BIODIVERSITY ASSESSMENT OF TERRESTRIAL INVERTEBRATES

FOR THE NEW ALIGNMENT OF THE MATESEVO-ANDRIJEVICA SECTION

SUB-SECTION: TRESNJEVIK TUNNEL – ANDRIJEVICA

October-November 2024

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I INTRODUCTION

The EBRD Bank has engaged PASECO S.P. Ltd Greece (hereinafter referred to as the "Leading Consultant") to provide consultancy services and implement the project "Montenegro: Construction of the Bar-Boljare Highway – Environmental and Social Assessment" (hereinafter referred to as the "Project"), in accordance with EBRD Performance Requirements. As part of the Project, a biodiversity assessment was conducted in 2019–2021 for the Matesevo-Andrijevica section. Biodiversity assessment for the purposes of the Project covered the following aspects:

- Habitats and flora
- Bats and other mammals
- Ichthyofauna and benthic fauna
- Amphibians and reptiles
- Ornithofauna

Due to recent changes in the preliminary design for an approximately 12 km stretch of the route, from the entrance of the Tresnjevik tunnel to Andrijevica, it became necessary to conduct a complementary biodiversity assessment for this new alignment, Tresnjevik-Andrijevica (hereinafter referred to as the "Sub-Project"). To carry out the Sub-Project, the Leading consultant engaged E3 Consulting Ltd. Montenegro (hereinafter referred to as the "Local consultant") to recruit a local team of biologists and provide key findings. The Sub-Project was conducted by a multidisciplinary team of national experts during October–November 2024, including both fieldwork and reporting in accordance with the methodology provided by the Leading consultant. The Sub-Project covered following biodiversity aspects:

- Flora and Habitats
- Bats
- Mammals
- Ornithofauna
- Icthyiofauna and benthic fauna
- Terrestrial invertebrates
- Aquatic invertebrates
- Amphibians and reptiles

The Sub-Project involved the following tasks:

1. Rapid review of the surveys conducted in the framework of conceptual/preliminary design (for the old alignment) for the Sub-Section (done in 2019-2021). These surveys covered:
   a. Habitats and flora
   b. Bats and other mammals
   c. Ichtyiofauna and bentic fauna
   d. Amphibians and reptiles
   e. Ornithofauna

Local consultant will assess the zones that were researched during the surveys 2019-2021 (e.g. flora and vegetation (habitats) surveys included 500m to the left and right of the planned Project) with the new alignment. The aim is to express the expert opinion on the degree on which the previous surveys cover the new alignment and determine the extent of the new campaign.

2. For the biodiversity features (among (a) to (e) above), for which it is estimated that tne new alignment is not covered by the previous surveys, Local consultant will conduct an additional survey, as follows:
   i. The survey will be conducted until the end of October 2024
   ii. Five on-site days are foreseen
   iii. The survey will follow the same methodology as the 2019-2021 research

3. Drafting of report with the findings. The report will have the main structure as per previous surveys and will be detailed enough to comply with EBRD ESP requirements. The report will include:
   i. Bibliographical data on biodiversity in the zone of the new alignment
   ii. Period of surveys and Methodology used
   iii. Findings of surveys
   iv. Assessment of protection status of habitats/species according to EU legislation, international agreements and national legislation
   v. Significant impact of the highway construction on habitats and species and proposal of relevant mitigation measures
   vi. Maps and photographical documentation

The Sub-Project resulted in the submission of eight separate reports, accompanied by supporting maps and photographic documentation, detailing key biodiversity aspects related to the Sub-Project, with a focus on autumnal research findings.

For the purposes of new alignment invertebrate surveys were conducted in the project area associated with the new alignment section between Trešnjevik and Andrijevica. This section is approximately 12 km long and forms part of the Bar–Boljare highway. The research also includes the zone of influence (500 meters on both sides of the road). The project area is located in the eastern part of Montenegro, between the Bjelasica Mountains in the north and the Komovi Mountains in the south. It extends in an east-west direction, mostly following the valley of the Kraštica River and its tributaries (Rajovića stream, Dubokalj, Novovića stream, Prisojački stream, Durački stream, and Gnjili stream), which flows into the Lim River near Andrijevica. The Kraštica River valley will be under direct pressure from the construction and operation of the highway. The Lim River valley is recognized as an area of special importance — an Important Plant Area (IPA) and an EMERALD area. Therefore, all potential risks that could lead to changes in water quality, especially pollution through the Kraštica River and its tributaries, must be minimized.

This study presents the research results, the potential negative impacts during various phases of the project, and the proposed mitigation measures. It is important to note that the research was conducted at a time when the activity period for many invertebrate groups (especially insects) had already ended. Additional research during the spring and summer months is recommendable in order to obtain a more accurate data.

II RAPID REVIEW OF SURVEYS CONDUCTED 2019-2021

During the previous biodiversity study for the Mateševo–Andrijevica highway section (2019-2021), no terrestrial invertebrate surveys were conducted. As a result, we are unable to enhance the existing data or make comparisons.

III BIBLIOGRAPHICAL DATA ON BIODIVERSITY IN THE ZONE OF THE NEW ALIGNMENT

A review of the available literature revealed no published data on this group of animals in the project area or the surrounding region. However, some unpublished data from research conducted around Mateševo, Berane, and Andrijevica are available (personal data).

IV SURVEY PERIOD AND METHODOLOGY

In accordance with the project tasks, five field days were conducted in October 2024 along the new alignment of the Mateševo–Andrijevica section, covering the area from the entrance of the Trešnjevik Tunnel towards Andrijevica.

Researching this group of animals presents certain challenges. Some invertebrate groups, especially insects, are highly sensitive to environmental conditions, and their presence in the field may not be detected if climatic conditions are unfavorable (e.g., low temperatures, wind, precipitation, or cloudiness). The autumn period is not ideal for researching terrestrial invertebrates, particularly insects, as the activity period for most species has already ended. To obtain a more realistic picture of the biodiversity of this group, research should be continued in the spring and summer when the majority of species, including those of national and international importance, are active.

Moreover, given the large and diverse nature of this group, it is recommendable inclusion of multidisciplinary team of experts specializing in different subgroups, as well as significant time and patience to register the numerous species in the field. All of these factors influence the research results and the detection of certain species.

Survey methodology

Species monitoring and material collection during field research were carried out in accordance with international standards (van Swaay et al., 2015; Parisi et al., 2022; Triplehorn and Johnson, 2005; Nautiyal et al., 2015).

Since invertebrates represent the most numerous and ecologically diverse group of animals, their ecological characteristics are also highly varied. As a result, the methods for collecting and processing materials are diverse as well. Several standard and widely accepted methods were used for collecting insects in the field, including: hand collection (for larger species from the orders Orthoptera and Coleoptera), the use of a standard entomological net (to collect species in flight, particularly from the orders Lepidoptera, Hymenoptera, Diptera, etc.); various types of traps (light, sticky, hormonal, and scent traps, Malais traps); and the umbrella method, which involves shaking bushes and shrubs over a light substrate placed underneath (Triplehorn and Johnson, 2005; Nautiyal et al., 2015).

The collected material was then properly stored until it could be returned to the laboratory. Butterfly wings were folded upwards, and the body was held gently between the fingers for a few minutes (until they stopped moving) before being placed carefully in paper envelopes. Most other species were briefly placed in mordants before being transferred to vials for transport. For material intended for further molecular analysis, the use of chemicals is avoided, and specimens are frozen instead. Specimens collected with scent traps (especially those captured using alcohol and vinegar) were stored in 70% alcohol.

Some specimens, which could be identified in the field (to the species level), were released, while others were kept for later identification under laboratory conditions. Easily identifiable species were recorded without being collected. For rare and endangered species, after being recorded in the field, they were photographed, documented, and then released back into nature.

Upon returning from the field, the collected material was processed using standard preparation methods and scientifically analyzed (identified) with the help of appropriate scientific literature (Bartsch, 2009a, b; Chinery, 2005; Dijkstra, 2006; Grković, 2018; Polak, 2009; Stubs and Falk, 2008; Tor, 2004) using stereo microscope equipment (40 to 90 times magnification).

For fieldwork, it is crucial to understand the ecological preferences of the species in question to determine when and where to search for them. Many species' appearance is linked to specific vegetation types and the presence of host plants. This understanding was an important factor in selecting research sites within the study area. Additionally, long-term fieldwork experience played a key role in enhancing the effectiveness of the research.

V KEY RESEARCH FINDINGS

Table 1 provides an overview of the species recorded during the research conducted in October 2024. The list also includes species that were recorded in the broader areas of Mateševo, Berane, and Andrijevica (personal data) in similar or identical habitat types, which are expected to be found in the project area. To confirm the presence of these species—some of which are of international and/or national importance—further research is recommendable during the spring and summer seasons.

Table 1. List of species presumed and recorded in the surveyed area

Group/Latin name	Group/English name
Lepidoptera	**Butterflies**
Papilio machaon (Linnaeus, 1758)	Old World Swallowtail
Iphiclides podalirius (Linnaeus, 1758)	Scarce Swallowtail
Parnassius mnemosyne(Linnaeus, 1758)	Clouded Apollo
Anthocharis cardamines (Linnaeus, 1758)	Orange Tip
Aporia crataegi (Linnaeus, 1758)	Black-veined white
Pieris brassicae (Linnaeus, 1758)	Large White
Pieris rapae (Linnaeus, 1758)	Cabbage White
Gonepteryx rhamni (Linnaeus, 1758)	Common brimstone
Colias croceus (Frourroy, 1785)	Clouded Yellow
Leptidea sinapis (Linnaeus, 1758)	Wood White
Callophris rubi (Linnaeus, 1758)	Green Hairstreak
Cupido minimus (Fuessly, 1775)	Small Blue
Scolitantides orion (Palla, 1771)	Chequered Blue
Pseudophilotes vicrama (Moore, 1865)	Eastern Baton Blue
Polyommatus icarus (Rottemburg, 1775)	Common Blue
Glaucopsyche alexis Poda, 1761	Green-underside Blue
Lycaena alciphron (Rottemburg, 1775)	Purple-shot Copper
Lycaena tityrus Poda, 1761	Sooty copper
Boloria euphrosyne (Linnaeus, 1758)	Pearl-bordered Fritillary
Euphydryas aurinia (Rottemburg, 1775)	Marsh Fritillary
Euphydryas maturna (Linnaeus, 1758)	Scarce Fritillary
Argynnis aglaja (Linnaeus, 1758)	Dark Greeen Fritillary
Argynnis adippe (Denis & Schiffermuller, 1775)	High Brown Fritillary
Aglais io (Linnaeus, 1758)	European Peacock
Aglais urticae (Linnaeus, 1758)	Small Tortoiseshell
Issoria lathonia (Linnaeus, 1758)	Queen of Spain fritillary
Melanargia galathea (Linnaeus, 1758)	Marbled White
Nymphalis polychloros (Linnaeus, 1758)	Large Tortoiseshell
Limenitis reducta Staudinger, 1901	Southern White Admiral
Polygonia c-album (Linnaeus, 1758)	Comma
Vanessa atalanta (Linnaeus, 1758)	Red admiral
Vanessa cardui (Linnaeus, 1758)	Painted lady
Melitaea cinxia (Linnaeus, 1758)	Glanville fritillary
Pararge aegeria (Linnaeus, 1758)	Speckled Wood
Lasiommmata megera (Linnaeus, 1758)	Wall Brown
Lassiommata maera (Linnaeus, 1758)	Large Wall Brown
Brintesia circe (Fabricius, 1775)	Great Banded Grayling
Maniola jurtina (Linnaeus, 1758)	Meadow brown
Erebia medusa (Denis & Schiffermuller, 1775)	Woodland Ringlet
Coenonympha pamphilus Elwes, 1900	Small Heath
Coenonympha arcania (Linnaeus, 1758)	Pearly Heath
Coenonymphy glyceron (Borkhausen, 1788)	Chestnut Heath
Amata phegea (Linnaeus, 1758)	Nine-spotted Moth
Zygaena filipendulae (Linnaeus, 1758)	Six-spot Burnet
Zygaena lonicerae (Scheven, 1777)	Narrow-bordered five-spot burnet
Euplagia quadripunctaria (Poda, 1761)	Jersey tiger
Lasiocampa quercus (Linnaeus, 1758)	Oak Eggar Moth
Pseudopanthera macularia (Linnaeus, 1758)	Speckled Yellow Moth
Macroglossum stellatarum (Linnaeus, 1758)	Hummingbird Hawkmoth
Hemaris tityus (Linnaeus, 1758)	Narrow-bordered Bee Hawkmoth
Hymenoptera	**Hymenopteran**
Xylocopa violacea (Linnaeus, 1758)	Violet Carpenter Bee
Apis mellifera Linnaeus, 1758	European Honeybee

Vespa crabro Linnaeus, 1758	Hornet (commonly referred to as European Hornet)
Vespula vulgaris (Linnaeus, 1758)	Common Wasp
Bombus lapidarius (Linnaeus, 1758)	Red-tailed Bumblebee
Bombus sylvarum Linnaeus, 1761	Shrill Carder Bee (also known as Milk Thistle Bumblebee)
Bombus terrestris Linnaeus, 1758	Large Earth Bumblebee (or Buff-tailed Bumblebee)
Bombus lucorum (Linnaeus, 1758)	White-tailed Bumblebee
Bombus sp.	Bumblebee
Cerceris sp. (fam Crabronidae)	Wasps
Dilichovespula sp.	Wasps
Eucera sp. (Apidae)	Bees
Diptera	**True flies**
Bombylis major Linnaeus, 1758 (Bombilidae)	Greater Bee Fly
Tabanus bovinus Linnaeus, 1758 (Tabanidae)	Horsefly
Tachina fera (Linnaeus, 1761) (Tachinidae)	Tachinid Flay
Empis sp. (Empididae)	Dance Flies
Tipula sp. (Tipulidae)	Crane Flies
Calliphora sp. (Calliphoridae)	Blowflies
Fam. Syrphidae	**Hoverflies**
Callicera aurata (Rossi),1790	Hoverfly
Caliprobola speciosa (Rossi,1790)	Hoverfly
Cheilosia albitarsis (Meigen, 1822)	Hoverfly
Cheilosia canicularis (Panzer, 1801)	Hoverfly
Cheilosia ranunculi Doczkal, 2000	Hoverfly
Cheilosia scutellata (Fallen, 1817	Hoverfly
Chrysotoxum bicinctum (Linnaeus, 1758)	Hoverfly
Chrysotoxum cautum (Harris, 1776)	Hoverfly
Chrysotoxum elegans Loew, 1841	Hoverfly
Chrysotoxum festivum (Linnaeus, 1758)	Hoverfly
Criorhina ranunculi (Panzer, 1804)	Hoverfly
Episyrphus balteatus (De Geer, 1776)	Hoverfly
Eristalis arbustorum (Linnaeus, 1758)	Hoverfly
Eristalis pertinax (Scopoli, 1763)	Hoverfly
Eristalis similis (Fallen, 1817)	Hoverfly
Eristalis tenax (Linnaeus, 1758)	Hoverfly
Eupeodes corollae (Fabricius, 1794)	Hoverfly
Eupeodes luniger (Meigen, 1822)	Hoverfly
Eumerus alpinus Rondani, 1857	Hoverfly
Eumerus tricolor (Fabricius, 1798)	Hoverfly
Lapposyrphuslapponicus (Zetterstedt, 1838)	Hoverfly
Meliscaeva auricolis (Meigen), 1822	Hoverfly
Meliscaeva cinctella (Zetterstedt), 1843	Hoverfly
Melanostoma mellinum (Linnaeus, 1758)	Hoverfly
Melanostoma scalare (Fabricius, 1794)	Hoverfly
Merodon armipes Rondani, 1843	Hoverfly
Microdon devius (Linnaeus), 1761	Hoverfly
Paragus haemorrhous Meigen, 1822	Hoverfly
Platycheirus albimanus (Fabricius, 1781)	Hoverfly
Scaeva dignota (Rondani), 1857	Hoverfly
Scaeva pyrastri (Linnaeus, 1758)	Hoverfly
Scaeva selenitica (Meigen, 1822)	Hoverfly
Sphaerophoria scripta (Linnaeus, 1758)	Hoverfly
Syrphus ribesii (Linnaeus, 1758)	Hoverfly
Syrphus vitripennis Meigen, 1822	Hoverfly

Syritta pipiens (Linnaeus, 1758)	Hoverfly
Philhelius stackelbergi Violovitsh, 1975	Hoverfly
Volucella bombylans (Linnaeus, 1767)	Hoverfly
Volucella zonaria (Poda, 1761)	Hoverfly
Xylota segnis (Linnaeus, 1758)	Hoverfly
Coleoptera	**Beetles**
Morimus funereus Mulsant 1863	Beech Longhorn Beetle
Lucanus cervus (Linnaeus, 1758)	Stag Beetle
Coccinela semptempunctata (Linnaeus, 1758)	Ladybug (or Ladybird)
Cantharis rustica Fallen, 1807	Soldier Beetle
Cantharis fusca Linnaeus, 1758	Black Soldier Beetle
Cetonia aurata (Linnaeus, 1758)	Rose Chafer (or Green Rose Chafer)
Carabus sp.	Ground Beetle
Geotrupes stercorarius (Linnaeus, 1758)	Dung Beetle or Dor Beetle
Geotrupes (Trypocopris) vernalis Linnaeus, 1758	Spring Dung Beetle
Melolontha melolontha (Linnaeus, 1758)	Common Cockchafer (Maybeetle)
Meloe violaceus Marsham, 1802	Violet oil beetle
Ocypus olens (O. F. Mùller, 1764)	Devil's Coach Horse Beetle
Paederus littoralis Fabricius, 1775	Littoral Whiplash Rove Beetle
Ruptela maculate (Poda, 1761)	Spotted Longhorn Beetle
Leptura aurelenta (Fabricius, 1792)	Longhorn Beetle
Leptura quadrifasciata Linnaeus, 1758	Four-spotted Longhorn Beetle
Dinoptera collaris (Linnaeus, 1758)	Longhorn Beetle
Trichius fasciatus (Linnaeus, 1758)	Bee Beetle
Rhagonycha fulva (Scopili (1763)	Red Soldier Beetle
Odonata	
Lubellula depressa (Linnaeus, 1758)	*Broad-bodied* Chaser
Anax imperator Leach, 1815	*Blue Emperor*
Calopteryx virgo Linnaeus, 1758	Beautiful Demoiselle
Orthetrum spp.	*Skimmers*
Sympetrum spp.	Darter
Hemiptera	**True bugs**
Spilostethus saxatilis (Scopoli, 1763)	Seed Bug, Stone Bug
Carpocoris purpureipennis (De Geer, 1773)	Shield Bugs, Stink Bugs
Pyrrhocoris apterus (Linnaeus, 1758)	European Firebug
Graphosoma italicum (Muller, 1766)	Italian Striped Bug
Cercopis vulnerata Rossi, 1805	-
Rhinocoris sp.	Asian Firebugs
Orthoptera	**Orthopterans (Grasshoppers and Crickets)**
Anacrydium aegiptum (Linnaeus, 1758)	Egyptian Grasshopper
Gryllus campestris Linnaeus, 1758	Mole Cricket
Tettigonidae (more species)	Crickets
Acridiidae (more species)	Grasshoppers
Dermaptera	**Earwig**
Forficula auricularia Linnaeus, 1758	European Earwig
Mantodea	**Mantis**
Mantis religiosa Linnaeus, 1758	European Mantis

Table2: Species of international and/or national importance presume to be presented

Group	Species name (latin/english)	Protected in Montenegro	conservation status (IUCN)	conservation status (IUCN) in Montenegro	EU HD directive annex	Bern convention appendix
Insects/ Lepidoptera	*Iphyclides podalirius* Scarce Swallowtail	+	LC	NT	-	-
Insects/ Lepidoptera	*Papilio machaon* Old World Swallowtail	+	LC	NT	-	-
Insects/ Lepidoptera	*Parnassius mnemosyne* Clouded Apollo	-	LC	VU	IV	II
Insects/ Lepidoptera	*Euphydryas aurinia* Marsh Fritillary	-	LC	VU	II	II
Insects/ Lepidoptera	*Euphydryas maturna* Scarce Fritillary	-	VU	VU	II, IV	II
Insects/ Lepidoptera	*Euplagia quadripunctaria* Jersey Tiger	-	LC	n.a.	II	I
Insects/ Coleoptera	*Morimus funereus* Beech Longhorn Beetle	-	VU	n.a.	II	II
Insects/ Coleoptera	*Rosalia alpina Alpine longhorn beetle*	+	VU	n.a.	II, IV	II
Insects/ Coleoptera	*Lucanus cervus Stag beetle*	+	NT	n.a.	II	III
Insects/ Coleoptera	*Cerambyx cerdo* Great Capricorn Beetle	-	VU	n.a.	II, IV	II
Insects/ Coleoptera	*Oryctes nasicornis* European Rhinoceros Beetle	+	NT	n.a.	-	-

List of protected species in Montenegro: "Decision on placing under protection particular plant and animal species" Official Gazette 76/06; **IUCN** (International Union for Conservation of Nature) **red list**; **LC**- **least concern; NT** – near threatened**; VU –** vulnerable species**; EU Habitat direktiva (HD)**- Council of European Communities (1992): Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wildlife and flora Habitats Directive - 92/43/EEC. **Resolution 6 of the Bern Convention (BC)**, - Council of Europe (1979): Convention on the conservation of European wildlife and natural habitats. Bern, Switzerland; **II, III, IV, V** – vrsta se nalazi u navedenom appendiksu ili aneksu; **CITES** - the Convention on International Trade in

Parnassius mnemosyne (Linnaeus, 1758) – Clouded Apollo

Endangerment at national and international level: This species has IUCN category NT in Europe, and IUCN category VU in Montenegro; listed in Annex IV of the EU Habitats Directive (Council Directive 92/43 / EEC on the Conservation of natural habitats and of wild fauna and flora), Annex II Berne Convention (Appendix II of the Council of Europe Bern Convention).

Ecological characteristics: Clouded Apollo prefers open habitats, clearings rich in plants (between and within forests), and also could be found along forest edges. This species inhabits meadows at slightly lower altitudes than Apollo (*Parnassius apollo*), but it can also be recorded in mountain meadows above 1500 m above sea level if there is enough food in these habitats. It feeds mainly on species of the genus *Cordylis (C. cava* and *C. intermedia*). Adults are active in the period from May to July in mountainous areas, while this period is somewhat longer at lower altitudes. The species has only one generation per year (Tolman & Lewington, 2008).

Preffered habitats in the project area (impact zone): It is expected that the species will be recorded in meadows located next to forests, or clearings in forests where there are a lot of host plants. Such habitats were recorded in a large number of locations along this section of the road (Peovac, Kralje, Laništa, Salevići, Miravčine, Gnjili Potok, Trešnjevik).

Some of the habitats preferred by the species will be under direct negative impacts (constructive zone) and some in the impact zone.

Causes of endangerment: This species is quite stenotopic and local and is not inclined to spread or migration, except in special cases, which makes it quite sensitive to changes in the habitat. It is particularly sensitive to the loss of plant species that their larvae feed on. Various anthropogenic factors, that lead to the destruction of their natural habitats, are the main reason for the decline in the number of species in many European countries (Ruchin, 2018).

Species listed in Annex IV of the Habitats Directive, is important for identifying critical habitats (CH).

Euphydryas maturna (Linnaeus, 1758) – Scarce Fritillary

Endangerment at national and international level: This species has IUCN category VU in Europe, and IUCN catergory VU in Montenegro, listed in Annexes II and IV of the EU Habitats Directive, as well as Annex II of the Bern Convention (Appendix II of the Council of Europe Bern Convention). It is not protected by law in Montenegro, unlike other European countries, where it has been recorded (Wahlberg, 1998).

Ecological characteristics: Species prefers moist and mesophilous meadows and clearings in deciduous forests, especially those with young ash trees. Females usually lay eggs on the underside of ash leaves (*Fraxinus excelsior*), although the larvae also feed on species of the genera *Lonicera, Veronica, Rhinantus, Plantago, Valeriana*. There are variations in the choice of host plants in different parts of its distribution, so in addition to ash, *Melampyrum pratense* in Finland and *Viburnum opulus* in some other parts of Europe are mentioned (Wahlberg, 1998). It was observed that adult individuals feed on nectar *Crepis biennis* and *Ranunculus acris*.

Preffered habitats in the project area (impact zone): It is expected that the species will be recorded in meadows and marginal parts of forests along the Kraštica river, Dubokalj stream, Mala rijeka, Rajovića stream, Novovića stream, Gnjili potok), wherever there are enough hostplants for adults, as well as those necessary for the development of larvae (especially where there is a lot of *Salix* and *Fraxinus* species).

Some of the habitats preferred by the species will be under direct negative impacts (constructive zone) and some in the impact zone.

Causes of endangerment: Some of the factors leading to species endangerment are of anthropogenic origin (pollution, eutrophication, soil drainage, deforestation and selective felling, as well as other activities they cause microclimate changes), and loss of host plants (eg diseases affecting ash trees).

Species listed in Annex IV of the Habitats Directive and has an IUCN status of VU (Vulnerable), is important for identifying critical habitats (CH), an also for identifying priority biodiversity features (PBF), because is listed in Annex II of the Habitats Directive.

Euphydryas aurinia (Rottemburg, 1775) – Marsh Fritillary

Endangerment nationally and internationally: This species has the IUCN category LC in Europe, and IUCN category VU in Montenegro, it is listed in Annex II of the EU Habitats Directive, as well as Appendix II of the Berne Convention. Widely distributed in the Palearctic region, however, the problem is that its populations have been declining in many countries for years, and it is considered to be one of the most endangered European butterfly species. It was recorded in smaller populations, and the formation of metapopulations is considered one of the ways of survival of the species (Hula et al., 2004).

Ecological characteristics: it prefers different types of habitats: limestone meadows, clearings in the forest, as well as wet wetlands and heaths. It inhabits different types of habitats in different parts of Europe, and chooses different host plants (Hula, 2004). Larvae feed on *Succisa pratensis*, *Scabiosa columbaria, Lonicera, Gentiana*, etc., while adults are polyphagous and feed on the nectar of *Ranunculus, Cirsium, Leucanthenum vulgare, Myosotis, Rubus, Caltha palustris, Ajuga reptans* species.

Preffered habitats in the project area (impact zone): The species is expected to be recorded along this section of the highway in the meadows around Peovac, Salevići, Kralje, Laništa, Gornje Luge, Miravčine) in wet meadows and in meadows on shallow ground, it is important that there are enough nurse plants.

Some of the habitats preferred by the species will be under direct negative impacts (constructive zone) and some in the impact zone.

Causes of endangerment: the main reasons are the destruction of natural habitats and the loss of host plants, as well as the global warming problem.

Species listed in Annex II of the Habitats Directive and has an IUCN status of VU (Vulnerable), is important for determining priority biodiversity features (PBF).

Papilio machaon Linnaeus,1758 – Old World Swallowtail

Endangerment nationally and internationally: This species has IUCN category LC in Europe, and IUCN catergory NT in Montenegro; protected by law in Montenegro. The species is widely distributed in the Palaearctic region and although it has been recorded throughout Europe, it is still protected by law in several European countries: Austria, Slovakia, Hungary, Romania, Moldova and Great Britain (Collins & Morris, 1985).
Ecological characteristics: It prefers different types of open and semi-open habitats, especially large clearings, at different altitudes. It is also recorded in urban and suburban areas. It hibernates in the larval stage and can have two to three generations during the season, while the period of activity lasts from April to September. Larvae feed on various species, especially from the families Apiacea and Rutacea.

Preffered habitats in the project area (impact zone): The habitats preferred by this species are located almost along the entire section that we investigated (larger clearings, meadows, orchards, etc.). Some of these meadows will be directly affected during the construction of the highway.
Causes of endangerment: The reduction in the number of populations in a wider area due to the loss of habitat is evident in cases of large-scale devastation. Due to its attractiveness, this species was, and still is, the target of numerous collectors (as pointed out by Holland, as early as 1907).

Iphiclides podalirius (Linnaeus, 1758) - Scarce Swallowtail

Endangerment nationally and internationally: This species has IUCN category LC in Europe, and IUCN catergory NT in Montenegro. It is protected in Montenegro, as well as in some other European countries: the Czech Republic, Slovakia, Hungary, Luxembourg, Russia, Ukraine, Poland (Collins et al., 1985).
Ecological characteristics: The species is widely distributed in Europe (except the northern parts), and even beyond the borders of the continent. It prefers grassy areas and forest clearings at altitudes above 1600 m above sea level (Forey & Fitzsimons, 2000), and even above 2000 m.

This is a polyphagous species, whose caterpillars prefer different types of wild and tame fruits (dogwood, thorn, hawthorn, white hawthorn, apple, cassia, cherry, sour cherry).

Preffered habitats in the project area (impact zone): The habitats preferred by this species are located almost along the entire section that we investigated (larger clearings, meadows with bushes, orchards, along local roads, etc.). Some of these habitats will be directly affected during the construction of the highway.

Causes of endangerment: apart from excessive hunting for the purpose of collecting, populations in some countries are also in decline due to the destruction of their natural habitats, primarily the clearing of forest vegetation, and especially certain types of bushes, on larger grassy areas.

Euplagia quadripunctaria (Poda, 1761) – Jersey Tiger

Endangerment nationally and internationally: This species has the IUCN category LC, and is listed on the Annex II of the EU Habitats Directive (Council Directive 92/43 / EEC on the Conservation of natural habitats and of wild fauna and flora). In Montenegro, it is not protected by national legislation. Jersey tiger is widespread in Europe.

Ecological characteristics: This species of butterfly prefers different types of habitats, from clearings in forests, forest edges, to bushy vegetation near rivers, often with a rocky base. It is only necessary that there are enough feeding plants in that area. This butterfly is most often recorded on the species *Eupatorum canabinum*, and species of the genera *Rubus, Taraxacum, Lamium, Urtica, Senecio, Plantago, Epilobium, Corylus, Lonicera* (Belin, 2003) are also plants. Adults actively fly in the period July-September.

Preffered habitats in the project area (impact zone): It is expected that this species will be recorded in several localities in the researched area (near the Kraštića river, Dubokalja stream, Gnjili potok), along the forest roads to Peovac, also in several locations below and above the road from Andrijevica via Kralje, Gnjili Potok to Trešnjevik, whenever there are enough plants that they prefer (especially *Eupatorum chanabinum*).

Causes of endangerment: The main threat to the populations of this species is the degradation of natural habitats, however, it was observed that habitats are mostly stable, as well as that the species expands its range to the north, and that populations have become more numerous (Fox et al., 2013).

Species listed in Annex II of the Habitats Directive is important for determining priority biodiversity features (PBF).

Rosalia alpina (Linnaeus, 1758) – Alpine longhorn beetle

Endangerment nationally and internationally: This species has IUCN category VU, it is on Annexes II and IV of the EU Habitats Directive, Appendix II of the Berne Convention, and in it is protected by law in Montenegro. It is present in most parts of Europe, except in the very north and southwestern parts (Nieto & Alexander, 2010).

Ecological characteristics: *Rosalia alpina* is an obligately saproxylic, xylophagous, xerothermophilic species. Larvae develop under the bark of beech trees, but also of some other deciduous trees (Campanaro et al., 2017) for up to three years. Adults are active from June to September. We can often find them resting on trees and stumps, but also on nearby low vegetation, where the adults feed on pollen.

Preffered habitats in the project area (impact zone): it is expected that the species will be recorded in mixed deciduous forests, especially those that are preserved and in which there are beech trees. The most important thing is that there are plenty of old trees and stumps. Such are the forests above the right bank of Kraštica river, Peovac (Žulevo brdo), Klisura, Laništa, as well as on Trešnjevik.

Causes of endangerment: populations are declining throughout Europe due to the loss of natural habitat, primarily the destruction of trees necessary for their development.

Species listed in Annex II of the Habitats Directive and has an IUCN status of VU (Vulnerable), is important for determining priority biodiversity features (PBF).

Morimus funereus Mulsant, 1863 – Beech Longhorn Beetle

Endangerment nationally and internationally: This species has IUCN category VU in Europe; it is listed on Annex II of the Habitats Directive and on Appendix II of the Berne Convention. It is widespread in the countries of Eastern and Southeastern Europe (Solano et al., 2013).

Ecological characteristics: This saproxylic species prefers different types of deciduous and mixed forests with lots of fallen and rotten trees and rotten stumps. It is especially common in beech forests. Old and decaying trees are necessary for the development of the larvae of this species. Adults are active from the beginning of spring to the end of summer.

Preffered habitats in the project area (impact zone): it is expected that the species will be recorded in mixed deciduous forests with plenty of old trees and stumps. They are most often found in beech forests, but also in forests with other deciduous species. It was recorded in the deciduous forests above the Peovac (Carpinus, Betula, Quercus), but with more detailed research it would have been recorded in other locations (forests) along the entire route. We registered one specimen in the forest near Peovac and a died specimen on Trešnjevik.

Causes of endangerment: populations are declining throughout Europe due to the loss of natural habitat (removal of fallen and rotten trees and stumps, fires, deforestation, etc).

Species listed in Annex II of the Habitats Directive and has an IUCN status of VU (Vulnerable), is important for determining priority biodiversity features (PBF).

Lucanus cervus (Linnaeus, 1758) – Stag Beetle

Endangerment nationally and internationally: This species has IUCN category NT in Europe; it is listed on Annex II of the Habitats Directive and on Appendix III of the Berne Convention. It is ptotected by law in Montenegro.

Ecological characteristics: This species prefers deciduous forests, primarily oak and beech forests, at lower altitudes up to 1000 meters above sea level, but it can also be found on species of *Salix, Tilia, Populus nigra, Fraxinus excelsior, Aesculus hippocastanum*, etc. It can also be recorded in parks in urban and suburban areas, as well as in old orchards. Adults are active from May to the end of summer (August, September) and are especially active during dusk. Larvae are xylophagous, they develop in rotten stumps or rotten tree roots, but mostly in the lower parts, i.e. near the root (Campanaro et al., 2011), and larval development lasts from 4 to 6 years.

Preffered habitats in the project area (impact zone): This species can be found in mixed deciduous forests along the entire section of the highway. The period of activity has already ended, so only the remains of adults were found in two localities (mixed forests before Peovac and oak forests around Salevići).

Causes of endangerment: The main reason for the populations declining of this species is the loss of the habitat necessary for the development of the species. During the felling of trees, the part of the tree above the roots is usually "lost", i.e. the stump remains, and it is known that the larvae develop in that part, which indicates the complexity of the problem (Reißmann , 2017).
Species listed in Annex II of the Habitats Directive is important for determining priority biodiversity features (PBF).

Cerambyx cerdo Linnaeus, 1758 - Great Capricorn Beetle

Endangerment nationally and internationally: This species has IUCN category VU in Europe; it is listed on Annexes II and IV of the Habitats Directive and on Appendix III of the Berne Convention. It is not ptotected by law in Montenegro.
Ecological characteristics: This is a saproxylic polyphagous species that prefers oak forests, but it is also recorded in different types of deciduous forests. It has been recorded that females lay eggs under the bark of trees of other deciduous species such as *Castanea sativa, Juglans regia, Fraxinus* spp., *Salix* spp., *Ulmus* spp., *Fagus sylvatica, Platanus* spp., *Prunus* spp. and others.

During development, the larvae decompose the wood they feed on, create corridors that can later serve as a habitat for other species, and are therefore considered "umbrella" species (Buse et al., 2008).

Preffered habitats in the project area (impact zone): This species can be found in mixed deciduous forests along the entire section of the highway. The period of activity has already ended, so t could not be recorded, and we did not find any remains

Causes of endangerment: The main reason for the populations declining of this species is the loss of the habitat necessary for the development of the species.

Species listed in Annex IV of the Habitats Directive and has an IUCN status of VU (Vulnerable), is important for identifying critical habitats (CH), an also for identifying priority biodiversity features (PBF), because is listed in Annex II of the Habitats Directive.

Oryctes nasicornis - European Rhinoceros Beetle

Endangerment nationally and internationally: The threat status this species is not evaluated (IUCN LC?). The species is protected by law in Montenegro.
Ecological characteristics: This species prefferes diferent tipes of deciduous forests. The larvae are xylophagous, and grow in decaying plants feeding on wooda debris. The adults emerge between the end of March to May, and live for a few months until autumn. It occurs mainly during the months of June and July.

Preffered habitats in the project area (impact zone): This species can be found in mixed deciduous forests along almost the entire section of the highway. The period of activity has already ended, so it could not be recorded, and we did not find any remains.

Causes of endangerment: The main reason for the populations declining of this species is the loss of the habitat necessary for the development of the species.

Table 3: List of important species confirmed during the survey in October 2024

Group	Species name (latin and english)	Localition name	Coordinates	Comment
Lepidoptera	*Iphiclides podalirius* Scarce Swallowtail	Gnjili Potok	42.741551° 19.723477°	Although it is expected that this species will be present in this area in greater numbers, only one late specimen was recorded during the research in October and that was during a warmer day.
Lepidoptera	*Papilio machaon* Old World Swallowtail	Peovac	42.733635° 19.775206°	Only the remains of one died specimen were recorded in a meadow near an orchard near Peovac.
Coleoptera	*Morimus funereus* Beech Longhorn Beetle	Peovac Trešnjevik	42.732505° 19.773575° 42.746386° 19.696539°	We registered one specimen in the forest near Peovac and a died specimen on Trešnjevik. Based on HD II, and IUCN category VU, it is a trigger for priority biodiversity features (PBF).
Coleoptera	*Lucanus cervus* Stag Beetle	Near Peovac Salevići	42.735752° 19.781053° 42.737271° 19.772739°	The activity period has already ended. We recorded only the remains of specimens in the mixed forests before Peovac and oak forests around Salevići. Based on HD II, and IUCN category VU, it is a trigger for priority biodiversity features (PBF).

During the autumn surveys, only four species of insects of international and/or national importance were confirmed. Two species, the butterflies Papilio machaon and Iphiclides podalirius, are protected at the national level, while two species of beetles, Lucanus cervus and Morimus funereus, are protected at the international level. As anticipated, many sensitive species could not be registered in October. However, it is likely that the presence of most of the assumed species could be confirmed through additional surveys conducted between May and July.

VI ASSESSMENT OF PROTECTION STATUS OF SPECIES

Biodiversity protection in Montenegro is governed by the following legislation:

- **Law on Nature Protection** ("Official Gazette of Montenegro", No. 51/08).
- **Decision on the Protection of Certain Plant and Animal Species** ("Official Gazette of the Republic of Montenegro", No. 76/06).

In addition, the IUCN species status at the national level for diurnal butterfly species is based on the **Red List of Diurnal Butterflies of Montenegro** (Roganović and Malidžan, 2023). This is currently the only group of insects for which a Red List has been compiled in Montenegro.

The international legal framework for the protection of insect biodiversity includes:

- **EU Habitat Directive** - Council of European Communities (1992): **Council Directive 92/43/EEC** of 21 May 1992 on the conservation of natural habitats and of wildlife and flora. Annex II lists species whose protection requires conservation and habitat protection, while Annex IV includes species requiring strict community protection.
- **Bern Convention** - Council of Europe (1979): **Convention on the Conservation of European Wildlife and Natural Habitats**. Bern, Switzerland. This is the first international legal instrument aimed at protecting habitats and species (especially endangered and migratory species) and promotes international cooperation in achieving these goals.
- **CITES** - The **Convention on International Trade in Endangered Species of Wild Fauna and Flora**.
- **The European Red List of Hoverflies** (2022).
- **IUCN 2009**: **IUCN Red List of Threatened Species**. www.iucnredlist.org. Based on the IUCN criteria, species are assigned the statuses: LC (Least Concern), NT (Near Threatened), VU (Vulnerable), EN (Endangered), and CR (Critically Endangered). Species with insufficient quality data for assessment are classified as DD (Data Deficient).

Additionally, the **Priority Biodiversity Features (PBF)**, **Critical Habitats (CH)**, and **Ecologically Appropriate Areas of Analysis (EAAA)** were assessed according to the criteria of **EBRD PR 6 (2023)** and **EIB Standard 3 (2018)**. The assessment of negative impacts considered the guidelines provided in **Hardner et al. (2015)**, and the proposed protection measures follow the recommendations of **Bennun et al. (2021)**.

VII IMPACTS OF THE HIGHWAY CONSTRUCTION ON HABITATS AND SPECIES AND MITIGATION MEASURES

When assessing the impact of a project, both the sensitivity of the potential receptors (habitats and species) to impacts and the magnitude of the resulting potential impacts should be carefully considered.

Sensitivity of Receptors:

- **High Sensitivity**: Habitats and species that are considered of notable international or national importance. This includes:
    - IUCN Red Data Book (RDB) species listed as Endangered (EN) or Critically Endangered (CR).
    - Species or habitats listed in Annex I, II, and/or IV of the EU Habitats Directive.
    - Sites of international importance, such as IUCN protected areas (categories I, II, III, & IV) or Key Biodiversity Areas.
- **Medium Sensitivity**: Habitats and species that are considered notable at a local or regional level. This includes:
    - IUCN RDB species listed as Vulnerable (VU) or Near Threatened (NT).
    - More common species and habitats listed in the Annexes of the EU Habitats Directive or sites designated at the national level for nature conservation.
- **Low Sensitivity**: Habitats and species considered least concern (LC) by IUCN, or species that are locally common and not listed in key EU Directives or international conservation lists.

Magnitude of Impacts:

- **Negligible Impact**: The activity is unlikely to result in any observable effects on species or habitats. The impact is so small that it can be considered negligible in terms of environmental consequences.

- **Low Impact**: The activity may have limited effects on species or habitats of low sensitivity, with no observable effects on species or habitats of medium or high sensitivity.
- **Medium Impact**: No observable impacts are expected on species or habitats of high sensitivity. Limited impacts may occur at an individual level to species or habitats of medium sensitivity. Impacts may also affect species or habitats of low sensitivity.
- **High Impact**: Limited impacts could occur to species or habitats of high sensitivity at an individual level, while species or habitats of medium sensitivity may experience impacts significant enough to reduce their ability to sustain populations or habitats. Impacts could also affect species or habitats of low sensitivity.
- **Very High Impact**: Impacts are likely to occur to species or habitats of high sensitivity, significant enough to reduce the ability to sustain habitats, habitat complexes, or populations of species of interest.

IMPACTS

7.1. Impacts during construction phase

The most significant negative impacts on the local environment during the project will occur primarily during the construction phase. These impacts include habitat loss and degradation, fragmentation, pollution, and other disturbances. However, the implementation of effective mitigation measures can significantly reduce the severity of these impacts.

1. Habitat Loss and Degradation

- **Impact**: The removal of the topsoil and vegetation layer will result in the loss of crucial "food sources" for various species, particularly insects. In addition, invertebrates living in the vegetation and soil will be displaced or destroyed, along with any underground nests, eggs, or larvae.

The operation of heavy machinery may also damage specific vegetation, particularly around puddles, which are essential for the life cycle of certain species. If puddles, sinkholes, or depressions are filled with excavated soil, this may have further negative effects on local species.

- **Probability**: High
- **Risk Reduction**: The risk can be reduced from high to medium/low with the careful planning of construction activities, including the protection and relocation of vegetation and wildlife.

2. Habitat Fragmentation

- **Impact**: Construction activities can fragment habitats, affecting the continuity of populations. This could result in the loss of plants that serve as food and shelter for certain species, and create barriers that hinder the movement of species across the landscape.
- **Probability**: High
- **Risk Reduction**: The risk can be reduced from high to medium/low by designing the project to minimize disruption to habitat connectivity, such as by including wildlife corridors or migration pathways.

3. Habitat Pollution

- **Impact**: Pollution from construction machinery, such as dust emissions, could harm sensitive species. Additionally, accidental spills of fuel, oil, or other toxic substances may occur, as well as potential fires due to careless handling of equipment. Solid and liquid waste generated by workers could also contribute to habitat pollution.
- **Probability**: Moderate
- **Risk Reduction**: The risk can be reduced from moderate to low through careful waste management practices, spill containment measures, and the use of environmentally friendly equipment.

4. Changes in Water Conditions

- **Impact**: The construction of the highway will be carried out near or across several rivers and streams (e.g., the Kraštica river). This may result in changes to water quality, turbidity, and increased sedimentation due to riverbed excavation, gravel dumping, or waste disposal. These changes could negatively affect aquatic invertebrates and species whose life cycle is tied to water.
- **Probability**: Moderate to High
- **Risk Reduction**: The risk can be reduced to low by implementing effective erosion control measures, ensuring proper waste disposal, and using techniques to minimize sedimentation in water bodies.

5. Direct Mortality

- **Impact**: Direct mortality of species could occur due to trampling and burial by heavy machinery. Soil compaction from machinery can destroy underground fauna, while excavation activities may bury species living in the soil or along construction paths.
- **Probability**: Moderate
- **Risk Reduction**: The risk can be reduced from high to low by enforcing speed limits for vehicles, ensuring careful handling of machinery, and relocating species when necessary.

6. Noise, Vibration, and Light Disturbance

- **Impact**: Construction activities will generate noise and vibration, which may disturb the behavior of certain species, possibly displacing them. Artificial lighting could also attract some insects, making them more vulnerable to predation.
- **Probability**: Moderate
- **Risk Reduction**: The risk can be reduced from moderate or low by implementing noise reduction techniques, limiting the use of artificial lighting, and adopting methods to minimize disturbance to wildlife.

7.2. Key impacts during operational phase

The operational phase of the project (once the highway and access roads are in use) can continue to impact local habitats and species, though the nature of these impacts differs from the construction phase. Some risks include ongoing habitat degradation, pollution, and disturbances from traffic. However, these risks can be minimized through appropriate mitigation measures.

1. Habitat Degradation and Fragmentation

- **Impact**: The continued use and maintenance of the highway and access roads will lead to the fragmentation of habitats for certain species. Additionally, if meadows are no longer maintained through mowing and grazing as they were previously, they will eventually become overgrown, resulting in habitat loss for pollinators like butterflies.
- **Probability**: Moderate to Low
- **Risk Reduction**: The risk can be reduced from moderate to low through active habitat management. For example, maintaining meadow areas through controlled mowing or grazing can prevent overgrowth, preserving critical habitat for pollinators.

2. Habitat Pollution

- **Impact**: Increased traffic along the highway will lead to higher emissions of exhaust gases and dust, potentially degrading the quality of surrounding habitats. The most significant risk occurs in the event of an accident, particularly involving fuel or oil spills from vehicles or machinery, or fires caused by mishandling.
- **Probability**: Moderate
- **Risk Reduction**: The risk can be reduced from moderate to low by implementing measures to prevent accidents, such as proper vehicle maintenance, spill containment systems, and the use of eco-friendly materials in construction. Routine monitoring and rapid response to spills or accidents will also help reduce pollution risks.

3. Noise, Vibration, and Light Disturbance

- **Impact**: As traffic increases, the noise and vibration levels along the highway will rise, which could disturb species in the area. However, it is expected that most species may have already relocated from the area by the time the highway is operational. Additionally, artificial lighting from the highway may affect nocturnal insects, attracting them and making them more vulnerable to predators.
- **Probability**: Low to Moderate
- **Risk Reduction**: The risk can be reduced to low by adhering to mitigation measures such as using noise-reducing materials for the highway surface, limiting the use of artificial lighting, and ensuring that lighting is directed away from natural habitats. Additionally, creating buffers or corridors for wildlife can help minimize disturbances.

MITIGATION MEASURES

7.3. Mitigation measures during construction works

To minimize the negative effects of construction activities on the environment and biodiversity, the following mitigation measures must be strictly adhered to:

1. **Soil and Vegetation Protection:**
    - Careful removal of topsoil, rocks, and vegetation must be done during site preparation. This material should be relocated to a designated area for potential use in site rehabilitation.
2. **Vehicle Movement and Parking:**
    - Vehicles, especially heavy machinery, should follow designated routes, using existing roads wherever possible. Parking and maneuvering should occur only in specifically designated areas.

3. **Construction of Access Roads:**
    - Special care should be taken when constructing new roads to minimize impact on surrounding vegetation and animal life, particularly in areas with recorded sensitive species.
4. **Vehicle Speed Control:**
    - Vehicle speed should be limited to reduce dust generation and prevent harm to species moving along or crossing roads.
5. **Dust Control:**
    - Tarpaulins should be used during the transportation of excavated materials to prevent spills and reduce dust emissions. Additionally, moisten the ground at certain locations to further reduce dust.
6. **Preserving Microhabitats:**
    - Excess soil, rocks, and stones should not be used to fill microhabitats like puddles, underground tunnels, or holes, which often contain specific plant and animal communities. Disposal must occur at designated sites.
7. **Waste Disposal:**
    - All organic and inorganic waste must be disposed of in accordance with waste management laws and should not be used to fill or destroy natural habitats.
8. **Water Discharge Management:**
    - Discharge of untreated water into waterways is prohibited. Proper purification or safe depositing of water is required, and drainage channels should not direct water into rivers and streams, in compliance with water laws.
9. **Protection of River and Stream Vegetation:**
    - Vegetation along rivers and streams must be preserved, avoiding coverage with excavated materials like gravel and mud.

10. **Handling Animal Dens and Nests:**
    - If animal dens or nests are encountered during construction, work must halt immediately, and consultation with biologists and ecologists should take place to determine appropriate action.
11. **Migration Pathways for Species:**
    - Where necessary, migration pathways should be provided, especially for mammals and reptiles, to allow safe movement across the construction area.
12. **Protection of Habitats for Endangered Species:**
    - Habitats crucial for the survival of rare and endangered species, particularly those hosting multiple species, must be preserved. Negative activities in these areas should be minimized or avoided altogether.
13. **Meadow Preservation for Butterflies:**
    - Meadows essential for the survival of endangered butterfly species should be preserved, and overgrowth should be prevented through controlled mowing and grazing before eggs are laid on the vegetation.
14. **Noise Reduction:**
    - Efforts should be made to minimize noise levels during construction, including using quieter machinery, limiting the number of machines operating simultaneously, and carefully handling materials.
15. **Artificial Lighting Control:**
    - Artificial lighting should be minimized to avoid disturbing nocturnal species, particularly insects. If used, light should be directed away from natural habitats, or screens should be implemented to limit its spread.
16. **Vehicle Repair and Fuel Spill Prevention:**
    - Vehicle repairs must not take place at the construction site. In case of breakdowns leading to oil or fuel leaks, necessary prevention and rehabilitation measures should be implemented.

17. **Fire Prevention:**
    - Flammable materials should be carefully handled to prevent fires, and forest fire protection regulations must be strictly followed.
18. **Constant Supervision and Monitoring:**
    - Ongoing monitoring of construction activities is required to ensure that mitigation measures are being followed and to allow for adjustments as necessary.

7.4. Mitigation measures during operational phase

In the operational phase, continued attention to environmental impacts is essential to ensure minimal disruption to local ecosystems:

1. **Minimizing Habitat Fragmentation and Degradation:**
    - Additional habitat fragmentation should be minimized. Where possible, revegetation should occur to restore original vegetation and mitigate habitat loss.
2. **Water Discharge Management:**
    - The discharge of untreated water into waterways is prohibited. Proper purification or safe depositing of water must be provided, and drainage channels should not direct water into rivers and streams, in accordance with water laws.
3. **Waste Management:**
    - All waste produced during the operational phase must be handled according to waste management laws. Clear protocols for waste disposal during machinery maintenance must be in place.

4. **Artificial Lighting Control:**
    - Use shades on artificial lighting to minimize light spill on natural habitats. Lighting should be directed towards the road for traffic safety, ensuring minimal disturbance to wildlife.
5. **Vehicle Repair Restrictions:**
    - Vehicle repairs are not allowed at project sites. Repairs at facilities must be conducted in a manner that does not endanger human health or the environment.
6. **Accident Prevention and Response:**
    - Measures to prevent accidental situations (e.g., fuel or oil spills, fires) should be in place, along with clear protocols for responding to such incidents to minimize negative impacts.
7. **Continuous Monitoring:**
    - Ongoing monitoring of operations is necessary to ensure that protective measures are being implemented effectively. Adjustments should be made if any measures are not followed or need modification.
8. **Biodiversity Monitoring:**
    - Periodic biodiversity monitoring should be conducted, with priority given to experts familiar with the current state of biodiversity in the area.

VIII KEY CONCLUSIONS

In accordance with the project objectives, a series of five field surveys were conducted in October 2024 along the new alignment of the Mateševo – Andrijevica section, specifically from the entrance of Trešnjevik Tunnel to Andrijevica. These surveys focused on the 12 km section within the direct influence zone of the project, including a buffer zone of 500 meters on both sides of the road.

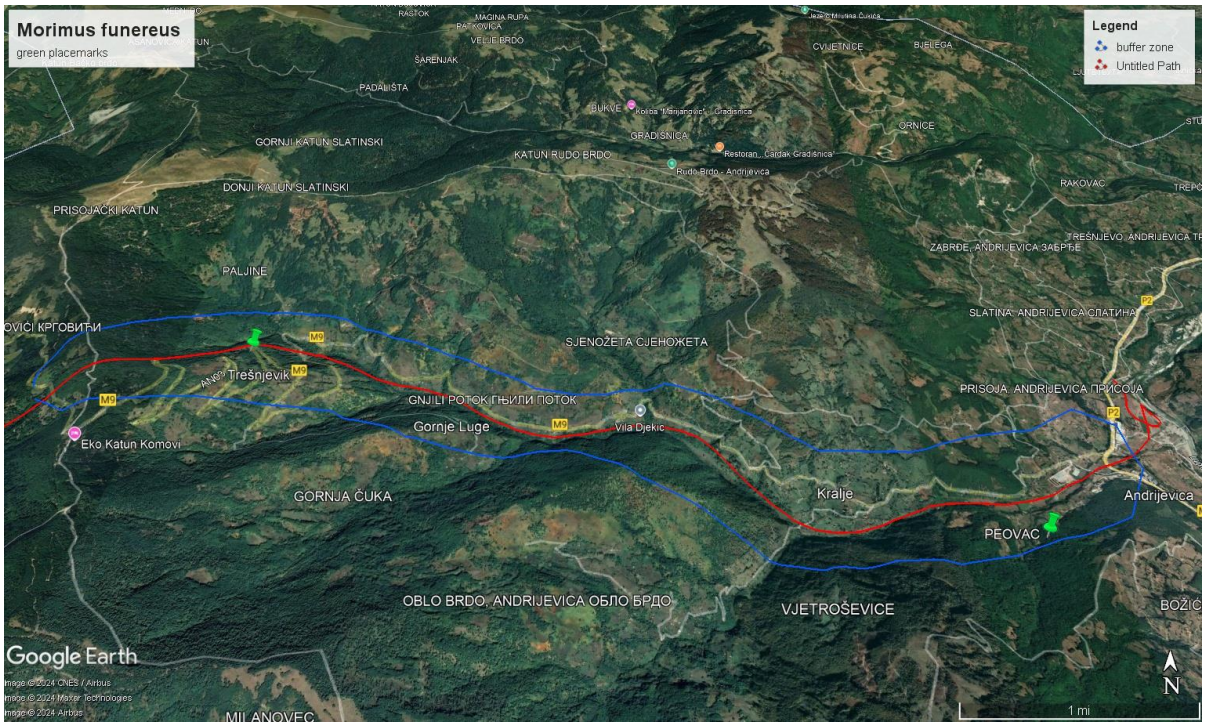
The terrestrial invertebrate surveys were carried out during a period when the activity of many invertebrate groups, particularly insects, had already ceased for the season. To obtain a more comprehensive and realistic understanding of the biodiversity within this group of animals, it is recommended that additional surveys be conducted in the spring and summer months, when invertebrate activity is more prominent. The results presented here are based on limited data recorded in October, supplemented by previous expert research data and expert knowledge regarding species likely to be present in the area, based on habitat types. No published data specific to this section were available.

The study also provides an overview of species of international and national importance that could be present along the project alignment. A key area of concern identified in this assessment is the valley of the Kraštica river, which lies directly within the project's scope. As a tributary of the River Lim, which is designated as an Important Plant Area (IPA), this region is particularly sensitive to any negative impacts, especially those related to pollution. Any changes in water quality in the Kraštica could ultimately affect the River Lim, making it crucial to minimize any risks associated with potential pollution from the project. The study outlines the potential negative impacts of the project during both the construction and operational phases, with a focus on biodiversity, habitat degradation, and the protection of sensitive species. In order to mitigate these impacts, the study proposes a series of protection measures and emphasizes the importance of regular monitoring throughout both phases of the project. This will help ensure that the identified risks are managed effectively and that any unforeseen issues can be addressed promptly.

In conclusion, while the project poses certain risks to local biodiversity and habitats, these can be significantly reduced through the implementation of appropriate mitigation measures and careful monitoring. By following these guidelines, it is possible to minimize the negative effects of the project and ensure the protection of sensitive species and ecosystems throughout the construction and operational phases.

IX MAPS AND PHOTOGRAPHICAL DOCUMENTATION

Map 1: The highway section Tresnjevik – Andrijevica is shown with a red line, and the buffer zone in blue.

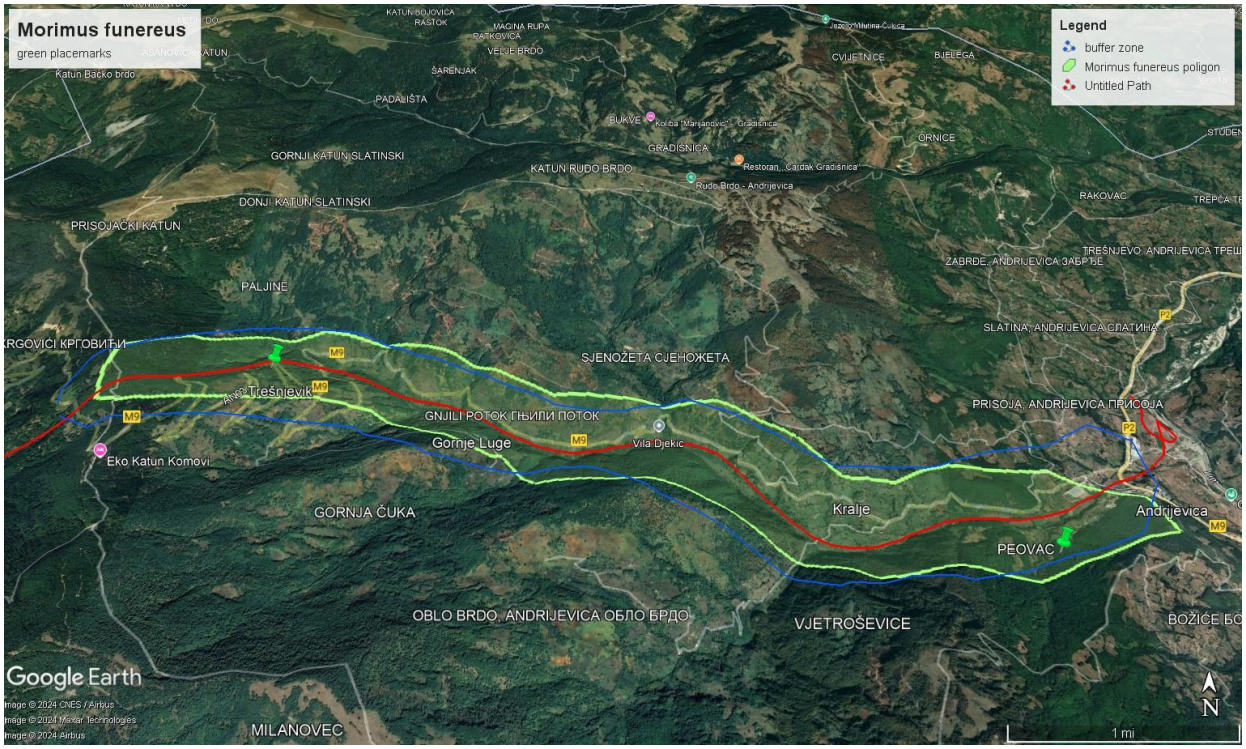


Map 2: Locations where the species *Morimus funereus* was recorded are marked in green

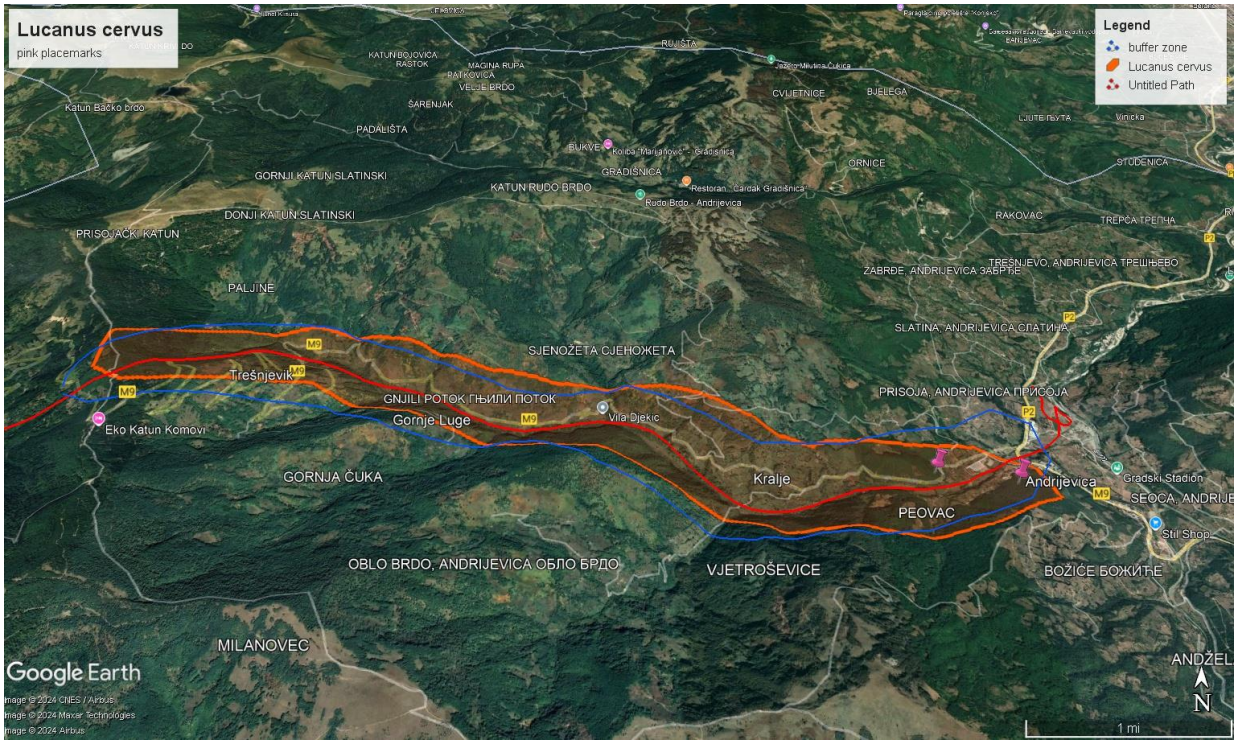
Map 3: Locations where the species *Morimus funereus* was recorded are marked with pink

Map 4: Location where the species *Papilio machaon* was recorded are marked with yellow

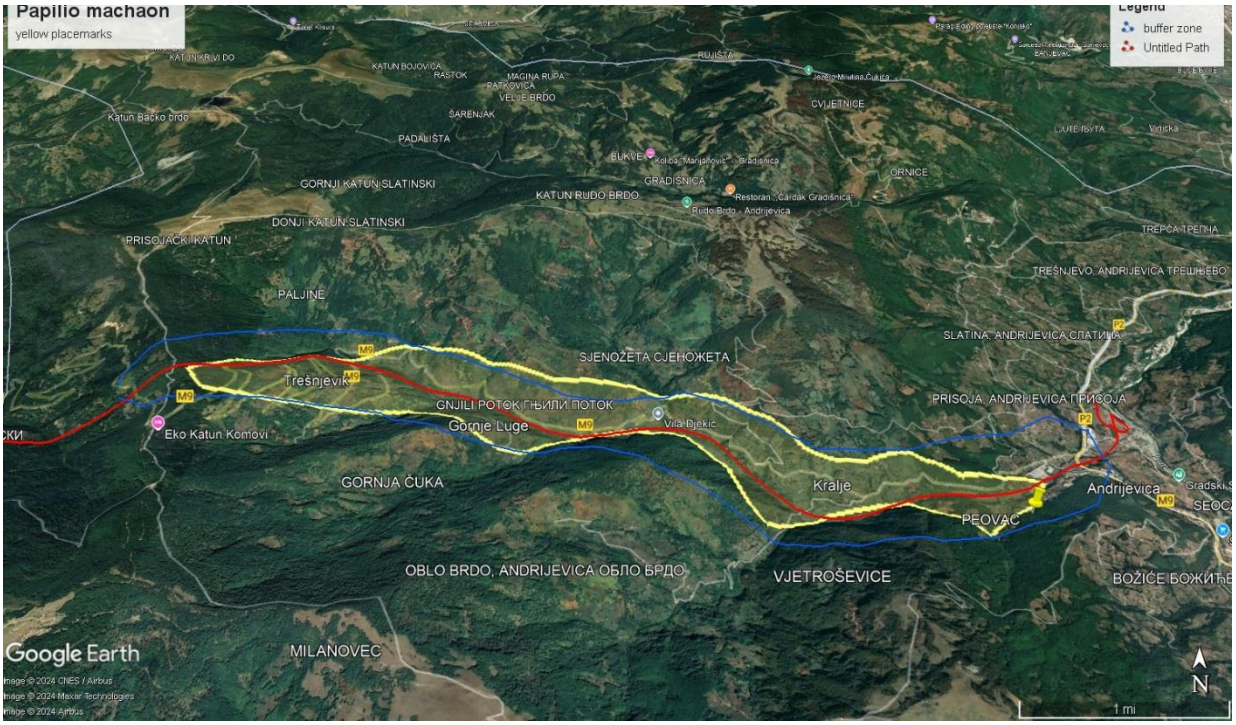
Map 5: Location where the species *Papilio machaon* was recorded are marked with blue

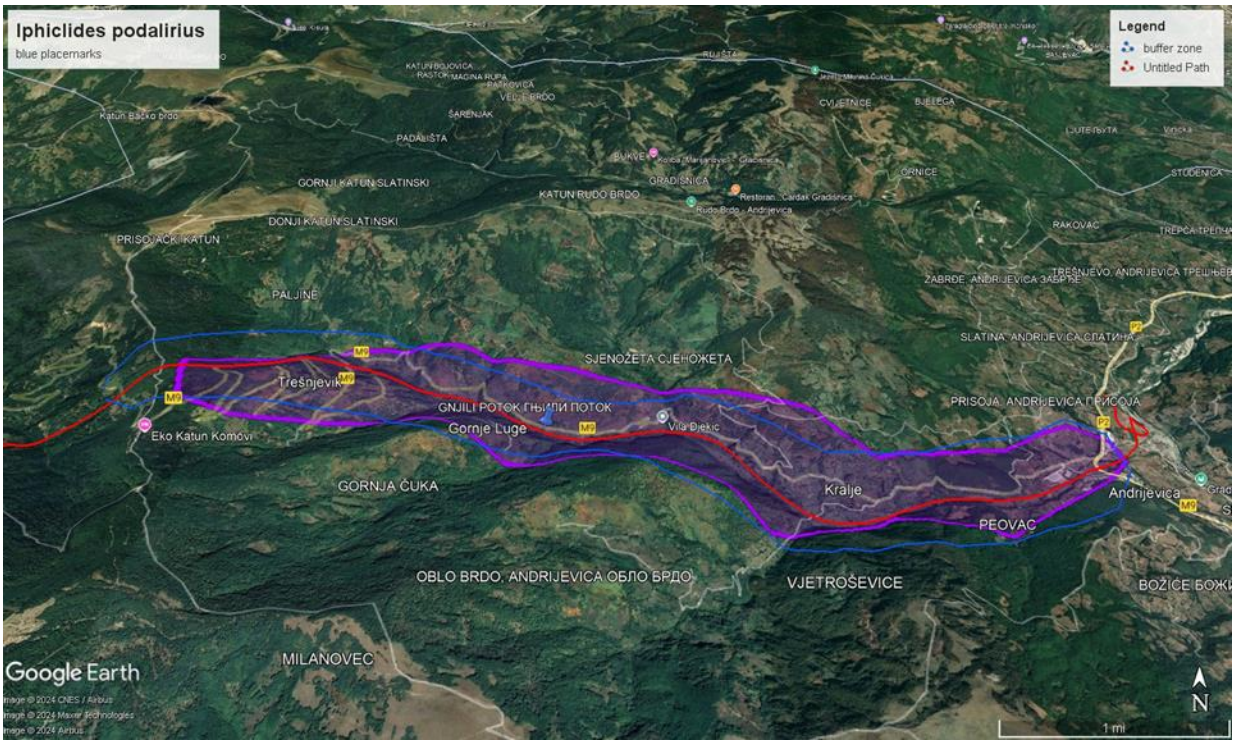


Map 6: EAA for the species *Morimus funereus* in the research area

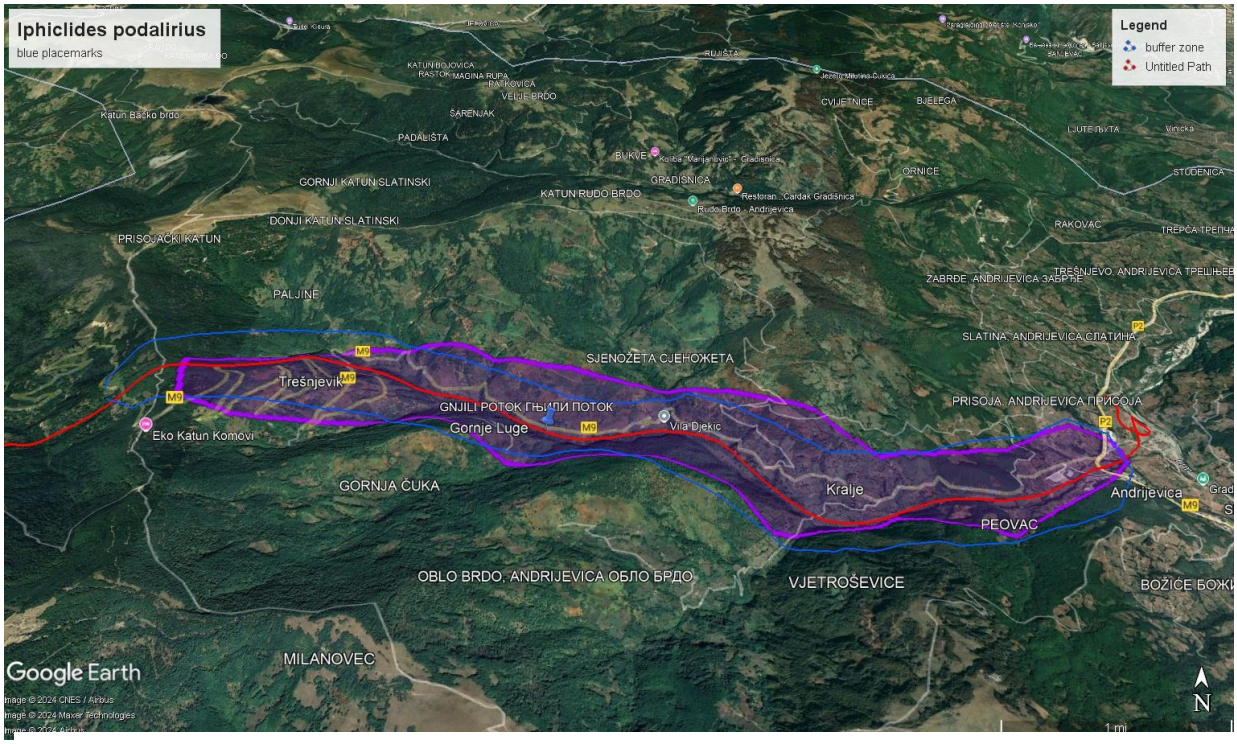


Map 7: EAA for the species *Lucanus cervus* in the research area





Map 8: Distribution of the species *Papilio machaon* in the research area



Map 9: Distribution of the species *Iphiclides podalirius* in the research area

Photo 1: Field work - searching for endangered forest beetles

Photo 2: Field work, catching butterflies

Photo 3: Knjaževac, near the future interchange of the highway

Photo 4: Mixed deciduous forests near Pevac,habitat of *Morimus funereus* species

Photo 5: Peovac, habitat of the species *Papilio machaon* and several other endangered butterflies.

Photo 6: Salevići, oak forests, habitat of the *Lucanus cervus* species.

Photo 7: The wet meadows near Kraštica, a potential habitat for several species of endangered butterflies.

Photo 8: The route of the road goes along the river Kraštica and crosses it in several places.

Photo 9: Gnjili Potok - oak forests above the road. Species *Iphiclides podalirius* registered nearby.

Photo 10: Laništa, beech forests with occasional presence of spruce trees

Photo 11: Kralje, potential habitat of several species of endangered butterflies.

Photo 12: Miravčine and stream Dubokalj, mixed forest and tall herbaceous plants

Photo 13: Trešnjevik, beech forests, habitat of the species *Morimus funereus*.

Photo 14: Trešnjevik towards Lisa and a view of Krgovići.

Photo 15: Dubirog, under the direct influence of highway construction.

Photo 16: On the route of the highway there are settlements, orchards and vineyards.

Photo 17: *Papilio machaon*, remains of died specimen.

Photo 18: *Iphiclides podalirius*, only one specimen was registered during a warm day

Photo 19: *Lucanus cervus*, remains.

Photo 20: *Morimus funereus*, died specimen.

Photo 21: *Pieris brassicae*, Large White

Photo 22: *Brintesia circe*, Great Banded Grayling

Photo 23: *Vanessa atalanta*, Red admiral

Photo 24: *Gonepteryx rhamni*, Common Brimstone

Photo 25: *Colias croceus*, Clouded Yellow

Photo 26: *Graphosoma italicum*, Italian Striped Bug

Photo 27: *Mantis religiosa*, European Mantis

Photo 28: *Eristalis tenax*, hoverflay

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