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 B: Invertebrates

December 2025

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Western Balkans Investment Framework (WBIF)

Infrastructure Project Facility Technical Assistance 8 (IPF8)

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

TA2018148 R0 IPA

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

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

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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 invertebrates.

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 importance;
- 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 invertebrate species of conservation concern 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 research was conducted as a part of mutiple site visits in 2020 and 2021: 24-25 October 2020, 7, 9-10, 17, 27 March 2021; 4, 15-16, 23-25 April 2021; 2, 8-9, 16-17, 21-23 May 2021. Field research took place in optimal weather conditions and during the period of activity of the researched group.

2.2 Survey Methodology

Systematic field research was preceded by the collection of available literature data. Relevant references (e.g. previous and ongoing assessments, scientific papers and reports) on the presence of invertebrate species important for conservation in the project area, as well as the ecological conditions of the project area of influence, were reviewed to determine the most appropriate research implementation sites.

Invertebrate research was done using the active terrain search methods. Field work consisted of site overview and active search for individuals, direct and indirect determination of the presence of species based on findings along transect lines within the scope of the direct project impact. Transect lines were 500-1.500 m long. Field work included day and night surveys, with a total of 21 days of invertebrate research throughout all seasons.

The research was performed on a total of 7 macro localities, which included 60 micro localities (Table 1).

Table 1: Overview and coordinates of the survey sites

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
	Kutilivac	43°23'41.53"N 17°53'45.98"E

Wider locality	Narrow locality	Coordinates
	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
	Podporim/Porim_4	43°27'18.37"N 17°56'30.51"E

Wider locality	Narrow locality	Coordinates
	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 Sub-species 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 abbreviations were used:

- IUCN RL – International Union for Conservation of Nature Red List
- 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
  - NE – Not Evaluated
- HD – European Habitats Directive:

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

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

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

- BC – Berne Convention

2.3 Assumptions and Limitations

The area is extremely difficult for hiking and surveying, it is a dynamic relief dominated by ravines, rock creeps and cliffs. During field research, minefields were encountered, where no transect lines were performed. However, detailed surveying of land mine-infested areas as well as inaccessible habitats did not present a problem because those habitats were surveyed using binoculars and no habitats of interest were identified. Gap identified in existing biodiversity data was bridged by extensive surveys in all seasons.

2.4 Project Area of Influence

It was confirmed that the area of 500 m on each side of the road is sufficient for invertebrate fauna, considering the impact of the planned works on invertebrates and taking into account that the direct project impacts on this group of animals will be maily focused on the motorway footprint. However, surveying area was expanded to include forest habitats outside of AOI in an attempt to confirm or exclude presence of invertebrates of interest characteristic for such ecosystems.

Area of influence was generally enough for field surveys, although biodiversity aspects must take biology of species and integrity of ecosystems into consideration. 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"[3] are included. Project's AOI was enlarged in a way that reflects ecological characteristics of the area and biology of found species. Output of said enlargement is ecologically appropriate area of analysis (EAAA). The methodology for ecologically 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 invertebrates of conservation concern and their habitats in the wider area so that the most adequate baseline for subsequent mitigation measures is ensured. EAAA was refined and aggregated for all invertebrates due to significant overlap between the species. Further evaluation of EAAA was done with regard to EOO based on IUCN data (if available) and expert inputs to

[3] EIB Guidance Note for Standard 3 on Biodiversity and Ecosystems, 2018

facilitate critical habitat assessment (CHA). Critical habitat assessment for this Project is done separately and it is presented in the Annex D of the ESIA Study.

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

3 Results

3.1 Survey Results

This section summarises the results of desk and field survey for invertebrate species of conservation concern and identifies the key potential sensitive species and their habitats. The evaluation is based on the field survey of threatened species/habitats of the species of invertebrates at the selected localities.

According to the results of a previous study[4] in the wider area of the Corridor Vc section Konjic (Ovcari) - Prenj Tunnel - Mostar North in the area of project activities, the analysis of invertebrate biodiversity has been reduced to several high taxonomic categories (e.g. insect orders) which does not meet the standards for adequate ESIA study.

The literature data of Apfelbeck (1894-1916) and the assessment study for Natura 2000 areas (Dreskovic, 2011) indicate the presence of 36 species in the wider area of mountain Prenj, however, older literature data are not georeferenced, and these species have not been found within the covered scope.

In the route area, field research has determined the permanent presence of six species with status of importance for EU and domestic legislation or with some degree of endangerment: *Nymphalis antiopa, Zerynthia polyxena, Euplagia quadripunctaria, Lasioglossum convexiusculum, Morimus funereus Hipparchia statilinus*. A summary of the survey results is shown in Table 2 below, whereas data on species of conservation concern from previous studies are critically assessed as well.

During the construction process on the subsection of the Prenj tunnel, there will be no indirect endangerment of invertebrate habitats. It should be noted that the plateau of the Prenj-Cvrsnica-Cabulja massif is a very important habitat for invertebrate species identified in literature and field research, but the effects of construction on these species are negligible due to:

- a very narrow area of direct project impact primarily in the vicinity of the northern Prenj tunnel portal;
- wide distribution of identified species.

[4] Zagrebinspekt "ZGI" d.o.o. Mostar. (2016). Environmental Impact Study. Section: Konjic (interchange Ovcari) - Mostar North, L = 36.50 km. Mostar.

Table 2: Overview of invertebrate species of importance for the European Union or having a degree of protection within the study area determined in the field and based on literature data

Species name	Scientific name	Conservation status	Suitable habitat in the area?	Research Finding — Has the Species Been Found?	Location (where?)	Reference (if it is a literature data)
Mourning cloak	*Nymphalis antiopa*	FBiH NT	Yes	Yes	Polje Bijela	Field studies
Southern festoon	*Zerynthia polyxena*	FBiH NT, HD IV	Yes	Yes	Podgorani	Field studies
Jersey tiger	*Euplagia quadripunctaria*	HD II (*)	Yes	Yes	Humilisani, Polje Bijela	Field studies
	Lasioglossum convexiusculum	IUCN NT	Yes	Yes	Kuti-Livac, Podgorani, Podporim	Field studies
Long-horned beetle	*Morimus funereus*	IUCN VU, HD II	Yes	Yes	Rakov Laz	Field studies
Tree grayling	*Hipparchia statilinus*	IUCN NT, FBiH VU	Yes	Yes	Humilisani, Podgorani	Field studies
White Banded Grayling	*Pseudochazara anthelea*	FBiH EN	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)[5]
	Aphodius foetidus	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)

[5] Apfelbeck, V. (1915). *Fauna insectorum balcanica*. The Herald of the National Museum in Bosnia and Herzegovina.

Species name	Scientific name	Conservation status	Suitable habitat in the area?	Research Finding — Has the Species Been Found?	Location (where?)	Reference (if it is a literature data)
Cardinal	*Argynnis pandora*	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
	Chilothorax paykulli	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Small blue	*Cupido minimus*	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Osiris blue	*Cupido osiris*	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Pea blue	*Lampides boeticus*	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Balkan marbled white	*Melanargia larissa*	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)

Species name	Scientific name	Conservation status	Suitable habitat in the area?	Research Finding — Has the Species Been Found?	Location (where?)	Reference (if it is a literature data)
	Onthophagus ovatus	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
	Sigorus porcus	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
	Trypocopris vernalis	FBiH NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
The Hermit	*Chazara briseis*	FBiH NT, IUCN NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Woodland grayling	*Hipparchia fagi*	FBiH NT, IUCN NT	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Cleopatra butterfly	*Gonepteryx cleopatra*	FBiH VU	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)

Species name	Scientific name	Conservation status	Suitable habitat in the area?	Research Finding — Has the Species Been Found?	Location (where?)	Reference (if it is a literature data)
Anomalous blue	*Polyommatus admetus*	FBiH VU	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Pine Chafe	*Polyphylla fullo*	FBiH VU	Yes	No	Expected in the area of direct impact of the route in the area of: Kuti-Livac, Podgorani, Podporim	Apfelbeck, V. (1915)
Marsh Fritillary	*Euphydryas aurinia*	HD II	Yes	No	Expected in the valley of Konjic Bijela	Red List of FBiH
	Rhysodes sulcatus	HD II	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)
	Stephanopachys linearis	HD II	Yes	No	Expected in the area of Ovcari, Zlatar	Apfelbeck, V. (1915)
	Stephanopachys substriatus	HD II	Yes	No	Expected in the area of Ovcari, Zlatar	Apfelbeck, V. (1915)
	Carabus (variolosus) nodulosus	HD II, IV	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)
False comma	*Nymphalis vaualbum*	HD II, IV (*)	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)
	Phryganophilus ruficollis	HD II, IV (*)	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)

Species name	Scientific name	Conservation status	Suitable habitat in the area?	Research Finding — Has the Species Been Found?	Location (where?)	Reference (if it is a literature data)
Scarce Fritillary	*Euphydryas maturna*	IUCN DD, IUCN-EV VU, HD II, IV	Yes	No	Expected in the valley of Konjic Bijela	Red List of FBiH
Goldstreifiger	*Buprestis splendens*	IUCN EN, HD II, IV	Yes	No	Expected in the area of Ovcari, Zlatar	Apfelbeck, V. (1915)
European stag beetle	*Lucanus cervus*	IUCN NT, FBiH VU, HD II	Yes	No	Expected in the area of Ovcari, Zlatar, southern slopes of Prenj mountain	Apfelbeck, V. (1915)
Balkan Goldenring	*Cordulegaster heros*	IUCN NT, HD II, IV	Yes	No	Expected in the valley of Konjic Bijela and the River Tresanica	Apfelbeck, V. (1915)
Red flat bark beetle	*Cucujus cinnaberinus*	IUCN NT, HD II, IV	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)
Large Copper	*Lycaena dispar*	IUCN NT, HD II, IV	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)
Hermit beetle	*Osmoderma eremita*	IUCN NT, HD II, IV (*)	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)
Large blue	*Phengaris arion*	IUCN NT, IUCN EN, HD IV	Yes	No	Expected in the valley of Konjic Bijela	Red List of FBiH
Cerambyx Longicorn	*Cerambyx cerdo*	IUCN VU, HD II, IV	Yes	No	Expected in the area of Ovcari, Zlatar, southern slopes of Prenj mountain	Apfelbeck, V. (1915)
Rosalia Longicorn	*Rosalia alpina*	IUCN VU, HD II, IV	Yes	No	Expected in the valley of	Apfelbeck, V. (1915)

Species name	Scientific name	Conservation status	Suitable habitat in the area?	Research Finding — Has the Species Been Found?	Location (where?)	Reference (if it is a literature data)
		(*)			Konjic Bijela	
Apollo	*Parnassius apollo*	IUCN VU, HD IV	Yes	No	Expected on slopes at higher altitudes in the area of Konjic Bijela	Red List of FBiH
Clouded Apollo	*Parnassius mnemosyne*	IUCN NT, HD IV	Yes	No	Expected in the valley of Konjic Bijela	Apfelbeck, V. (1915)
White-clawed Crayfish	*Austropotamobius pallipes*	IUCN EN, HD II, IV	Yes	No	Expected in the valley of Konjic Bijela and the River Tresanica	Red List of FBiH

4 Discussion and Recommendations

4.1 Summary of Major Findings

During field research conducted in 2020 and 2021 in the impact area of the construction of the Corridor Vc section Konjic (Ovcari) - Prenj Tunnel - Mostar North, a total of six invertebrate species were confirmed. The found species are as follows: mourning cloak (*Nymphalis antiopa*), southern festoon (*Zerynthia polyxena*), Jersey tiger (*Euplagia quadripunctaria*), long-horned beetle (*Morimus funereus*), tree grayling (*Hipparchia statilinus*) and *Lasioglossum convexiusculum*.

Even though literature data suggests possible presence of a higher number of invertebrates of conservation concern, lack of habitats and georeferenced data suggests these species are very likely to be limited to preserved natural ecosystems at higher altitudes or other pristine habitats of Mt. Prenj not in project's vicinity. However, our motorway impact area analysis was extended beyond AOI to habitats important for species relevant for the assessment, such as *Lucanus cervus* and *Cucujus cinnaberinus* which are species associated with forest habitats. In spite of that, the aforementioned insect species were not found during the survey. The area of Konjic bypass is not a core habitat for invertebrate species.

4.1.1 Sensitive Species

Due to the nature of good practice for biodiversity baseline data collection, all of the invertebrates found in the field and literature listed in this document are considered sensitive species. We can highlight the IUCN VU species *Morimus funereus* found in the area of direct impact of the motorway section. Additionally, species of importance for the European Union (Habitats Directive Annexes II and IV) are present as well: *Zerynthia polyxena, Euplagia quadripunctaria* and *Morimus funereus*.

4.2 Mitigation Measures

4.2.1 Pre-construction Phase

Mitigation measures in the pre-construction period are reduced to avoiding works in the area of forest ecosystems within the zone of physical impact, and it should be especially emphasised that, during the construction of access roads, it is necessary to plan works in a manner to avoid additional deforestation and ecosystem damage. Impact measures and mitigation measures are significant for the prevention of avoidable negative impacts on invertebrates; however, due to the wide distribution of found species and the possibility of subsequent recolonisation of habitats, no significant irreversible negative effects are expected. Of the species found, only *Morimus funereus* is related to forest habitats. Habitat loss during the exploration phase can be compensated through the excavation site recultivation during the project exploitation phase.

4.2.2 Construction Phase

Restrict the movement of construction machinery, mechanisation and means of transport exclusively in the construction area for the purpose of maximal habitat protection without any additional disturbance of habitats.

During the construction period, whenever possible, and after completion of the construction of the Prenj tunnel, it is necessary to recultivate the excavated material disposal sites, which will compensate for the loss of habitats that will be buried in landfills. Recultivation should be done with indigenous species, including Dalmatian laburnum (*Petteria ramentacea*), hornbeam (*Carpinus orientalis*) and oak (different species of the genus *Quercus* found in the project area). This should be done through a biodiversity management plan when all excavated material sites are known.

During the construction period, underground cave systems and caverns with cave organisms may open. In case of encountering underground structures, it is obligatory to suspend the works. All cases of such systems opening must be reported to the Lenders. Pending approval, a speleological company, NGO or other competent entity must be hired to examine the significance of open systems and to safely seal and separate underground habitats from tunnel systems. Improper closure of such systems by backfilling may cause an unacceptable pressure on valuable underground habitats and animals.

The species *Zerynthia polyxena* was found in the locality of Podgorani. Areas inhabited by this species are open meadow habitats. The female lays eggs on species of the genus *Aristolochia*. No habitats with a nourishing plant from the genus *Aristolochia* were found within the route area. However, opening of forest habitats, provided that the area is maintained in a way to promote the development of meadows rather than lawns along the motorway, can lead to an increase in open micro-habitats of this species.

Euplagia quadripunctaria was found at the locality of Humilisani and Polje Bijela. Areas inhabited by this species are thermophilic deciduous forests and forest edges. The larvae feed on various plant species. Opening of forest habitats and larger areas of marginal parts favour the species tied to the forest edge. The specific habitats of the species will not be endangered during construction but the construction of the motorway will increase the marginal parts of forest habitats resulting in net gain of habitats for said species.

Morimus funereus and *Lucanus cervus* (species not found but expected to be present in the project area according to literature and distribution data) species depend on preserved forest areas, old beech and oak trees. During cutting down of trees in the belt of the route, all trees are to be stacked in piles that will remain in the area along the route to ensure that individuals developing in the trees complete the cycle and that subsequent generations of insects can lay eggs in the trees until the natural decay of the collected plant mass. Whenever possible, avoid unnecessary cutting of older trees and removal of dead wood.

4.2.3 Operational Phase

Avoid the use of dissolving salts and other chemicals as much as possible and their discharge into the natural habitats.

Possible negative pressure on the invertebrate species caused by the construction of the Prenj tunnel comes down to the aggregation of insects in the lighting and the death of insects when in contact with cars moving at high speed. The ecotone along the corridor Vc route can play a significant role in the expansion of the habitats of butterflies and other insect species that inhabit marginal habitats. The importance of the ecotone along the motorway will be reflected through the increase of the habitat area of indigenous species of open habitats, such as the species *Euplagia quadripunctaria*. However, the effects of ecotones and habitat fragmentation are much more significant for forest species (such as *Lucanus cervus*) that fly from forest to open habitats, thus increasing the likelihood of individuals being killed by cars. Possible mitigation measures are the use of red lighting that is less attractive to insects and, if necessary, the installation of high barriers (mesh materials) in the parts where the high frequency of dead individuals is determined after monitoring as given in BMP.

Revitalisation of habitats after the construction with planting of autochthonous plant species characteristic for the area must be done as aforementioned.

4.3 Monitoring Measures

4.3.1 Pre-construction Phase

In the pre-construction phase, conduct monitoring to obtain a better picture of species diversity, with focus on *Lucanus cervus* and *Cerambyx cerdo* which are very likely to be present in the project area of influence.

4.3.2 Construction Phase

Through the biodiversity management plan, monitor and implement mitigation measures for the species *Lucanus cervus, Cerambyx cerdo* and *Morimus funereus*. Monitoring measures should be applied in the area of Humilisani and Konjic Bijela.

Provide biospeleological supervision during excavations along the route.

4.3.3 Operational Phase

Monitoring to estimate the number of killed individuals within the route is needed for the species *Lucanus cervus* and *Cerambyx cerdo*.

Monitoring of habitat recolonisation for species: *Euplagia quadripunctaria, Zerynthia polyxena* in the cleared and artificially maintained areas along the motorway route.

Monitoring of afforested excavated material landfills for the purpose of adopting measures to improve and accelerate the process of recolonisation of *Lucanus cervus* and *Cerambyx cerdo* species.

5 Annexes

5.1 Maps

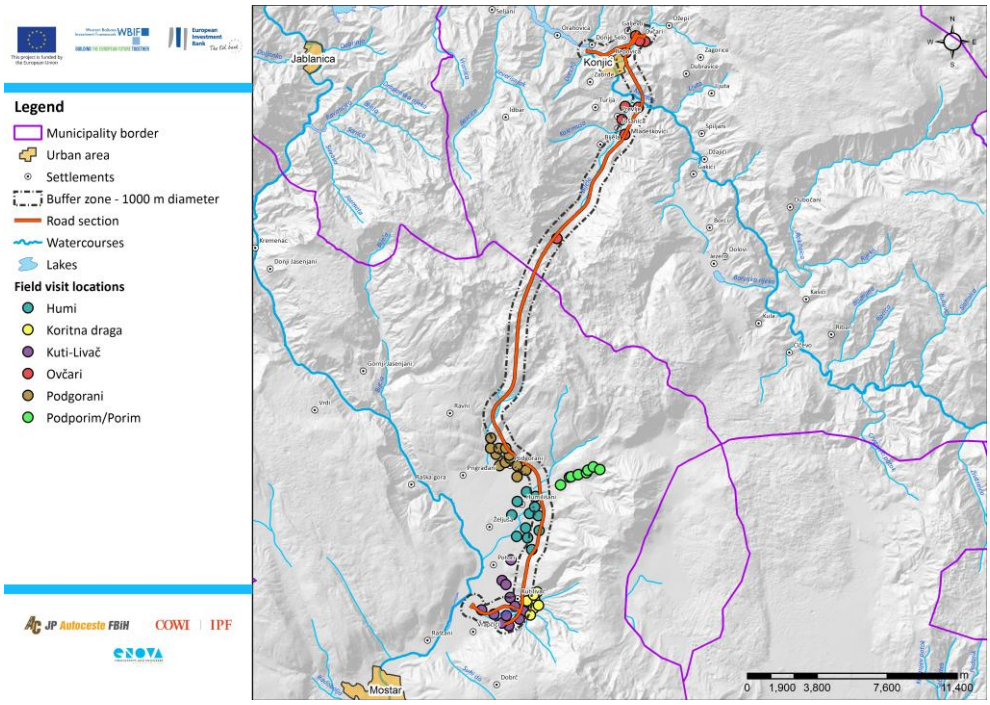

Figure 1: Invertebrate survey sites

5.2 Habitat Photos

Figure 2: Habitat type on the locality of Humilisani

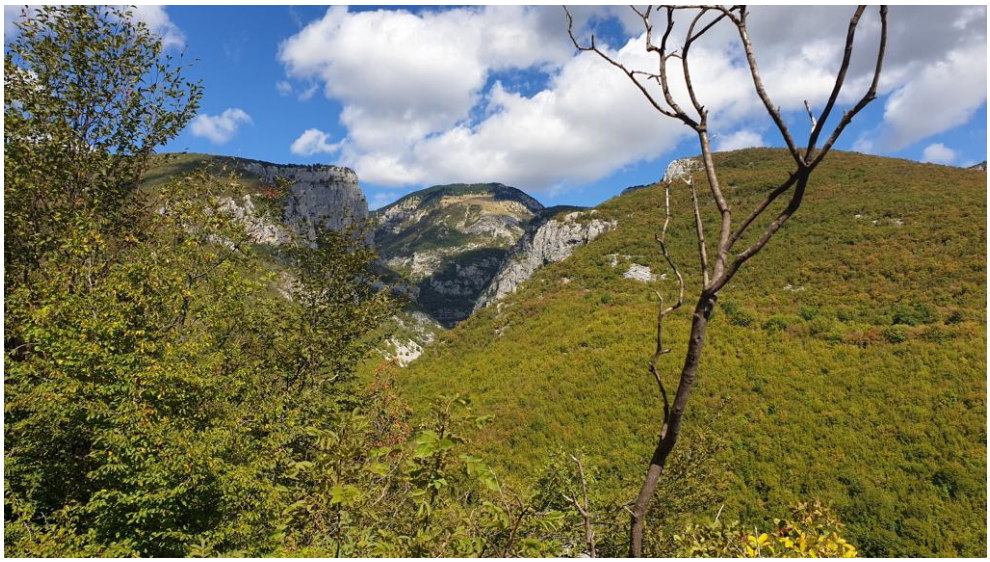

Figure 3: Locality of Podgorani

Figure 4: Porim-Podporim locality

Figure 5: Rakov Laz locality

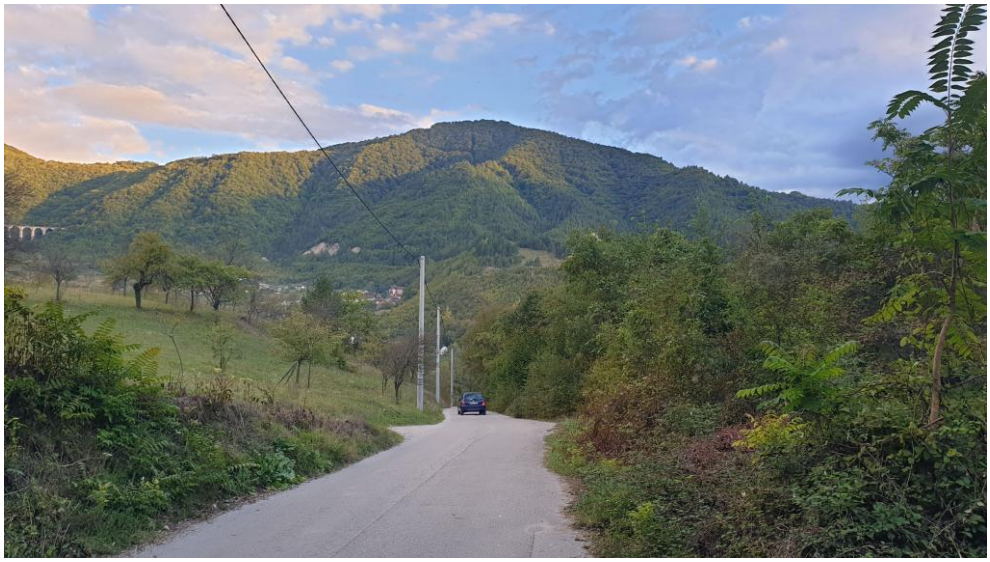

Figure 6: Ovcari locality, view of Zlatar Mt.

5.3 Photos of Species

Figure 7: Southern festoon (Zerynthia polyxena)

Figure 8: Balkan Green-veined White (Pieris balcana), IUCN LC

Figure 9: Small heath (Coenonympha pamphilus), IUCN LC