Funded by the specific grant agreement number 2018/402-850 from the EU IPA II Multi-Beneficiary Programme for Albania, Bosnia and Herzegovina, Northern Macedonia, Kosovo*, Montenegro and Serbia

Western Balkans Investment Framework Infrastructure Project Facility Technical Assistance 8 (IPF8)

TA2018148R0 IPA

Mediterranean Corridor, Bosnia and Herzegovina - Croatia CVc Road Interconnection, Subsection: Konjic (Ovcari) - Prenj Tunnel - Mostar North

Gap Analysis & ESIA Disclosure Pack

WB20-BiH-TRA-02 Component 1

Volume 2: Technical Annexes to the ESIA

Annex C-4: Mammals (Bats)

December 2025

COWI | IPF

Western Balkans Investment Framework (WBIF)

Infrastructure Project Facility Technical Assistance 8 (IPF8)

Infrastructures: Energy, Environment, Social, Transport and Digital economy

TA2018148 R0 IPA

Volume 2: Technical Annexes to the ESIA

Annex C-4: Mammals (Bats)

December 2025

The Infrastructure Project Facility (IPF) is a technical assistance instrument of the Western Balkans Investment Framework (WBIF) which is a joint initiative of the European Union, International Financial Institutions, bilateral donors and the governments of the Western Balkans which supports socio-economic development and EU accession across the Western Balkans through the provision of finance and technical assistance for strategic infrastructure investments. This technical assistance operation is financed with EU funds.

PROJECT NO.	DOCUMENT NO.
WB20-BiH-TRA-02	

VERSION	ISSUE DATE	DESCRIPTION	PREPARED BY	VERIFIED BY	APPROVED BY
1	25/09/2021	Annex C-4: Mammals (Bats)	Team of experts	Irem Silajdžić Konstantin Siderovski	Richard Thadani
2	21/11/2022	Annex C-4: Mammals (Bats)	Team of experts	Irem Silajdžić	Richard Thadani
3	03/03/2023	Annex C-4: Mammals (Bats)	Team of experts	Irem Silajdžić	Richard Thadani
4	10/10/2023	Annex C-4: Mammals (Bats)	Team of experts	Irem Silajdžić	Richard Thadani
5	06/01/2025	Annex C-4: Mammals (Bats)	Team of experts	Irem Silajdžić	Richard Thadani
6	01/08/2025	Annex C-4: Mammals (Bats)	Team of experts	Irem Silajdžić	Richard Thadani
7	31/12/2025	Annex C-4: Mammals (Bats)	Team of experts	Irem Silajdžić	Richard Thadani

CONTENTS

List of tables

List of figures

1 Introduction

1.1 Project Background

In August 2020, ENOVA was commissioned to conduct an environmental and social impact assessment referring to the Corridor Vc section Konjic (Ovcari) - Prenj Tunnel - Mostar North. The results of the previous biodiversity gap analysis indicated that additional information on biodiversity would be needed for an informed assessment of sensitive habitats and ecological characteristics. Additional information was obtained through field research and analysis of available literature and project documentation. The following field research has been done and is to be included in Annexes to the final Environmental and Social Impact Assessment Report:

- Annex A: Habitats, vegetation and invasive species
- Annex B: Invertebrates
- Annex C: Vertebrates
  - Annex C-1: Ichthyofauna
  - Annex C-2: Herpetofauna (amphibians and reptiles)
  - Annex C-3: Ornithofauna
  - Annex C-4: Mammals (Bats)
  - Annex C-5: Mammals (Large mammals).

This report presents the results of a field study of chiroptera (bats).

1.2 Site Locations

This subproject includes three subsections between Konjic (Ovcari) and Mostar North along motorway Vc. According to the ToR, the subproject starts with the Konjic Intersection in Ovcari and ends with the Mostar North Interchange and the total length is 35.26 km, has six bridges and nine viaducts.

The motorway subsection Konjic (Ovcari) - Prenj Tunnel - Mostar North (Vrapcici) starts in settlement Ovcari with an interchange which will enable connection of the motorway and the existing main road M17. At the northern entrance to the City of Konjic, after the interchange, the motorway crosses the Sipad industrial zone. Further ahead, the subsection passes through the slopes where steep cuts are envisaged and where the Viaduct 3 over river Tresanica was designed to cross to the opposite side of the M17. Immediately after the end of Viaduct 3, the route enters the slope which passes through tunnels - Tunnel T1 and Tunnel T2.

After exiting the Tunnel T2, the route crosses over the Neretva River and the local road with Viaduct 4. Crossing to the opposite side, the motorway continues along the slopes at the rear of the settlement Bijela up to the settlement Mladeskovici, where the Konjic South interchange is positioned. Further on, the motorway route is laid at the foot of the slope above the settlements of Bijela and Gornja Bijela all the way to the end of the section. The route further runs along the slopes parallel to the Rakov Laz shooting range, continues through the

uninhabited green landscape to the slopes of Prenj Mountain, where the tunnel under Prenj (Tunnel T3) begins and terminates in the territory of the City of Mostar.

After exiting the tunnel through the Prenj mountain, the motorway route traverses mountain curves towards the south and the City of Mostar, through a system of cuts and bridges through uninhabited mountain areas. At the exit from the Prenj mountain range, the road crosses the valley on 300 m long embankment and enter the Klenova Draga Tunnel (Tunnel T3A) on the western cliffs of the gorge.

After the Klenova Draga Tunnel the next viaduct of approx. 800 m begins and turns into approx. 640 m long Tunnel T4. The viaduct over Badnjena Draga near Seliste, which stretches parallel to the settlement begins here.

The route continues northeast of the settlement and extends along the edges of the hill north of Podgorani, where the bridge over Seocka Draga begins and leads the route to Dolac, north of Humlisani. Further, the route continues in a slight semicircle around the settlement of Humilisani along the slopes of Porim. Below Humilisani, the route runs south and under Sljemen, it enters the 2,200-meter-long Tunnel T5, and exits into the Kuti area, the point where the Mostar (north) exit ramp has been envisaged.

The south connection to main road M17 (hereinafter: Konjic Bypass) is also a subject of this ESIA. Konjic bypass will connect the motorway at Ovcari Interchange with the M17 to Jablanica. This bypass will allow for M17 traffic to access the motorway directly without entering the urban area of Konjic. Konjic Bypass begins by turning off the motorway via the Ovcari Interchange. After that, motorway passes the next 100 m in an embankment and reach the first 80-meter-long viaduct. After the viaduct, it enters an 800-meter-long tunnel. After exiting the tunnel, the route goes for approx. 500 m through embankments and another 500 m through a cut with the highest point of approx. 30 m. The next 200 m of the route passes through embankments and cuts and reaches a 350-meter-long bridge that crosses the existing Sarajevo-Capljina railway, the Neretva River, and the main road M17. After 200 m, Konjic Bypass connects to M17.

1.3 Reporting Purpose and Objectives

The main purpose of this task is to prepare a written report to serve as basis for Environmental and Social Impact Assessment (ESIA) Disclosure Package and the Biodiversity Management Plan (BMP). For this purpose to be met, this report has been written in accordance with the following objectives:

- Provide field research methodology and results;
- Assess the respective project and impact areas for the potential presence of sensitive species and species of conservation concern;
- Recommend mitigation measures and/or monitoring if necessary.

2 Methodology

2.1 Survey Background

The purpose of this survey was to determine the presence and the distribution of bat species in the project area or species with the potential to occur within the project impact area due to the habitat type, in order to determine the potential effects of the project activities on key habitats and species.

Field surveys were conducted in 2020 and 2021. They were carried out in two phases: a literature review for the study area and field trips for the purpose of species confirmation. The field surveys were conducted: from 28 to 30 September 2020, from 16 to 18 April 2021 and from 7 to 9 May 2021.

2.2 Survey Methodology

The research was conducted on 7 macro localities encompassing 60 micro localities along the future motorway route (Table 1, Figure 4). Prior to the field trips the literature review was done on recorded bat species in the respective area. The available information was then verified through field surveys. The species were identified based on analysis of sound recorded on a heterodyne recorder Pettersson D1000X Ultrasound Detector (Bat detector) and by USB microphone u256 USB Ultrasound Microphone. The sound was then analysed in the software BatSound 5 (Windows software) and in application BatSound (Android phone application). The literature used for analysis of the recordings was: *Die Fledermause Europas* (2014) and *Bats of Britain and Europe* (2018). All species were identified exclusively based on the *time expansion* analysis, i.e. the analysis of frequency and length of call for the species where possible. Determination of specific variations within the same species requires a morphological analysis.

As during the field surveys the bat species were not caught by mist nets, but were recorded by the heterodyne recorder and microphone, the species were not photographed. The potential habitats of bats were surveyed and photographed.

Table 1: Coordinates of localities where field survey was done

Wider locality	Narrow locality	Coordinates
Kuti-Livac	Dubrava	43°23'12.23"N 17°53'7.00"E
	Dubrava_2	43°23'19.66"N 17°52'37.04"E
	Komic	43°22'51.79"N 17°53'43.17"E
	Budjevci	43°22'56.75" N 17°53'26.37"E
	Susica	43°23'9.90"N 17°53'36.95"E
	Kuti	43°23'17.51"N 17°54'18.64"E
	Kuti_1	43°23'26.17"N 17°53'57.87"E
	Kuti_3	43°23'3.77"N 17°54'8.72"E

Wider locality	Narrow locality	Coordinates
	Kutilivac	43°23'41.53"N 17°53'45.98"E
	Livac	43°24'11.60"N 17°53'26.72"E
	Orlov kuk	43°24'4.56"N 17°53'35.69"E
	Orlov kuk_2	43°24'47.91"N 17°53'48.07"E
Koritna draga	Koritna draga	43°23'22.56"N 17°54'42.32"E
	Orlinka	43°23'10.89"N 17°54'34.94"E
	Dobrusa	43°23'39.39"N 17°54'44.95"E
	Dobrusa_2	43°23'51.11"N 17°54'51.32"E
	Kuti_2	43°23'35.71"N 17°54'26.74"E
	Dobrusa_3	43°23'28.11"N 17°54'54.83"E
	Dobrusa_4	43°23'46.15"N 17°54'42.90"E
Humi	Lisani	43°25'29.40"N 17°54'1.86"E
	Lisani_2	43°25'6.15"N 17°54'38.46"E
	Lisani_3	43°25'26.69"N 17°54'27.95"E
	Lisani_4	43°25'39.85"N 17°54'56.20"E
	Lisani_5	43°25'43.99"N 17°54'23.48"E
	Humi	43°26'7.13"N 17°53'49.68"E
	Humi_2	43°26'30.84"N 17°54'2.85"E
	Humi_3	43°26'9.90"N 17°54'32.64"E
	Humi_4	43°26'6.12"N 17°54'54.02"E
	Humi_5	43°26'21.12"N 17°54'45.37"E
	Humi_6	43°26'39.65"N 17°54'47.16"E
	Humi_7	43°26'47.87"N 17°54'25.54"E
Podgorani	Dolac	43°27'26.05"N 17°54'23.79"E
	Dolac_2	43°27'14.55"N 17°54'2.50"E
	Dolac_3	43°27'33.70"N 17°54'2.55"E
	Podgorani	43°27'34.23"N 17°53'20.29"E
	Podgorani_2	43°27'39.50"N 17°53'34.03"E
	Podgorani_3	43°27'46.95"N 17°53'45.20"E
	Podgorani_4	43°27'52.48"N 17°53'43.47"E
	Podgorani_5	43°27'54.06"N 17°53'11.79"E
	Podgorani_6	43°28'4.82"N 17°52'58.37"E
	Podgorani_7	43°28'22.39"N 17°52'59.06"E
	Podgorani_8	43°28'4.42"N 17°53'18.78"E
	Podgorani_9	43°28'4.99"N 17°53'34.78"E
Podporim/Porim	Podporim/Porim	43°27'0.04"N 17°55'47.49"E
	Podporim/Porim_2	43°27'13.77"N 17°56'9.18"E
	Podporim/Porim_3	43°27'14.43"N 17°56'13.07"E

Wider locality	Narrow locality	Coordinates
	Podporim/Porim_4	43°27'18.37"N 17°56'30.51"E
	Podporim/Porim_5	43°27'21.78"N 17°56'49.98"E
	Podporim/Porim_6	43°27'26.20"N 17°56'53.87"E
	Podporim/Porim_7	43°27'31.90"N 17°57'7.01"E
	Podporim/Porim_8	43°27'27.17"N 17°57'22.76"E
Ovcari	Ovcari_1	43°40'1.35"N 17°59'11.77"E
	Ovcari_2	43°40'11.43"N 17°58'49.51"E
	Ovcari_3	43°40'2.52"N 17°58'58.34"E
	Ovcari_4	43°39'42.07"N 17°58'26.06"E
Polje Bijela	Polje_Bijela_1	43°38'5.64"N 17°58'55.69"E
	Polje_Bijela_2	43°38'7.04"N 17°58'23.60"E
	Polje_Bijela_3	43°37'43.89"N 17°58'16.12"E
	Polje_Bijela_4	43°37'17.71"N 17°58'22.78"E
	Rakov_laz	43°34'14.25"N 17°55'38.71"E

The *Red List of Wild Species and Subspecies of Plants, Animals and Fungi*[1] and *Regulation on Protection Measures for Strictly Protected Species and Subspecies and Protected Species and Subspecies of Federation of Bosnia and Herzegovina*[2] were used to identify protected/endangered species at the entity level in the study area.

The list of species of international importance for conservation given in this report is based on the following documents:

- Annexes II and IV to the Habitats Directive - Council of the European Union (2013). Council Directive 2013/17/EU of 13 May 2013 adapting certain directives in the field of the environment, by reason of the accession of the Republic of Croatia. *Official Journal of the European Union* L158: 193–229.
- IUCN Red List of Threatened Species: http://www.iucnredlist.org/

The following standard abbrediations were used in the remainder of this report:

- IUCN – International Union for Conservation of Nature
- FBiH RL – Federation of Bosnia and Herzegovina Red List
- IUCN and FBiH RL conservation status abbreviations:
  - CR – Critically Endangered
  - EN – Endangered
  - VU – Vulnerable
  - NT – Near Threatened
  - LC – Least Concern
  - DD – Data Deficient
- HD – European Habitats Directive:
  - II – Annex II

[1] Official Gazette of FBiH, No. 7/14

[2] Official Gazette of FBiH, No. 21/20

- IV – Annex IV
- (*) - priority species.

- BC – Berne Convention

2.3 Assumptions and Limitations

The presence of mined areas recorded around the section did not impede or limit the field activities as the recording and registration of species was performed by means of bat detectors and microphones for bat recording. For the same reason, fences private properties did not present an issue during suverying either.

2.4 Project Impact Area

It was confirmed that a protection area of 500 m on each side of the road is sufficient, considering the impact of the planned works on the bat fauna, because the most of natural habitats have already been degraded and the direct project impacts will be limited to the motorway route.

Area of influence was generally enough for field surveys, although biodiversity aspects must take biology of species and integrity of ecosystems into consideration as well. This is done so that "wider distribution of potentially affected biodiversity features and the ecological patterns, processes and functions that are necessary for maintaining them throughout this distribution" (EIB Guidance Note for Standard 3 on Biodiversity and Ecosystems, 2018) are included. Project's AOI was enlarged in a way that reflects ecological characteristics of the area and biology of found bat species. Output of said enlargement is ecologically appropriate area of analysis (EAAA). The methodology for EAAA was applied on the basis of field research, confirmed and expected species, characteristics of surrounding habitats and ecosystems, literature data, expert opinion and, later, IUCN estimated extent of occurrence (EOO) and the area of occupation (AOO) for each individual species. Initial AOI was expanded to include distribution of registered bat species and their habitats in the wider area so that the most adequate baseline for subsequent mitigation measures is ensured. Further evaluation of EAAA was done with regard to EOO based on IUCN data (if available) and expert inputs to facilitate critical habitat assessment (CHA). Critical habitat assessment for this Project is done separately and it is presented in the Annex D of ESIA.

Habitats in the project area were analysed separately from the remaining potential impact area of the protection zone as stated in Chapter 3.1.

3 Results

3.1 Survey Results

According to the literature studies for the surroundings of the area (Mts. Prenj, Velez, Zlatar) Corridor Vc Konjic (Ovcari) – Prenj tunnel – Mostar North section,

the presence of 11 species was recorded in 2020. During the field surveys in 2020 the presence of eight species was confirmed: *Myotis oxygnathus* (Lesser mouse-eared bat), *Myotis mystacinus* (Whiskered bat), *Pipistrellus kuhlii* (Kuhl's pipistrelle), *Pipistrellus nathusii* (Nathusius's pipistrelle), *Eptesicus serotinus* (Serotine bat), *Nyctalus noctula* (Common noctule), *Nyctalus leisleri* (Lesser noctule), *Tardarida teniotis* (European free-talied bat).

The 2021 field surveys recorded the presence of four bat species. The species identified based on heterodyntal sound recording and analysis in Batsound software can be divided into two groups based on the appearance of the calls they emit.

Group 1: The species identified are Greater horseshoe bat (*Rhinolophus ferrrumequinum*) and Lesser horseshoe bat (*Rhinolophus hipposideros*). By heterodyntal sound recording, these two species may be classified in the group of Rhinolophida based on the sound they emit and appearance of the call during the analysis in the Batsound software (FM/CF/FM call form).

Group 2: Genus *Pipistrellus* (calls are of the FM/qCF form) with two identified species: Common pipistrelle (*Pipistrellus pipistrellus*) and Khuli's pipistrelle (*P. kuhlii*).

In total, the presence of 11 species of bats has been confirmed in the period from 2020 and 2021. Field and literature research suggests possible presence of 22 species for the surrounding area of the section of the Corridor Vc Konjic (Ovcari) - Prenj tunnel - Mostar North. However, not all of them could have been confirmed (Table 1).

During the topographic mapping of speleological sites, the presence of a number of speleological objects were recorded near Konjic (Figure 1), as well as two speleological objects north of the settlement of Podgorani (Figure 2). Based on stakeholder consultations, potential presence of approx. 10 speleological objects on the Prenj Mt. plateau is also anticipated; however, precise locations are not known. Analysis of the area by field visits has established that the Project activities are not expected have a direct impact on caves and habitats of identified species.

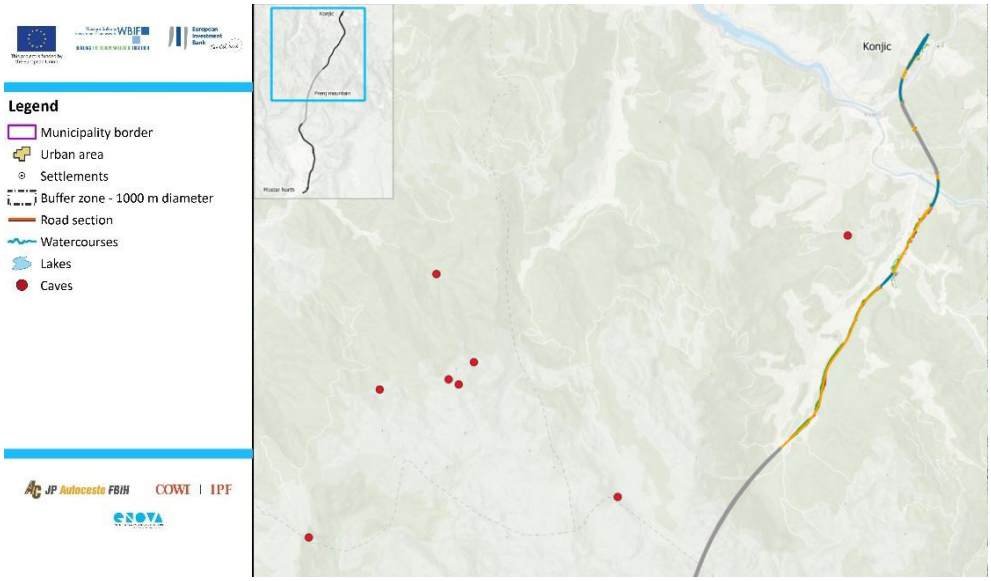

Figure 1: Speleological objects in the vicinity of subsection Konjic (Ovcari)-Tunnel Prenj

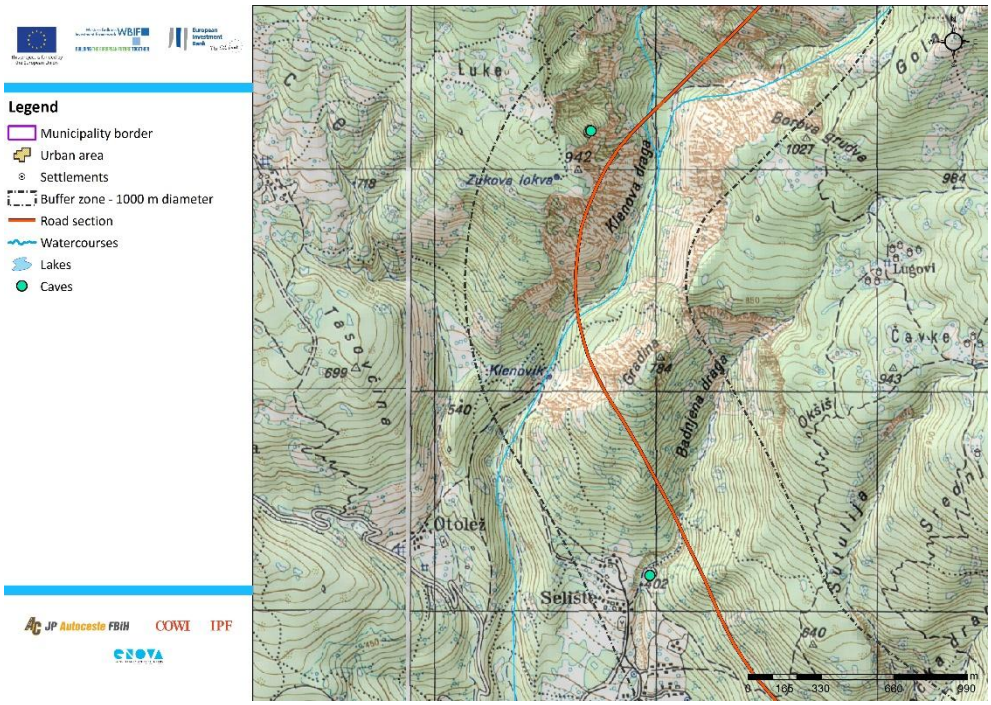

Figure 2: Speleological objects in the vicinity of subsection Tunnel Prenj – Mostar North

Estimating BiH bat populations is complicated due to very low local knowledge of bat population, distribution, and trends. The information on roost sites in the surrounding territory is still scarce due to lack of field studies and is most likely going to increase rapidly during next years. Data on local migration routes are almost completely absent.

Locality of Konjicka Bijela stands out thanks to its diversity since all the 11 species were registered there. Five species were found in the locations of Ovcari and Humilisani. Spatial distribution of registered bat species in project's AOI is shown in Figure 3 below.

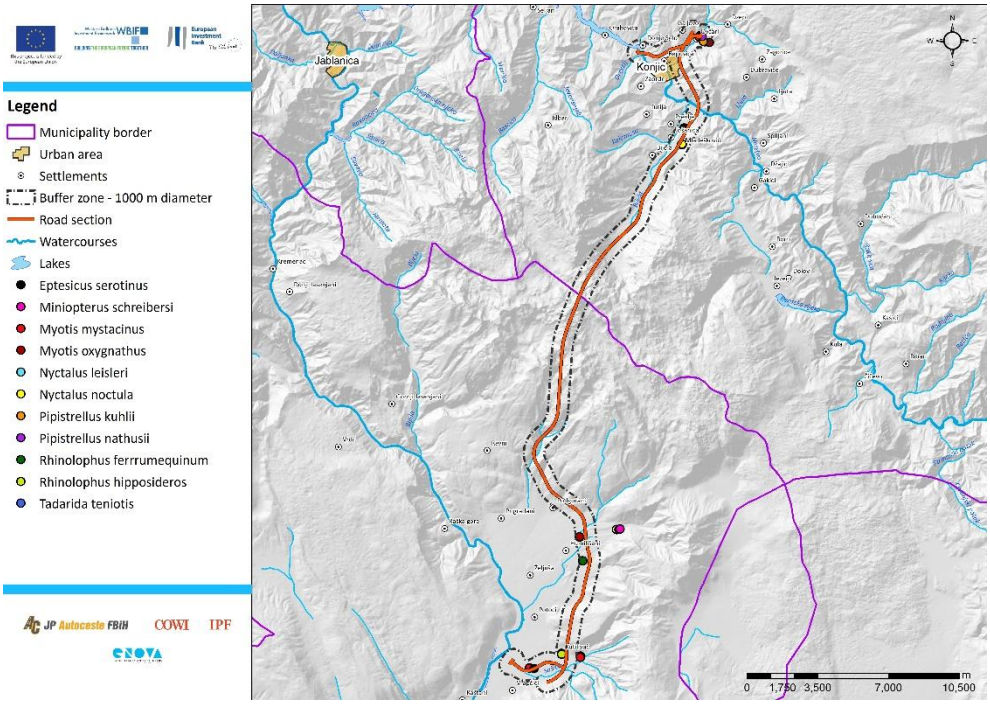

Figure 3: Spatial distribution of registered bat species in relation to the motorway route

Table 1: List of field and literature data on bat species of the surveyed area

Name in English	Scientific name	Conservation status	Suitable habitat in the area?	Research finding - has the species been found?	Locality (where?)	Reference (for literature data)
Lesser mouse-eared bat	*Myotis oxygnathus*	IUCN LC, FBiH EN, HD II, IV	Yes	Yes	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari	Field research
Whiskered bat	*Myotis mystacinus*	IUCN LC, FBiH VU, HD IV	Yes	Yes	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari, Podgorani	Field research
Kuhl's pipistrelle	*Pipistrellus kuhlii*	IUCN LC, FBiH VU, HD IV	Yes	Yes	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari, Podporim	Field research
Nathusius' pipistrelle	*Pipistrellus nathusii*	IUCN LC, HD IV	Yes	Yes	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari	Field research
Serotine bat	*Eptesicus serotinus*	IUCN LC, HD IV	Yes	Yes	Konjicka Bijela	Field research
Common noctule	*Nyctalus noctula*	IUCN LC, FBiH EN, HD IV	Yes	Yes	Konjicka Bijela	Field research
Leisler's bat	*Nyctalus leisleri*	IUCN LC, HD IV	Yes	Yes	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari, Podgorani	Field research
Free-tailed bat	*Tadarida teniotis*	IUCN LC, HD IV	Yes	Yes	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari, Podgorani	Field research
Greater horseshoe	*Rhinolophus*	IUCN LC, FBiH VU, HD	Yes	Yes	Kutilivac, Humilisani,	Field research

Name in English	Scientific name	Conservation status	Suitable habitat in the area?	Research finding - has the species been found?	Locality (where?)	Reference (for literature data)
bat	*ferrrumequinum*	II, IV			Gornje selo, Konjicka Bijela, Ovcari, Podporim	
Lesser horseshoe bat	*Rhinolophus hipposideros*	IUCN LC, FBiH EN, HD II, IV	Yes	Yes	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari	Field research
Common pipistrelle	*Pipistrellus pipistrellus*	IUCN LC, FBiH VU, HD IV	Yes	Yes	Humilisani, Konjicka Bijela, Ovcari, Podporim	Field research
Western barbastelle	*Barbastella barbastellus*	IUCN NT, HD II, IV	Possible	No	Prenj Mountain	Hodzic et al. (2017)
Savi's pipistrelle	*Hypsugo savii*	IUCN LC, FBiH VU, HD IV	Possible	No	Prenj Mountain	Hodzic et al. (2017) Support to the implementation of the Birds and Habitat Directive in Bosnia and Herzegovina, 2012-2015.
Schreibers' Bent-winged bat	*Miniopterus schreibersi*	IUCN NT, FBiH EN, HD II, IV	Possible	No	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari	Support to the implementation of the Birds and Habitat Directive in Bosnia and Herzegovina, 2012-2015. Rnjak et al. (2017)

Name in English	Scientific name	Conservation status	Suitable habitat in the area?	Research finding - has the species been found?	Locality (where?)	Reference (for literature data)
Bechstein's bat	*Myotis bechsteinii*	IUCN NT, HD II, IV	Possible	No	Prenj Mountain	Hodzic et al. (2017)
Geoffroy's bat	*Myotis emarginatus*	IUCN LC, FBiH VU, HD II, IV	Possible	No	Prenj Mountain	Rnjak et al. (2017)
Greater mouse-eared bat	*Myotis myotis*	IUCN LC, FBiH EN, HD II, IV	Possible	No	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari	Support to the implementation of the Birds and Habitat Directive in Bosnia and Herzegovina, 2012-2015.
Natterer's bat	*Myotis nattereri*	IUCN LC, HD IV	Possible	No	Prenj Mountain	Hodzic et al. (2017)
Alpine long-eared bat	*Plecotus macrobullaris*	IUCN LC, HD IV	Possible	No	Prenj Mountain	Hodzic et al. (2017)
Blasius's horseshoe bat	*Rhinolophus blasii*	IUCN LC, FBiH VU, HD II, IV	Possible	No	Prenj Mountain	Rnjak et al. (2017)
Mediterranean horseshoe bat	*Rhinolophus euryale*	IUCN NT, FBiH EN, HD II, IV	Possible	No	Kutilivac, Humilisani, Gornje selo, Konjicka Bijela, Ovcari, Zlatar	Support to the implementation of the Birds and Habitat Directive in Bosnia and Herzegovina, 2012-2015.
Parti-coloured bat	*Vespertilio murinus*	IUCN LC, FBiH IUCN LC, HD IV	Possible	No	Brdo Zlatari, Prenj Mountain	Hodzic et al. (2017)

4 Discussion and Recommendations

4.1 Summary of Major Findings

During the field research conducted in 2020 and 2021 in the area of impact of construction of the Vc Corridor section Konjic (Ovcari) – Prenj Tunnel – Mostar North 11 species were recorded from the Annex II and/or IV of the Habitats Directive VU, EN, CR species from the Red List of the Federation of Bosnia and Herzegovina and/or IUCN Global Red List.

4.1.1 Sensitive Species

A total of 10 bat species has been recorded during field surveys have the status of EN or VU according to the Red List of the Federation of Bosnia and Herzegovina (Table 2). No critically endangered bat species have been registered.

Table 2: List of sensitive species according to the FBiH Red List

Name	Scientific name	FBiH RL
Lesser mouse-eared bat	*Myotis oxygnathus*	EN
Whiskered bat	*Myotis mystacinus*	EN
Kuhl's pipistrelle	*Pipistrellus kuhlii*	VU
Common noctule	*Nyctalus noctula*	EN
Greater horseshoe bat	*Rhinolophus ferrrumequinum*	VU
Lesser horseshoe bat	*Rhinolophus hipposideros*	EN
Common pipistrelle	*Pipistrellus pipistrellus*	VU
Savi's pipistrelle	*Hypsugo savii*	VU
Schreibers' bent-winged bat	*Miniopterus schreibersi*	EN
Geoffroy's bat	*Myotis emarginatus*	VU

4.2 Mitigation Measures

4.2.1 Preconstruction Phase

In order to prevent adverse impact to bat species, measures presented in Biodiversity Management Plan regarding development of Main Design and planning of construction works must be respected.

4.2.2 Construction Phase

Deforestation should be reduced to a minimum, only the necessary interventions required for the implementation of project activities. This kind of degradation is irreversible and inavoidable directly on the motorway, however, degraded habitats used in construction activities need to be revitalised through the process of reforestation. Due to the fact that bats use forests as a shelter, reforestation with autochtonous species is necessary.

No roost sites have been identified during desk or field surveys. Their potential destruction would be an unaccaptable loss of biodiversity therefore if any are found during construction, a biodiversity expert must be included in planning of adverse impacts mitigation such as relocation to alternative sites.

The Biodiversity Management Plan proposes an assessment of the significance of these facilities for bat fauna.

4.2.3 Operation Phase

All species of bats are nocturnal animals. They rest in dark places during the day and go out to eat in the evening. The light near the colony will affect their behavior and reduce the amount of outings intended for hunting. Strong light will reduce social flight and cause the species to move to another darker location. Illumination of the bat litter leads to disturbances that cause the bats to leave the litter. Also, light causes insects to accumulate allowing bats to aggregate in those places. As mitigation measures replacement bulbs may be used such as:

- Low pressure sodium lights (typical yellow lamps seen along roadsides). The light is emitted in one wavelength, does not contain ultraviolet (UV) light and does not attract a large number of insects.
- High pressure sodium bulbs (lighter purple-yellow bulbs). Light is emitted through a wide band of long wavelengths. Insects are attracted to stronger light that is captured only by some species of bats.
- Mercury bulbs (bluish-white bulbs). They emit light in a very wide spectrum, including UV light to which insects are particularly sensitive. Insects are attracted in large numbers along with the high density of bat species, especially from the genera *Nyctalus*, *Eptesicus* and *Pipistrellus* (the mentioned genera were recorded during field research).

4.3 Monitoring Measures

4.3.1 Construction Phase

Monitoring of mitigation measures proposed in this Annex as well as measures listed within the Biodiversity Management Plan.

4.3.2 Operational Phase

Bat monitoring by bat detectors along the route over a period of three to four years, to determine the effects of the highway on recorded species and the degree of bat aggregation.

5 Annexes

5.1 Maps

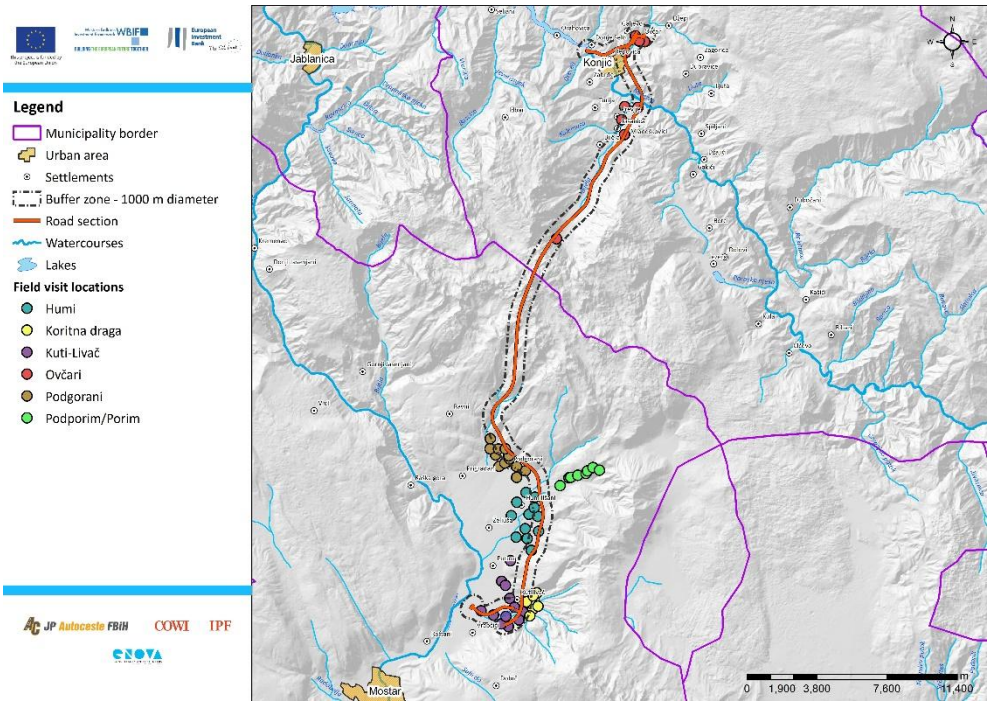

Figure 4: Bat survey locations

5.2 Habitat Photos

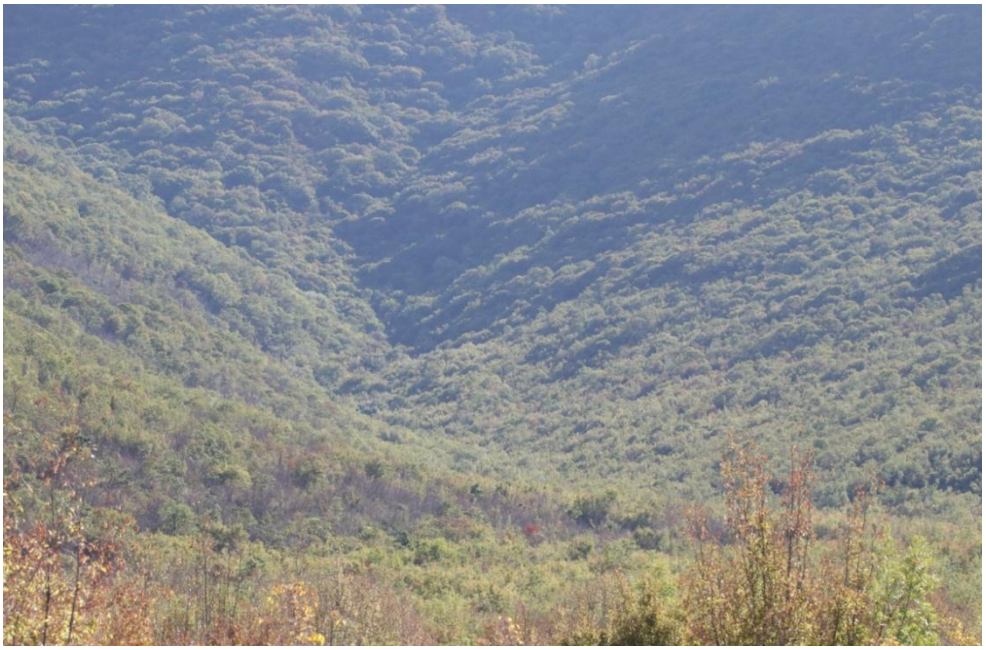

Figure 5: Overview of habitats from field visits