Preliminary Design and ESIA for the Mateševo-Andrijevica section of the Bar-Boljare Highway – Environmental Survey

- Amphibians and Reptiles –

Final Report

Client: European Investment Bank

Beneficiary/Promoter:
Ministry of Transport and Maritime Affairs,
Montenegro

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Podgorica, July 2020

CONTENTS

INTRODUCTION

The Mateševo-Andrijevica road section of the Bar-Boljare highway passes through the part of the Mountain–valley region of Montenegro which is characterized by lower diversity of Amphibians and Reptiles compared to Maritime region (e.g. Ljubisavljević et al. 2018). Although there are no precise findings of Amphibians and Reptiles for the project impact zone, a review of literature data for the wider area identified 18 species of Amphibians and Reptiles. This is about 35% of Amphibians and Reptiles known to occur in Montenegro. The area mainly contains habitats suitable for terrestrial reptiles such as meadows, forests and field edges, as well as streams and rivers important for amphibians and aquatic reptiles (e.g*., Natrix natrix*, *N. tessellata*). Roads and traffic affect wildlife populations by increasing mortality, decreasing habitat amount and quality and fragmenting populations into smaller sub-populations which are more vulnerable to local extinction (e.g. Rytwinski and Fahrig, 2015). Amphibians and reptiles are prone to negative road effects as they are particularly susceptible to road mortality and habitat loss and fragmentation by roads, which may influence the behavior, survival, growth, and reproductive success of animals and consequently species richness and diversity in an area (e.g. Jochimsen et al., 2004). Therefore, the survey of amphibians and reptiles in the proposed project area is important in order to identify the possible project impacts on these groups of animals, species most affected and to suggest appropriate and effective mitigation measures.

Brief project description

The Mateševo-Andrijevica road section of the Bar-Boljare highway is located in eastern part of the Mountain-valley region of Montenegro. It starts in vicinity of Mateševo and extends along the hilly slopes above Drcka River valley up to Trešnjevik mountain pass, through which the tunnel is planned to run. The highway route continues along the slopes of Rajovića and Kraljštica streams up to Lim River valley around Andrijevica. The project impact zone includes a number of rivers, intermittent and perennial streams of the Tara River Basin (Drcka River with its tributaries - Bukov stream, Veljebrdski stream, Vranještica River and Ljubaštica River) and Lim River Basin (Kraljštica River with its tributaries Novovića stream, Rajovića stream, Dubokalj stream and Prisojački stream). The project area also includes northern edges of the Regional Nature Park “Komovi”, as well as the southern parts of the Area of Special Conservation Interest (ASCI) “Lim River”.

Proposed highway route variants (V1 and V2) largely overlap. The main difference between the two variants appears around Ljubaštica River (Han Drndarski area) prior to Trešnjevik mountain pass, with V1 impact zone encompasses the greater part of the riparian area of the Ljubaštica

River on the left side of the main road Mateševo-Andrijevica, while the V2 extends along the hilly slopes above on the right side of the road. The V1 may have somewhat greater impact on the riparian area of Ljubaštica River than V2 route.

Table 1. Selected locations for surveys of amphibians and reptiles.

Nos. in Figures	Location description	Alt	Coordinates
1	Drcka River	1013 m	42.759445°, 19.563593°
2	Regional park "Komovi"	1030 m	42.748994°, 19.577293°
3	Bukov stream	1050 m	42.748821°, 19.586973°
4.	confluence of the Vranjestica and Drcka rivers (Bare Kraljske)	1070 m	42.752074°, 19.606890°
5.	Veljebrdski stream	1153 m	42.743267°, 19.632300°
6	Ljubaštica River	1185 m	42.735512°, 19.655579°
7.	Novovića stream (Gnjili stream)	1000 m	42.745150°, 19.715817°
8.	Dubokalj stream	944 m	42.744833°, 19.737433°
9.	Kraljštica River (Lim ASCI 1st point)	770 m	42.735350°, 19.773917°
10.	confluence of the Prisojački stream and Kraljštica River in Most Bandovica (Lim ASCI 2nd point)	757 m	42.739901°, 42.739901°
11.	Lim River (Lim ASCI 3rd point)	730 m	42.755116°, 19.801226°

Research preparations

Research preparations included a review of the literature data for amphibians and reptiles of the subject area and their location on the map. The selection of the locations for further survey (Figures 1 – 6, Table 1) was performed in accordance with literature data and data obtained during a quick survey of the route. The sites within natural and semi-natural habitats (river banks, road banks, meadows and forest edges) where amphibians and reptiles were assumed to be present were selected, with an emphasis on the belts where the route crosses rivers and streams. Where possible, 500 m wide belt on the left and right from the proposed highway route was explored.

Fieldwork dynamics

Field surveys of Amphibians (batrachofauna) and Reptiles (herpetofauna) in the impact zone of the project - Mateševo-Andrijevica road section of the Bar-Boljare highway, were carried out during six days of late summer/early autumn (September 2019) and five days during spring/early summer (May-June, 2020) under favorable weather conditions when these groups of animals were active.

Limitations of filed surveys

Some transport limitations imposed by Covid-19 pandemic caused a certain shift in the planned schedule of fieldwork during the spring.

Methodology

A desk-based review of existing data sources was conducted. Determination of the presence of expected species of amphibians and reptiles in favorable habitats in the subject area was carried out by walked transects. Animals were recorded by visual inspection and netting, following standard methods for estimating the diversity of batracho-and herpetofauna (e.g. Gent and Gibson, 1998; Hill et al., 2005, Manley et al., 2006). After data collection, individuals caught were immediately released at the point of capture. Coordinates of each record were taken by GPS Garmin E-Trex 10.

RESULTS

Species presumed to be present

Presumptions were based on the literature findings for the sites through which the route passes and broader area around the project impact zone (ZZPCG, 2013; Čađenović, 2014; AZŽS, 2015; Džukić et al. 2017; Ljubisavljević et al. 2018 ; Gvozdenović and Iković, 2019; Polović and Ljubisavljević, 2020). Expected species of amphibians and reptiles are listed in Table 2.

Table 2. **Species expected to occur** in the project area according to literature data

Amphibians	Reptiles
Salamandra salamandra	*Testudo hermanni*
Ichthyosaura alpestris	*Lacerta agilis*
Bombina variegata	*Lacerta viridis*
Bufo bufo	*Podarcis muralis*
Pelophylax ridibundus	*Zootoca vivipara*
Rana graeca	*Anguis fragilis*
Rana temporaria	*Zamenis longissimus*
	Coronella austriaca
	Natrix tessellata
	Vipera berus
	Vipera ammodytes

Confirmed species

Eleven species of Amphibians and Reptiles were recorded during autumn field surveys, while additional four species were recorded during the spring. In total, six species of amphibians and nine species of reptiles were detected within the 500 m impact zone of the Project (Tables 3-4, Figs. 7-21). The exact locations and number of specimens are given in Table 4 and presented in Figs. 22-32 .

Table 3. **The list of confirmed species** with their conservation statuses and levels of threats in Europe

Group	Species name (latin)	Species name (in English)	Endemicity	List of protected species in Montenegro	conservation status (IUCN)	EU Habitat directive annex	Bern convention appendix	note
Amphibians	*Salamandra salamandra*	Fire salamander	-	+	LC	/	III	
Amphibians	*Bombina variegata*	Yellow-bellied toad	-	-	LC	II,IV	II	
Amphibians	*Bufo bufo*	Common toad	-	+	LC	/	III	
Amphibians	*Pelophylax ridibundus*	Marsh frog	-	+	LC	V	III	Listed in some documents under the previous latin name *Rana ridibunda*
Amphibians	*Rana graeca*	Greek stream frog	endemic species of the Balkans	+	LC	IV	III	
Amphibians	*Rana temporaria*	European common frog	-	-	LC	V	III	
Reptiles	*Lacerta agilis*	Sand lizard	-	+	LC	IV	II	Balkan endemic subspecies *L.a.bosnica* occurs in Montenegro
Reptiles	*Lacerta viridis*	Eastern green lizard	-	+	LC	IV	II	
Reptiles	*Podarcis muralis*	Common wall lizard	-	+	LC	IV	II	
Reptiles	*Anguis fragilis*	Slow worm	-	+	LC	/	III	

Table 3. (continued)

Group	Species name (latin)	Species name (in English)	Endemicity	List of protected species in Montenegro	conservation status (IUCN)	EU Habitat directive annex	Bern convention appendix	note
Reptiles	*Zamenis longissimus*	Aesculapian snake	-	+	LC	IV	II	
Reptiles	*Coronella austriaca*	Smooth snake	-	+	LC	IV	II	
Reptiles	*Natrix natrix*	Grass snake	-	+	LC	-	III	Subspecies not present in Montenegro are included in Habitat directive
Reptiles	*Natrix tessellata*	Dice snake	-	+	LC	IV	II	
Reptiles	*Vipera ammodytes*	Nose-horned viper	-	-	LC	IV	II	

Table 4. The list of exact locations and number of specimens observed. Locations recorded during the autumn and spring surveys are marked in brown and green, respectively.

Group	Species name (latin and english)	No. of selected location	Location name	Number of specimens	coordinates
Amphibians	*Salamandra salamandra*	7	Novovica stream (Gnjili stream)	1	42.744783°, 19.713833°
	(Fire salamander)	8	Dubokalj stream	1	42.746137°, 19.737000°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735050°, 19.772700°
Amphibians	*Bombina variegata*	2	Regional park "Komovi"	5	42.748646°, 19.577565°
	(Yellow-bellied toad)	6	Ljubaštica River	6	42.735683°, 19.655033°
		6	Ljubaštica River	1	42.735683°, 19.655067°
		6	Ljubaštica River	1	42.733083°, 19.659383°
		6	Ljubaštica River	1	42.729663°, 19.662283°
		7	Novovica stream (Gnjili stream)	1	42.744600°, 19.713567°
		11	Lim River (Lim ASCI 3rd point)	2	42.756302°, 19.800117°
Amphibians	*Bufo bufo*	1	Drcka River	1	42.756033°, 19.567550°
	(Common toad)	1	Drcka River	numerous	42.758317°, 19.564517°
		1	Drcka River	numerous	42.756352°, 19.567538°
		4	confluence of the Vranještica and Drcka rivers	numerous	42.751900°, 19.606617°
		7	Novovica stream (Gnjili stream)	1	42.744300°, 19.717533°
		11	Lim River (Lim ASCI 3rd point)	numerous	42.756283°, 19.800117°
Amphibians	*Pelophylax ridibundus*	11	Lim River (Lim ASCI 3rd point)	2	42.756517°, 19.796850°
	(Marsh frog)	11	Lim River (Lim ASCI 3rd point)	numerous	42.756302°, 19.800117°
		11	Lim River (Lim ASCI 3rd point)	numerous	42.755767°, 19.801133°
		11	Lim River (Lim ASCI 3rd point)	2	42.755350°, 19.799733°
		11	Lim River (Lim ASCI 3rd point)	numerous	42.755300°, 19.797117°

Table 4. (Continued)

Group	Species name (latin and english)	No. of selected location	Location name	Number of specimens	coordinates
Amphibians	*Rana graeca* (Greek stream frog)	1	Drcka River	numerous	42.758494°, 19.564370°
		1	Drcka River	1	42.758350°, 19.564433°
		1	Drcka River	2	42.755233°, 19.567817°
		1	Drcka River	1	42.758317°, 19.564517°
		2	Regional park "Komovi"	5	42.750300°, 19.571333°
		3	Bukov stream	numerous	42.747417°, 19.586533°
		4	confluence of the Vranještica and Drcka rivers	numerous	42.751900°, 19.606617°
		8	Dubokalj stream	1	42.746150°, 19.737017°
		8	Dubokalj stream	1	42.745383°, 19.737283°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735350°, 19.773917°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735470°, 19.774110°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735150°, 19.772983°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735050°, 19.772767°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735583°, 19.772267°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735800°, 19.771300°
		9	Kraljštica River (Lim ASCI 1st point)	numerous	42.735417°, 19.772400°
		9	Kraljštica River (Lim ASCI 1st point)	numerous	42.735050°, 19.772700°
		10	Kraljstica II (Lim ASCI 2)	1	42.739867°, 19.781633°
		10	Kraljstica II (Lim ASCI 2)	1	42.739867°, 19.781533°
		10	Kraljstica II (Lim ASCI 2)	1	42.739783°, 19.781333°
		10	Kraljstica II (Lim ASCI 2)	1	42.739583°, 19.781000°
		10	Kraljstica II (Lim ASCI 2)	1	42.740133°, 19.779717°
		11	Lim River (Lim ASCI 3rd point)	numerous	42.756183°, 19.800100°
		11	Lim River (Lim ASCI 3rd point)	numerous	42.756302°, 19.800117°
		11	Lim River (Lim ASCI 3rd point)	numerous	42.755400°, 19.800717°
		11	Lim River (Lim ASCI 3rd point)	numerous	42.755767°, 19.801133°

Table 4. (Continued)

Group	Species name (latin and english)	No. of selected location	Location name	Number of specimens	coordinates
Amphibians	*Rana graeca* (Greek stream frog)	11	Lim River (Lim ASCI 3rd point)	numerous	42.754800°, 19.800533°
		11	Lim River (Lim ASCI 3rd point)	1	42.755350°, 19.799733°
Amphibians	*Rana temporaria* (European common frog)	6	Ljubaštica River	1	42.729663°, 19.662283°
Reptiles	*Lacerta agilis* (Sand lizard)	2	Regional park "Komovi"	1	42.749172°, 19.577492°
Reptiles	*Lacerta viridis* (Eastern green lizard)	1	Drcka River	1	42.757659°, 19.565814°
		8	Dubokalj stream	1	42.744784°, 19.736894°
		11	Lim River (Lim ASCI 3rd point)	1	42.757468°, 19.796793°
Reptiles	*Podarcis muralis* (Common wall lizard)	1	Drcka River	1	42.756400°, 19.567700°
		1	Drcka River	1	42.756317°, 19.567650°
		1	Drcka River	1	42.757383°, 19.567500°
		2	Regional park "Komovi"	2	42.746601°, 19.579469°
		2	Regional park "Komovi"	3	42.745501°, 19.580342°
		2	Regional park "Komovi"	5	42.750800°, 19.572117°
		2	Regional park "Komovi"	5	42.750383°, 19.572117°
		2	Regional park "Komovi"	3	42.751850°, 19.572550°
		2	Regional park "Komovi"	1	42.747033°, 19.572917°
		2	Regional park "Komovi"	1	42.750383°, 19.572117°
		3	Bukov stream	1	42.748050°, 19.587133°
		3	Bukov stream	2	42.748567°, 19.587033°
		3	Bukov stream	1	42.749100°, 19.587333°
		4	confluence of the Vranještica and Drcka rivers	4	42.751900°, 19.606617°

		4	confluence of the Vranještica and Drcka rivers	1	42.753067°, 19.606200°
		4	confluence of the Vranještica and Drcka rivers	1	42.750017°, 19.607933°
		5	Veljebrdski stream	4	42.743000°, 19.629783°
		5	Veljebrdski stream	3	42.742883°, 19.629867°
		5	Veljebrdski stream	2	42.743500°, 19.629417°
		5	Veljebrdski stream	1	42.744900°, 19.623417°
		6	Ljubaštica River	1	42.735483°, 19.656183°
		6	Ljubaštica River	2	42.735550°, 19.656883°
		6	Ljubaštica River	1	42.735667°, 19.657067°
		6	Ljubaštica River	2	42.738883°, 19.659400°
		6	Ljubaštica River	1	42.735517°, 19.655867°
		6	Ljubaštica River	1	42.733133°, 19.659067°
		7	Novovica stream (Gnjili stream)	2	42.744150°, 19.713417°
		7	Novovica stream (Gnjili stream)	1	42.744983°, 19.712433°
		7	Novovica stream (Gnjili stream)	4	42.745067°, 19.711500°
		7	Novovica stream (Gnjili stream)	1	42.745033°, 19.711817°
		7	Novovica stream (Gnjili stream)	2	42.744450°, 19.715533°
		7	Novovica stream (Gnjili stream)	3	42.744350°, 19.715800°
		7	Novovica stream (Gnjili stream)	5	42.744500°, 19.717067°
		7	Novovica stream (Gnjili stream)	1	42.745067°, 19.711333°
		7	Novovica stream (Gnjili stream)	1	42.745233°, 19.710883°
		7	Novovica stream (Gnjili stream)	1	42.744567°, 19.713467°
		7	Novovica stream (Gnjili stream)	1	42.744461°, 19.715682°
		7	Novovica stream (Gnjili stream)	1	42.744583°, 19.716733°
		8	Dubokalj stream	1	42.744883°, 19.737167°
		8	Dubokalj stream	1	42.744633°, 19.737450
		8	Dubokalj stream	1	42.744750°, 19.736633°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735883°, 19.771917°

		11	Lim River (Lim ASCI 3rd point)	1	42.757583°, 19.796600°
		11	Lim River (Lim ASCI 3rd point)	1	42.756302°, 19.800117°
		11	Lim River (Lim ASCI 3rd point)	1	42.755400°, 19.800717°
		11	Lim River (Lim ASCI 3rd point)	1	42.755767°, 19.801133°
		11	Lim River (Lim ASCI 3rd point)	1	42.754883°, 19.800283°
		11	Lim River (Lim ASCI 3rd point)	1	42.754867°, 19.799767°
		11	Lim River (Lim ASCI 3rd point)	1	42.756000°, 19.798750°
Reptiles	*Anguis fragilis* (Slow worm)	2	Regional park "Komovi"	1	42.749833°, 19.575150°
		10	Kraljstica II (Lim ASCI 2)	1	42.740117°, 19.782950°
Reptiles	*Zamenis longissimus* (Aesculapian snake)	1	Drcka River	1	42.756950°, 19.567567°
		1	Drcka River	1	42.755883°, 19.567467°
		1	Drcka River	1	42.756633°, 19.567150°
		3	Bukov stream	1	42.749717°, 19.587383°
		4	confluence of the Vranještica and Drcka rivers	1	42.749983°, 19.607900°
		6	Ljubaštica River	1	42.736446°, 19.653926°
		8	Dubokalj stream	2	42.745067°, 19.737583°
Reptiles	*Coronella austriaca* (Smooth snake)	4	confluence of the Vranještica and Drcka rivers	1	42.748961°, 19.598793°
Reptiles	*Natrix natrix* (Grass snake)	1	Drcka River	1	42.758401°, 19.564563°
		4	confluence of the Vranještica and Drcka rivers	2	42.751900°, 19.606617°
		6	Ljubaštica River	1	42.735717°, 19.655767°
		7	Novovica stream (Gnjili stream)	1	42.744600°, 19.713567°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735417°, 19.772400°

Table 4. (Continued)

Group	Species name (latin and english)	No. of selected location	Location name	Number of specimens	coordinates
Reptiles	*Natrix tessellata*	9	Kraljštica River (Lim ASCI 1st point)	1	42.735683°, 19.772067°
	(Dice snake)	9	Kraljštica River (Lim ASCI 1st point)	3	42.735050°, 19.772700°
		9	Kraljštica River (Lim ASCI 1st point)	1	42.735183°, 19.772983°
		11	Lim River (Lim ASCI 3rd point)	1	42.755300°, 19.797117°
Reptiles	*Vipera ammodytes*	2	Regional park "Komovi"	1	42.748967°, 19.577500°
	(Nose-horned viper)	3	Bukov stream	3	42.748533°, 19.587033°
		3	Bukov stream	2	42.748633°, 19.587383°
		5	Veljebrdski stream	1	42.739950°, 19.640300°
		8	Dubokalj	5	42.744850°, 19.737483°

Description of type and state of habitats and populations of the recorded species

Type and state of habitats and populations of the recorded species are listed below and briefly presented in Table 5.

***Salamandra salamandra* (Fire salamander)**

Distribution in Montenegro: Predominantly inhabits Mountain –valley region of Montenegro (Džukić, 1991).

Habitat in the route impact zone: The project impact zone lies well within the known range of *S. salamandra* in Montenegro. The fire salamander can be found in springs and shallow brooks (larvae) or under the stones, fallen leaves, wood (adults) in deciduous forests. The larvae of the fire salamander were found in slow-flowing portions of the streams in deciduous forests within the project impact zone (e.g. Fig 7).

Density/Abundance: Literature data on density or abundance of the fire salamander in the project area or generally in Montenegro are lacking. The species was found on three selected locations during spring surveys, but it is probably quite common within the project area due to the widespread presence of suitable habitats (hilly/mountainous deciduous or mixed forests, near small rivers and streams, combined with an abundance of shelters such as rocks and logs – Speybroeck et al., 2016).

Relation (adaptability) to anthropogenically altered habitats: Usually found in natural habitats, but to a certain degree populations can also persist in agricultural landscapes and gardens when suitable breeding water is present. Larvae can be deposited in ponds or even flooded wheel tracks (Speybroeck et al., 2016).

Corridors and reproductive centers in the route impact zone: Numerous intermittent streams, brooks, springs and small rivers represent important breeding sites of the fire salamander in the Project area. Considering that the Project includes the construction of bridges and crosses over the rivers and streams, it is assumed that these habitats won't be destroyed if the necessary measures of protection and mitigation during the project construction phase are applied. Since it is a terrestrial species, the route of the highway is possible located in the area of corridors for spring migration to the breeding sites.

Seasonal dynamics: Terrestrial species. Reproduction occurs between spring and autumn. Larvae are deposited directly in water. They metamorphose into a juvenile salamander a few months later. Hibernation, typically in groups, occurs at higher altitudes from October to April (Kuzmin, 1999).

***Bombina variegata* (Yellow-bellied toad)**

Distribution in Montenegro: It is widely distributed in Montenegro, with more numerous occurrences in Mountain-valley region (Čadjenović, 2014).

Habitat in the route impact zone: The project impact zone lies well within the known range of *B. variegata* in Montenegro. The specimens of the yellow-bellied toad were found in well vegetated temporary puddles and brooks along dirt roads in the route impact zone (e.g. Fig 8).

Density/Abundance: There are no literature data on the density or abundance in the project area or generally in Montenegro. The species was found on four selected locations during autumn and spring surveys, and is probably common within the project area due to the presence of suitable habitats (flooded wheel-ruts, puddles, springs, brooks, slow-flowing parts of mountain streams– Speybroeck et al., 2016).

Relation (adaptability) to anthropogenically altered habitats: Often found close to human settlements (rural landscapes, wheel-ruts, cattle troughs, artificial lakes and ponds, urban parks) and even in polluted wetlands (Kuzmin, 1999).

Corridors and reproductive centers in the route impact zone: Numerous intermittent streams, brooks and altered small water bodies represent important habitats and breeding sites of the yellow-bellied toad in the Project area. Considering that the Project includes the construction of bridges and crossings over the rivers and streams, it is assumed that these habitats won't be destroyed if the necessary measures of protection and mitigation during the project construction phase are applied.

Seasonal dynamics: Active from March until October depending on local climate. Reproduction takes place throughout spring and summer. Juveniles emerge during summer and autumn (Speybroeck et al., 2016).

***Bufo bufo* (Common toad)**

Distribution in Montenegro: It is widely distributed in Montenegro (Čadjenović, 2014).

Habitat in the route impact zone: The project impact zone lies well within the known range of *B. bufo* in Montenegro. The common toad inhabits a wide range of habitats, but is common in humid places with dense vegetation. The slow moving portions of permanent or intermittent streams and rivers were identified as breeding sites of the Common toad (e.g. Fig. 9).

Density/Abundance: Literature data on density or abundance of the Common toad in the project area are lacking. The species was found on four selected locations mainly during spring

surveys, and is probably common within the project area due to the presence of suitable breeding habitats (such as slow-flowing parts of streams– Speybroeck et al., 2016).

Relation (adaptability) to anthropogenically altered habitats: Often found in or close to human settlements, in gardens, backyards, parks, ditches (Čađenović, 2014; Speybroeck et al., 2016).

Corridors and reproductive centers in the route impact zone: Slow-flowing parts of streams represent important breeding sites of the Common toad in the Project area. Considering that the Project includes the construction of bridges and crossings over the rivers and streams, it is assumed that these habitats won't be destroyed if the necessary measures of protection and mitigation during the project construction phase are applied. Since it is a terrestrial species, the route of the highway is possible located in the area of corridors for spring migration to the breeding sites.

Seasonal dynamics: Terrestrial species. Mass breeding occurs in early spring after hibernation when animals start to move directly to the breeding waters. Metamorphosed juveniles usually leave the aquatic habitat over the June. Hibernation usually takes place from November, under the litter, in holes in the ground, under rocks, etc. (Speybroeck et al., 2016; field data).

***Pelophylax ridibundus* (Marsh frog)**

Distribution in Montenegro: It is widely distributed in Montenegro (Čadjenović, 2014), but more numerous in the wide southern plains, than in the mountain region (Džukić, 1991).

Habitat in the route impact zone: The project impact zone lies well within the known range of *P. ridibundus* in Montenegro. According to field survey the Marsh frog occupies sunny banks of the Lim River in the route impact zone (e.g. Fig. 10).

Density/Abundance: According to field survey the Marsh frog is abundant in the appropriate habitat such as wide, sunny valley of the Lim River. The species is absent from most of the project impact zone, which includes a mountainous landscape with fast permanent or intermittent streams and rivers.

Relation (adaptability) to anthropogenically altered habitats: The Marsh frog occupies a very wide variety of aquatic and wetland habitat types including ones under anthropogenic influence or man-made habitats, such as roadside ditches, drainage canals, garden ponds, etc. It may be quite common in urban, suburban and rural areas (e.g. Mollov, 2014).

Corridors and reproductive centers in the route impact zone: Lim river valley represents important habitat and dispersal corridor of the Marsh frog in Mountain-valley region.

Considering that the project includes the construction of bridges and crossings over the rivers, movement corridors and habitats are not expected to be disrupted if the necessary measures of protection and mitigation during the project construction phase are applied. Special attention should be paid to the selected point 11 where the route passes very close to the river (see below).

Seasonal dynamics: The Marsh frog typically hibernates between November and February, but timing depends on weather conditions. It is highly aquatic species. Hibernation usually takes place in mud or under water. Reproduces in spring and early summer. Metamorphosed juveniles emerge over the summer (Speybroeck et al., 2016).

***Rana graeca* (Greek stream frog)**

Distribution in Montenegro: It is predominantly distributed in the Mountain-valley region of Montenegro, occasionally penetrating southwards along with gorges and valleys of cold fast-flowing streams (Čadjenović, 2014; Ljubisavljević, field data).

Habitat in the route impact zone: The project impact zone lies well within the known range of *R. graeca* in Montenegro. According to field survey the greek frog is usual in fast-flowing streams, small rivers and springs in the route impact zone (e.g. Fig. 11).

Density/Abundance: According to field survey the Greek stream frog is evaluated as abundant within the project impact zone. It is found on eight out of 11 selected locations in the project impact zone, and is probably common within the project area due to the presence of suitable habitats (fast-flowing well-oxigenated streams, rivers and springs with rocky banks in forested areas – Speybroeck et al., 2016).

Relation (adaptability) to anthropogenically altered habitats: Although it can be found in somewhat altered habitats such as cattle troughs and ponds, it is predominantly a species of natural habitats.

Corridors and reproductive centers in the route impact zone: Numerous streams, brooks and small rivers represent important habitats and breeding sites of the Greek streams frog in the Project area. Considering that the project includes the construction of bridges and crossings over the rivers, these habitats are not expected to be affected if the necessary measures of protection and mitigation during the project construction phase are applied.

Seasonal dynamics: The Greek stream frog is early breader. After hibernation the reproductive period usually lasts from February to May depending on altitude. Tadpoles hatch after couple of weeks (Urošević and Džukić, 2015a; Speybroeck et al. 2016).

***Rana temporaria* (European common frog)**

Distribution in Montenegro: Its distribution in the Balkan Peninsula (and Montenegro) is disjunct and restricted to mountain ranges (Speybroeck et al. 2016).

Habitat in the route impact zone: The project impact zone lies within the known range of *R. temporaria* in Montenegro. The European common frog is encountered in moist meadows and peat bog near water bodies.

Density/Abundance: Literature data on density or abundance of the European common frog in the project area or generally in Montenegro are lacking. The species was found only at one selected location during spring survey (e.g. Fig. 12).

Relation (adaptability) to anthropogenically altered habitats: Although it can be found in somewhat altered habitats such as ditches and ponds, it is predominantly a species of natural habitats.

Corridors and reproductive centers in the route impact zone: Numerous water bodies and moist habitats in the project impact zone could be important for *R. temporaria.* Considering that the project includes the construction of bridges and crossings over the water bodies, these habitats are not expected to be affected if the necessary measures of protection and mitigation during the project construction phase are applied.

Seasonal dynamics: Hibernation of the European common frog lasts from October-November to spring months with reproductive period from March to June depending on altitude. Tadpoles hatch after one to two weeks. Metamorphosis usually completes between June and August (Urošević and Džukić, 2015b)

***Lacerta agilis* (Sand lizard)**

Distribution in Montenegro: The sand lizard is discontinuously distributed at higher altitudes in Mountain-valley region of Montenegro (Ljubisavljević et al., 2018).

Habitat in the route impact zone: The project impact zone lies within the known range of *L. agilis* in Montenegro. The Sand lizard was found in a meadow close to the river (e.g. Fig. 13).

Density/Abundance: Literature data on density or abundance of the Sand lizard in the project area are lacking. The species was found only at one selected location during spring survey.

Relation (adaptability) to anthropogenically altered habitats: The species prefers natural habitats such as alpine meadows, pastures and forest edges, but can be found in more human environments such as quarries, roadsides and hedgerows (Speybroeck et al., 2016).

Corridors and reproductive centers in the route impact zone: Given that forests dominate the landscape of the project impact zone, patches of meadows and pastures within the zone do not represent the main habitats of the Sand lizard of the wider area.

Seasonal dynamics: Active between mid-March to mid-October. Mating takes place from April to June. Females lay eggs from end of May to July, juveniles emerge from July to October (Polović and Ljubisavljević, in press).

***Lacerta viridis* (Eastern green lizard)**

Distribution in Montenegro: Widely distributed in Montenegro (Ljubisavljević et al., 2018).

Habitat in the route impact zone: The project impact zone lies within the known range of *L. viridis* in Montenegro. The Eastern green lizard inhabits scrubland, hedgerows along roads, open woods and overgrown fields (e.g. Fig. 14).

Density/Abundance: There are no exact data on the density in the project area. It was recorded at three selected locations in the project impact zone, but could be more common due to the presence of suitable habitats that contain a lot of vegetation with warm basking opportunities, often quite near to water (Speybroeck et al., 2016).

Relation (adaptability) to anthropogenically altered habitats: Often encountered close to human habitation along roadsides and paths, dry-stone walls, vineyards and gardens. Can be seen basking on roads (Speybroeck et al., 2016). Data collected during surveys indicate that in the project impact zone it is found in human-altered habitats.

Corridors and reproductive centers in the route impact zone: The species spreads along the river valleys. Hence, The Lim and Drcka river valleys, as many other river valleys, gorges and canyons in Montenegro, could be corridors for spreading of *L. viridis.*

Seasonal dynamics: In general, it is active from March to October. Mating takes place in April. Females laid clutches between end of May to mid- July. Juveniles emerge in August or September (Polović and Ljubisavljević, in press).

***Podarcis muralis* (Common wall lizards)**

Distribution in Montenegro: Widely distributed in Montenegro (Ljubisavljević et al., 2018).

Habitat in the route impact zone: The project impact zone lies within the known range of *P. muralis* in Montenegro. It is common species throughout Montenegro (Ljubisavljević et al., 2018) and occupies variety of habitats. *P. muralis* was recorded at almost all selected locations, at overgrown river and streams banks, road sides (Fig. 15).

Density/Abundance: There are no exact data on the density in the project area. However according to field surveys, species is quite common in the project impact zone and all parts of Montenegro.

Relation (adaptability) to anthropogenically altered habitats: It is one of the most successful reptile species in man-made habitats (Speybroeck et al., 2016). During field surveys, *P. muralis* was also found in anthropogenically-modified habitats within the project impact zone.

Corridors and reproductive centers in the route impact zone: The species is widespread in Montenegro and very adaptable. The Lim and Drcka river valleys, as many other river valleys, gorges and canyons in Montenegro, could be corridors for spreading of *P. muralis.*

Seasonal dynamics: Active between February and November, but also on favorable sunny days in late autumn or winter in southern part of the range and at lower altitudes. Mating takes place between March and June. Females laid clutches between April and August. Juveniles emerge between July and October (Speybroeck et al., 2016).

***Anguis fragilis* (Slow worm)**

Distribution in Montenegro: Widely distributed in Montenegro (Ljubisavljević et al., 2018).

Habitat in the route impact zone: The project impact zone lies within the known range of *A. fragilis* in Montenegro. It usually inhabits well – vegetated and relatively moist places such as meadows and open woods (Speybroeck et al., 2016). During field surveys, road-killed specimens of *A. fragilis* were found at two selected locations along the Mateševo-Andrijevica route (Fig. 16).

Density/Abundance: There are no exact data on the density in the project area or generally in Montenegro. The species is secretive and rarely seen basking in the open places, but is presumed to be common across Mountain-valley region of Montenegro due to availability of suitable habitats.

Relation (adaptability) to anthropogenically altered habitats: It can be found near human habitation, such as embankments, gardens and parks (Speybroeck et al. 2016).

Corridors and reproductive centers in the route impact zone: The Lim and Drcka river valleys, as many other river valleys, gorges and canyons in Montenegro, could be corridors for spreading of the Slow worm.

Seasonal dynamics: Active mainly between March and late October-beginning of November. Mating takes place in April and May. Females give birth to juveniles from July to late summer (Radovanović, 1951; Džukić, 1991).

***Zamenis longissimus* (Aesculapian snake)**

Distribution in Montenegro: Widely distributed in Montenegro (Polović and Ljubisavljević, in press).

Habitat in the route impact zone: The project impact zone lies within the known range of *Z. longissimus* in Montenegro. It is found at five selected locations at forest edges and overgrown road sides (Fig. 17).

Density/Abundance: There are no exact data on the density in the project impact zone or generally in Montenegro. However it is presumed to be common across Mountain-valley region of Montenegro due to availability of suitable habitats.

Relation (adaptability) to anthropogenically altered habitats: The Aesculapian snake is frequently found near roads and overgrown ruins, dry-stone walls, abandoned railway tracks (Speybreock et al., 2016).

Corridors and reproductive centers in the route impact zone: The Lim and Drcka river valleys, as many other river valleys, gorges and canyons in Montenegro, could be corridors for spreading of the the Aesculapian snake.

Seasonal dynamics: Active between March and October. Mating takes place in May or June. Females lay one clutch by the end of June or in July. Juveniles emerge in August or September (Speybroeck et al., 2016).

***Coronella austriaca* (Smooth snake)**

Distribution in Montenegro: Distributed in Mountain-valley region of Montenegro (Polović and Ljubisavljević, in press).

Habitat in the route impact zone: The project impact zone lies well within the known range of *C. austriaca* in Montenegro. It occurs on partially-vegetated road banks, close to forests in hilly terrain, but also could be found on meadows, near streams and river banks (Džukić, 1991). A road-killed specimen was found at one selected location in the project impact zone (Fig. 18).

Density/Abundance: There are no exact data on the density of the Smooth snake in the project area or generally in Montenegro. However it is presumed to be common across Mountain-valley region of Montenegro due to availability of suitable habitats.

Relation (adaptability) to anthropogenically altered habitats: The Smooth snake generally occupies natural habitats, but could be found along vegetated road banks and dry stone walls (Speybreock et al., 2016).

Corridors and reproductive centers in the route impact zone: The Lim and Drcka river valleys, as many other river valleys, gorges and canyons in Mountain-valley region of Montenegro, could be corridors for spreading of the Smooth snake.

Seasonal dynamics: Active between March-April and October-November. Mating takes place in April or May. Females give birth to juveniles in August or September (Speybroeck et al., 2016; Polović and Ljubisavljević, in press).

***Natrix natrix* (Grass snake)**

Distribution in Montenegro: Widely distributed in Montenegro (Polović and Ljubisavljević, in press).

Habitat in the route impact zone: The project impact zone lies within the known range of *N. natrix* in Montenegro. It is common species throughout Montenegro (Polović and Ljubisavljević, in press) and occupies all kinds of wetlands. Numerous streams and rivers of the project area represent favorable habitats for the Grass snake. During field surveys, *N. natrix* was recorded in rivers and streams and along their banks at five selected locations (Fig. 19).

Density/Abundance: There are no exact data on the density of the Grass snake in the project area or generally in Montenegro. However, the species is quite common in all parts of Montenegro, and according to field data, including area through which the route passes.

Relation (adaptability) to anthropogenically altered habitats: The Grass snake occupies a very wide variety of wetland habitat types including ones under anthropogenic influence or man-made habitats, such as roadside ditches, drainage canals, garden ponds, etc. It may be quite common in urban, suburban and rural areas (e.g. Mollov, 2014).

Corridors and reproductive centers in the route impact zone: Rivers in the project impact zone represent important dispersal corridors and connection between wetlands.

Seasonal dynamics: Active between February/March and November, depending on altitude. Mating takes place in April and May. Eggs are laid between May and August (Speybroeck et al., 2016).

***Natrix tessellata* (Dice snake)**

Distribution in Montenegro: Widely distributed in Montenegro (Polović and Ljubisavljević, in press).

Habitat in the route impact zone: The project impact zone lies within the known range of *N. tessellata* in Montenegro. It is common species throughout Montenegro (Polović and Ljubisavljević, in press) and occupies ponds, canals, streams, rivers, lakes and nearby habitats. Numerous fast-flowing streams and rivers of the project area represent favorable habitats for the Dice snake. During field surveys, *N. tessellata* was recorded in the second half of the route in Kraljštica and Lim rivers (Fig. 20).

Density/Abundance: There are no exact data on the density in the project area or generally in Montenegro. However, the species is quite common in all parts of Montenegro. In the project impact zone the Dice snake is obviously common in somewhat wider river valleys , such as Lim River and lower course of Kraljštica River.

Relation (adaptability) to anthropogenically altered habitats: The Dice snake is usually found in natural habitats (e.g. Mollov, 2014), but can occur in man-made habitats, such as roadside ditches and drainage canals (own field data).

Corridors and reproductive centers in the route impact zone: Rivers in the project impact zone represent important dispersal corridors and connection between wetlands.

Seasonal dynamics: Active between March and October. Mating takes place from April to July. Eggs are laid in July. Juveniles emerge in August or September (Speybroeck et al., 2016).

***Vipera ammodytes* (Nose-horned viper)**

Distribution in Montenegro: Widely distributed in Montenegro (Polović and Ljubisavljević, in press).

Habitat in the route impact zone: The project impact zone lies within the known range of *V. ammodytes* in Montenegro. It is found in dry, sunny, rocky hillsides with some vegetation such as small trees and shrubs and in open woods. During field surveys, specimens were found on four selected locations, mainly in the first half of the route, near the main and side roads that pass between hillsides and deciduous forests (Fig . 21)

Density/Abundance: There are no exact data on the density in the project impact zone or generally in Montenegro. However, the species is quite common in all parts of Montenegro, including area through which the route passes.

Relation (adaptability) to anthropogenically altered habitats: The nose-horned viper shows no preferences regarding the origin of the habitat: man-made stone walls and natural rocks are equally favoured (Speybroeck et al., 2016)

Corridors and reproductive centers in the route impact zone: The Lim and Drcka river valleys, as many other river valleys, gorges and canyons in Mountain-valley region of Montenegro, could be corridors for spreading of *V. ammodytes.*

Seasonal dynamics: Active between the end of March and October. Mating takes place in April and May. Juveniles are born in late summer (Speybroeck et al., 2016; field data).

Table 5. Characteristics of habitats and populations of the recorded species.

Species	**Distribution in ME**	**Habitat under the Project impact zone-importance in ME**	**Abundance/ Commonness in the Project impact zone**	**Relation to man-made, altered or habitats under anthropogenic impact**	**Corridors/reproductive centers in the Project impact zone**	**Activity (depending on altitude)**
Salamandra salamandra	Mountain-valley region	No special importance with regard to other ones	Common	sometimes occupies	Corridor and repr center	Apr-Oct
Bombina variegata	more numerous in Mountain-valley region	No special importance with regard to other ones	Common	often occupies	Corridor and repr center	March-Oct
Bufo bufo	wide	No special importance with regard to other ones	Common	often occupies	Corridor and repr center	March-Nov
Pelophylax ridibundus	wide	No special importance with regard to other ones	Common in second part of the route	often occupies	Corridor and repr center	March-Nov
Rana graeca	predominantly in Mountain-valley region	No special importance with regard to other ones	Abundant/ Common	rarely occupies	Corridor and repr center	March-Oct
Rana temporaria	Mountain-valley region	No special importance with regard to other ones	Rarely found but could be more common	rarely occupies	Corridor and repr center	March-Oct/Nov
Lacerta agilis	Mountain-valley region	No special importance with regard to other ones	Rarely found but could be more common	sometimes occupies	Corridor	Mid March-Mid Oct
Lacerta viridis	wide	No special importance with regard to other ones	Common	often occupies	One of the many corridors in ME	March-Oct
Podarcis muralis	Wide	No special importance with regard to other ones	Abundant, Common	very adaptable	One of the many corridors in ME	March-Nov
Anguis fragilis	Wide	No special importance with regard to other ones	Presumed to be common	Sometimes occupies	One of the many corridors in ME	March-Oct/Nov
Zamenis longissimus	wide	No special importance with regard to other ones	Common	often occupies	One of the many corridors in ME	March/Apr-Oct/Nov

Table 5. Continued

Species	**Distribution in ME**	**Habitat under the Project impact zone-importance in ME**	**Abundance/ Commonness in the Project impact zone**	**Relation to man-made, altered or habitats under anthropogenic impact**	**Corridors/reproductive centers in the Project impact zone**	**Activity**
Coronella austriaca	Mountain-valley region	No special importance with regard to other ones	Presumed to be common	sometimes occupies	One of the many corridors in ME	March/Apr-Oct/Nov
Natrix natrix	wide	No special importance with regard to other ones	Common	sometimes occupies	One of the many corridors in ME	March-Nov
Natrix tessellata	wide	No special importance with regard to other ones	Common	sometimes occupies	One of the many corridors in ME	March-Nov
Vipera ammodytes	wide	No special importance with regard to other ones	Common	often occupies	One of the many corridors in ME	March-Oct

Sensitive areas of batracho- and herpetofauna

The proposed highway routes pass through or around the edges of the following designated or proposed sites for nature protection: Regional Nature Park “Komovi” and Area of Special Conservation Interest (ASCI) “Lim River”. Riparian areas of the Lim river and other numerous streams and small rivers within the Project impact zone are very sensitive to impacts on water quality through pollution, disturbance of river beds, sedimentation and turbidity. The impacts associated to highway construction and operation should be minimised, otherwise they will result in significant damage to the ecological value of these areas and their batracho-and herpetofauna.

Key risks during the construction process and mitigation measures

Habitat loss and degradation

The impacts on batracho- and herpetofauna related to the loss and degradation of natural habitats are: excessive vegetation removal for the construction of the road; elimination of the natural characteristics of the land within the paved area and adjacent roadsides; soil compaction due to operating machinery. These actions can adversely affect amphibians and reptiles both directly - by limiting their home ranges, changing their foraging ability and strategy reducing the places that may be used as refugia and hibernacula and indirectly – affecting prey availability.

These risks are expected to be of short-term duration if appropriate mitigation measures are applied. The construction of a long tunnel and a number of bridges and crossings reduce the width of the area of permanent habitat loss. Also, most of the detected terrestrial species often occupy man made, altered or habitats under anthropogenic impacts (see Table 5). Therefore, post-mitigation significance of risks related to habitat loss and degradation are expected to be low to moderate.

Route variants

Two route variants largely overlap. However, as V1 may have somewhat greater impact on the riparian area of Ljubaštica River and protected area of RP “Komovi”, V2 route is expected to have lower impacts related to loss and degradation of natural habitats of amphibians and reptiles than Variant 1 (V1).

Mitigation measures

-Limit the clearing of natural vegetation only to the extent necessary.

-Restrict the movement of heavy machinery to the most necessary surface, using already existing clearings in order to avoid additional degradation of the habitats. Special attention should be paid to the end of the route (selected point 11 - Lim ASCI 3rd point, Lugovi site) in Lim River ASCI where the route passes very close to the river.

- Save topsoil removed for construction activities and spread over the disturbed area as soon as possible after disturbance to accelerate natural re-vegetation, thus helping to minimize erosion and return lands to a useable condition for amphibians and reptiles.

Habitat fragmentation

Habitat fragmentation caused by road construction can directly and adversely affect amphibian and reptile species by disruption of their movements through the landscape and increasing mortality of animals who try to cross the road. Considering that the Project includes the construction of bridges over the rivers and streams, crossings and tunnels, movement corridors and habitats are not expected to be disrupted if the necessary measures of protection and mitigation during the project construction phase are applied. Potential fragmentation can be expected with regard to terrestrial habitats of amphibians and reptiles. The risks related to habitat fragmentation are expected to be of short-term duration and their significance after implementation of adequate mitigation measures are expected to be low to moderate.

Route variants

Two route variants largely overlap. However, V2 route is expected to have lower impacts related to loss of habitat connectivity than Variant 1 (V1), as it involves the construction of a larger bridge and a couple of short tunnels in the area of Han Drndarski (Ljubaštica River).

Mitigation measures

-Use of heavy machinery should be limited to the project right-of –way area to avoid additional fragmentation of habitats.

Changes in water conditions

An increase of sedimentation and turbidity within the project's sensitive riparian area caused by disposal of removed soil and waste along the banks of the rivers and streams, direct disposal into aquatic and wetland habitats and emission of dust during construction phase, may adversely directly and indirectly impact both amphibians and aquatic/semiaquatic reptiles and their food supply (fish, aquatic invertebrates). In-river works and gravel extraction can also result in sediment deposition. After application of necessary mitigation measures this impact is expected to be of short-term duration and of low-moderate significance.

Route variants

V2 route is somewhat less proximate to the river Ljubaštica in Han Drndarski area and is expected to contribute less sediment than the other Variant (V1).

Mitigation measures

- Pollution prevention measures should be put in place such as: use of silt fences; retain of vegetation cover as much as possible on the river/stream banks; vegetation restoration; minimizing dust emission by reducing vehicle speed and watering roads; prevent disposal of removed soil and construction waste on the slopes along the banks of the rivers and streams; that is to act in accordance with the Law on Waters and Waste Management Law.

-The river bed should be protected, and activities around watercourses should be executed within the smallest possible time frame.

Habitat pollution

Inadequate or untimely application of protection measures can lead to contamination of aquatic and terrestrial habitats by emissions of dust, waste and pollutants by construction vehicles and wastes from working camps. Pollutants can have direct and indirect adverse effects on both amphibians and reptiles and their prey items and long-term consequences on their habitats. The contaminants (such as heavy metal and nitrogen pollution) may cause direct mortality of individuals resulting from exposure, developmental anomalities, increased metabolic rates, which all may result in demographic shifts causing detrimental effects on amphibian and reptile populations (e.g. Todd et al., 2010; Egea-Serrano et al. 2012). After application of necessary mitigation measures this impact is expected to be of short-term duration and of low-moderate significance. Otherwise, especially in areas near watercourses, **unmitigated effects** of run off would be regarded as **high impact with potentially long-term duration.**

Route variants

V2 route is somewhat less proximate to the river Ljubaštica in Han Drndarski area and is expected to have lower impacts related to pollution of aquatic habitats of amphibians and reptiles at this point than the other Variant (V1).

Mitigation measures

- Act in accordance with the Law on Waters and Waste Management Law. A number of measures should be put in place to prevent accidental pollution of aquatic habitats and wetlands, such as: prohibition of servicing and fuelling of vehicles in the immediate vicinity of these habitats; prohibition of dumping of waste materials and construction consumables in the riparian area during crossing construction; setting back of chemical and oils storages at adequate distance from watercourses; installation of drainage systems to divert runoff into drains, soak-aways and detention basins to avoid contamination of watercourses.

-Minimize dust emission by reducing vehicle speed and watering roads.

-Location of construction camps should be away from riparian area.

Direct mortality

Amphibians and reptiles may be affected by collision with construction vehicles during habitat clearance, deliberate killing by construction workers due to fear (e.g. snakes) or accidental trapping in pits and excavations. It is expected that animals will try to avoid the project area due to presence of people, noise and vibration from construction machinery. The potential adverse impact of direct mortality is expected to be of short-term duration and post-mitigation significance would be low.

Route variants

Two route variants largely overlap, having similar effects on animal mortality during construction. However, V2 route is somewhat less proximate to the river Ljubaštica and its riparian area around Han Drndarski and is expected to have lower impacts related to direct mortality of amphibians and aquatic reptiles during construction than V1.

Mitigation measures

- The movement of heavy machinery and vehicles should be restricted to the most necessary surface, using dedicated haul routes.
- Speed limits on vehicles should be imposed.
- Pits and excavations should be filled in as soon as possible following works. If they are created for a longer period of time they should be equipped with escape ramps and regular crossing points. If needed, the trapped animals should be rescued by the help of a qualified person.
- Construction workers must be informed that the intentional killing of animals is not permitted.

Visual, noise and vibration disturbance

Displacement of individuals as a reaction to visual, noise and vibrations disturbance during construction is expected to be localized and of short term duration. Sufficient data are not yet available to identify anthropogenic noise as the critical variable affecting vocalization or reception systems of amphibians and reptiles and their courtship and reproductive behaviour (Simmons and Narins, 2018). Also, most of the species detected during the field surveys were found close to the main or side roads and are already habituated to the certain degree of noise.

Route variants

No significant difference in impact related to visual and noise disturbance during construction is expected between the two route variants.

Mitigation measures

-Impacts from noise and vibrations could be reduced by confining most intensive construction works if possible outside the hibernation and late spring breeding periods.

Key risks during the operations and maintenance and mitigation measures

Habitat degradation and fragmentation

The highway-induced habitat fragmentation may prevent amphibians and reptiles to reach suitable habitats for feeding, breeding and hibernation and make them more visible to predators when crossing the gaps. The risks of habitat fragmentation are possibly related to open sections of the road along the hilly slopes of the Project zone. However, the greater diversity and abundance of amphibians and reptiles have been recorded in lower parts of the area along watercourses. Considering that the project includes the construction of a number of bridges and crossings over the rivers and streams, species movement corridors and habitats are not expected to be disrupted. Therefore, it is expected that the impact could be of long-term duration along the open ground sections and its initial significance, without mitigation measures could be low to moderate.

Route variants

V2 route is expected to have lower impacts related to loss of habitat connectivity than Variant 1 (V1), as it involves the construction of a larger bridge and a couple of short tunnels in the area of Han Drndarski (Ljubaštica River) before the long tunnel through the Trešnjevik pass that is planned for both variants.

Mitigation measures

- Field research has not identified any precise locations at proposed open ground sections of the route where the construction of animal passages would be required. The exception could be selected point 11 (Lim ASCI 3rd point, see Fig. 32), in ASCI Lim River at Lugovi site where seven species of Amphibians and Reptiles were recorded. The route passes very close to the Lim River. If an elevated road section (viaduct) is not planned to be constructed, it is proposed to build a passage/culvert that would enable connection between the intermittent tributary of the Lim river (42.756517°, 19.796850°) and the Lim River, and thus mitigate the fragmentation effect and allow animals to disperse between the wet areas on both sides of the highway.

- One year after completion of the works, monitor the frequency of road kills, and if necessary, define additional mitigation measures.

- Preservation of roadside vegetation.

Habitat pollution

Pollution from operational road includes water runoff and accidental spillage of chemicals, such as gasoline, oil and various toxic compounds, and would have impacts similar to those from construction. The effects of

pollutants on amphibians and reptiles are described above. This impact could be of long-term duration and its initial significance, without mitigation measures could be moderate. Post-mitigation significance is expected to be low.

Route variants

No significant difference in impact related to pollution of natural habitats of amphibians and reptiles is expected between the two route variants.

Mitigation measures

-Prohibition of direct discharge of untreated runoff into the watercourses and wetland area; The drainage systems should be installed to divert runoff into drains, soak-aways and detention basins in order to avoid contamination of watercourses. Detention basins and drainage systems should be fenced or grilled to prevent trapping of animals.

- A regular control and maintenance of drainage structures shall be conducted to check their permeability.

-Roadside waste collection and regular clean up of the road.

Direct mortality

Collisions between amphibians/reptiles and cars cause direct mortality of these animals. Therefore, the operational road represents significant risk to amphibians and reptiles which cross road for the purposes of choosing new habitat, finding a food source or reproduction. Some of them are also attracted to road surface for thermoregulation (Langen et al., 2009).

There are no literature data on road-kill rates of amphibians and reptiles on main and local roads in the surroundings of the Project area, as well as in the area itself. Sporadic road kills of amphibians and reptiles were detected along the main road Mateševo-Andrijevica during field work. Road kills were detected in *B. bufo, R. graeca, P. muralis, A fragilis, Z. longissimus, C. austriaca*. During operation phase, this impact may be permanent, but it is not expected to be high for toads and other amphibians due to the position of the open part of the route along elevated terrain above the valleys and gorges, construction of bridges/crossings over the rivers and streams and a long tunnel through the Trešnjevik pass. The impact may be moderate to high for some species of reptiles. However, field research has not identified obvious reptile corridors and precise locations at proposed open ground sections of the projected routes where the construction of animal passages would be required. The position of the open part of the route at elevated slopes above watercourses, construction of bridges and crossings and the road tunnels reduce the risk of direct road mortality. As described above the exception could be selected location 11 (Lim ASCI 3rd point, at Lugovi site) (see under “Habitat degradation and fragmentation”)

Route variants

Two route variants largely overlap, having similar effects on animal mortality during operation stage. The main difference between the two variants appears around Ljubaštica River (Han Drndarski area) prior to Trešnjevik mountain pass. Although V1 is characterized by open road section in Han Drndarski area it includes longer continuous tunnel section through the Trešnjevik mountain pass. V2 involves the construction of a larger bridge, a couple of short tunnels in the area of Han Drndarski but shorter continuous tunnel section through the Trešnjevik mountain pass.

Being that V1 route is somewhat more proximate to the river Ljubaštica around Han Drndarski area where the open ground section is planned to be constructed, it is expected to have greater impact related to direct mortality of amphibians and reptiles associated to riparian area of Ljubaštica river than V2 route.

Mitigation measures

- If parts of the route are fenced off due safety issues as a stand-alone measure to prevent landslides or mortality of large animals, then it should be designed and installed as gap-free, permanent fence with small mesh holes or as additional fencing material such as hardware cloth at the appropriate height, that can be attached to the base of the fencing to prevent passing of reptiles through the large mesh holes and reduce the risk of small snakes getting stuck. For reptiles, the fence should include an overhang lip extended away from the road to deter climbing and requires attachment to post at regular intervals to avoid collapse. The fence should lead the animals towards safe crossing points (tunnel, under the bridges or crossings).

- Mitigation measure at selected location 11 (Lim ASCI 3rd point, at Lugovi site) is described under "Habitat degradation and fragmentation"

- One year after completion of the works, monitor the frequency of road kills, and if necessary, define additional mitigation measures.

Noise, light and vibration disturbance

Insects may be attracted to the lighted road increasing collision risk for their predators – e.g. some nocturnal species of amphibians (e.g. toads). Also, exposure to artificial light can cause nocturnal frogs to suspend normal foraging and reproductive behavior (Buchanan, 1993). Impacts of noise and vibrations are described above. Most of the species detected during the field surveys were recorded close to the main or local roads and are already habituated to the certain degree of noise. They also may become accustomed to highway transportation related noise and vibration over time. Therefore, these impacts are expected to be of low significance.

Route variants

No significant difference in impact related to visual and noise disturbance during operation stage is expected between the two route variants.

Mitigation measures

-Avoid installing lighting near potentially vulnerable sites, unless required for human safety or other road safety requirements; If the artificial lighting is required adjacent to important habitat sites, then design lighting or install shades to emit down and away from the natural area.

Impacts and mitigation measures for notable species

During field surveys only one notable species (on the grounds of nature protection - i.e. IUCN threatened –CR, EN, VU and near threatened NT species, and/or species listed in Annex II of the EU Habitats Directive – target species in Natura 2000 network) was detected within the project impact zone: *Bombina variegata.*

Bombina variegata

The Yellow –bellied toad *Bombina variegata* is listed under Annex II of the EU Habitats Directive, and therefore it is a target species in Natura 2000 network. It is not listed under the threatened species in IUCN categorisation and is not protected in Montenegro.

Locations within the project impact zone: V1/V2, selected locations: edges of Regional park "Komovi", terrain around Ljubaštica river (Han Drndarski area), terrain around Novovića stream (Gnjili stream) and Lim river ASCI.

Main impacts: *Construction phase*: changes in water conditions, habitat degradation and pollution

Operational phase: habitat degradation and pollution

Mitigation measures:

- During construction phase general measures outlined above should be strictly followed especially pollution prevention and limitation of machinery to the Project RoW at points close to watercourses. If possible, heavy machinery should avoid side roads at selected points 2 (RP Komovi), 6 (Ljubaštica River) and 7 (Novovića stream) (see Figures in Appendix for exact locations) where *B. variegata* is detected.

- Mitigation measure at selected location 11 (Lim ASCI 3rd point, at Lugovi site) is described under "Habitat degradation and fragmentation"

- Although dry period is not pronounced, it is expected that in late summer – early autumn watercourses in the Project area have lower flow, small water bodies (such as puddles, wheel ruts, side road ditches where *B. variegata* is usually found) dry out and construction works are expected to have less adverse impact on *B. variegata.*

-Location of construction camps should be away from riparian area.

- During operational phase also general measures of habitat pollution prevention outlined above should be strictly followed.

Potential Critical Habitat/Priority Biodiversity Features triggers

No species were identified as potential Critical Habitat/Priority Biodiversity Features triggers

Preferred route alternative with regard to impacts on notable species and sensitive areas

Variant 2 (V2) is preferable route variant for notable species and other species as well. V2 route is somewhat less proximate to the river Ljubaštica and its riparian area around Han Drndarski and is expected to have lower impact related to habitat degradation, pollution and direct mortality of the Yellow-bellied toad in this area. For other locations there is no difference related to *B. variegata* and its habitats between the two route variants.

Also, based on the field surveys it is concluded that greater part of sensitive area around Ljubaštica river is likely to be affected by the construction of the route V1 and it is suggested the construction of route V2.

Cumulative impacts

-The construction of the Bar-Boljare highway, section Smokovac -Mateševo

Two sections of the Bar-Boljare highway intersect at the Mateševo. However, it is considered that works on the Podgorica-Mateševo section will be completed before the Project begins, but some cumulative effects may rise during the operation and maintenance phase, especially in the sensitive zone of the lower course of Drcka River. These include habitat pollution and changes in water conditions. Therefore, a monitoring is needed to ensure that mitigation measures foreseen for the first highway section are implemented and are effective during operations and maintenance. Mitigation measures should be improved or modified if they prove to be inadequate or inappropriate.

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APPENDICES

Figure 1. Selected locations 1 and 2 for field surveys of Amphibians and Reptiles: Drcka River (left) and RP "Komovi"(right).

Figure 2. Selected locations 3 and 4 for field surveys of Amphibians and Reptiles: Bukov stream (left) and confluence of the Vranjestica and Drcka rivers (Bare Kraljske) (right).

Figure 3. Selected locations 5 and 6 for field surveys of Amphibians and Reptiles: Veljebrdski stream (left) and Ljubaštica River (right).

Figure 4. Selected locations 7 and 8 for field surveys of Amphibians and Reptiles: Novovića stream (Gnjili stream) (left) and Dubokalj stream (right).

Figure 5. Selected locations 9 and 10 for field surveys of Amphibians and Reptiles: Kraljštica River (Lim ASCI 1st point) (left) and confluence of the Prisojački stream and Kraljštica River in Most Bandovića (Lim ASCI 2nd point) (right).

Figure 6. Selected location 11 for field surveys of Amphibians and Reptiles: Lim River (Lim ASCI 3rd point)

Figure 7. Larvae of the Fire salamander *Salamandra salamandra* and its habitat in the Project impact zone. A specimen and reproductive center at locality 7 – Novovića stream (Gnjili stream) (left and right).

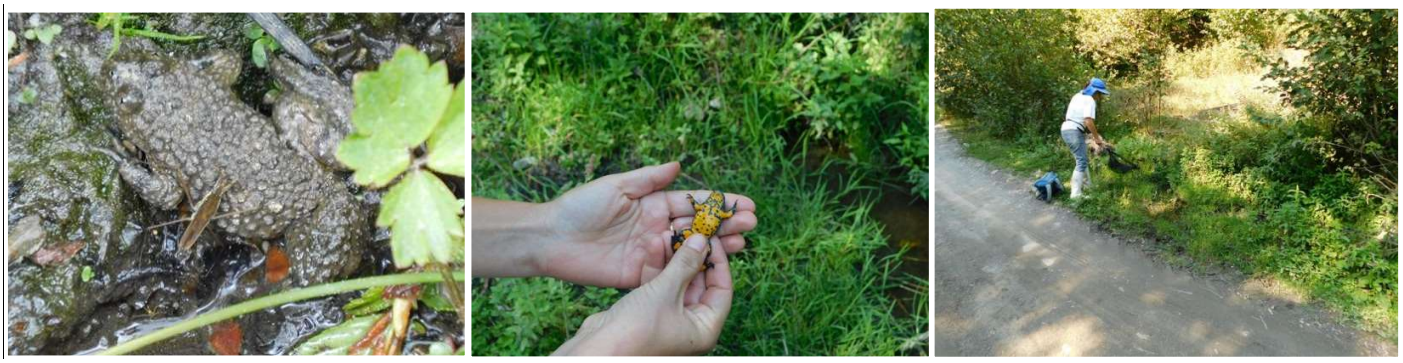

Figure 8. Yellow-bellied toad *Bombina variegata* and its habitat in the Project impact zone. A specimen and its habitat at locality 6 – Ljubaštica River (left and right).

Figure 9. Common toad *Bufo bufo* and its habitat in the Project impact zone. A side road-killed specimen at locality 7 - Novovića stream; tadpoles and reproductive center at locality 1 – Drcka River (left and right).

Figure 10. Marsh frog *Pelophylax ridibundus* and its habitat in the Project impact zone. A specimen and its habitat at locality 11 – Lim River (Lim ASCI 3rd point) (left and right).

Figure 11. Greek stream frog *Rana graeca* and its habitat in the Project impact zone. A specimen and its habitat at locality 8 – Dubokalj stream (left and right).

Figure 12. European common frog *Rana temporaria* and its habitat in the Project impact zone. A specimen and its habitat at locality 6 – Ljubaštica river (left and right).

Figure 13. Sand lizard *Lacerta agilis* and its habitat in the Project impact zone. A specimen and the habitat at locality 2 – RP „Komovi" (left and right).

Figure 14. Eastern green lizard *Lacerta viridis* and its habitat in the Project impact zone. A juvenile specimen and the habitat at locality 8 – Dubokalj stream (left and right).

Figure 15. Common wall lizard *Podarcis muralis* and its habitat in the Project impact zone. A specimens and the habitat at locality 5 – Veljebrdski stream (left and right).

Figure 16. Slow worm *Anguis fragilis* and its habitat in the Project impact zone. A road-killed specimen and the habitat at locality 2 – RP „Komovi" (left and right).

Figure 17. Aesculapian snake *Zamenis longissimus* and its habitat in the Project impact zone. A specimen and the habitat at locality 3 – Bukov stream (left and right).

Figure 18. Smooth snake *Coronella austriaca* and its habitat in the Project impact zone. A road-killed specimen and the habitat at locality 4 – confluence of the Vranještica and Drcka rivers (Bare Kraljske) (left and right).

Figure 19. Grass snake *Natrix natrix* and its habitat in the Project impact zone. A specimen and the habitat at locality 4 – confluence of the Vranještica and Drcka rivers (Bare Kraljske) (left and right).

Figure 20. Dice snake *Natrix tessellata* and its habitat in the Project impact zone. A specimen and the habitat at locality 9 – Kraljštica River (Lim ASCI 1st point) (left and right).

Figure 21. Nose-horned viper *Vipera ammodytes* and its habitat in the Project impact zone. Specimens and the habitat at locality 3 – Bukov stream (left and right).

Figure 22. Mapped locations of species recorded at the first surveyed site (1) Drcka River: (L) *L. viridis,* (M) *P. muralis*, (N) *N. natrix,* (Z) *Z. longissimus,* red pin – *B. bufo,* violet pin – *R. graeca.*

Figure 23. Mapped locations of species recorded at the second surveyed site (2) RP "Komovi": (A) *L. agilis,* (M) *P. muralis*, (F) *A. fragilis,* (V) *V. ammodytes,* yellow pin – *B. variegata,* violet pin – *R. graeca.*

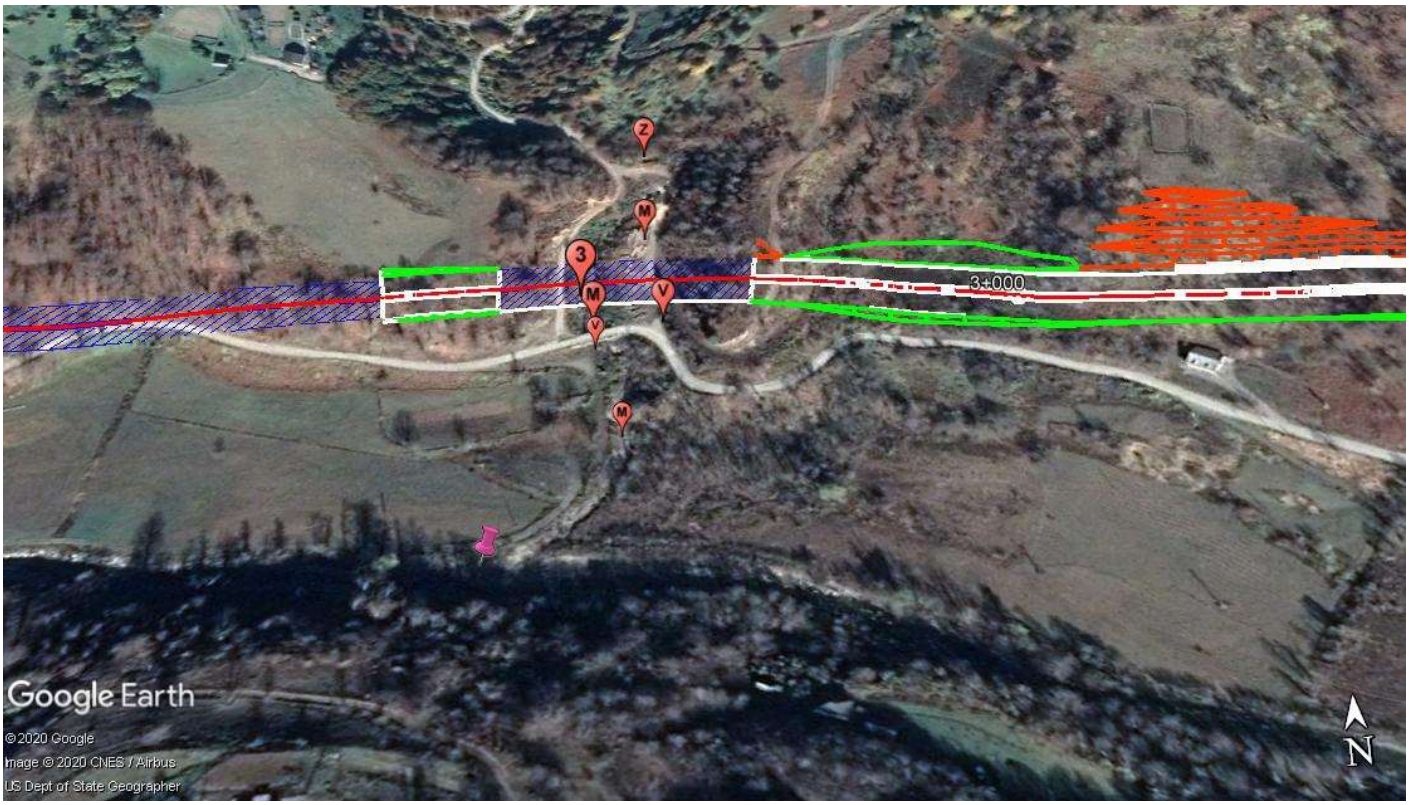

Figure 24. Mapped locations of species recorded at the third surveyed site (3) Bukov stream: (M) *P. muralis*, (V) *V. ammodytes,* (Z) *Z. longissimus,* violet pin – *R. graeca.*

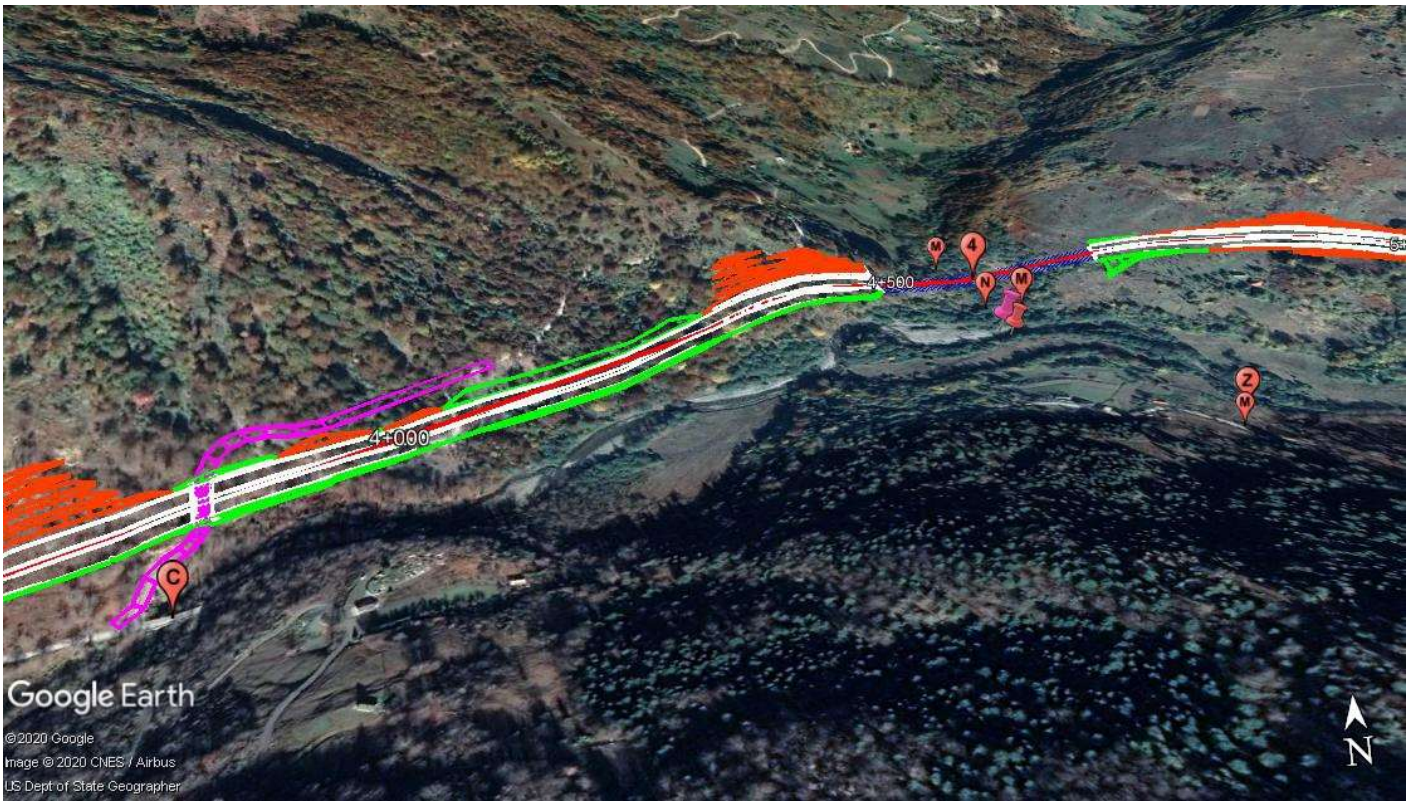

Figure 25. Mapped locations of species recorded at the fourth surveyed site (4) confluence of the Vranjestica and Drcka rivers (Bare Kraljske): (M) *P. muralis*, (N) *N. natrix,* (Z) *Z. longissimus,* red pin – *B. bufo,* violet pin – *R. graeca.*

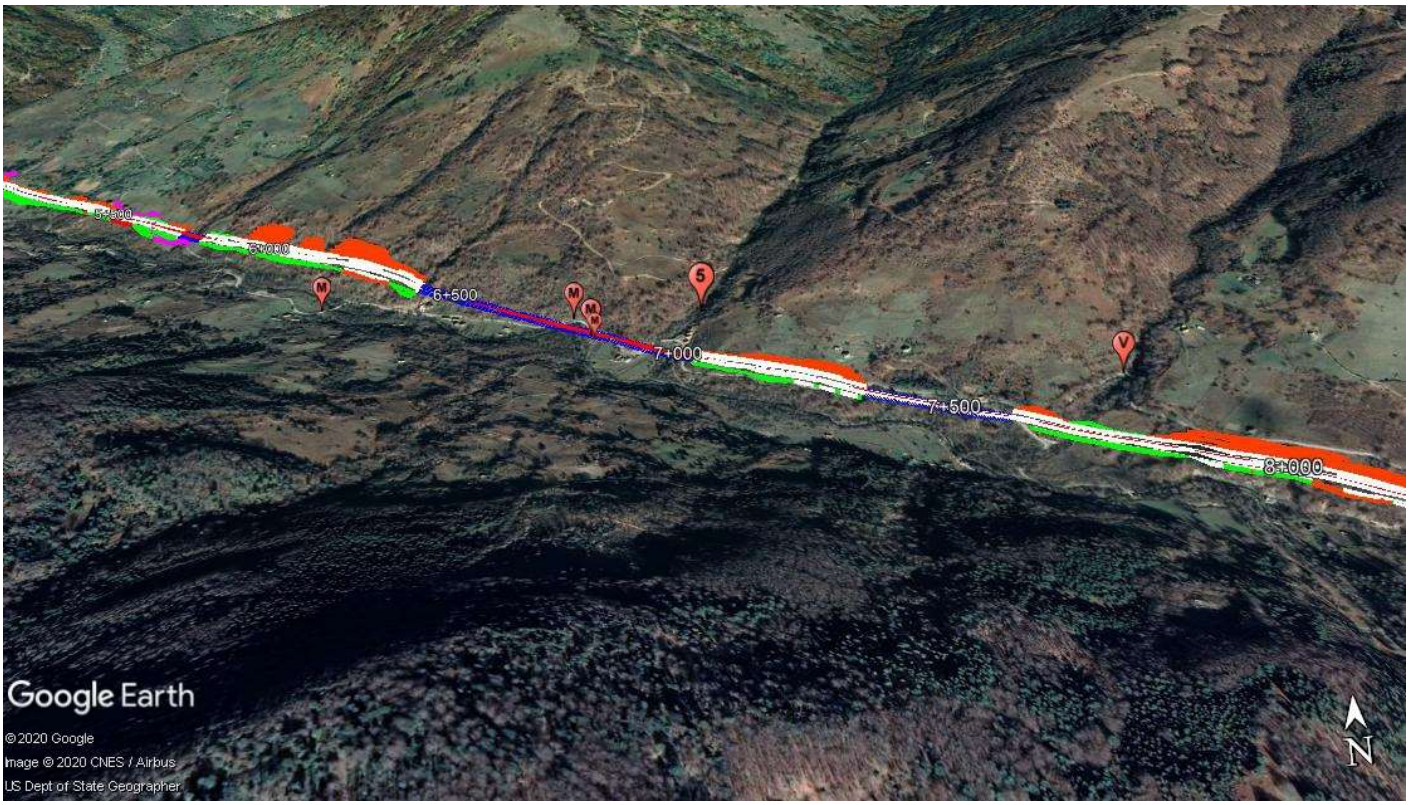

Figure 26. Mapped locations of species recorded at the fifth surveyed site (5) Veljebrdski stream: (M) *P. muralis*, (V) *V. ammodytes.*

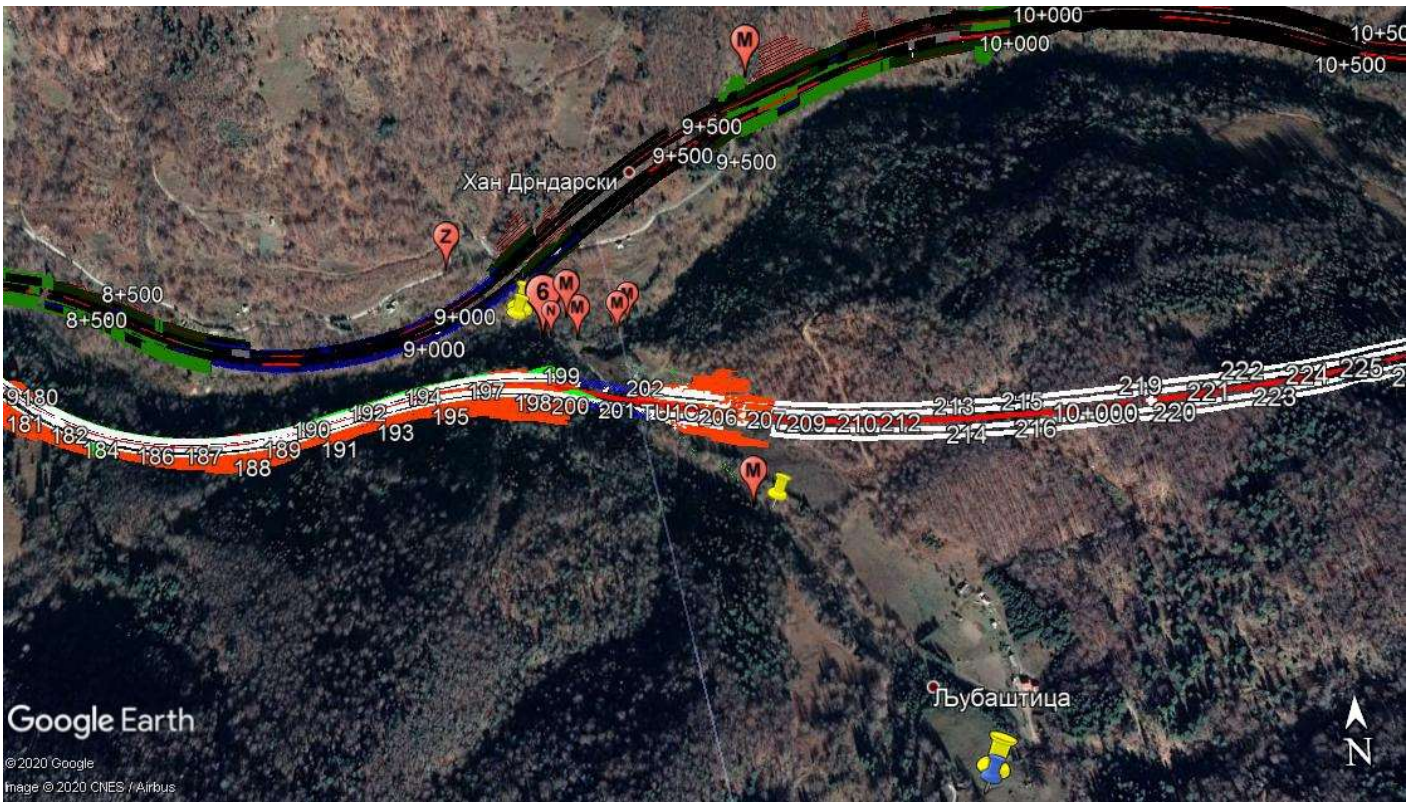

Figure 27. Mapped locations of species recorded at the sixth surveyed site (6) Ljubaštica River: (M) *P. muralis*, (N) *N. natrix,* (Z) *Z. longissimus,* yellow pin – *B. variegata,* blue pin – *R. temporaria.*

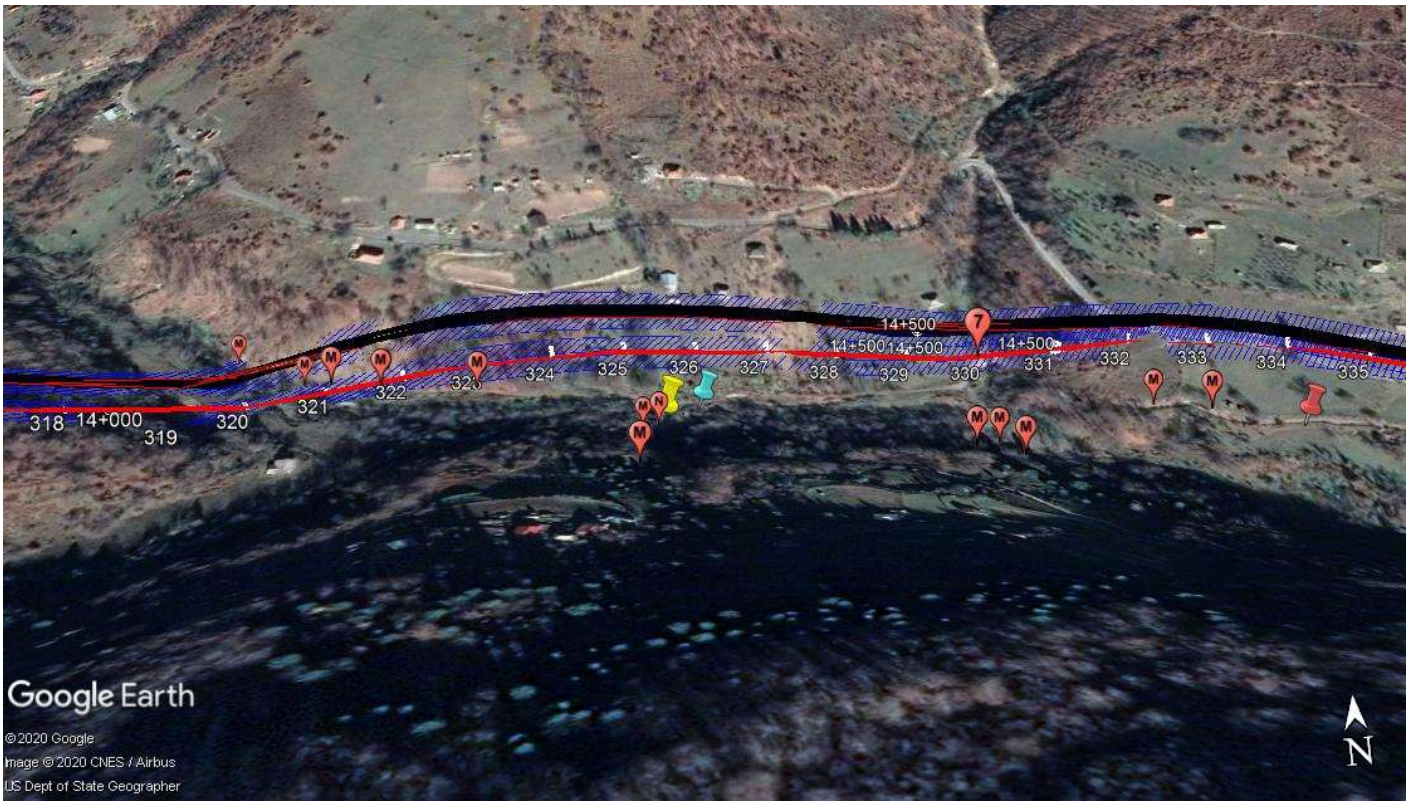

Figure 28. Mapped locations of species recorded at the seventh surveyed site (7) Novovića stream (Gnjili stream): (M) *P. muralis*, (N) *N. natrix,* red pin – *B. bufo,* yellow pin – *B. variegata,* light blue pin – *S. salamandra.*

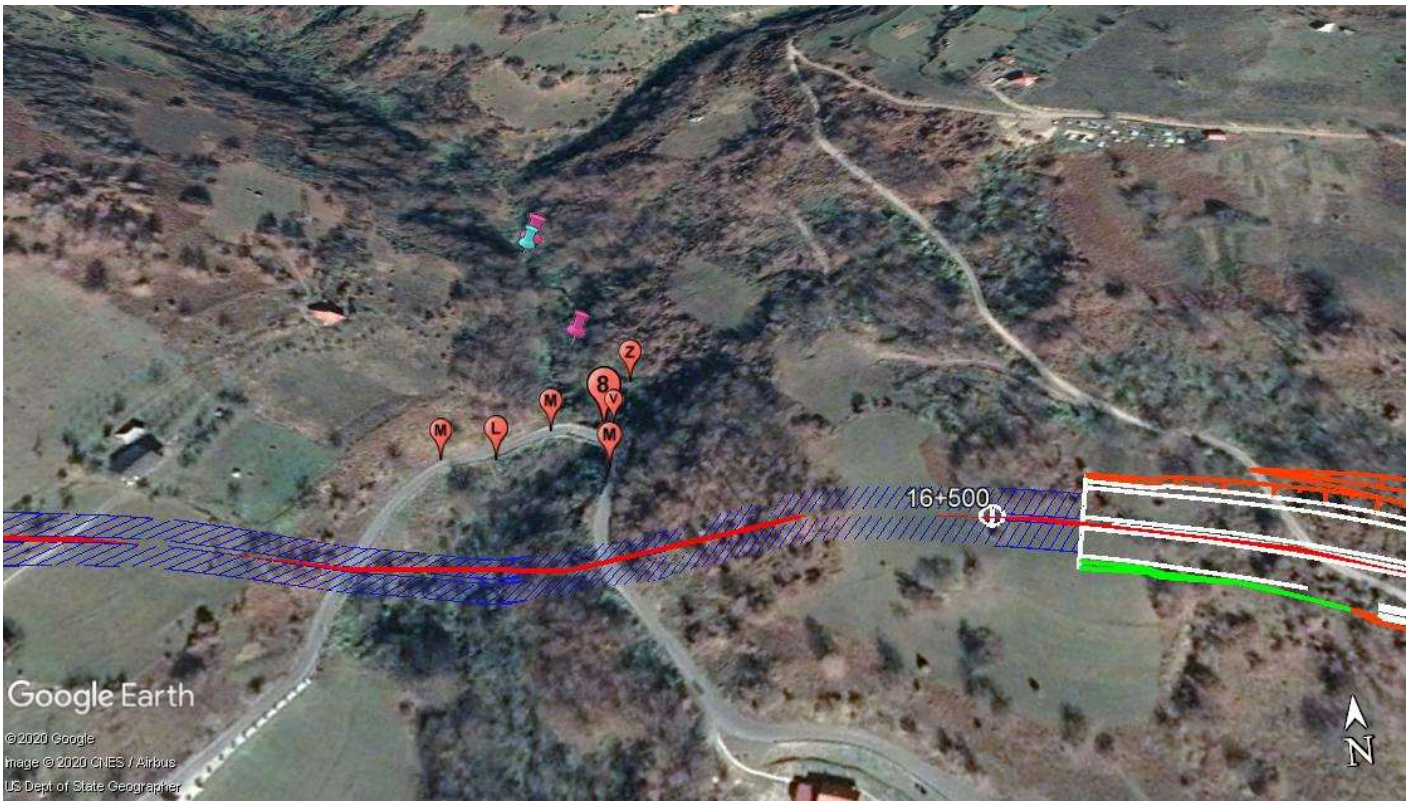

Figure 29. Mapped locations of species recorded at the eight surveyed site (8) Dubokalj stream: (L) *L. viridis,* (M) *P. muralis*, (Z) *Z. longissimus,* (V) *V. ammodytes,* violet pin – *R. graeca,* light blue pin – *S. salamandra.*

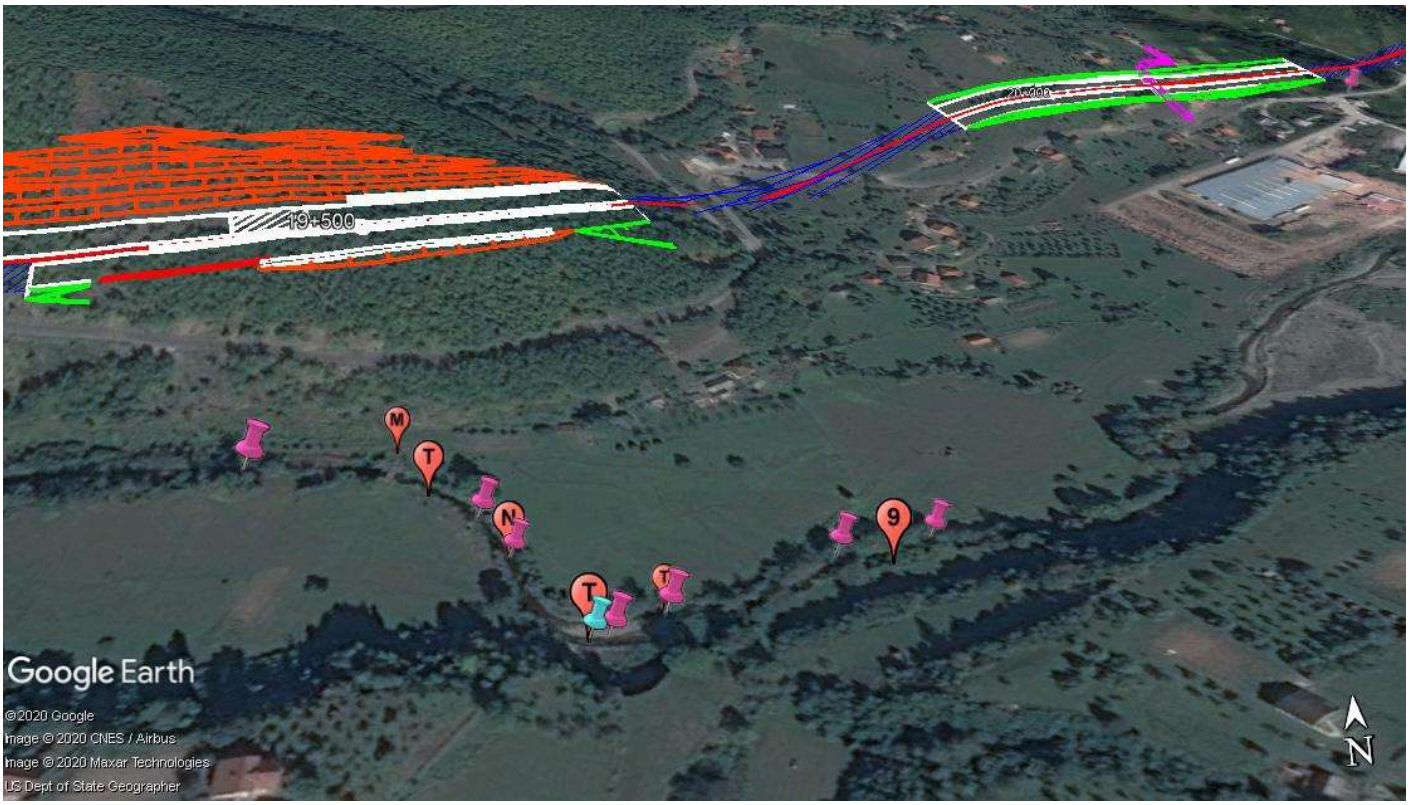

Figure 30. Mapped locations of species recorded at the ninth surveyed site (9) Kraljštica River (Lim ASCI 1st point): (M) *P. muralis*, (N) *N. natrix,* (T) *N. tessellata,* violet pin – *R. graeca,* light blue pin – *S. salamandra.*

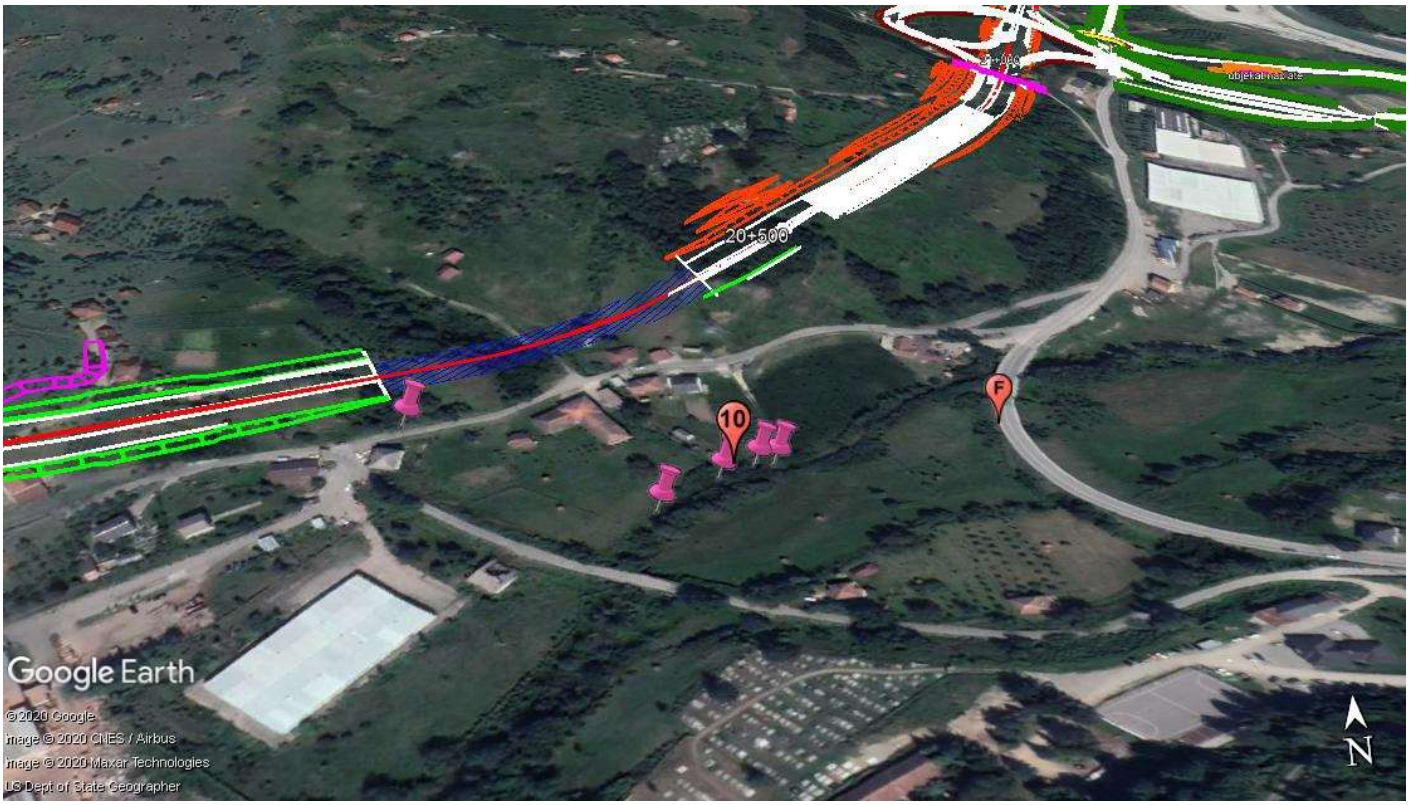

Figure 31. Mapped locations of species recorded at the tenth surveyed site (10) confluence of the Prisojački stream and Kraljštica River in Most Bandovića (Lim ASCI 2nd point): (F) *A. fragilis,* violet pin – *R. graeca.*

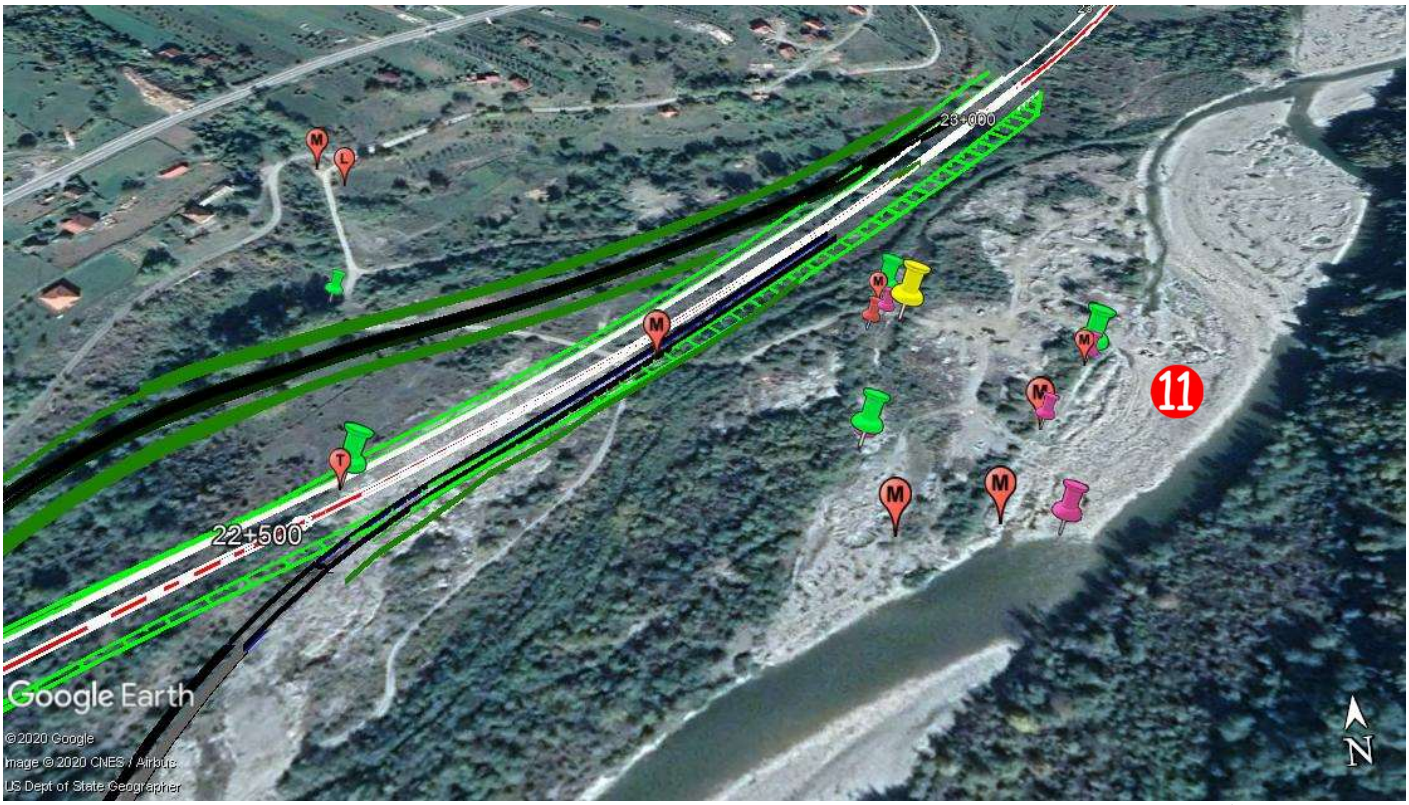

Figure 32. Mapped locations of species recorded at the eleventh surveyed site (11) Lim River (Lim ASCI 3rd point): (L) *L. viridis,* (M) *P. muralis*, (T) *N. tessellata*, yellow pin – *B. variegata,* green pin – *P. ridibundus*, red pin – *B. bufo,* violet pin – *R. graeca.*