Biodiversity of herpetofauna of the Prenj and Čvrsnica Mts. (Bosnia and Herzegovina)

Bioraznolikost herpetofaune planina Prenj i Čvrsnica (Bosna i Hercegovina)

EMINA ŠUNJE*[1], ADNAN ZIMIĆ[1], BORIS STJEPANOVIĆ[1], BENJAMIN JUSIĆ[1], MIRZA ČENGIĆ[1], MAJA BRADARIĆ[1], SAUDIN MERDAN[1]

[1]*Herpetological Association in Bosnia and Hercegovina ATRA, Sarajevo, Bosnia and Hercegovina;*

**Corresponding author: sunje.emina@gmail.com*

Abstract

Herpetological research of the Prenj and Čvrsnica mountains has a relatively long tradition, but not enough scientific attention was devoted to them. Literature data on herpetofauna of Prenj and Čvrsnica is old, sporadic and rare. The aim of this research was to collect all data on the herpetofauna for the given mountains and determine the importance of the area for the herpetofaunal biodiversity of Bosnia and Herzegovina (B-H). The analysis of data showed that the area of Prenj and Čvrsnica is inhabited by 11 species of amphibians (55 % of the total number of amphibians in B-H) and 24 species of reptiles (83% of the total number of reptiles in B-H) which differ in vertical and horizontal distribution. The registered biodiversity is extremely high and is a consequence of the geographical position of these mountains which border the Mediterranean climate zone in B-H.

Key words: distribution, submediterranean, amphibians, reptiles, biodiversity.

Sažetak

Herpetološka istraživanja planina Prenj i Čvrsnica imaju relativno dugu tradiciju, no znanje o njima još uvijek nije zadovoljavajuće. Literaturni podaci o herpetofauni Prenja i Čvrsnice su stari, sporadični i rijetki. Cilj istraživanja bio je prikupiti sve dostupne podatke o herpetofauni navedenih planina i odrediti važnost područja za bioraznolikost herpetofaune Bosne i Hercegovine (BiH). Analiza podataka je pokazala da na Prenju i Čvrsnici živi 11 vrsta vodozemaca (55 % od ukupnog broja vodozemaca u BiH) i 24 vrste gmazova (83% od ukupnog broja gmazova u BiH) te da se razlikuju po vertikalnoj i horizontalnoj distribuciji. Opažena je izuzetno visoka bioraznolikost koja je posljedica zemljopisnog položaja planina koje graniče sa mediteranskom klimatskom zonom u BiH.

Ključne riječi: rasprostranjenost, submediteran, vodozemci, gmazovi, bioraznolikost.

INTRODUCTION

Research of herpetofauna in Bosnia and Herzegovina (B-H) has been conducted since the Ottoman and Austro- Hungarian periods (Möellendorff, 1873). Nevertheless, data about amphibians and reptiles exist only for about 51% of the total territory, while the other 49% remains completely unsurveyed (Čengić 2013). Currently there are 20 species of amphibians and 29 species of reptiles (Lelo et al. 2014, Jablonski et al. 2012) known from Bosnia and Herzegovina. This group of animals is essential for proper energy distribution in food webs (Alford et al. 2001, Lelo 2012). Considering their physiological sensitivity, they are also known as ecosystem bioindicators

(Collins & Storfer 2003); based on their abundance and diversity, the quality and condition of an environment can be estimated.

Prenj is one of the highest mountains in Bosnia and Herzegovina with 11 peaks higher than 2000 meters above sea level (highest peak: Zelena glava – 2155 m). This mountain begins near Glavatičevo on the Neretva river, upstream of Konjic, and it extends as far as Bijelo Polje near Mostar. Prenj was formed in the Mesozoic era and is characterized by a special type of dolomitic karst and limestone (Lepirica 2008).

Čvrsnica mountain is situated in the northern part of Herzegovina. The most populated places are the city of Jablanica on the northeastern side, and Posušje and Tomislavgrad in the southwest. The highest peak Pločno is located 2229 meters above sea level, and is the third highest peak in Bosnia and Herzegovina. Čvrsnica is a part of the "Nature Park Blidinje", and greatly resembles Prenj in its geology and morphology.

A coniferous and deciduous forest belt covers the lower altitude zones of these mountains. The highest floristic diversity is expressed in plant communities that are in direct contact with limestone, whether in rock cracks (class *Asplinietea trichomanis*), or screes (class *Thlaspietea rotundifolii* and *Drypetea spinosae*). Alpine and subalpine grasslands are represented by the class *Elyno–Seslerietea*, while rocky grasslands are characterized with the class *Thero–Brachypodietea* (Redžić et al. 2010.)

Prenj and Čvrsnica mountains are positioned in the area of B-H where two distinct climate zones meet each other: the continental and the Mediterranean, therefore, they represent distribution borders for many amphibians and reptiles. The main objective of this paper was to collect all the herpetofauna data of the wide area of the mountains Prenj and Čvrsnica, as well as to determine their significance for the overall biodiversity of B-H herpetofauna.

MATERIAL AND METHODS

Data about the herpetofauna of Prenj and Čvrsnica Mts. was collected sporadically from 2004 to 2014. Field research was carried out on two mountain ecosystems: Mt. Čvrsnica and Mt. Prenj, and their wider area (Fig. 1). A total of 110 localities were visited. Individual animals at the point of capture were identified, photographed and released safely afterwards in their environment.

Literature data about the herpetofauna of the area was found in the following publications: Möllendorff (1873), Werner (1897, 1898, 1899, 1904, 1905, 1907), Karaman (1921), Bolkay (1924, 1928), Buresch & Zonkow (1932), Bolkay & Ćurčić (1920, 1933), Radovanović (1941, 1951); Pavletić (1964), Dimovski (1966), Mikšić (1970), Džukić (1972), Đurović (1987), Denoel et al. (2001), Muftić (2003), Dragobratović (2007), Šunje & Lelo (2008, 2010), Lelo et al. (2008, 2015), Jelić & Lelo (2009), Šunje (2011), Jelić et al. (2011, 2012a), Jablonski et al., (2012), Lelo (2005, 2015).

In the collection of the National Museum in Sarajevo a total of four species records were found for the areas of interest. Based on collected and literature data, as well as the few records from the National Museum in Sarajevo, a database of 458 individual herpetological records was created.

Identification of the species was conducted according to Arnold et al. (1992) and Lelo (2007). The taxonomy follows Speybroeck et al. (2010) and Frost (2014).

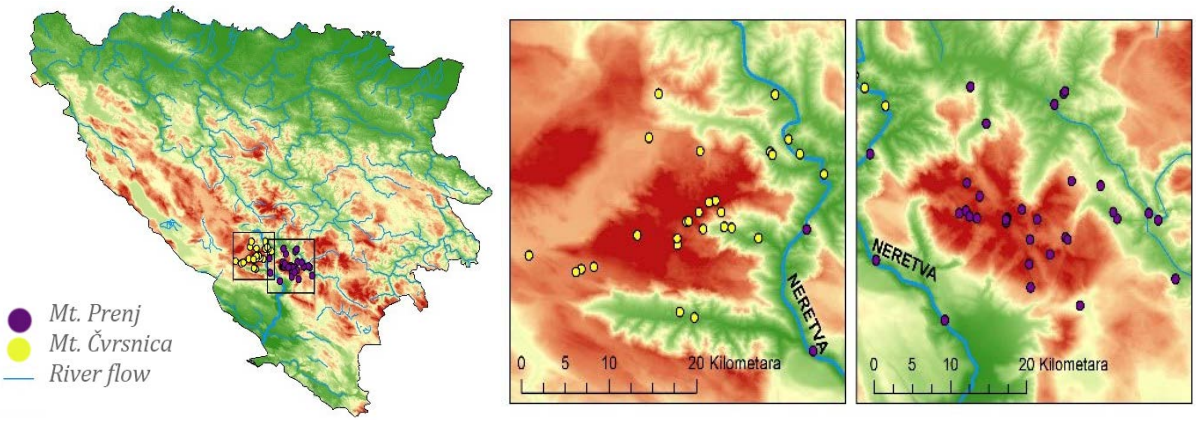

Figure 1. Position of the study area of the Prenj and Čvrsnica Mts. with the locations visited

Slika 1. Smještaj istraživanog područja planina Prenja i Čvrsnice s naznačenim istraženim lokacijama

The locations were divided into four main categories respectively: (A) Mt. Prenj, (B) Mt. Čvrsnica; (C) Neretva river - bordering zones between the two mountains, (D) Wider area of Mt. Prenj. In within the categories, locations were divided according to their altitude and main city of the area with its surroundings (see Appendix 1). The northernmost points of the research area are Vrtaljice and Gračac, the easternmost point is Kruševac. The southernmost point is north of the village of Potoci. The westernmost point is Vitrenjača.

All species records are shown in Table 1. Location codes for the table are given in Appendix 1. In Table 1 the locations can be separated by **“,”** or by **“;”**. The dates of the records are respectively ordered after the **“;”** signs which individually separate the locations. If the locations are separated by **”,”**, this indicates that they are registered on the same date. For a significant number of species some locations are repeated more than once which is why we only give the latest date of the record, for an easier presentation of the results. For species that were recorded only in the literature, we presented the original date of sampling/observation of the species. Repeated (old) records transmitted in newer literature were not taken into consideration when the date of such species is already presented in the table. Dates listed in *italic* denote museum specimens.

RESULTS

A total of 11 species of amphibians and 24 species of reptiles were recorded in the surveyed area (Table 1), comprising 55 % and 82.7 % of the total herpetofauna species in B-H, respectively. The paper provides photographs of the most interesting records, mostly including NATURA 2000 species and species listed in the local Red list (Fig. 3).

About 44.4 % of data presented in this paper was collected during the field work and represents the largest source of information, although 55.6 % of records used originated from both literature and museum data (Fig. 2).

Localities that have shown the highest level of biodiversity are the following: B2e – 16: 12 registered species; A2m – 10: 10 species B2b – 13: eight species; and A2k – 14: eight species. With 20 species records belonging to 14 species, the locality A2e and its surroundings showed the highest level of biodiversity.

The species *Elaphe quatuorlineata* (Lacepède, 1789), *Hierophis gemonensis* (Laurenti, 1768), *Lacerta agilis* Linnaeus, 1758, *Malpolon insignitus* (Geoffroy De St-Hilaire, 1809), *Platyceps najadum* (Eichwald, 1831), *Telescopus fallax* Fleischmann, 1831, *Zamenis longissimus* (Laurenti, 1768), *Dinarolacerta mosorensis* (Kolombatović, 1886) and *Algyroides nigropunctatus* (Duméril & Bibron, 1839) are confirmed for the first time on Mt. Prenj through this work. The species *Salamandra salamandra* (Linnaeus, 1758), *Bufotes viridis* (Laurenti, 1768), *H. gemonensis*, *L. agilis* and *Natrix natrix* (Linnaeus, 1758) are for the first time reported for Mt. Čvrsnica.

The northernmost point of distribution for *H. gemonensis* and *Pseudopus apodus* were identified and further discussed.

DISCUSSION

None of these observations are the result of a systematic sampling scheme for the purpose of this paper; therefore some conclusions presented could be derived from the preferences of the authors to visit certain localities more often than others. The research area borders with the Mediterranean region of B-H, and it represents the marginal climate zone which limits the distribution of some Mediterranean (sub)species. Distribution of amphibians in B-H is largely influenced by the temperate climate that comes from the central parts of Europe, while the Mediterranean climate plays a key role in defining the distribution of reptiles (Jablonski et al. 2012). This fact explains why some Mediterranean species are found in the area under investigation, therefore increasing the total number of reptile species that occur there.

Overview of data

A small number of actual sightings by earlier authors are often cited in various publications over time: these repeated records give the impression that there are many more records than the original records actually show. The significance of field data, although smaller in number, is greater in revealing new localities. An example can be shown through *A. nigropunctatus*, which is mentioned only for location Jablanica in three literature sources (Bolkay 1924, 1928, Dimovski 1966), while our field investigations confirmed that the species occurs also in the areas of Diva Grabovica, Crno Vrelo and Glavatičevo.

Therefore, 58% of new records for Mt. Prenj are field data. For Mt. Čvrsnica, literature data (55%) contributed slightly more than field records.

The data for *Lacerta trilineata* Bedriaga, 1886 for the area of Konjic (A3b location), inferred from a museum specimen, seem to be incorrect since it represents a locality too far north for the species distribution. Our opinion is that it might have been confused with *Lacerta viridis* (Laurenti, 1768) since we believe that *L. trilineata* Bedriaga, 1886 is not expected to occur on Mt. Prenj. It is possible that incorrect determination was carried out based on old museum material, and the identification needs to be confirmed.

Most of the data for the region originates from the early 19th century. The interest in the research and publication of herpetological data has increased considerably in the last 20 years. Literature data is nevertheless very scarce: from 1980 to 1999 there have been only five publications dealing with the herpetofauna of the area. This is probably due to the (post)war period which limited scientific activities.

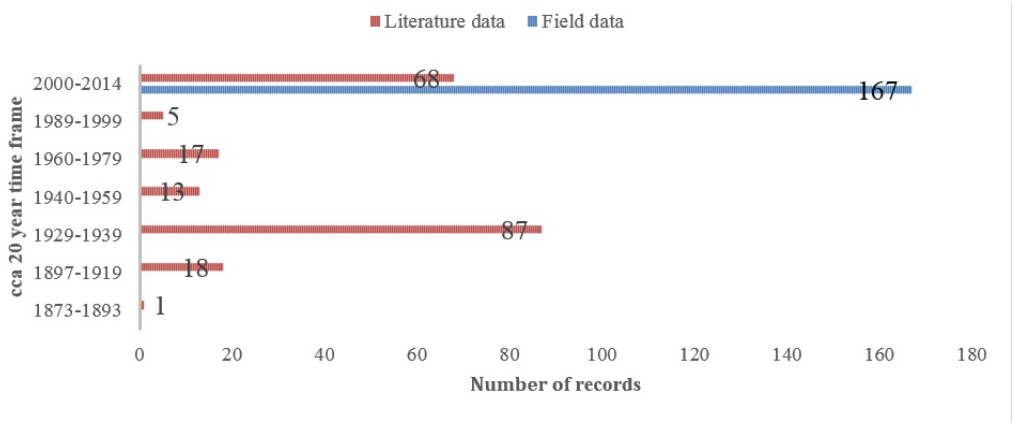

Figure 2. Number of literature and field records from the study area over a period of 141 years.

Slika 2. Broj literaturnih i terenskih nalaza s istraživanog područja u period od 141 godine.

Figure 3. Photographs of some rare, NATURA 2000 species (*) and species from the local Red List (*): a) *S. atra prenjensis*; b) *R. graeca*; c) *P. najadum dahlii*; d) *D. mosorensis*; e) *B. variegata*; f) *H. gemonensis* (the northernmost finding); g) *E. quatuorlineata*; h) *V. berus bosniensis*; i) *A. nigropunctatus.*

Slika 3. Fotografije nekih rijetkih NATURA 2000 vrsta (*) i vrsta sa lokalnog Crvenog popisa (*): a) *S. atra prenjensis*; b) *R. graeca*; c) *P. najadum dahlii*; d) *D. mosorensis*; e) *B. variegata*; f) *H. gemonensis* (the northernmost finding); g) *E. quatuorlineata*; h) *V. berus bosniensis*; i) *A. nigropunctatus.*

Table 1. List of species found in the investigated area; * indicates questionable records. Codes for locations are given in the Appendix I.

Tablica 1. Popis vrsta zabilježenih u istraživanome području; * ukazuje na upitne nalaze. Šifre lokacija dati su u Appendixu I.

No.	Species	Prenj field data	Date	Prenj lit. data	Reference	Čvrsnica field data	Date	Čvrsnica lit. data	Reference
1.	*Salamandra atra*	A1:a,b,e,g,j,n,p,w	July 2013	A1:k,l,m,o, A2b, A1f	Šunje & Lelo (2010), Bolkay (1924)	B1:a,d,e,f	Aug. 2013	B1k	Šunje & Lelo (2010)
2.	*Salamandra salamandra*	A2e	Aug. 2012	A2c, Ca	Šunje & Lelo (2008), Bolkay (1928)	B2b; B2	Oct.2010, feb, 2010		
3.	*Lissotriton vulgaris*			A2f, C	Bolkay (1924), Bolkay (1928)				
4.	*Ichthyosaura alpestris*	A1v, A2i, A2d,	June 2014, Sep. 2008	A1w	Bolkay (1924)	B1:a, b, h; B1c,B2l	July 2013, Sep. 2008	B2i; B3g	Đurović (1987), Radovanović (1941)
5.	*Bombina variegata*	A2:e, y, A2m	Aug. 2012, July 2005	A2c, A3:g,b, A2: n, ž, a	*(1929)*, Bolkay (1924), Lelo et. al (2015)	B2b; B2:p, m	June 2006, May 2007	B3g; C: a,b; B2:c,d,n,o, B3c, Ch;	Radovanović (1941), Bolkay (1928), Lelo et. al (2014)
6.	*Bufo bufo*	A1v, A1u,	Sep. 2014, May 2005	A3b	Bolkay (1924)	B1a	Aug. 2013	Ca	Bolkay (1928)
7.	*Bufotes viridis*	A1v	Aug. 2013	A2a, A2z	*(Aug. 1971, (May 1971)*	B1g	Aug. 2013p	B3g, Ca; Ci	Radovanović (1941), Dragobratović (2007)
8.	*Hyla arborea*			Ci, A2n	Dragobratović (2007), Lelo et. al (2015)				
9.	*Rana dalmatina*	A2e, A1a, A2n	Aug. 2012, Aug. 2013, June 2013	A3b, A3f, Ca	Bolkay (1924), Lelo et. al (2015), Bolkay (1928)				
10.	*Rana graeca*	A2:e,y, A2v	Aug. 2012, July 2013	A3b, B2p, A2c, Ca	Lelo et. al (2015), Radovanović	B2m; B3g;	June 2006, may, 2007	B1i, B3c	Bolkay (1924)

No.	Species	Prenj field data	Date	Prenj lit. data	Reference	Čvrsnica field data	Date	Čvrsnica lit. data	Reference
					(1941), Bolkay (1924)				
11.	*Pelophylax ridibunudus*			A3b, Ca,Cb, A2e, A2u	Bolkay (1924), Bolkay (1928), Lelo et. al (2015), Šunje & Lelo (2008)			B2:b,c,d, e,l,q	Lelo et al. (2015)
12.	*Podarcis melisellensis*	A2e;	Aug. 2012,	A3g, A2c	Bolkay (1924), Lelo (2015)	B2m, B2b, B2f	June 2006, Mar. 2013, May 2006	B3g, B3a	Bolkay (1924)
13.	*Podarcis muralis*	A2e; A2a; A2i; A3a	Aug. 2012, June 2006, Apr. 2005, Mar. 2013	A2n, Ce	Lelo (2015), Jablonski et. al (2012)	B2m, B2f	June 2006, May 2006	B2:c,d,e,q, B3g	Bolkay (2014)
14.	*Pseudopus apodus*	Db	June 2014						
15.	*Lacerta trilineata**			A3b*	*(Sep. 1914)*				
16.	*Lacerta agilis*	A2o, A1d; A2a, A1: c,v,x,e,g,u,p,j; A2d	Aug. 2005, July 2013, May 2006			B1: a,e,g,f,d,	Aug. 2012		
17.	*Lacerta viridis*	A2: e,c, w; A2: a,n,c, A1c; A3a; A2k; A2i; A2g	Aug. 2012, Jun. 2013, Mar. 2013, Apr. 2006, Apr. 2005, Oct. 2004	A2e, C: a,b	Bolkay (1924), Bolkay (1928)	B2b	Aug. 2012	B2: c,d,q; Cc; B3g	Lelo et al. (2015); Bolkay (1924); Werner (1904)
18.	*Dalmatolacerta oxycephala*	A2x	Aug. 2012	A2e, A3g	(*May 1922*), Lelo (2015)	B2:a,b, B2f, B2m	July 2013, May 2014, June 2006	B3d	Bolkay (1924)
19.	*Dinarolacerta mosorensis*	A2aa	Aug. 2012						
20.	*Algyroides nigropunctatus*	A2c	Apr. 2013,			B2a, B2b	Apr. 2013, Apr. 2006	B3a; B3g;	Werner (1904), Dimovski (1966);
21.	*Zootoca vivipara*			A1 (no	Bolkay (1924)				

No.	Species	Prenj field data	Date	Prenj lit. data	Reference	Čvrsnica field data	Date	Čvrsnica lit. data	Reference
				concrete locality)					
22.	*Angius fragilis*	A2d; A2e;A1aa; A2g; A3a	Sep. 2004, Aug. 2012, July 2013, Aug. 2005, May 2013	A2c, Ca	Lelo (2015), Bolkay (1928)	B2b,	July 2006	B2q; B3g	Lelo et al. (2015); Bolkay (1924)
23.	*Testudo hermanni*	A2m; A2k	June 2005, Apr. 2006	A3g	Lelo (2005)				
24.	*Coronella austriaca*	A2k; A2: dž, š; A2: a,n, A3a	July 2005, May 2003, June 2013, Mar. 2013	A2f, A3g, Ca	Werner (1898), Lelo (2015) Bolkay (1928)	B2h; B2b	June2009, Apr. 2006	B3g	Lelo et. al (2015)
25.	*Zamenis longissimus*	A2a; A2:k,g; A2n; A3a;	June 2014, Apr. June 2005, July 2009, Mar. 2009	C:a,b	Bolkay (1928)				
26.	*Elaphe quatuorlineata*	A2m; A2k	June 2005, Aug. 2008						
27.	*Telescopus fallax*	A2m	June 2009						
28.	*Malpolon insignitus*	A2k	Aug. 2010						
29.	*Hierophis gemonensis*	A2k	Apr. 2006			B2f; B2m; B2g	May 2006, June 2006, July2013		
30.	*Platyceps najadum*	A2m	May 2005	Da	Radovanović (1951)				
31.	*Natrix tessellata*	A2m; A2e, A2lj	May 2005, Aug. 2012	A3e, A2ć, Cb, Cf, Ce	Jelić et Lelo (2011); Jablonski et al (2012)	B2m	June 2006	B2b	Jelić et Lelo (2011)

Diversity of herpetofauna of Mts. Prenj and Čvrsnica and (un)expected species

All expected species of amphibians in the research area were registered. *Rana temporaria* does not occupy the (sub)mediterranean regions of the Balkan Peninsula (according to Kuzmin et al. 2009, Lelo et al. 2014), and is not expected in the study area. When it comes to reptiles, the expected species to be found at lower altitudes of the overall area (e.g. valley of Neretva river) are the pond turtle, *Emys orbicularis* (Linnaeus, 1758) and *Podarcis siculus* (Rafinesque, 1810). Taking into consideration that data for *L. trilineata* on Mt. Prenj is incorrect (see previous section), this changes the overall registered number of reptile species on Mt. Prenj from 22 to 21. Distribution of unexpected reptiles for the overall area can be further discussed: the possibility of finding *Hemidactylus turcicus* (Linnaeus, 1758) and the leopard snake, *Zamenis situla* (Linnaeus, 1758), is questionable because their northernmost distribution is the area of Mostar (personal observations of the authors).

A higher percentage of diversity registered on Mt. Prenj can be explained by two facts: Mt. Prenj is more than twice the size (463 km^2) of Mt. Čvrsnica (190 km^2). The other fact is the geographic position of the mountains: the south-eastern and north-western areas of Mt. Prenj are almost fully adjacent to the Mediterranean climate zone, while the area of Mt. Čvrsnica is significantly smaller and borders with the continental part of B-H in the north-west, whereas the NW side of Prenj face the Neretva river. Areas of Mt. Čvrsnica that are suitable habitat for a small number of (sub)mediterranean species are Diva Grabovica and Drežnica. On these locations several Mediterranean species were recorded (*Podarcis melisellensis*, *A. nigropunctatus*, *Dalmatolacerta oxycephala* and *H. gemonensis*).

About 94% of all expected species are found on Mt. Prenj in respect to 66% of the expected species for Mt. Čvrsnica.

The absence of *Testudo hermanni*, *P. apodus*, *L. trilineata*, *P. najadum*, *E. quatuorlineata*, *T. falax* on Mt. Čvrsnica is expected, given that these are (sub)mediteranean species. Collected data have also shown the absence of *P. siculus*, *D. mosorensis* and *Zootoca vivipara* on Mt. Čvrsnica, therefore more field research is needed to confirm the true distribution of these species. *D. mosorensis* is the true representative of the Bosnian-Herzegovinian karst, and is present at altitudes above 1000 m (Radovanović 1951), therefore the area of Mt. Čvrsnica represents a potentially suitable habitat for this species. Amphibians that are not yet recorded on Čvrsnica are *Lissotriton vulgaris* (Linnaeus, 1758), *Hyla arborea* (Linnaeus, 1758) and *Rana dalmatina* (Bonaparte, 1840). Locations on Mt. Čvrsnica were mostly visited in late summer, when conditions for finding amphibians are not ideal mostly because the humidity is lower. More field research is required in order to ascertain the presence of these species on Mt. Čvrsnica, especially at lower altitudes in humid areas of deciduous forests.

On Mt. Prenj *Vipera ursinii* (Bonaparte, 1835) and *Vipera berus* (Linnaeus, 1758) were not found. It is very likely that *V. berus* inhabits the given area, but neither field nor literature data exist to prove this. The presence of *Vipera ursinii macrops* (Méhley, 1911) on Mt. Prenj is questionable, given that the convenient microhabitat with specific microclimate that can support survival of this species was not found during the field research. Since all three venomous snakes inhabit Mt. Čvrsnica, it can be argued that this is the third area ever recorded where the three venomous snakes (*V. ammodytes*, *V. berus and V.ursinii*) coexist together in the Balkans. These areas are also found on Mt. Troglav and Mt.

Zelengora (Jelić et al. 2013) in B-H. The absence of field data on Mt. Prenj for *L. trilineata* is expected since our opinion is that this area does not meet the conditions required for this species to survive. Neimarlija & Merdan (2012) report the possibility of finding *P. siculus* on Mt. Prenj on slopes in the area of lake Boračko. Additional field studies are needed to confirm this.

Species for which the investigated area represents the northernmost point of distribution

The Karst or Dalmatian Wall lizard – *Podarcis melisellensis*, is a species distributed in southern B-H and is very rare in Bosnia, but is a common species in Herzegovina (Lelo 2015). The area around Konjic (more precisely, river Ljuta) is considered to be its most northern habitat in B-H (Lelo 2015). Data from the National Museum in Sarajevo shows the presence of the karst lizard in the areas of Mt. Ravna, Mt. Borja and a road Bistrica-Borje (near Pale), but this is most likely a case of incorrect identification.

H. gemonensis is poorly studied in B-H, and literature data is scarce. During field research, a dead on road individual was found between Jablanica and Sovići (Fig. 3f), which represents the northernmost locality of this species in B-H so far. This species is typical for the Adriatic coast (Lymberakis & Ajtic 2009), and prefers dry, rocky areas, bushy terrain, overgrown ruins, sparse woods and low underbrush and roadsides (Arnold & Ovenden 2002).

Data for *P. apodus* for the location of Potoci could be the northernmost point of distribution for the species although data given by Stanković (2013) indicates that the species could be found further north, in the area of Kupreško polje but this must be investigated further, since a lot of data from that paper is unreliable.

For (sub)mediterranean species and their respective sightings: *M. insignitus* – road to Rujište, *P. najadum* – Mostarska bijela, *T. fallax* – Diva Grabovica and *E. quatuorlineata* – Mostarska bijela, could represent northernmost points of distribution for these species since, so far, little is known about their distribution in general.

If data for *P. siculus* in the area of Boračko lake (Neimarlija & Merdan 2012), could be confirmed, this would represent the northernmost point of distribution for this species.

Important biodiversity hotspots

Localities that have shown the highest level of herpetological biodiversity (Diva Grabovica, Drežnica, Mostarska bijela, the road to Rujište from Kruševac and Boračko) represent very important biodiversity hotspots due to intense Mediterranean influence for these areas.

During the last ice age, the study area represented a refugia (Redžić et al. 2010) which explains the remarkable biodiversity registered. Glacial refugia are also known to be speciation centres (Tarkhnishvili et al. 2012), that have contributed to a constant evolutionary development that manifested great morphological and ethological variations within species, that resulted in the description of a large number of subspecies for almost all listed species in this paper (see: Džukić & Kalezić 2004; Jelić et al. 2012b). The subspecies status of many of them still remains unresolved. To fully resolve the taxonomic disagreements it is mandatory to conduct additional environmental, ecological and phylogenetic studies.

According to the results presented here, the herpetological biodiversity of Mt. Prenj and Mt. Čvrsnica is high and specific. This study confirmed the presence of 12 additional species to 23 already known inhabiting the area, which makes a total of 35 species of herpetofauna. Due to the high

diversity that has been registered, the research area must be protected from high anthropogenic pressures in order to ensure that undisturbed survival of the species present is an ongoing priority.

Threats to the herpetofauna of the area

While the surveyed area still remains mostly in its natural state, there are several possible threats to the amphibian and reptile diversity. Along the study area there are four active hydro-electric power plants with associated dams and one quarry. The actual building of the highway: "Corridor 5c" from the north, as well as activities directed towards oil extraction in the area of Drežnica, would be devastating. Because of the vulnerability of these areas, it is of utmost importance to protect them.

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Appendix I. List of localities visited along with their codes and coordinates presented in the WGS84 coordinate system.

Appendix I. Popis posjećenih lokacija zajedno sa kodovima i kordinatama danim u WGS84 kordinatnom sustavu.

No.	Code	Locality name	Coordinate N	Coordinate E
A Mt Prenj				
	A1	**High altitude zones on Mt. Prenj (>1550 m)**		
1.	A1a	Kopilice	43,552958	17,914869
2.	A1b	Podotiš	43,552958	17,914869
3.	A1c	Taraš	43,550000	17,905869
4.	A1d	Milanova koliba	43,556783	17,919941
5.	A1e	Osobac	43,593701	17,834230
6.	A1f	Kapa	43,548569	17,940647
7.	A1g	Otiš	43,581888	17,858122
8.	A1h	Herač	43,550000	17,905869
9.	A1i	Velike bare	/	/
10.	A1j	Zelena glava	43,544800	17,931175
11.	A1k	Sivadije	43,549102	17,904397
12.	A1l	Path under Erač	43,516050	17,956130
13.	A1m	Vjetrena brda	43,550950	17,861213
14.	A1n	Soplje	43,549311	17,869938
15.	A1o	Harareve stanine	43,556413	17,856983
16.	A1p	Zakantar	43,569663	17,873097
17.	A1q	Lučine	43,569663	17,873097
18.	A1r	Has	43,568133	17,833197
19.	A1s	Under peak Cetina	43,597538	17,832016
20.	A1t	Berni do	43,532472	17,841977
21.	A1u	Lasni do	43,529769	17,932272
22.	A1v	Jezerce	43,557575	17,922808
23.	A1w	Lupoglav	43,554136	17,849244
24.	A1x	Kopilice	43,552958	17,914869
	A2	**Lower altitude zones of Mt. Prenj (< 1550 m)**		
25.	A2a	Crno polje	43,531650	17,973988
26.	A2aa	Crno polje just after pizdino vrelo	43,531650	17,973988
37.	A2b	Tisovica	43,581888	17,858122
28.	A2c	Glavatičevo	43,493255	18,103861
29.	A2d	Kruševac	43,583611	17,981388
30.	A2e	Boračko lake	43,549019	18,035213
31.	A2f	Rujište	43,485569	17,932991
32.	A2g	Rujište H. polje	43,595000	18,141111
33.	A2h	Zmijinac (trail Idbar-Tisovica)	43,622047	17,874647
34.	A2i	Rujište, Ošljak spring	43,468611	17,991388
35.	A2j	forest on the road to Rujište just before Česim	43,482500	18,090833
36.	A2k	Road to Rujište from Kruševac direction	43,685555	18,102500
37.	A2l	Bahtijevići	43,627500	18,247222
38.	A2m	Mostarska bijela	43,506944	17,931389
40.	A2n	Borci village	43,579386	18,015558
41.	A2o	Bijele vode hut	43,579386	18,015558
42.	A2p	Džajići	43,609416	18,017763
43.	A2q	Glavatičevo	43,498413	18,109499
44.	A2r	Glogošnica	43,618961	17,763663
45.	A2s	Gorje Stranine above Boračko lake	43,556111	18,035000
46.	A2t	road between Bjelimići and Glavatičevo	43,493255	18,103861
47.	A2u	Stream Baštica (village Idbar)	43,636466	17,880652
48.	A2v	Idbar village	43,636466	17,880652

No.	Code	Locality name	Coordinate N	Coordinate E
49.	A2w	Kula village up from Boračko lake	43,532111	18,046505
50.	A2x	way to village Kašići from Boračko lake	43,542136	18,077694
51.	A2y	mouth of Rakitnica	43,547891	18,083436
52.	A2z	Zuljevlje bara	43,545427	17,611011
53.	A2č	Dabica poljana	43,604722	18,026388
54.	A2ć	Ljuta river	43,640688	18,011847
55.	A2dž	Vilin klanac	43,543611	18,080000
56.	A2đ	Zijemlje, before Rujište	43,615555	18,027777
57.	A2š	Rujište, ski resort	43,636666	18,176944
58.	A2lj	Rakitnica	43,547891	18,083436
59.	A2ž	crossroad Bahtijevići – Boračko lake	43,750278	18,169444
	A3	**City of Konjic and surroundings**		
60.	A3a	Vrtaljice - from Konjic to Buturović polje	43,772952	17,792761
61.	A3b	Trešanica dolina, near Ovčari	43,772952	17,792761
62.	A3c	Ovčari	43,666327	17,973861
63.	A3d	Repovica	43,668111	17,978966
64.	A3e	Grabovci near Čelebići	43,657736	17,958450
65.	A3f	Suhi do near Čelebići	43,617627	17,750486
66.	A3g	Konjic	43,670758	17,862213
		B Mt. Čvrsnica		
	B1	**High altitude zones of Mt. Čvrsnica (> 1550 m)**		
67.	B1a	Ledeno jezero	43,596563	17,611125
68.	B1b	jezero Crvenjak	43,631902	17,650488
69.	B1c	Hajdučka vrata to Vilinac	43,631902	17,650488
70.	B1d	Pločno	43 37 50.8	17 38 38.2
71.	B1e	Vilinac under the hut	43,604033	17,569730
72.	B1f	Žandarmerija	43,601288	17,611011
73.	B1g	Hajdučka vrata	43,630177	17,654616
74.	B1h	Peharovi stanovi	43,615250	17,623025
75.	B1i	Veliko Šljeme	43,649438	17,681161
76.	B1j	Veliki kuk	43,609055	17,637683
77.	B1k	Vilinac peak	43,622836	17,633436
	B2	**Lower altitude zones of Mt. Čvrsnica (< 1550 m)**		
78.	B2a	Crno vrelo	43,578530	17,716575
79.	B2b	Diva Grabovica	43,609769	17,667286
80.	B2c	Muharnica	43,671808	17,634580
81.	B2d	Stipića livade	43,671808	17,634580
82.	B2e	Drežnica	43,537655	17,628808
83.	B2f	Drežnica, vrt ciklama climbing spot	43,521218	17,737822
84.	B2g	road Doljani – Sovići	43,702452	17,617377
85.	B2h	way to Plasa	43,629758	17,713513
86.	B2i	Sovićka vrata	43,682711	17,581858
87.	B2j	Strmenica	43,622602	17,656219
88.	B2k	Žlijeb	43,616263	17,670063
89.	B2l	Donje bare	43,574261	17,506638
90.	B2m	Gornja Drežnica	43,541403	17,613611
91.	B2n	Konjsko vrelo	43,578608	17,525280
92.	B2o	Modri kamen	43,578608	17,525280
93.	B2p	Bivak	43,779722	17,852500
94.	B2q	Vitrenjača	43,587602	17,458305
	B3	**City of Jablanica and surroundings**		
95.	B3a	Krstac	43,653130	17,799413
96.	B3b	Donja Jablanica	43,653038	17,762388
97.	B3c	Field Doljanka above Jablanica	43,669161	17,709063
98.	B3d	road from Jablanica to Rama	43,726500	17,692027
99.	B3e	Jablanica – the bridge Ribnički		

No.	Code	Locality name	Coordinate N	Coordinate E
100.	B3f	village Mirke	43,653038	17,762388
101.	B3g	Jablanica	43,653038	17,762388
	C	**Neretva river (bordering zone between 2 mountians)**		
102.	Ca	downstream flow: Drežnica – Glavatičevo	43,669780	17,737497
103.	Cb	upstream flow: from Glavatičevo to the spring of Neretva	43,537655	17,628808
104.	Cc	right shore of the river above Konjic	43,537655	17,628808
105.	Cd	Ostrožac town	43,493255	18,103861
106.	Ce	Gračac village	43,654447	17,961400
107.	Cf	Jablaničko lake	43,681763	17,828522
108.	Cg	Neretva downstram	43,726500	17,692027
109.	Ch	old flow of river Neretva (before the arfiticial lake Jablaničko was made),	43,691797	17,875200
110.	Ci	valley of Neretva	43,455563	17,832105
120.	**D**	**Wider area of Mt. Prenj**		
111.	Da	Raštani	43,681269	17,725691
112.	Db	Potoci, Humilišani	43,394013	17,863617