2001.

Habitat description of registered locations where the species was present (Fig. 15):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Batal, Trešnjevik, Kralje, river junction of Krašnica river to Lim river
Transitional woodland shrub	
Mixed forest	Krgovići
Broad- eaved forest	

Population estimate

This species is present in the project area.

Global location assessment

As the size of the population is unknown at the national level and the smallest percentage (%) is important from a global perspective.

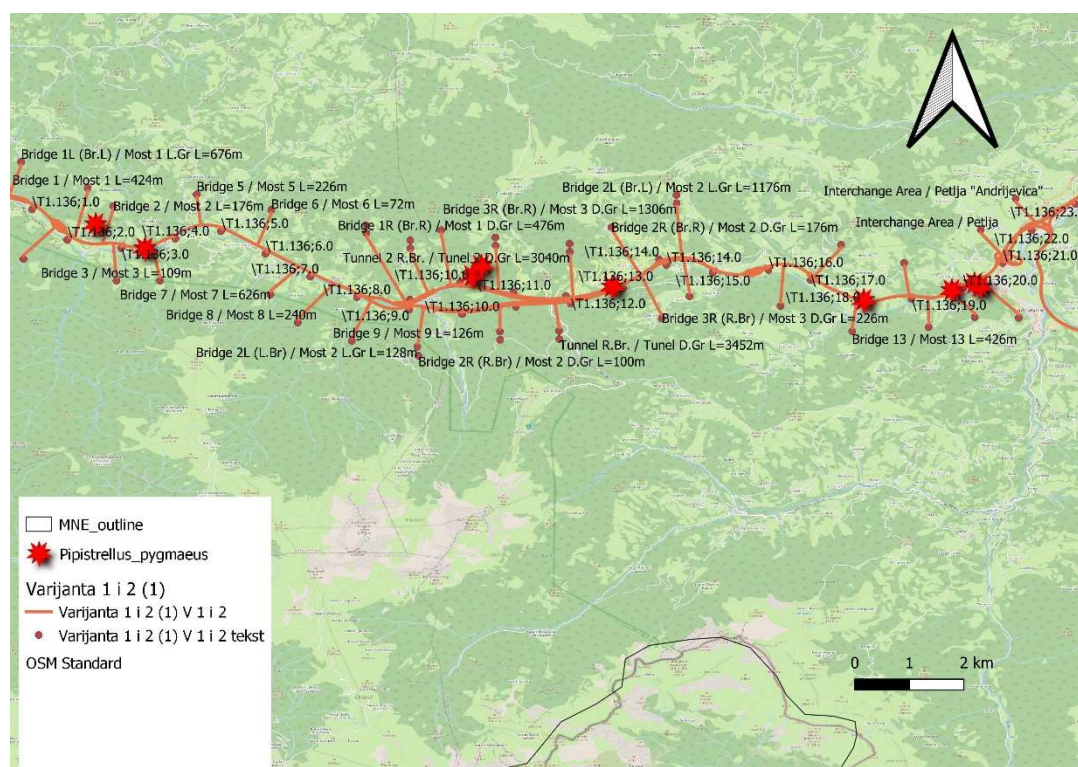


Figure 14. Records of *Pipistrellus pygmaeus* in the project area.

12. Pipistrellus kuhlii (Kuhl, 1817); Bjeloruski slijepi mišić; Kuhl's Pipistrelle⁴

Species data quality

Kuhl's Pipistrelle is a very common species in Montenegro, represented in both biogeographical regions, although almost all, so far, maternity shelters have been destroyed, precisely by the construction of new facilities and other infrastructures. The species can be found in all possible environments and especially in urbanism and semi-urban environments. In our country, it is represented from the coast to 1100m above sea level.

Ecological characteristic for species

The most important ecological elements for this species are lowland thermophilic habitats, but it also inhabits warm mountainous areas. Very connected with human settlements, it inhabits cracks in residential buildings, but also rocks and trees.

Distribution in Montenegro

The species is insufficiently researched in the alpine biogeographical region of Montenegro, but it can be stated that the population density in the Mediterranean bioregion is high.

Habitat description of registered locations where the species was present (Fig. 16):

Habitats	Locations
Land principally occupied by agriculture, with significant areas of natural vegetation	Mateševo, river junction of Krašnica river to Lim river

Population estimate

The species is present in a smaller percentage (%) compared to the presumed population in the Mediterranean biogeographical region. In alpine region it could be considered as rare.

Global location assessment

As the size of the population is unknown at the alpine biogeographical level and the smallest percentage (%) is important from a local perspective.

⁴ This field survey, through use of detector, recorded the phonetic group *P.khulii* / *nathisii*, but based on the habitat, it is not likely that it is Nathusius' bat, and in the following text, we described the characteristics related to this statement.

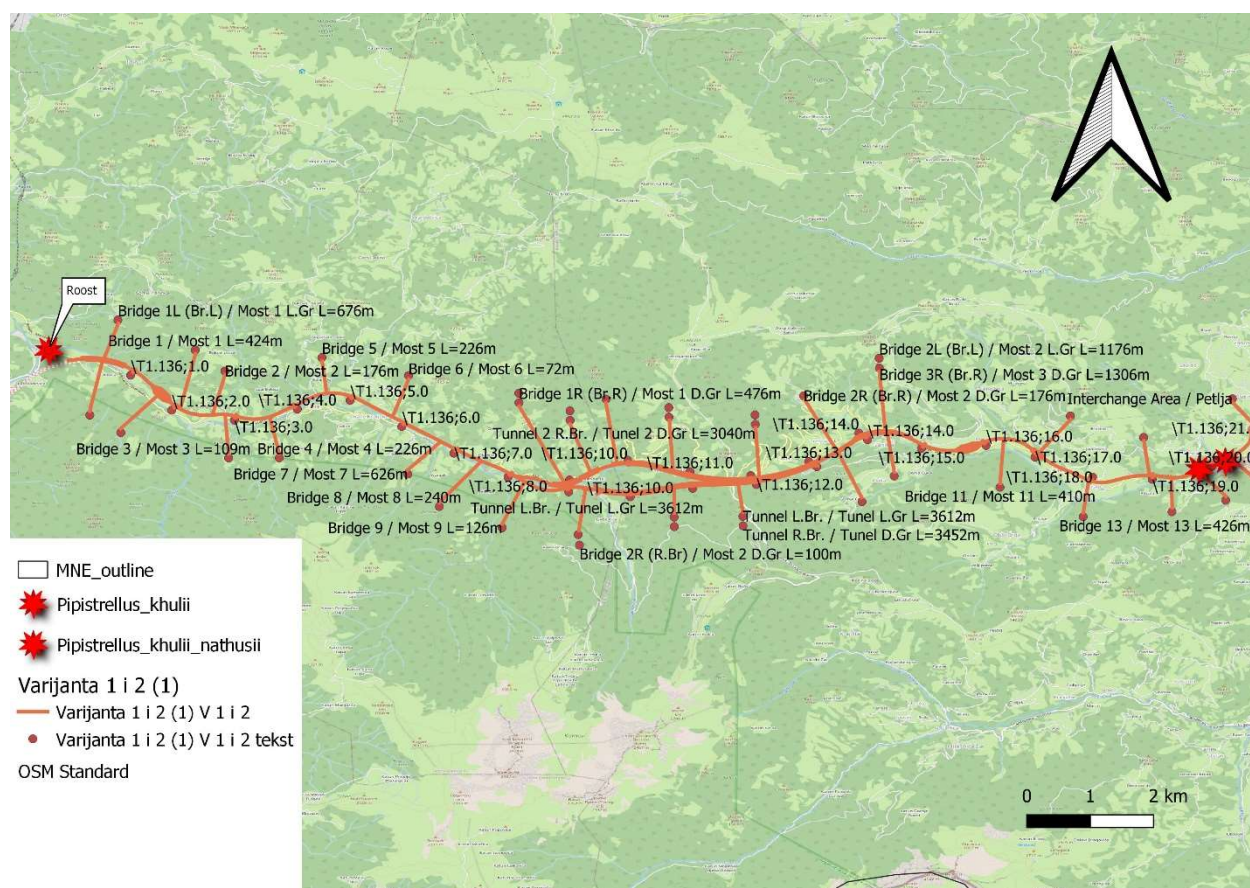


Figure 16. Records of *Pipistrellus khulii* (Matešev) and *Pipistrellus khulii/nathusii* fonetic group

Additional information about the sister species that is likely to be present but it is not registered:

***Pipistrellus nathusi* (Keyserling & Blasius, 1839); Natuzijev slijepi mišić.**

Species data quality

The presence of this species has been recorded in only a few localities in Montenegro, based on which it can be concluded that the species is present in both the Alpine and Mediterranean biogeographical region. The size of the population at the national level is unknown.

Ecological characteristics for species

The most important ecological elements for this type of mature deciduous and coniferous forest, along the edges of which it hunts as well as above water bodies. This is a typical forest species. However, it can inhabit abandoned objects created by human activity.

Distribution in Montenegro

The species is insufficiently researched, so the size of the population cannot be roughly estimated.

13. *Rhinolophus hipposideros* (Bechstein, 1800); Mali potkovičar; Lesser Horseshoe Bat.

Species data quality

This species is widespread in Montenegro, which can be concluded, both from the literature and from the new findings collected during the field inspection within this project.

This species is found at almost all altitudes from sea level to 1700m above sea level. And in both scopes given by the project task. However, even though it is so widespread, little is known about maternity and even less about hibernation shelters. The largest registered maternity colony of this species so far has more than 215 adults and is located in the house at the entrance to the NP Biogradska Gora, which was never put into function by the so-called visitor center. It is also the only such large colony known so far in the Alpine biogeographical region. Until 2011, another colony of similar size was known in the school in Tepci, NP Durmitor. However, that colony has not returned to this day, most likely due to the opening of that facility and putting it into operation due to certain needs of the village. In the Mediterranean biogeographical region, the most important maternity colony so far (about 100 adults) is located in an abandoned hotel on the shores of Lake Shasko. Very little is known about hibernation colonies of this species and further research is needed.

Ecological characteristics of species

Due to the relatively well-preserved ecosystems and the application of good agriculture practices, the habitats of this species in Montenegro are still well preserved. The most important ecological elements for this species are thermophilic meadows with linear bushy vegetation as well as open forests as well as gardens, pastures and orchards in the surrounding villages.

Distribution in Montenegro

The species is widespread in both biogeographical regions. According to current literature data, the population in both biogeographical regions can be roughly estimated at 700 individuals because the dynamics of this species have not been well researched. In general, 1/3 of the population is concentrated in the north, while 2/3 of the population is in the Mediterranean biogeographical region. Of course, this estimate does not represent a realistic numerical value because the northern part of the country is scarcer with data.

Location 1- Abandoned traditional house in river junction of Crnja River into Drcka river

Location description

The house is located in location named Jelenak on 1200m a.s.l. It is almost 500 far away from the planned road.

Population estimate

More than 3% of the known estimated population so far.

Global location assessment

Since these are highly endangered species, any shelter of this species is of global importance.

Location 2- Abandoned traditional house in Han Drndarski near existing road Mateševo-Andrjevica

Location description

The house is approx. 100m far away from the planned road, but it is approx. 20m higher than planned road.

Population estimate

Less than 2% of the known population so far.

Global location assessment

Since these are highly endangered species, any shelter of this species is of global importance.

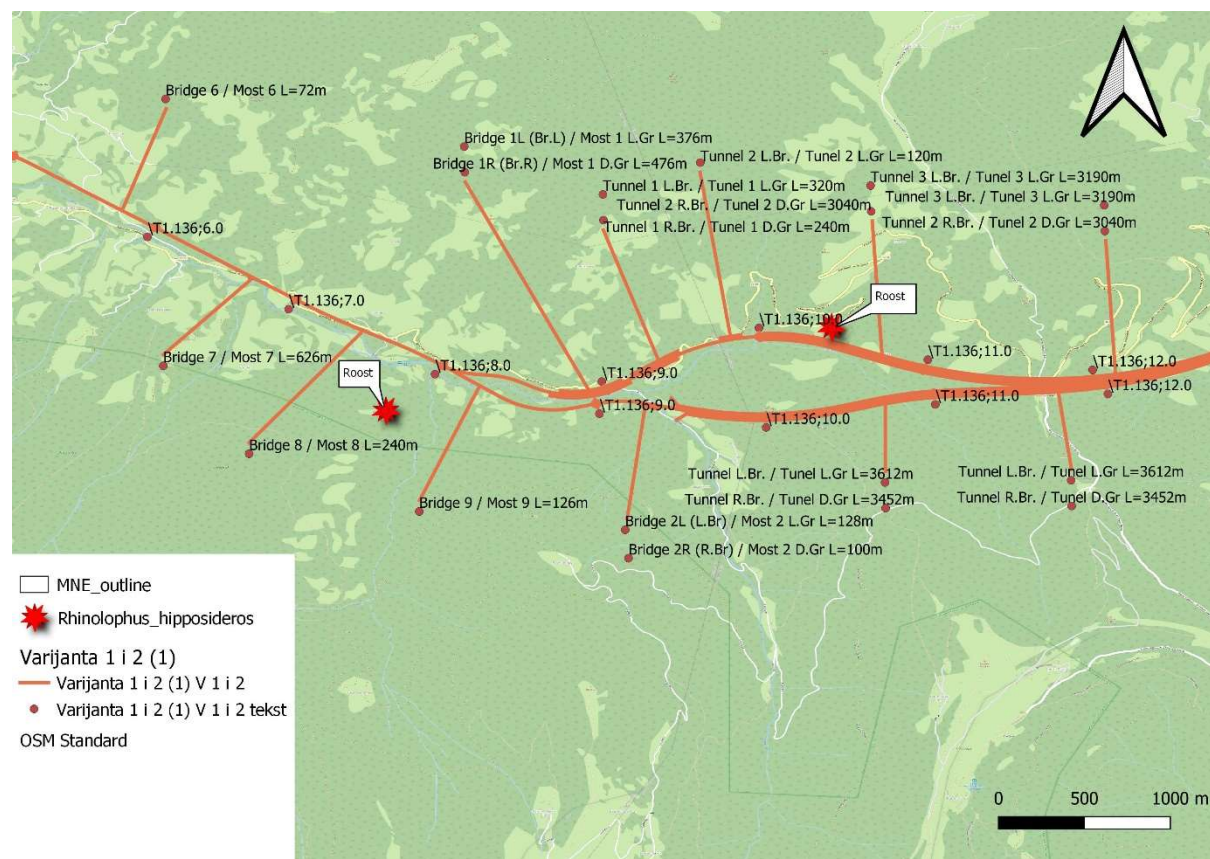


Figure 17. Records of *Rhinolophus hipposideros* in the project scope

HABITAT AND FUNCTIONAL ELEMENTS OF REGISTERED BAT SPECIES IN THE SCOPE OF THE PROJECT AREA

Construction activities may destroy the bat habitat and its functional elements (shelters, flight corridors, hunting areas, migratory corridors). However equally likely, the additional road lighting will attract higher insect populations that in turn attract more feeding bats. The following tables provide a general overview of the significance of certain bat habitats, as well as the significance of impact which may harm bats, and which may be caused by some activities that will be carried out during construction and reconstruction of the road. In the following tables, habitat functional elements of registered species are shown, and the activity of registered species per transects as well.

Table 2. Habitat preference of bat species registried in Mateševo-Andrijevića planned road.

Legend: 1- primary, very important; 2- secondary, probably; 3- unfavorable, not likely; 4- probably favorable (probably important)

	Habitat preference						
	Forest	Bushy	Meadows	Wetland	Rocky	Underground	Artificial
<i>B. barbastellus</i>	1	2		2		1	
<i>E. serotinus</i>	1	1	3	1		2	1
<i>H. savii</i>	2	1		2	1	1	1
<i>M. alcaethoe</i>	2	1		1		4	2
<i>M. brandtii</i>	1	2		2			
<i>M. daubentonii</i>	2	2		1		3	3
<i>M. myotis</i>	1	1	4	2		1	2
<i>N. leisleri</i>	1	2		1			1
<i>N. noctula</i>	1	2	3	1		3	1
<i>P. pipistrellus</i>	1	2		2	3	1	1
<i>P. pygmaeus</i>	4	4		2			1
<i>P. khulii</i>		4		4			1

<i>P. nathusii</i>	1	2		1			2
<i>R. hipposideros</i>	1	1		2	3	1	2

In Europe, there are 5 designated functional groups of bat species:

A. Extremely maneuverable bats, which often fly within the foliage, or close to vegetation, surfaces and structures at variable flight heights. When commuting, they often follow linear and longitudinal landscape elements. Low-flying (typically < 2 m) when commuting over open gaps.

B. Very maneuverable bats that most often fly near vegetation, walls, etc. at variable heights but occasionally hunt within the foliage. When commuting, they often follow linear and longitudinal landscape elements. Flying at low to medium height when commuting over open gaps (typically < 5 m).

C. Bats with medium maneuverability. They often hunt and commute along with vegetation or structures at variable heights, but rarely close to or within the vegetation. May also hunt in open areas. Commuting over open stretches generally takes place at low to medium heights (typically 2 – 10 m) with no clear tendency to lower flight.

D. Bats with medium maneuverability with a more straight flight pattern than bats in category **C**. They hunt and commute away from vegetation and structures in a variety of flight heights. May occasionally fly but never hunt within vegetation. Commuting over open stretches tend to occur at medium heights (2 – 10 m) with no clear tendency to lower flight.

E. Less maneuverable bats that most often fly high and in the open airspace away from vegetation and other structures. These bats generally commute over open stretches at medium heights or higher (10 m and often higher). It must be stressed that even these species may fly quite low over open areas under certain conditions, e.g. when hunting insects over warm (road) surfaces, or when they emerge from a roost site.

Table 3. Provisional categorization of registered bat species to functional groups based on their typical flight behavior and height. Brackets indicate that the knowledge of the species' flight behavior is limited.

Latin name	Common name	In or near vegetation and surface			Open air space	
		A	B	C	D	E
<i>Barbastella barbastellus</i>	Barbastelle				X	
<i>Eptesicus serotinus</i>	Serotine				X	
<i>Hypsugo savii</i>	Savi's pipistrelle			(X)		
<i>Myotis alcathoe</i>	Alcathoe bat		X			
<i>Myotis brandtii</i>	Brandt's bat		X			
<i>Myotis daubentonii</i>	Daubenton's bat		X			
<i>Myotis capaccinii</i>	Long-fingered bat			X		

<i>Myotis myotis</i>	Greater mouse-eared bat			X		
<i>Nyctalus leisleri</i>	Leisler's bat					X
<i>Nyctalus noctule</i>	Common noctule					X
<i>Pipistrellus pipistrellus</i>	Common pipistrelle			X		
<i>Pipistrellus pygmaeus</i>	Soprano pipistrelle			X		
<i>Pipistrellus kuhlii</i>	Kuhl's pipistrelle			X		
<i>Pipistrellus nathusii</i>	Nathusius's pipistrelle			X		
<i>Rhinolophus hipposideros</i>	Lesser horseshoe bat	X				

In the following Figure shows the activity of recorded species per chosen survey transects in the roadway project scope:

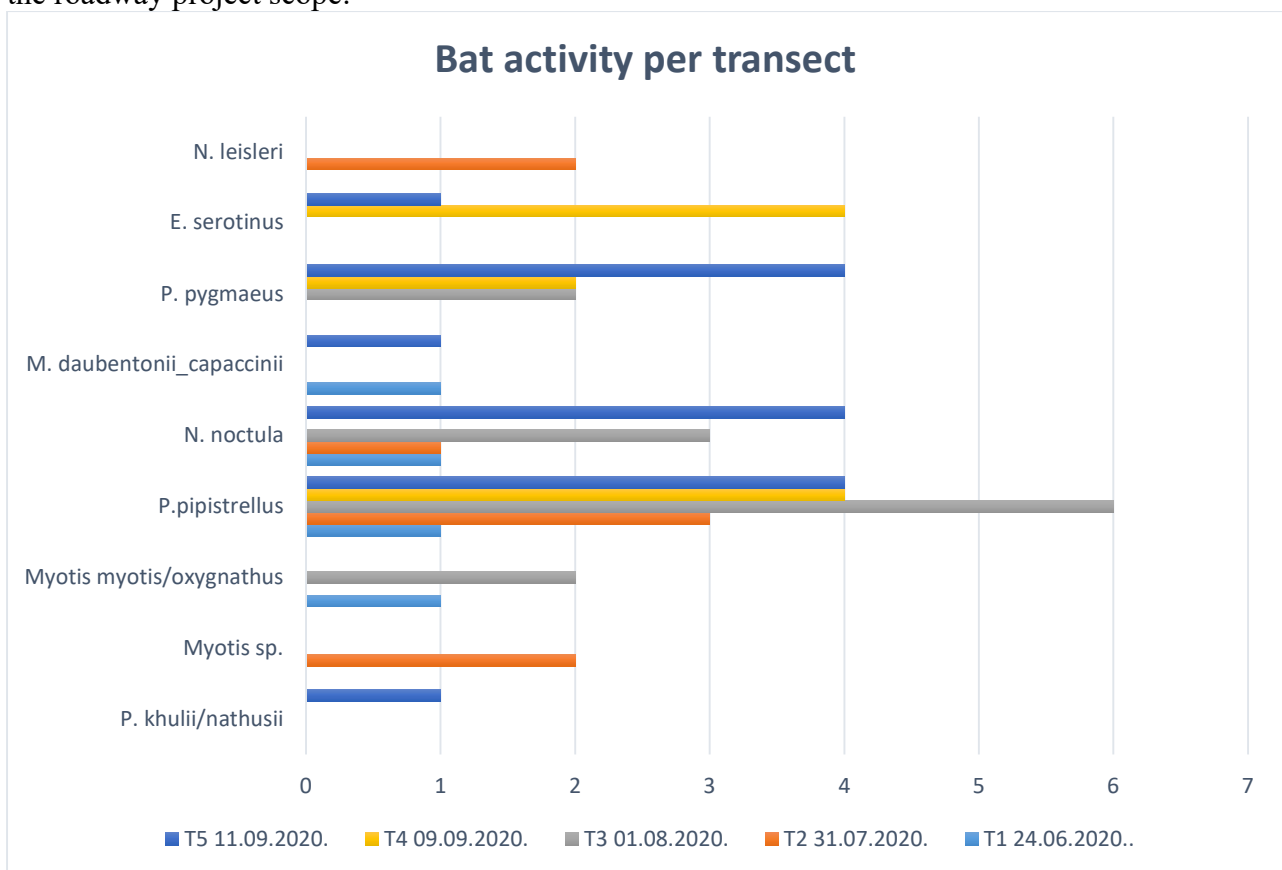


Figure 18. Activity of recorded bat species in the project scope

Based on the results presented above, the following table shows the types and locations that may be endangered during the construction and operation of the road.

Table 4. The most sensitive locations during the construction and use of the route; Bold species are the most endangered species according to IUCN criteria in the scope of this road project.

Species Locations	<i>Barbastella</i>	<i>Myotis myotis</i>	<i>Rhinolophus</i>	<i>Hypsugo savii</i>	<i>Myotis daubentonii</i>	<i>Nyctalus noctula</i>	<i>Pipistrellus pipistrellus</i>	<i>Pipistrellus kuhlii</i>	<i>Myotis alcathoe</i>	<i>Myotis brandtii</i>
Han Drndarski and Krgovići Habitats that provide roosts of endangered species which foraging areas would be cut by road. But also this habitats are recognizes as as corridor for 6 recorded bat and should be consideres as important place for proper under/ overpass.(START 42.73945,19.63674-END 42.73588,19.68712)	x	x	x	x	x	x	x			
Abandoned building in Mateševo roost of rare and endangered bat species on national level. (42.74638211174462,19.67611737549305)					x	x	x	x	x	x

MEASURES FOR MITIGATION, REDUCTION AND ELIMINATION OF NEGATIVE IMPACTS

Impacts. Transport infrastructures may affect bat populations in many ways during the construction and operational phase. The effects of the different factors are cumulative. Therefore, the effects of each factor do not need to be substantial but combined they may have a significant effect. The effects of the different pressures and threats have different time scales. Damaging effects of roost site destruction and habitat loss and degradation occur immediately during the construction phase. Noise and light pollution will be a constant pressure when the road opens to traffic, and once roads are operational, the traffic collisions may take a toll on the populations, but these effects may take several years to detect. Similarly, the negative effects on bat populations caused by the road induced barrier effect and habitat fragmentation may take many generations to materialize. Consequently, it may take many years before the full impacts on the population status are seen.

The impact of traffic on bats has been well documented in Central and Eastern Europe, but published studies in Mediterranean areas are very scarce. However, there is a scientific study done very near the proposed infrastructural project area. Between August 2012 and October 2013 it was found 195 mammals as victims of road traffic, and 8.7% were bats (17 specimens) of 7 different species. Most numerous were *Pipistrellus kuhlii*, followed by *Rhinolophus hipposideros* (4) and *Pipistrellus pygmaeus* (3), all other bat species *R. blasii*, *Myotis mystacinus* (s. str.), *M. capaccinii* and *P. nathusii* were represented by a single specimen each. Species composition probably reflects the local abundance of particular species in the area. Our study brought evidence that also in the Mediterranean areas of SE Europe that bats are victims of traffic, including rare and endangered *R. blasii* and *M. capaccinii* (Iković et al. 2014) The

season when most casualties were found (August–September) and microhabitats in which collisions occurred (linear features, watercourses) were similar to other studies in Europe. The following tables will show the significance of certain bat habitats and the impact of roadway project implementation that may harm bats.

Table 5. Significance of the type of habitats for life functions of bats: x-low significance, xx moderate significance, xxx high significance, 0 no significance, ? potential significance, but there is insufficient data (Paunović et al, 2011).

Life functions	Habitat type						
	Forests	Bushy	Meadows	Wetland	Rocky	Underground	Artificial
Shelters	xxx	0	xxx	xxx	xx	0	xxx
Hunting territories	xxx	xxx	xx	xxx	xx	0	xxx
Flight corridors	xxx	xxx	xx	xxx	0	0	xxx
Migratory corridors	xxx	x	?	xxx	?	0	x

Table 6. Probability of impact that certain activities may have on bats: x- low, xx relatively high, xxx very high, 1- possible direct bat casualty, 0 no impact + positive impact is probable but also bat casualties, * depends on species' ecology (Paunović et al, 2011).

Activity	Life functions/ Shelters						Direct bat casualties
	Trees	Overground Artificial objects	Underground objects	Hunting territories	Hunting corridor	Migratory corridor	
Removal of woody vegetation	xxx	x	x	xxx	xxx	X - xxx	1
Artificial light	xxxx*	0-xxx*	xxx	xxx/+*	0-xxx*	0-xxx*	0
Road traffic	x	0	0-x	x-xxx*	x-xxx*	0	1

Based on results and estimations the highest impact would be in forest habitats in Project area. The all mentioned impacts above are considered permanent for the construction and the operation of the road but of unknown extent (low, medium, major) given that we do not know enough of the species population, either locally and in relation to the national population of the species.

PROPOSED MITIGATION MEASURES

The goal is to prevent the occurrence of circumstances under which the roadway could disturb/interrupt the flight corridors, which connect shelters and hunting territories, as well as the (seasonal) migratory corridors, which connect summer and winter habitats/shelters. Additionally, one of the goals is to avoid high rates of bat casualties during construction, operation and maintenance of the road. The existing measures for mitigation, reduction and elimination of the abovementioned negative impacts have not yet been completely proven in practice. Adequacy of an impact mostly depends on the species, i.e. on their behavior. A recommendation regarding mitigation measures for certain bat species is provided in the publication “Bats and Road Construction”, Limpens et al. 2005. These recommendations should be taken into account during the construction of the road, and they should be complied with in proportion to the significance that certain areas have concerning bats. It is especially important to do this at the locations which have been estimated as important for bats (Location Han Drndarski where several roost of endangered species were found).

General recommendations:

- Variant 2 for the planned road, which is naturally follow the valley of Drcka river and do not cross it in Han Drndarski, is very probably the best solution regarding mammal fauna.
- Road construction activities in places important for bats should be exclusively performed by daylight, as noise and artificial lights may significantly disturb their activities;
- Whenever possible, the existing flight paths and migration routes, as well as landscape elements that define them (vegetation which surrounding Drcka river and its tributaries), should be preserved. Special measures should be taken in places where the road interrupts them to enable safe “transit” of bats – for example specific hop-over vegetation formations (Figures 19), green viaducts (20), appropriate passes below the road (21 a and b) or green bridge (Figure 22), etc.

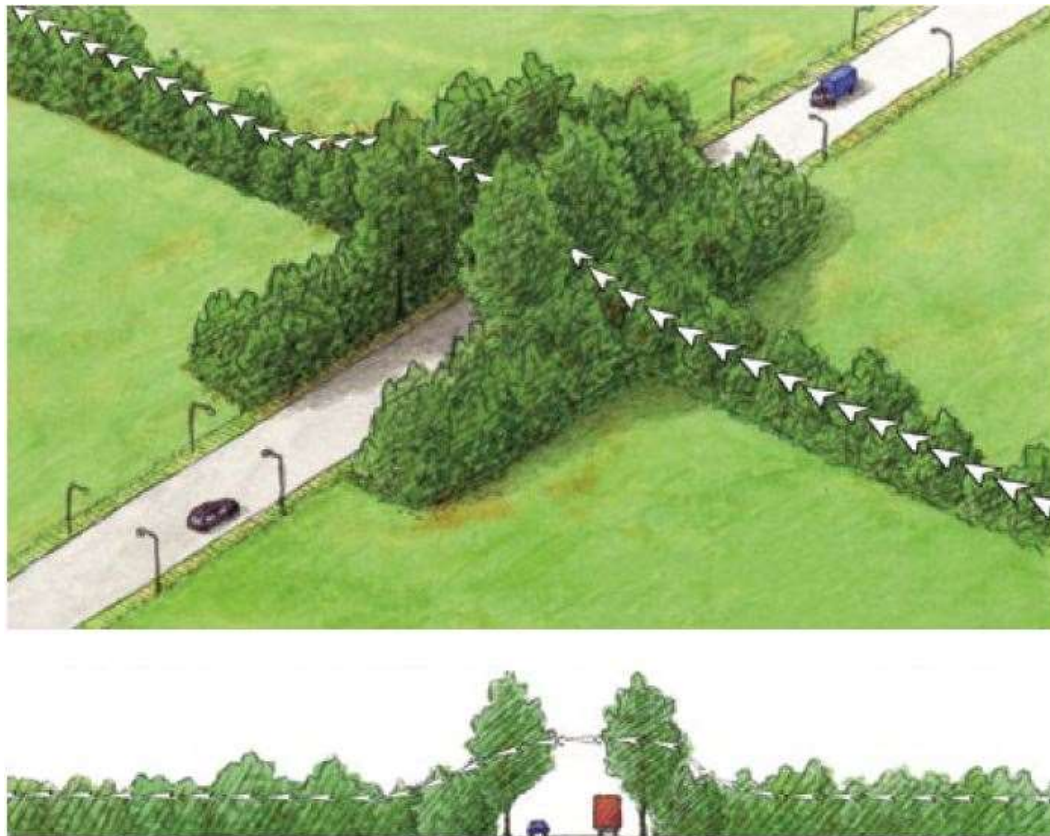


Figure 19. Hop-over vegetation (Limpens et al. 2005).



Figure 20. Green viaduct (Limpens et al. 2005).



Figure 21a. Water Underpasses (Limpens et al. 2005).



Figure 21b. Road underpasses (Limpens et al. 2005).



Figure 22. Green bridge (Paunović et. al 2011)

- When it is not possible to preserve the safety of the existing flight paths and migration routes for bats, and/or it is not possible to provide safe “crossing” for bats at the places where the road interrupts these corridors, it is necessary to develop a system of measures, which must include the following:

1. Discouraging bats from crossing the road at unsafe places – for example by bright light, removal of vegetation, etc.;
 2. Redirection of flight paths toward the closest safe crossing – for example by reshaping the linear landscape elements;
 3. Enabling an appropriate safe crossing at the closest possible location – for example by specific hop-over vegetation formations (Figures 19), green viaducts (Figure 20), appropriate passes below the road (Figure 21 a&b) or green bridge (Figure 22), etc.
- Avoid any removal of trees and shrub vegetation that is not in direct function of project realization except when it is proposed by the measures in the function of decreasing the possibility of bat fatalities;

Figure 23. Proper lights can restrict light dispersion

- Artificial lights should be projected in such a way to disrupt the life activities of bats as little as possible (Fig. 23), except when it is proposed by the measures in the function of decreasing the possibility of bat
- Protective walls that prevent the spreading of noise should be erected wherever needed, and at the same time they will prevent the occurrence of animal casualties on the road (including bats);
- If forest vegetation including some more important hunting areas and/or a number of roosts of dendrophilous species (like *Barbastella barbastellus* and *Myotis species*) must be removed during the realization of the project, this must be compensated by appropriate measures. For example, forming new appropriate forest stands in safe zones, making appropriate replacements for lost roosts; install bats boxes in safe area and proper habitats.

CONCLUSION ON MITIGATION MEASURES

(Specific recommendations)

- Linear vegetation from the left and right sides of the planned road under planned bridges and between planned tunnels should be connected.
- For tributary streams (for exemple, Crni Potok stream located between Tunnel 2 and tunnel 3; floating to Drcka river and Drcka river, be sure to consider using some of the proposed proper over/under passes (please see Appendix IV - Proposed underpasses for Variant 2).
- Every underpass need to have a panel that prevent collisions with bats travelling between their roost and their feeding areas (figure 25, figure 26).

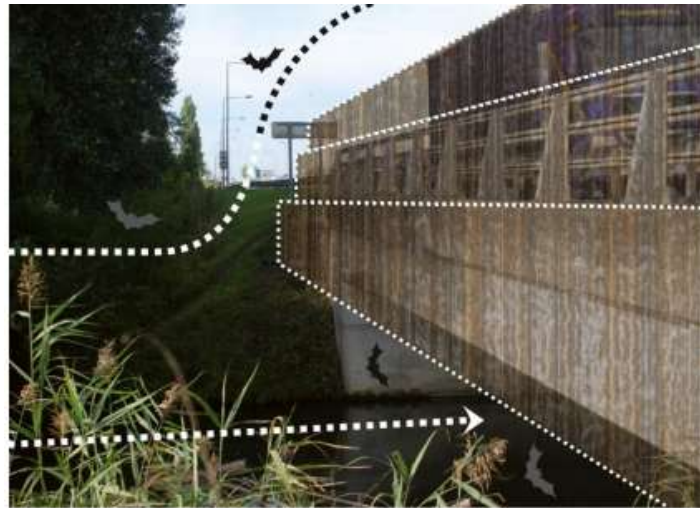


Figure 25. Panels (3m high, wooden, metal, mesh etc.) which stops bats from collision with vehicles and force them to use underpasses.



Figure 26. Example of the mesh which prevents collision with flying fauna [Width of wire: 5 mm, diameter of open part: 40 mm, Material: steel (square or hexagonal) + anticorrosion protection (zinc/aluminium)]

		Passing over					Passing under							
		High over landscape	Hop-over at crown height	Hop-over vegetation	Hop-over vegetation + wall	Over or along viaduct	Culverts (h x b = 1 x 2 m)	Bridge over water (h ≤ 1 m)	Tunnels (h x b = 4 x 4 m)	Bridge over water (h ≈ 2 m)	Tunnels (h x b = 6 x 6 m)	Under viaduct (h > 6 m)	Bridge over water (h > 6 m)	
A	Lesser horseshoe bat			*	*	*	*	*	*	*	*	*	*	From small to large, species that hunt close to or in vegetation, and formal structures. Flying on the route made easy by vegetation.
	Geoffroy's bat			*	*	*	*	*	*	*	*	*	*	
	Natterer's bat			*	*	*	*	*	*	*	*	*	*	
	Bechstein's bat			*	*	*	*	*	*	*	*	*	*	
	Brown long-eared bat			*	*	*	*	*	*	*	*	*	*	
	Grey long-eared bat			*	*	*	*	*	*	*	*	*	*	
	Greater horseshoe bat			*	*	*	*	*	*	*	*	*	*	
B	Greater mouse-eared bat		*	*	*	*			*	*	*	*	*	Large species that hunts close to the vegetation, follows structures, but also crosses open areas.
	Whiskered bat		*	*	*	*			*	*	*	*	*	
	Brandt's bat		*	*	*	*			*	*	*	*	*	From small to large, species that hunt along border structures, and follow structures.
	Barbastelle		*	*	*	*			*	*	*	*	*	
	Daubenton's bat		*	*	*	*	*	*	*	*	*	*	*	
	Pond bat		*	*	*	*	*	*	*	*	*	*	*	
C	Soprano pipistrelle		*	*	*	*		*	*	*	*	*	*	From small to large, species that hunt along structures out into the half-open surroundings, and follow structures.
	Common pipistrelle		*	*	*	*		*	*	*	*	*	*	
	Nathusius's pipistrelle		*	*	*	*		*	*	*	*	*	*	
	Northern bat	*	*	*	*	*				*	*	*	*	From small to large, species that hunt in half-open to open surroundings, and sometimes follow structures.
	Parti-coloured bat	*	*	*	*	*				*	*	*	*	
	Serotine	*	*	*	*	*				*	*	*	*	
	Noctule	*	*	*	*	*				*	*	*	*	

Figure 24. Type of corridors over /under roadway used by a different flying group of bats - **A**: Species which use vegetation for orientation during the flight are directed towards higher altitude, which enables the bats to “hop-over” the roadway by the means of structures which span over the road; **B&C**: Species which may be directed to higher altitude by vegetation; **C**: Species which independently follow the height of tree crowns (Limpens et al., 2005).

- One of the additional recommendation is to propose/ foresee in the ESIA pre-construction research on exact underpasses and vegetation planting if it is not obvious in situ by construction management.
- Recommend pre/post-construction monitoring:
 - Visit recorded roosts in pre-construction period (in summer before planned construction), several days per summer season, using regular bat survey methods (observation, netting, acoustic method etc.).
 - Post-construction: summer / autumn, a quick check for bat presence in the roosts should be done. Check of possible carcasses should be done around the underpasses (and other places where dead bat could be found) during spring summer and autumn. The places where dead bats may be found will be recorded using GPS. Carcasses will be collected for species identification.

OTHER MAMMAL SPECIES

By this fieldwork survey, **15** other mammal species were detected Four (**4**) of these species are recognized as rare / endangered on a national / international level (Table 7): *Canis lupus* (Grey wolf), *Lutra lutra* (Eurasian otter), *Nannospalax leucodon* (Lersser mole rat) and *Ursus arctos* (Brown bear). Species such as *Felis silvestris* (Wild cat), *Mustela nivalis* (Weasel) should be expected, but during this biological survey were not registered.

Table 7: Overview of mammal species in the project scope with conservation status at the international and national level (legend: + - species protected by the national law (Official Gazette of the Republic of Montenegro No. 76/06); HD - Habitats Directive; Bern - Bern Convention-Convention on the Conservation of European Wildlife) species and natural habitats; Bonn - Bonn Convention - Convention on the Conservation of Migratory Animal Species (Eurobats - One of the agreements under the auspices of the Bonn Convention); CITES – Convention on International Trade in Species of Wild Flora and Fauna).

No.	Latin name	Montenegrin name	English name	National legislation	IUCN (Mediterranean)	BERN	BONN (Convention on Migratory species)	EU HABITAT DIRECTIVE	CITES
1	<i>Canis lupus</i> (Linnaeus, 1758)	Vuk	Grey Wolf		LC	Appendix II		Annex II, Annex IV, Annex V	Append ix I, Append ix II
2	<i>Capreolus capreolus</i> (Linnaeus, 1758)	Srna	European Roe Deer		LC				

3	<i>Erinaceus roumanicus</i> Barrett-Hamilton, 1900	Sjeverni bjeloprski jež	Northern White-breasted Hedgehog		LC				
4	<i>Glis glis</i> (Linnaeus, 1766)	Obični puh	Edible Dormouse		LC	Appendix III			
5	<i>Lepus europaeus</i> Pallas, 1778	Zec	European hare		LC	Appendix III			
6	<i>Lutra lutra</i> (Linnaeus, 1758)	Vidra	Eurasian Otter	+	NT	Appendix II		Annex II, Annex IV	Appendix I
7	<i>Martes foina</i> (Erxleben, 1777)	Kuna bjelica	Beech Marten/ Stone Marten		LC	Appendix III			Appendix III, NC
8	<i>Martes martes</i> (Linnaeus, 1758)	Kuna zlatica	Pine Marten		LC	Appendix III		Annex V	
9	<i>Meles meles</i> (Linnaeus, 1758)	Jazavac	Badger		LC	Appendix III			
10	<i>Mustela putorius</i> Linnaeus, 1766	Tvor	European Polecat		LC	Appendix III		Annex V	
11	<i>Nannospalax leucodon</i> (Nordmann, 1840)	Slijepo kuće	Lesser Mole Rat	+	DD				
12	<i>Sciurus vulgaris</i> Linnaeus, 1758	Crvena vjeverica	Eurasian Red Squirrel		LC	Appendix III			
13	<i>Sus scrofa</i> Linnaeus, 1758	Divlja svinja	Wild Boar		LC				
14	<i>Ursus arctos</i> Linnaeus, 1758	Mrki medvjed	Brown bear		VU	Appendix II		Annex II, Annex IV	Appendix I, Appendix II

15	<i>Vulpes vulpes</i> (Linnaeus, 1758)	Lisica	Red Fox		LC				Appendix III, NC
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Species protected by national legislation (Official Gazette of the Republic of Montenegro No. 76/06) are species that are rare or sparse at the national level and need protection for their trend to increase at the national level.

The Bern Convention protects species whose habitats are of great importance for the preservation of wildlife, ie. habitats of species recognized in the Annexes to the Convention to preserve migration routes (corridors), all in the function of preserving the free movement of genes, while the Bonn Convention protects those migratory species whose conservation depends on cross-border cooperation.

The CITES Convention controls the international trade (international trade) of endangered animals recognized by the CITES list.

Eurobats is an Agreement on the protection of European bat populations, entered into force in 1994, and currently has 32 member states, including Montenegro since 2011. It is one of the agreements under the auspices of the Bonn Convention, the Convention on the Conservation of Migratory Species of Wild Animals (CMS), which aims to ensure the active protection of endangered migratory animal species throughout their range. The Eurobats Agreement protects all 52 species of bats that occur in Europe, through legislation, education, implementation of protection measures and international cooperation between States Parties, but also those that have not yet acceded to the Agreement.

The main objective of the Habitat Directive is to establish protected areas within the community to maintain both the distribution and the richness of endangered species and habitats, both terrestrial and marine.

The following report provides detailed descriptions and maps, for species protected by national legislation (Official Gazette of the Republic of Montenegro No. 76/06) and those listed in the Habitats Directive in Annexes II and IV.

Canis lupus (Linnaeus 1758); vuk; Grey wolf

Species data quality

The wolf population in Montenegro belongs to the Dinaric-Balkan population, which is approximately 4,000 in size. The population trend is completely unknown. In addition, there are no precise data on the distribution and number of wolves in Montenegro. According to the available data and personal estimation, it can be concluded that the total population is declining.

Ecological characteristics for species

The wolf is a generalist, whose natural distribution includes not only the forest zone but also other habitats. Availability of food and safe shelters for rest and making a den are the main requirements of this large mammal. The proximity of the water is also of great importance for wolves. Today, forests are the main habitat of wolves in Europe, because large carnivores feel safer there. The fact that wolves have become typical forest dwellers is secondary and its occurrence on high mountain pastures is a common thing.

Distribution in Montenegro

According to the available literature, the species is widespread in both biogeographical regions, and most of the population is certainly concentrated in the alpine biogeographical region.

LOCATION Gnjili Potok, Fig. 27

Population estimate

Mosaic of ecosystems with the domination of broad-leaf forest and land principally occupied by agriculture, with significant areas of natural vegetation.

Global location assessment

One individual was registered on the site, which represents, a very small percentage at the national level. According to the local community, the wolf is constantly present in this area.

Global location assessment

The species uses this area and its home-range is much larger than the project area. As this is a species whose population is not yet known, every percentage is important.

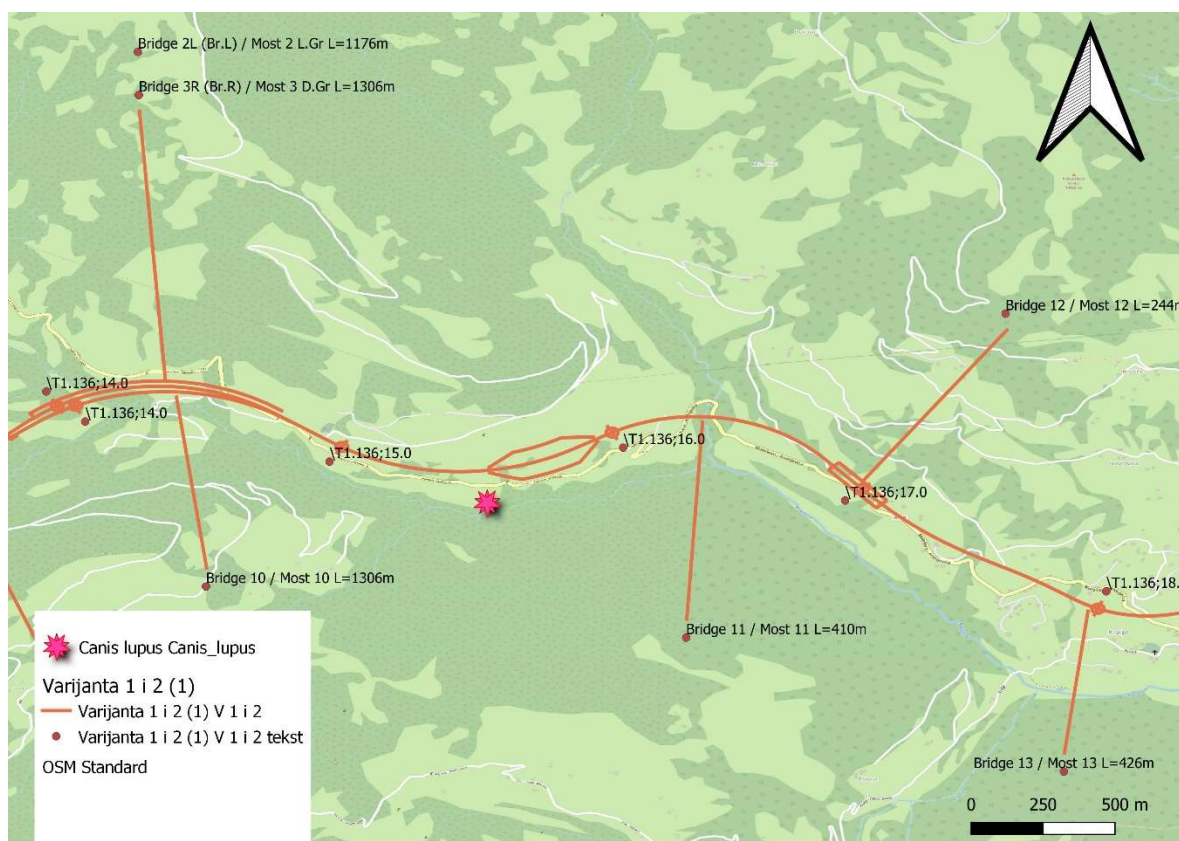


Figure 27. Records of *Canis lupus* in the project scope

2. *Lutra lutra* (Linnaeus, 1758); Vidra; Eurasian Otter.

Species data quality

The otter is one of the least researched mammals in Montenegro. Paunović & Milenković (1996) conclude that otters are more widespread in Montenegro than previously known and that individuals have been recorded in most areas except the western and central part of Montenegro, but its presence is not excluded from these areas. According to the data of Paunović & Milenković (1996), the otter in Montenegro is located along the coast, probably in small numbers and extends from 0 to 1400 m above sea level. Recent data on the presence of this species were recorded in the water net of Lim, Ibar, Piva, Čehotina, Morača (Mrtvica and Cijevna) and on the river Grlja (Prokletije) within the Project "Establishment of Natura 2000 network in Montenegro" where it is generally assessed that the population of this species is growing slightly.

During the field survey within this Project, high otter activity was recorded along the entire course of the Drca river as well as in its streams from from both sides. Based on recent data, it can be concluded that in Montenegro there are very suitable habitats for otter life, which is

associated with a very rich web of watercourses and lakes. The great richness of the ichthyofauna of both the Black Sea and the Adriatic basin has a great influence on the life cycle of otters as roof predatory species on water surfaces. Due to the lack of data, we cannot conclude what the status of the population is (ie. what is the density and trend), but one should expect great activity in other ecologically attractive habitats for this species.

Ecological characteristics of habitats for species

The otter is the only semi-aquatic mammal from the *Mustelidae* family, which inhabits Montenegro, for whose life cycle it is necessary to closely connect the water surface with the coastal land areas. It is an indicator of healthy ecosystems and as a top predator an important link in food chains. It inhabits large aquatic habitats (rivers and lakes) on whose banks it makes dens and on which it feeds on fish as well as crabs, amphibians, birds and even smaller mammals.

Distribution in Montenegro

This species is present in both biogeographical regions. According to some rough estimates, it can be concluded that it is more widespread in the alpine than in the mediterranean biogeographical region. This may be reflected by habitat loss in the coastal region in the last 20 years, but to confirm this it is necessary to apply regular field surveys to the most attractive ecological sites for this species in the country. Due to the lack of continuous data collection on this species, it is still not possible to assess its status (distribution, abundance and trend).

Location - Drcka, Krašnica and Lim river valleys; fig. 28

Location description

River valleys, overgrown with the deciduous forest that is mostly degraded.

Population estimate

In the area of the described location, it can be concluded that this species is present. Due to the small amount of available data, its size cannot be estimated at the local and national level. At the local level, it can be concluded that its occurrence is common, which confirms the fact that it is an exceptional habitat.

Global estimate of the location

The location is very important for the survival of this species and locally it is very important for the survival of this species. However, as it is a highly endangered species, the described area is also considered globally important.

3. *Nannospalax leucodon* (Nordmann, 1840); Slijepo kuće; Lesser Mole Rat

There is not much data on this species both at the level of the Balkan and at the level of Montenegro. Although the distribution of this species has not yet been defined. It is known so far that it is found only in the alpine biogeographical region of Montenegro. The three most important habitats for this species are the Durmitor plateau, the Sinjajevina plateau and Krnovo (personal observations). Globally, the trend of this species is declining because it has little reproductive power and locally, where the population is stable it is generally considered a “pest”. Precisely because of all the above, the mole rat is a legally protected species. In the project scope at an altitude of 1800m, this biodiversity survey confirmed the 4th habitat of this species in Montenegro. As its habitats are located at a higher altitude than planned road, thus its population is not endangered.

It inhabits steppe grasslands, meadows and pastures (from 0 to 2400 m above sea level), in areas with a deep layer of soil, in which it digs its large pits. It is not found in fields and arable monocultures, although it can be found in agricultural areas where pastures, small arable lands and orchards are mixed.

Based on the available data, it can be concluded that the species is present only in the alpine biogeographical region.

Location - Vranještica village, Suva gora location (fig. 29)

Location description

Natural pastures or pastures formed by deforestation with small farms. Open, degraded beech forests are also registered near grassy habitats. Such sparse stands are not an obstacle for this species.

Population estimate

According to the literature, about 1 to 13 individuals are registered per 1 ha of suitable land. According to some ecological models, less than 2% of the total estimated population at the level of Montenegro is present in this area.

Global location assessment

The area is very important from a global perspective.

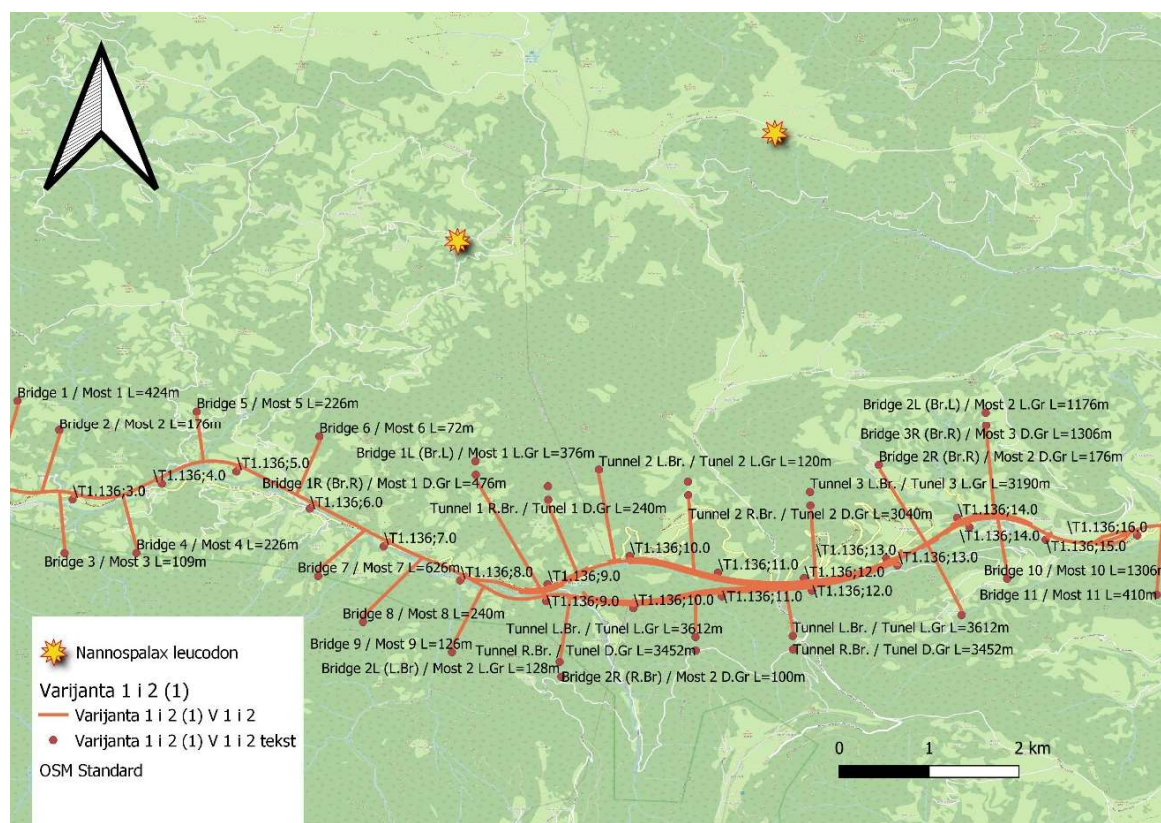


Figure 29. Records of *Nannospalax leucodon* in the project scope.

4. *Ursus arctos* (Linnaeus, 1758); mrki medvjed, Brown bear

Species data quality

The population of the brown bear in Montenegro belongs to the Dinaric-Pindus population, which has not yet been scientifically estimated. Status of this species is unknown. However, according to available data, it can be concluded that the total population has been increasing in the last 30 years and that according to the Ministry of Agriculture, the population size is about 400 individuals.

Ecological characteristics of habitat for species

Found in deciduous and mixed forests with open grasslands around them. Availability of food and safe shelters for rest and roaming are the main requirements of this large mammal. The proximity of the water is also of great importance for bears as well as mature deciduous forests. Today, forests are mostly wolf habitats in Europe, because large carnivores feel safer there. As

the bear is exclusively a nocturnal animal, in the search for food at night it also descends to rural households to orchards and beehives.

Distribution in Montenegro

According to the available literature, the species is widespread in both biogeographical regions, and most of the population is certainly concentrated in the Alpine biogeographical region.

Location - Han Drndarski, Fig. 30

Population estimate

Mosaic of ecosystems with the domination of broad-leaved forest and land principally occupied by agriculture, with significant areas of natural vegetation.

Population estimate

One individual was registered on the site, which represents a very small percentage at the national level. According to the local population, the bear is constantly present in this area.

Global location assessment

The species uses this area and its home range is much larger than the project area. As this is a species whose population is not yet known, every percentage is important.

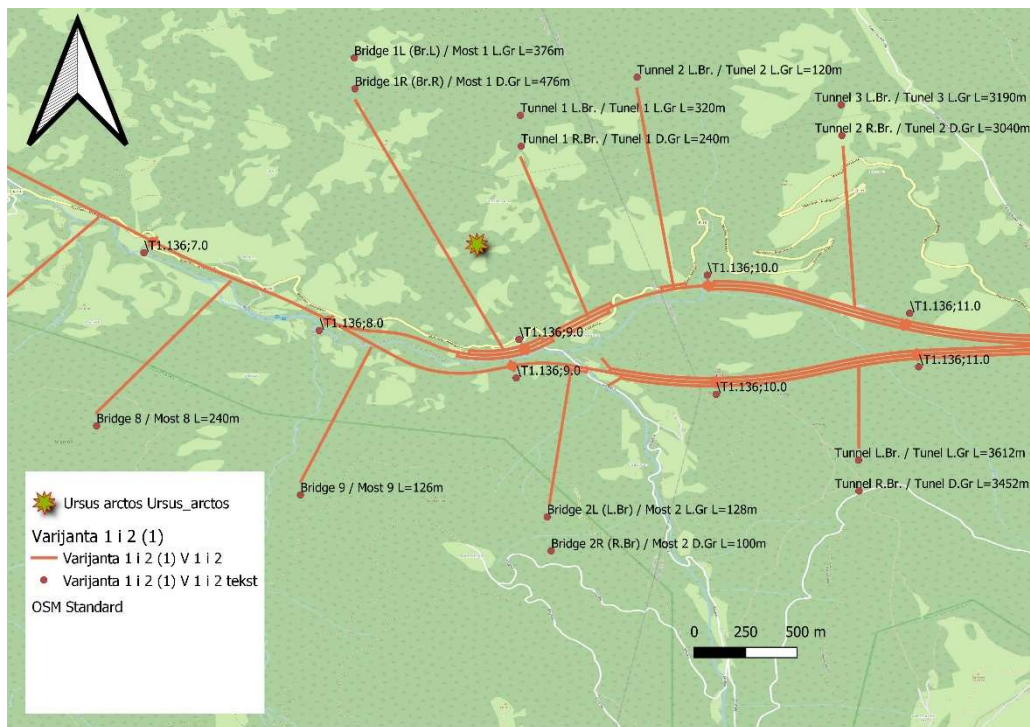


Figure 30. Records of *Ursus arctos* in the project scope

TYPE AND STATUS DESCRIPTION OF HABITATS AND POPULATIONS OF RECORDED SPECIES

In the following Table the basic characteristics of habitat use and recorded other mammal species status in project scope is showed. The detailed maps of all registered mammals species are showed in Appendix III.

Table 8: Habitat use characteristics and status of other recorded mammal species description

Species	Species data quality	Ecological characteristics for species	Distribution in Montenegro	Locations	Habitat description	Population estimate
<i>Capreolus capreolus</i>	Common species	Forests with open landscapes	Distributed in Alpine and the Mediterranean Biogeographical region.	Crni potok, Han Drndarski	Broad-leaved forest	Present
<i>Glis glis</i>	Common species	Mature oak and beech forests	Distributed in Alpine and the Mediterranean Biogeographical region. Size of population unknown.	Matešev o, Han Drndarski	Broad-leaved forest, Land principally occupied by agriculture, with significant areas of natural vegetation	Present
<i>Erinaceus roumanicus</i>	Very common species	Farmland, parks&gardens, forest &marshland during summer, occasionally urban areas.	Alpine and Mediterranean biogeographical region. Size of population unknown.	Bare Kraljske, Matešev o	Land principally occupied by agriculture, with significant areas of natural vegetation	Present
<i>Lepus europaeus</i>	Common species	Open landscapes with bushes or hedges, sparse	Alpine and Mediterranean biogeographical	Ljuban, Han Drndarski	Transitional woodland shrub,	Present

		forests, marshlands, steppes, meadows	cal region. Size of population unknown.		Natural grass land	
Martes foina	Very common species	Relatively open and rocky landscapes, mountains, woodland (oak, beech), farmland.	Alpine and Mediterranean biogeographical region. Size of population unknown.		Land principally occupied by agriculture, with significant areas of natural vegetation, Broad- leaved forests, Transitional woodland shrub	Less than 2%
Mustela putorius	Very rare	Lowland forests near water	Alpine and Mediterranean biogeographical region. Size of population unknown.	Pecka river	Broad- leaved forest near water	Present
Meles meles	Very common species	Forests, steps, farmland	Alpine and Mediterranean biogeographical region. Size of population unknown.	Matešev o, Han Drndars ki, Trešnjevi k, Gnjlji potok	Land principally occupied by agriculture, with significant areas of natural vegetation, Pastures, Broad- leaved forest	Less than 2%
Sciurus vulgaris	Common	Coniferous and deciduous forests	Alpine and Mediterranean biogeographical region. Size of	Suva gora, Bare kraljske, Han Drndars ki,	Land principally occupied by agriculture, with significant areas of	Present

			population unknown.	Trešnjevi k	natural vegetation, Pastures, Broad-leaved forest	
<i>Sus scrofa</i>	Very common species	Very diversified habitats: from Mediteranian shurblands to boreal mixed forest, marshlands, reed beds, mountain forests, farmland	Alpine and Mediterranean biogeographical region. Size of population unknown.	Vranještica, Han Drndars ki	Broad-leaved forest	Less then 2%
<i>Ursus arctos</i>	Common species	Deciduous and mixed forests, natural grasslands	Alpine and Mediterranean biogeographical region. Size of population unknown..	Han Drndars ki	Broad-leaved forest, Mixed forest, Transitional woodland shrub	Present
<i>Vulpes vulpes</i>	Very common species	Urban areas, farmlands, forests, grasslands, almost everywhere.	Alpine and Mediterranean biogeographical region. Population size 5000 animals.	Vranještica, Han Drndars ki, Gnjili potok, Krgovići, Trešnjevi k	Land principally occupied by agriculture, with significant areas of natural vegetation, Pastures, Broad-leaved forests, Transitional woodland shrub	Less then 2%

Distribution of other mammal species recorded in the project scope

The locations with the highest probability of collision with other mammals are **Han Drndarski** and **confluence of River Pecka in Drcka river** locations (Fig. 31).

The mentioned locations represent the mosaic of the agricultural area with pastures, shrubs and drainage channels, that make corridors for middle-sized mammals which have been proven by photo-taps.

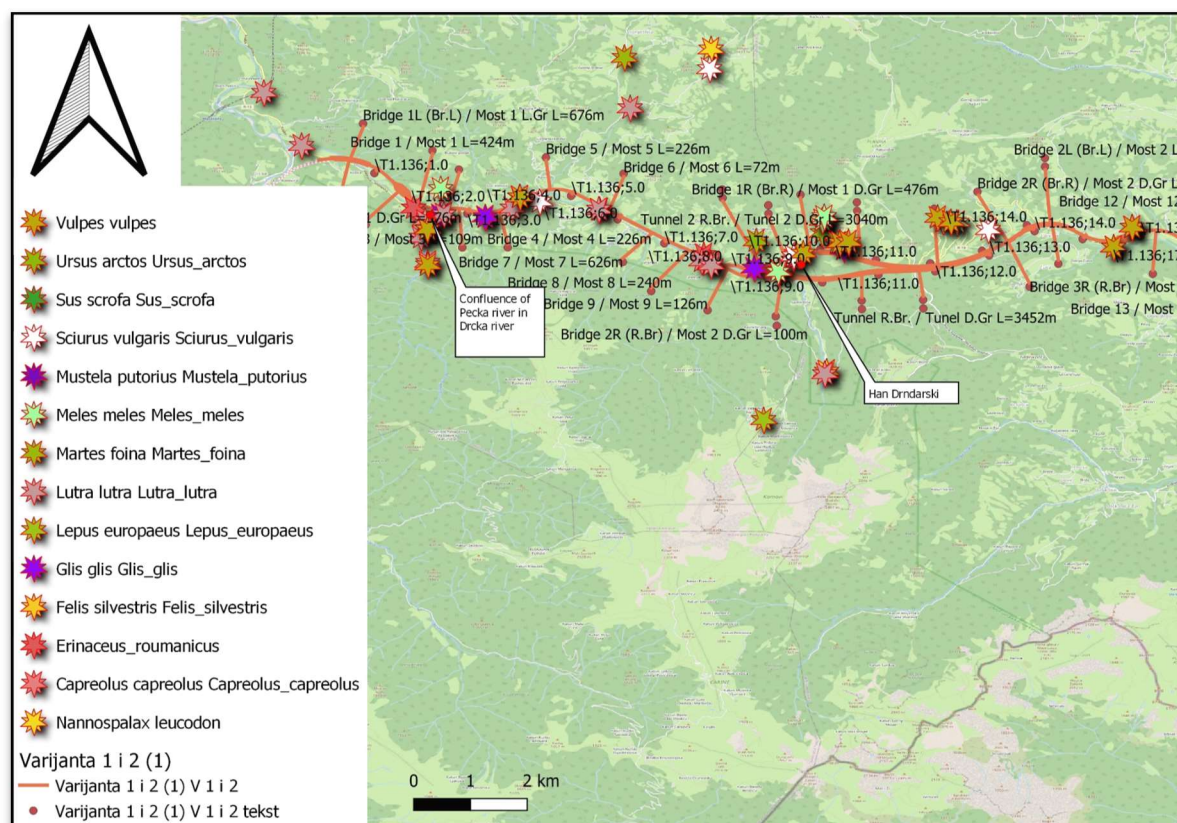


Figure 31. Distribution of registered other mammals in comparison with planned road

MITIGATION MEASURES FOR REDUCTION AND ELIMINATION OF NEGATIVE IMPACTS

Impact. Road infrastructure can disturb movement patterns of large and middle-size mammal species, cut their territories and an increasing of roadkill, which leads toward the decreasing of many populations in long term perspective. For small mammals, roads effectively sever habitats and they also fragment populations. The role of roads at filtering dispersal and migration is such that it changes the population structure, reduces species richness and isolates sub-populations.

Medium and large-sized mammals are particularly at risk, especially when the emergence of young coincides with high traffic volumes. Various species show seasonal peaks (dispersal of young animals, breeding season or high touristic season peak, etc.) that may be the reasons for higher traffic collisions.

Previously collected data in Montenegro showed that the most abundant species are the most abundant victims on the roads: *Erinaceus roumanicus* (hedgehog), *Martes foina* (Stone marten), *Vulpes vulpes* (fox) and *Meles meles* (badger) which is similar to data in other countries in Europe. Additionally, rare traffic collisions with brown bear, grey wolf, Eurasian otter and European polecat in Montenegro were registered on regular high frequency roads.

Generally, many information is still lacking about the effects of roads and traffic at the middle-sized mammal population level but the consensus is that road-kill is insignificant at the population level of middle-sized mammals, but negative effect on population appears generally to be at a local level where there are small populations or for endangered species.

There is a large degree of infrastructure construction across Europe, related to transport (road and rail), energy production (roads, windmills, hydropower schemes) and some types of recreational development (especially ski slopes). These linear features threaten to fragment habitat and reduce connectivity within and between large carnivore populations, increase mortality of carnivores, and increase human access to previously undisturbed habitats. The issue is especially important in eastern and southern Europe where development is rapid. In the same time large carnivores are common species in the south-east Europe and therefore mitigation measures are obligate (Key actions for Large Carnivore populations in Europe, 2015).

PROPOSED MITIGATION MEASURES

Mitigation measures must reflect the local and global endangerment of registered species in the project area. The more species depend on habitat fragmentation, the more concrete and specific mitigation measures are.

Measures to protect wildlife along transport infrastructure and to reduce habitat fragmentation can be divided into two groups (Fig. 32):

- Measures that directly reduce fragmentation by providing links between habitats severed by the infrastructure, e.g. wildlife crossing structures or fauna passages (overpasses, underpasses, etc.).
- Measures that aim to improve road safety and reduce the impact of traffic on animal populations by reducing traffic-related mortality.

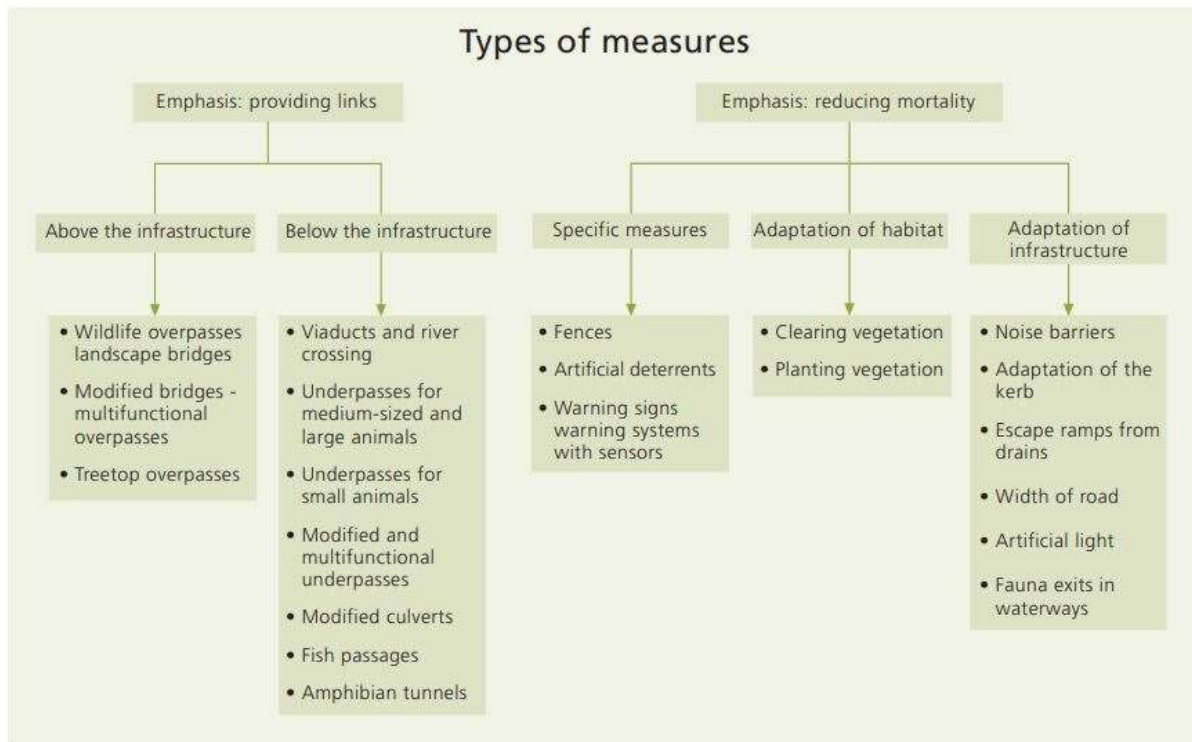


Figure 32. Types of measures to mitigate habitat fragmentation (Iuel et al. 2003)

Above/Below the infrastructure

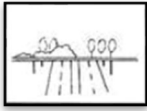
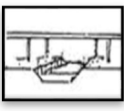
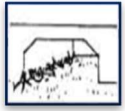
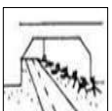
Passageways, bridges showed (Fig. 33 a&b), have been largely successful when they have been appropriately positioned and are of the appropriate dimensions for the designated species. In the Andrijevic –Mateševo alignment, structures such as bridges or culverts that were planned to span streams and rivers, protect wetlands, or provide access for farm animals or equipment may function as a wildlife crossing. Still, they need to be adapt for the wild-life (please see explanation in Iuell et al. 2003 for construction details).



Figure 33 a & b. Green bridge in NP Canada & Underpasses (passageways) under the highspeed railway in Spain.

Based on the European Handbook for Identifying Conflicts and Designing Solutions by Iuel et al. (2003) the following table shows the most suitable recommendation of measures that directly reduce fragmentation for registered mammal species on planned project scope.

Table 9. Suitability of different types of fauna passages for a selection of (non-flying) species or groups of species (Iuell et al. 2003).

Registered species	Landscape bridges	Wildlife overpasses	Modified bridges/multifunctional overpasses	Viaducts and river crossings	Underpasses for large and medium-sized animals	Modified and joint-use underpasses
						
<i>Canis lupus</i> Grey wolf	x	x	x	x	x	x
<i>Capreolus capreolus</i> Roe deer	x	x	x	x	x	x
<i>Glis glis</i> Edible Dormouse	x	x ⁵	x*	x*	--	-
<i>Lutra lutra</i> Eurasian otter	x*	x*	x*	x	x	x
<i>Erinaceus roumanicus</i> White-breasted Hedgehog	x	x	x	x	x	x
<i>Lepus europaeus</i> European hare	x	x	x*	x	x	x
<i>Martes foina</i> Stone Marten	x	x	x	x	x	x

⁵ * - Can be used with some adaptation to local condition

<i>Mustela putorius</i> European polecat	x	x	X	x	x	x
<i>Meles meles</i> Badger	x	x	X	x	x	x
<i>Sciurus vulgaris</i> European Red Squirrel	x	x	X	x	x	x
<i>Sus scrofa</i> Wild Boar	x	x	X*	x	x	X*
<i>Ursus arctos</i> Brown bear	x	x	X*	x	X*	X*
<i>Vulpes vulpes</i> Red fox	x	x	X	x	x	x

Addaptation of habitats

- A planned tunnel on Mateševo-Andrijevića alignment might be the best design solution to protect high-value landscapes and mitigate the road kills. Though construction costs may be high, the benefits to the natural environment will be incalculable. The scale of these benefits is dependent upon the method of tunnel construction. Bored tunnels allow sites of high nature conservation value to remain undisturbed and are least damaging environmentally. Cut-and-cover tunnels may be more appropriate for sites of lower conservation interest. However, where the maintenance of connectivity between habitats is needed, these tunnels are desirable. Methods of habitat restoration can be chosen to provide a safe crossing for a range of wildlife.
- Minimising the extent of habitat loss and maintain connectivity with vegetation structures that carry the landscape over the infrastructure or permit the landscape to flow under the infrastructure.

CONCLUSION ON MITIGATION MEASURES

- Based on the biodiversity survey results, the variant XX is better solution for Mateševo-Andrijevića alignment.
- Road construction activities should be exclusively performed by daylight, as noise and artificial lights may significantly disturb their activities;
- Linear vegetation from the left and right sides of the planned road under planned bridges and between planned tunnels should be connected.

- Whenever possible, the existing corridors (Han Drndarski/Krgovići, Confluence of river Pecka into Drcka river), as well as landscape elements that define them (linear vegetation, water bank vegetation, etc.) should be preserved, and special measures should be taken in places where the road interrupts them to enable the safe crossing of other mammal species-appropriate passes below the road (Fig 21 a&b, Fig. 22). Badgers are particularly vulnerable to habitat fragmentation because of their faithfulness to traditional routes, regardless of new constructions. The maintenance of their traditional pathways is, therefore, considered of particular importance and connections have been retained by artificial means to mitigate the effects of new roads. Badger-tunnels (Fig. 34) in this research indicate that measures of mitigation for badgers have been effective in maintaining connectivity and other mammal species can benefit to the same level.



Figure 34. The badger tunnel

Many otters (*Lutra lutra*) are killed on roads each year in Europe. At present, it is not possible to determine whether or not this has an impact on otter populations. Planned road should be designed with the needs of otters in mind. It is possible to reduce the number of otters being killed on existing roads by appropriate mitigation but this may be expensive and it is important to consider the costs as well as the benefits. Planned culverts and bridges can be also helpful in mitigation negative impact on this species if they are properly addapeted (Fig. 35). The construction of new road will require the crossing of the various rivers and streams that lie along the proposed route. The development process may result in the destruction of riverbank or floodplain habitat, which in turn reduces the amount of cover available to otters. Bridge and culvert design which canalise water creating faster flows reduce the opportunities for the otter to swim.

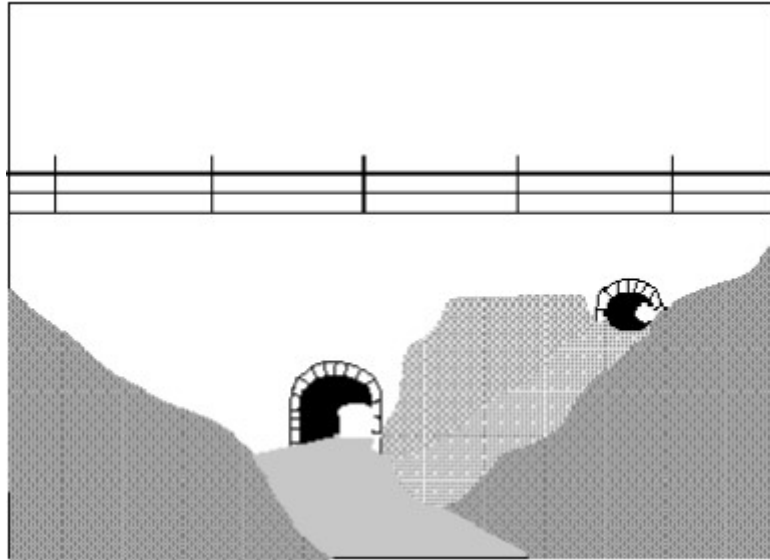


Figure 35. Culvert with undepass with a path leading from the stream to the entrance (Design manual for roads and bridges, 2001)

- Site compounds and storage or waste dumping facilities should be located away from potential otter habitat (in this case, all rivers, streams, even dry riverbanks). This will avoid disturbance to the otters' routine and minimise pollution risks.
If there are a number of different contractors and subcontractors on site, it is essential to inform each contractor of mitigation schemes present and any obligations they may have regarding such schemes. All personnel working on site should also be aware of the mitigation in place and of the obligations.
- One of the additional recommendations is to propose/ foresee in the ESIA pre-construction research on exact underpasses and vegetation planting if it is not obvious in situ by construction management.
- Post-construction monitoring has to be implemented to follow the success of recommended mitigation measures.

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Appendix I

(Photo-documentation)



Vulpes vulpes on Pecka river bank

Mustela putorius in Pecka river bank



Martes foina (Crni potok, Krgovici/Han Drndarski)

Capreolus capreolus (Crni potok, Krgovici/Han Drndarski)- reproduction



Rhinolophus hipposideros which is using house for shelter(lower part even for hibernation)

Rhinolophus hipposideros roost near existing road in Han Drndarski



Myotis alchathoe found in abandoned building in Mateševu



Myotis brandtii found in abandoned building in Mateševu



Abandoned building in Mateševu



Barbastella barbastellus juvenile in Bare Kraljske/Han Drndarski

Wooden part of the house near Crnja river confluence into Dracka river, is used as roosts for *Barbastella barbastellus*



Maternity collony in Bare Kraljske



Wooden house used as roost for *R. hipposideros*

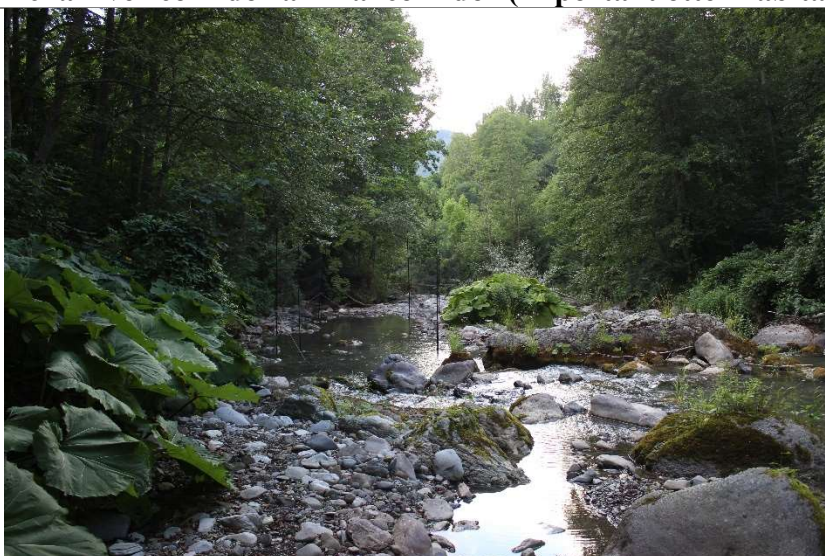


Differen bridges where activity of otter was found





Drcka river corridor animal corridor (important otter habitat)



Degraded forest in Batal



Appendix II

(Additional analyses
on bats activity)

Table 10: Detailed overview of the survey along the transects

TRANSECT	DATE	TIME	NO. OF HOURS	SPECIES	NO. OF CALLS
T1 START 42.728888,19.794578 (ANDRIJEVICA) -END 42.7489272,19.577276 (MATEŠEVO)	24.06.2020.	20.45-22.30	1.45h	<i>N. noctula</i>	1
				<i>B.barbastellus</i>	1
				<i>M.myotis/oxygnathus</i>	1
				<i>M. daubentonii/capaccinii</i>	1
				<i>P.pipistrellus</i>	1
T2 START 42.7368911,19.6415278 (HAN DRNDARSKI) -END 42.743668,19.6651062 (KRGVIĆI)	31.07.2020.	20.20-9.40	1.30h	<i>Myotis sp.</i>	2
				<i>N. noctula</i>	1
				<i>N. leisleri</i>	2
				<i>P.pipistrellus</i>	3
T3 START 42.7485923,19.6173441 (BARE KRALJSKE))- 42.747817,19.582908 (MATEŠEVO)- END 42.735530, 19.656007 (HAN DRNDARSKI)	01.08.2020.	20.30-23.00	2.30H	<i>N. noctula</i>	3
				<i>M.myotis/oxygnathus</i>	2
				<i>P. pygmaeus</i>	2
				<i>P.pipistrellus</i>	6
T4 START 42.73758027924421,19.644735865294933 (BARE KRALJSKE)- END 42.74141452152548,19.670626223087307 (KRGVIĆI)	09.09.2020.	21.40-22.40	1.00h	<i>P.pipistrellus</i>	4
				<i>P. pygmaeus</i>	2
				<i>E. serotinus</i>	1
T5 START42.7383584,19.7745581(MOST BANDOVIKA)-END 42.736369455515664,19.64877661317587 (HAN DRNDARSKI)	11.09.2020.	19.30-22.30	3.00h	<i>E. serotinus</i>	1
				<i>P.pipistrellus</i>	4
				<i>P. khulii/nathusii</i>	1
				<i>P. pygmaeus</i>	4
				<i>N. noctula</i>	3
				<i>M. daubentonii/capaccinii</i>	1

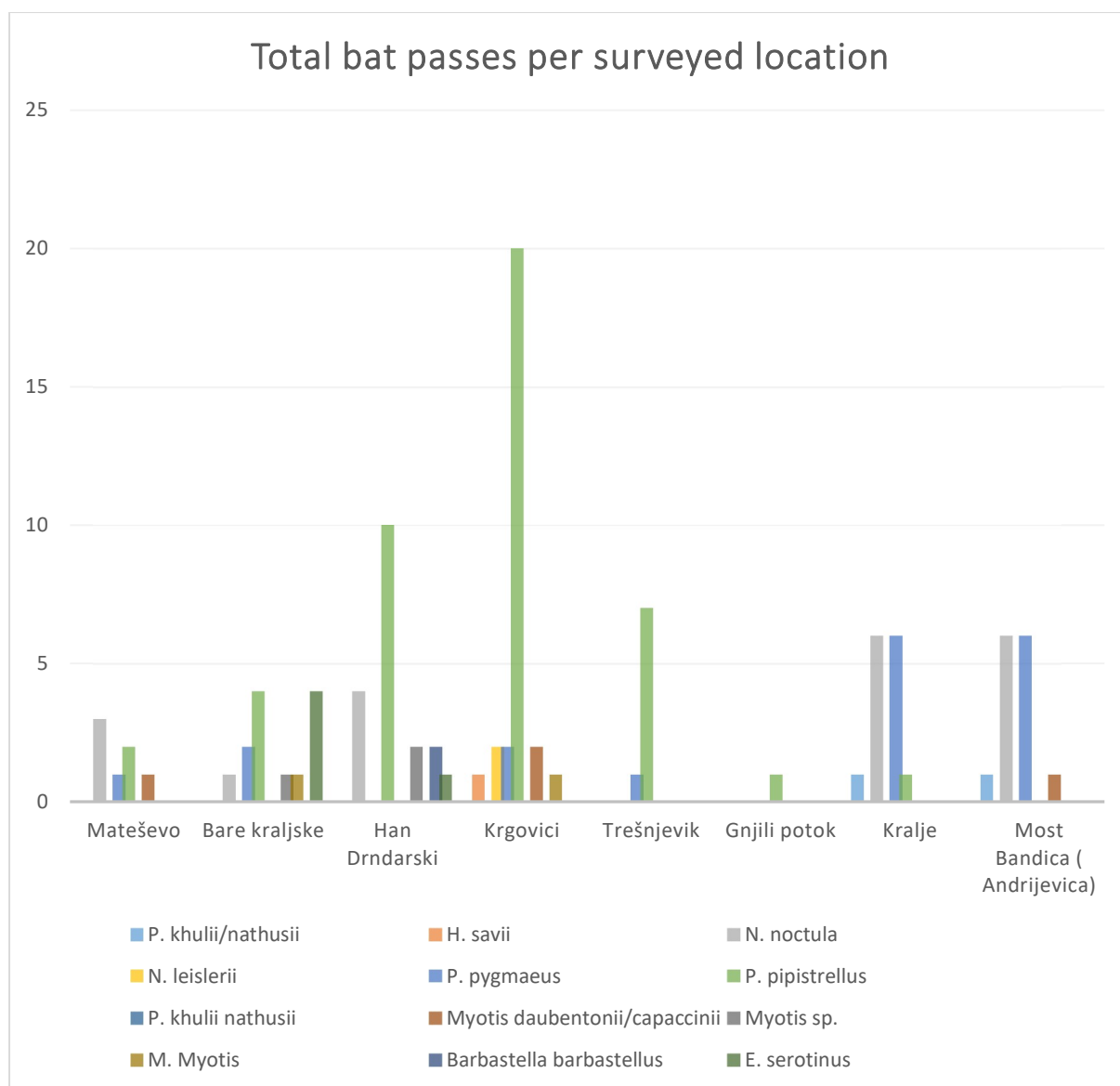


Figure 36. Total bat activity per surveyed location

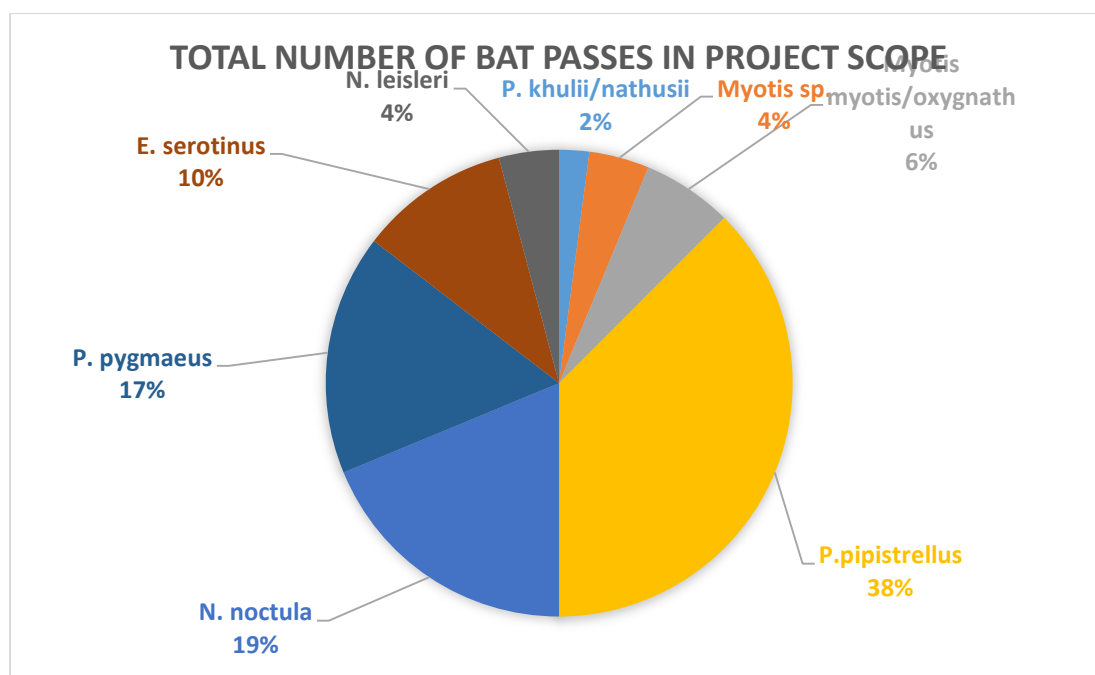


Figure 37. Total activity of bats by transects in the project area

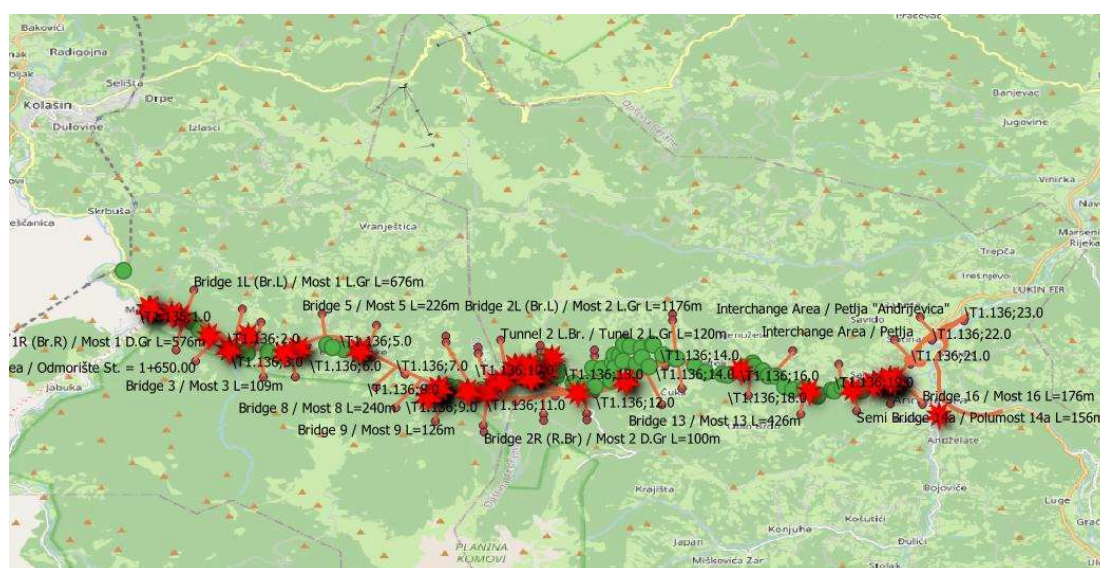
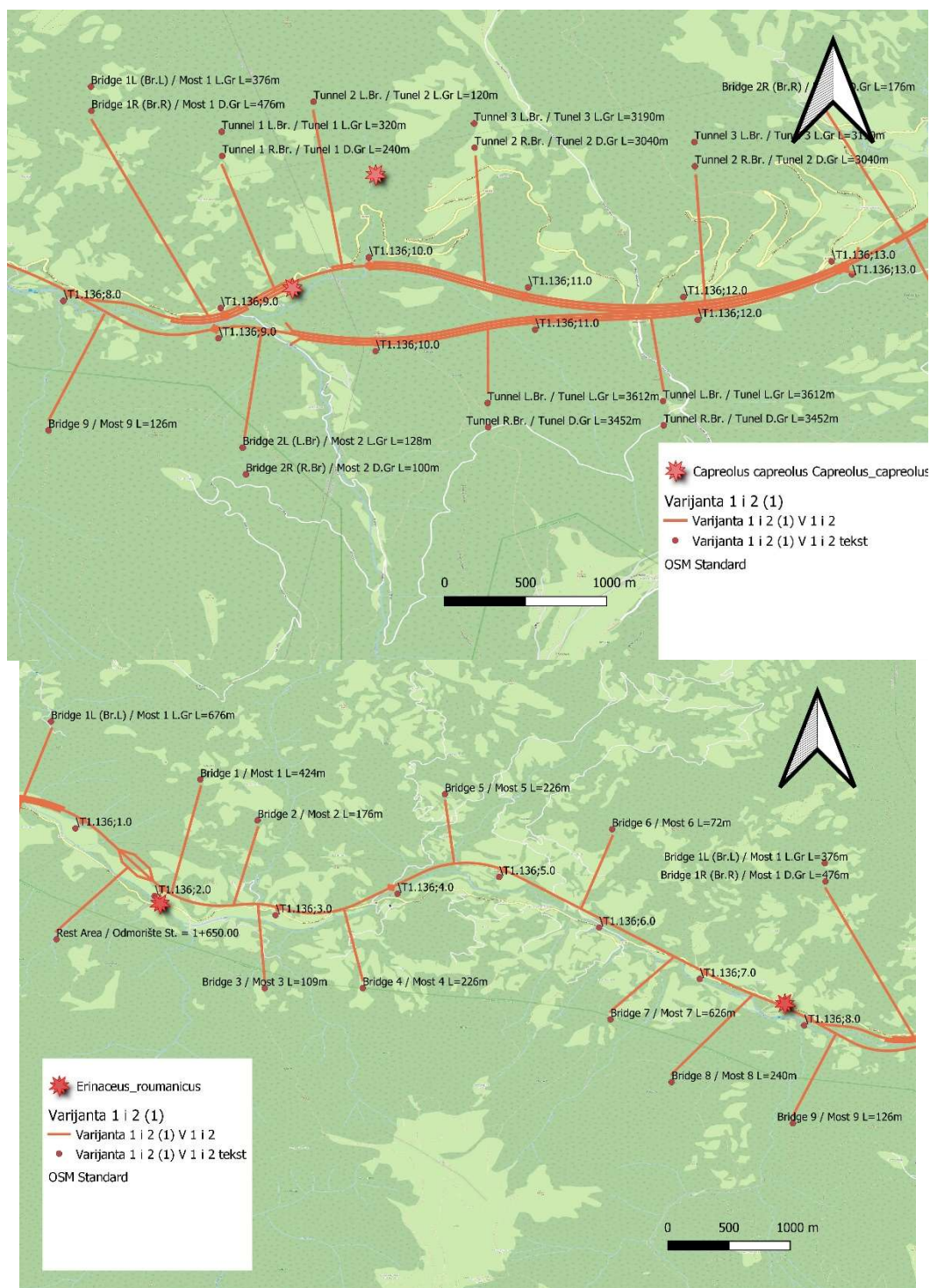
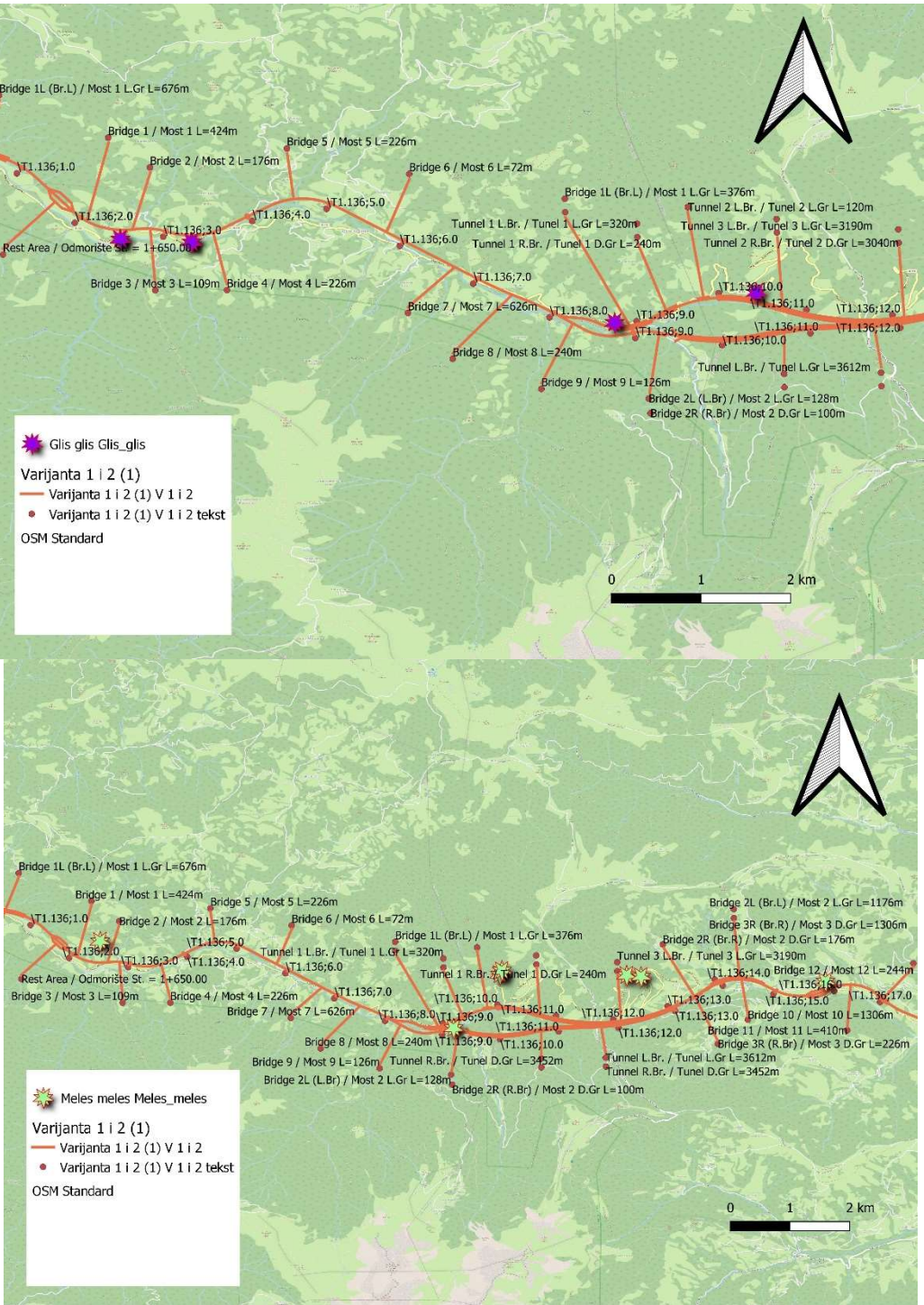


Figure 38. Less activity was registered from Trešnjevnik toward Andrijevica (green dots)

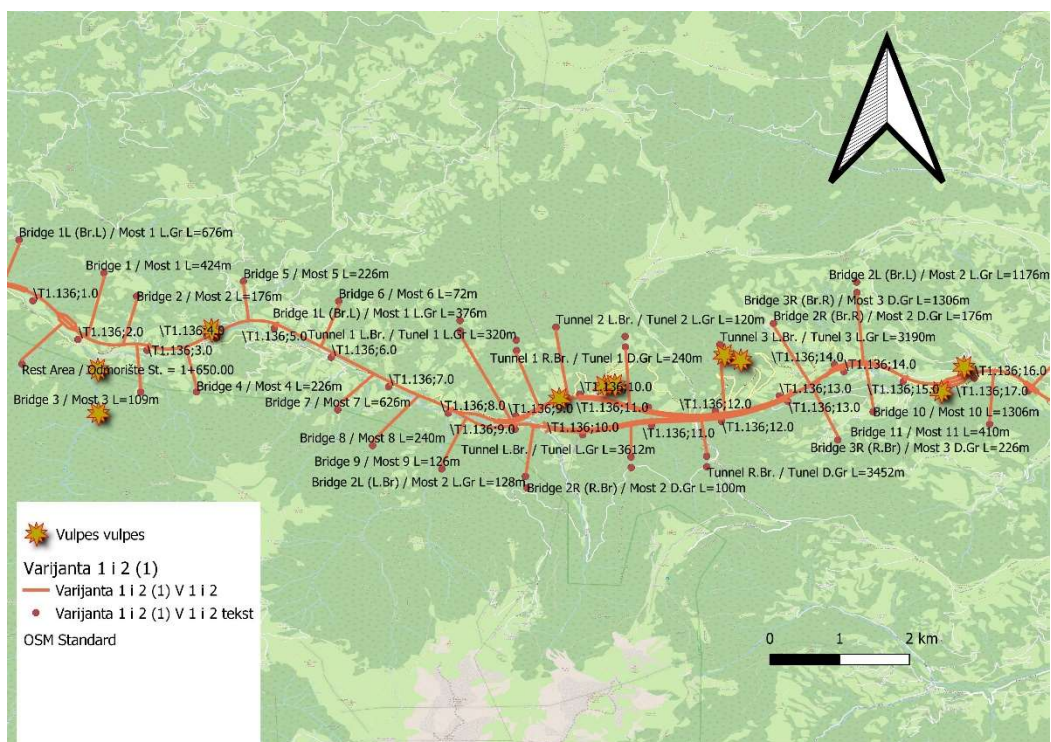
Appendix III

(Maps of other mammals locations)









Appendix IV

(Proposed underpasees for Variant 2)

