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AMPHIBIANS OF THE CITY OF TREBINJE – A CHECKLIST WITH ECOLOGICAL AND CONSERVATION NOTES

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Abstract

The batrachofaunistic studies of the City of Trebinje, situated in the southern part of the Republic of Srpska (SE Bosnia and Herzegovina) used to be rather neglected. The goal of this paper was to create a faunistic list of amphibians in the City of Trebinje, according to both original field research and literature references, with an overview of certain aspects of ecology and conservation status of the recorded species. The review of literature references, combined with six years of field research by the authors, has shown that batrachofauna of the City of Trebinje includes eight species of amphibians (*Proteus anguinus*, *Lissotriton graecus*, *Bufo bufo*, *Bufotes viridis*, *Bombina variegata*, *Hyla arborea*, *Pelophylax ridibundus* and *Rana graeca*), systematized into eight genera, six families and two orders. Three species (*Bombina variegata*, *Hyla arborea* and *Rana graeca*) are recorded for the study area for the first time. Four of the recorded taxa are endemic for Balkans/Dinarides. This paper also includes certain ecological data (which are scarce in literature pertaining to the study area) and a comparative overview of the conservation status of the recorded species.

Key words: batrachofauna, ecology, biodiversity conservation, Trebinje, Bosnia and Herzegovina.

INTRODUCTION

The amphibians are the only class of recent vertebrates that has been declared endangered as a whole (Stuart *et al*., 2004). According to the estimates by the International Union for Conservation of Nature, about 41% of currently living species of amphibians are in danger of extinction (https://www.iucnredlist.org/). The main threat factors for amphibians include destruction and modification of their habitats, invasive species, pollution, overexploitation, global climate change and emerging infectious diseases (Collins and Storfer, 2003). Most species are characterized by thin permeable skin so they quickly react to any changes in immediate environment, and therefore they are considered the best biological indicators of ecosystem health among the vertebrates (Vitt *et al*., 1991).

The diversity of recent batrachofauna includes 8952 species (Frost, 2025). The representatives are grouped into three orders: 1) tailed amphibians (Caudata), 2) tailless amphibians (Anura) and 3) limbless amphibians (Gymnophiona). The European fauna includes 85 species: 50 species of Anura and 35 species of Caudata (Temple and Cox, 2009). According to data provided by Lelo *et al*. (2015), diversity of amphibians at Bosnia and Herzegovina includes 21 species: nine species of Caudata and 12 species of Anura. However, not all the parts of Bosnia and Herzegovina have been equally covered within the batrachofaunistic studies. The southern part of the Republic of Srpska, including the area of the City of Trebinje, was particularly neglected, as indicated by the collection of the Natural History Department of the "Museum of Herzegovina" in Trebinje (Milošević, 2014).

The first written data of diversity of amphibians in the broader region of Trebinje may be found in the works of Werner (1898), citing presence of three species of Anura (*Bufo bufo* as "*Bufo vulgaris"*, *Bufotes viridis* as "*Bufo viridis"* and *Pelophylax ridibundus* as "*Rana esculenta* var. *ridibunda"*). Later, Bolkay (1924) cited another species of Caudata (*Proteus anguinus*), while Džukić *et al*. (2015) also contributed to knowledge on tailed amphibians in this region with a record of species *Lissotriton graecus* (as "*Lissotriton vulgaris"*). More recent data on diversity of amphibians of Bosnia and Herzegovina may be found in the publication by Lelo *et al*. (2015), where presence of the five above-mentioned species in the area of the City of Trebinje was re-confirmed.

Taking into account all the above, the aim of this paper was to present the diversity of amphibians of the City of Trebinje, as well as certain aspects of their ecology and conservation, based on the results of both literature data and our own field studies.

MATERIALS AND METHODS

The City of Trebinje, previously administered as the Municipality of Trebinje, is situated in the extreme southern part of the Republic of Srpska (SE Bosnia and Herzegovina), occupying the total area of 904 km^2. The climate is Mediterranean, with short mild winters and dry warm summers. The relief is characterized by typical Herzegovinian karst, with sparse vegetation and numerous sinkholes, valleys and pits, interspersed with periodically flooded karst fields. This area is also characterized by a wide spectrum of hydrographic phenomena (typical watercourses, sinkholes, ponds, springs, marsh habitats, underground and surface lakes) that represent potential habitats for amphibians (Asanović, 2011).

Collection of field data in the area of the City of Trebinje was carried out by using the transect method at a total of 17 sites, in the period from April 2019 to October 2024 (Figure 1).

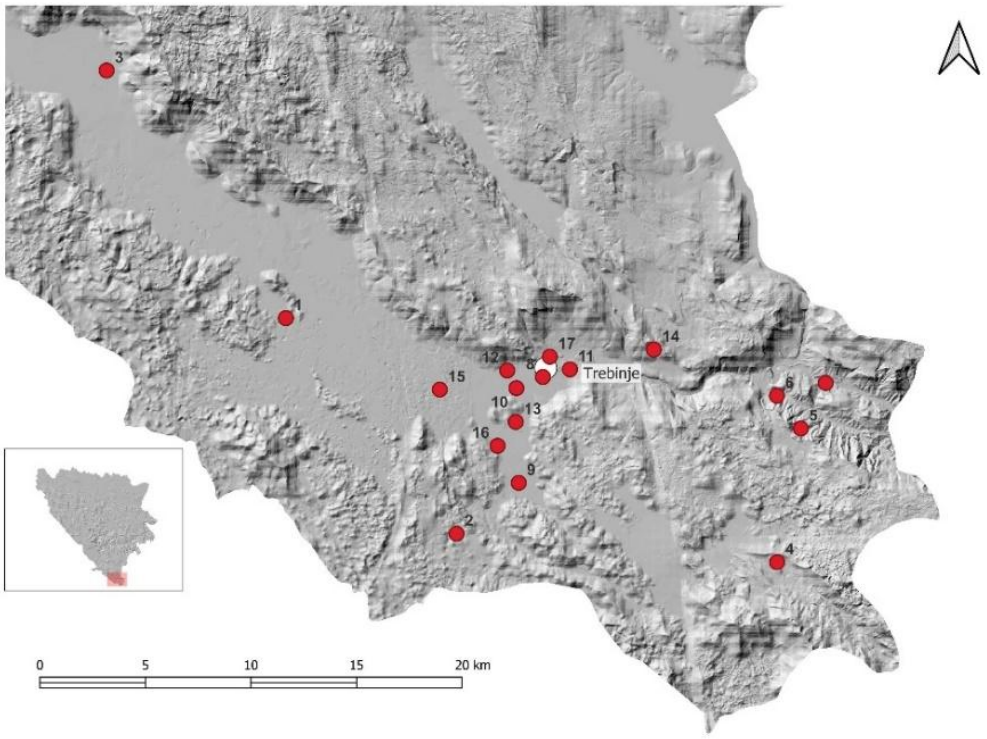

Figure 1. Analyzed sites in the area of the City of Trebinje: 1) Hum, 2) Poljice Čičevo, 3) Mrkonjići, 4) Ubla, 5) Orovac, 6) Lastva, 7) Jazina, 8) Bregovi, 9) Zgonjevo, 10) Pridvorci, 11) Crkvina, 12) Zasad, 13) Todorići, 14) Necvijeće, 15) Dražin Do, 16) Bihovo, and 17) the Trebišnjica River (city center).

The fieldwork took place in potential habitats of amphibians (except for underground waters), in different seasons and weather conditions (Figure 2). The individuals were captured, identified, photographed, and then released at the capture site. Species identification was done using identification keys (Đurović *et al*., 1979; Speybroek *et al*., 2016), while the systematic list of amphibians was organized according to Speybroek *et al*. (2020). The number of individuals per species is shown only as a descriptive measure of their relative occurrence, since the observation effort and time spent at sites were not standardized.

The list of amphibian species created after the authors' original fieldwork was supplemented with literature data from available herpetological publications (except conference proceedings). The list of threat status and protection status of the listed taxa was compiled according to the relevant sources of international and national importance.

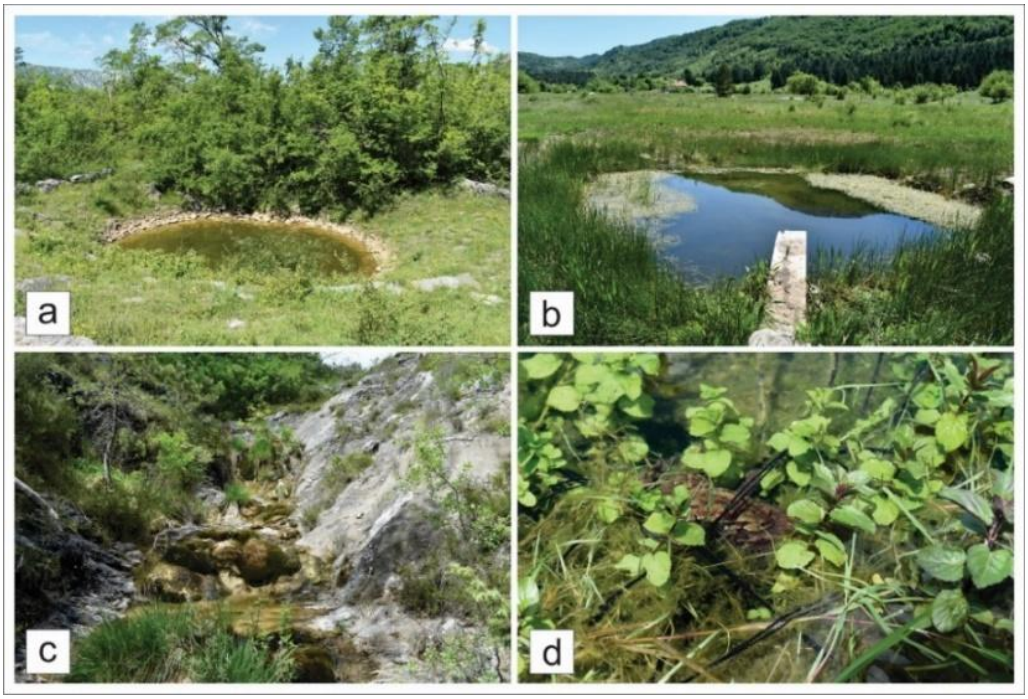

Figure 2. Different types of habitats for amphibians in the area of the City of Trebinje: a) pond – site Mrkonjići, b) pond – site Ubla, c) stream – site Orovac, and d) the Sušica River – site Jazina.

RESULTS AND DISCUSSION

The total number of amphibian species (Class: Amphibia) in the area of the City of Trebinje is eight. Of these, seven were observed during the field surveys, while one species (*Proteus anguinus*) was added based on literature data. The order Caudata includes two species systematized into two genera and two families, while the order Anura includes six species systematized into six genera and four families.

Order: Caudata Scopoli, 1777 or **Urodela** Duméril, 1805

Family: **Salamandridae** Goldfuss, 1820

Genus: *Lissotriton* Bell, 1839

1. *Lissotriton graecus* (Wolterstorff, 1906) – Greek Smooth Newt

Greek Smooth Newt is an endemic species inhabiting the southern part of the Balkan Peninsula, while within Bosnia and Herzegovina it is limited to the southern parts of the country (Đurović *et al*., 1979). This was the most frequently recorded tailed amphibian during our field research. The adult females and males (Figure 3a) were observed and captured on several occasions in April and May (more than 100 individuals) in deeper ponds at sites Hum, Poljice Čičevo, Mrkonjići (Figure 2a) and Ubla (Figure 2b). Adults were also recorded in a smaller stream with cold water and rocky substrate at the Orovac site (Figure 2c), together with three species of anurans (*Rana graeca, Pelophylax ridibundus* and *Bombina variegata*). The only published literature data on presence of Greek Smooth Newt in a broader region of Trebinje are related to Orjen Mt.: Begova korita and Tuljani – waterholes in vicinity of hamlet Vukalovići (Lelo *et al*., 2015) and settlement Turica (Džukić *et al*., 2015).

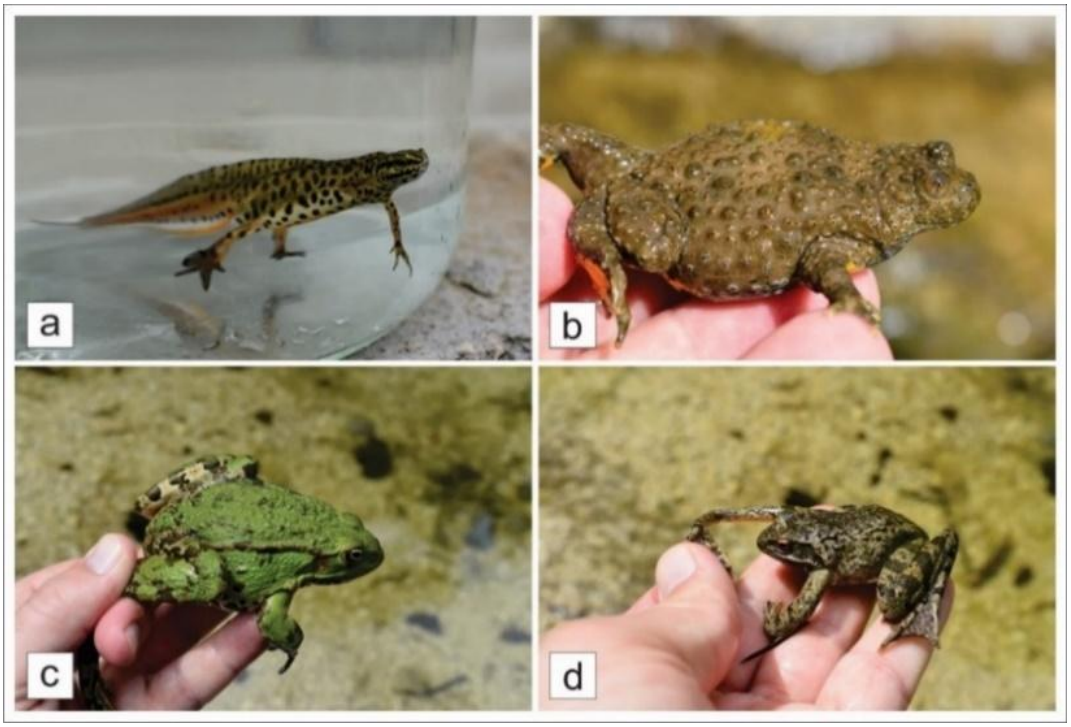

Figure 3. Selected representatives of amphibians from the area of the City of Trebinje: a) *Lissotriton graecus*, b) *Bombina variegata*, c) *Pelophylax ridibundus* and d) *Rana graeca.*

Family: **Proteidae** Gray, 1825

Genus: *Proteus* Laurenti, 1768

2. *Proteus anguinus* Laurenti, 1768 – Olm

Olm is endemic to the Dinarides and a typical representative of cave fauna (Radovanović, 1951). It is the only real subterranean vertebrate in Europe (Jelić *et al*., 2012). In Bosnia and Herzegovina, it occupies the southern and the western part of the country (Lelo *et al*., 2015). Due to the specificity of its habitat, this species was not recorded during our field research. However, according to relevant literature references, Olm was recorded in several dozen sites within the area of the City of Trebinje (Čučković, 1967; Lewarne, 1999; Kotrošan, 2002).

Order: Anura Duméril, 1805

Family: **Bufonidae** Gray, 1825

Genus: *Bufo* Garsault, 1764

3. *Bufo bufo* (Linnaeus, 1758) – Common Toad

Common Toad is a widespread species in Bosnia and Herzegovina (Lelo *et al*., 2015). In the area of the City of Trebinje, adult individuals (≈30 individuals) were recorded at the Lastva and Jazina sites in March and April. At the Jazina site, they were recorded in the bed of the Sušica River (Figure 2d) during the breeding season, as well as in the canal behind "Jazina" restaurant, while at Lastva they were recorded in a smaller stream. On the other hand, the pre-metamorphosis tadpoles were recorded in a pond next to a local road at the Mrkonjići site

(Figure 2a) in the first half of May. According to the available literature data, the first record of Common Toad for the area of present-day the City of Trebinje was provided by Werner (1898). Bolkay (1924) and Lelo *et al*. (2015) reported this species from the site of Kozmač, while Džukić *et al*. (2015) reported Common Toad from the site Ljubovo.

Genus: *Bufotes* Rafinesque, 1815

4. *Bufotes viridis* (Laurenti, 1768) – Green Toad

Green Toad is also a widespread species in Bosnia and Herzegovina (Lelo *et al*. 2015). Individuals were often recorded within the area of the City of Trebinje during the months of March, May, June, July, August and September. Adults (≈20 individuals) were recorded in a number of sites: Bregovi, Zgonjevo, Pridvorci, Crkvina, Zasad, Todorići, Necvijeće, Dražin Do and Bihovo, mostly at dusk and during the night. The only literature reference on presence of Green Toad in the area was provided by Werner (1898), who emphasized that *Bufotes viridis* is a common species in vicinity of Trebinje, and even observed moving about in daylight hours.

Family: **Bombinatoridae** Gray, 1825

Genus: *Bombina* Oken, 1816

5. *Bombina variegata* (Linnaeus 1758) – Yellow-bellied Toad

Yellow-bellied Toad inhabits the hilly and mountain regions of Bosnia and Herzegovina (Đurović *et al*., 1979), where the southern and south-eastern parts of the country are inhabited by the subspecies *Bombina variegata scabra*, which is endemic to the Balkan Peninsula (Vukov *et al*., 2006). During the field research this species was recorded only at the Orovac site, in a small cold-water stream with rocky substrate (Figure 2c). Adult forms (≈20 individuals) were recorded several times in May and June (Figure 3b). There were no literature data about this species for the area of the City of Trebinje. The closest known record in Bosnia and Herzegovina was Popovo polje (Zavala, a stream below the Lukavac spring) (Lelo *et al*., 2015).

Family: **Hylidae** Rafinesque, 1815

Genus: *Hyla* Laurenti, 1768

6. *Hyla arborea* (Linnaeus, 1758) – Common Tree Frog

Common Tree Frog is a widespread species in Bosnia and Herzegovina (Lelo *et al*., 2015). During our field research it was recorded only at the Mrkonjići site in the larval stage. A number of tadpoles was collected in a pond next to the local road (Figure 2a) in the first half of May, together with tadpoles of Common Toad that were about to metamorphose. At the same time, the pond also hosted a significant number of adult Greek Smooth Newts. There were no literature data on records of Common Tree Frog in the area of the City of Trebinje. The closest known records of this species in Bosnia and Herzegovina were: Zavala (Jablonski *et al*., 2012) and Čepelica (Werner, 1898).

Family: **Ranidae** Batsch, 1796

Genus: *Pelophylax* Fitzinger, 1843

7. *Pelophylax ridibundus* (Pallas, 1771) – Marsh Frog

Marsh Frog is a widespread species in Bosnia and Herzegovina (Lelo *et al*., 2015). Both adult (Figure 3c) and juvenile individuals were recorded in many sites: Poljice Čičevo, Lastva, Hum, Jazina, Orovac, and the bank of the River Trebišnjica (city centre). More than 100 adults were recorded during the study period. Literature references on presence of Marsh Frog in area of Trebinje were provided by Werner (1898), who stated that *Pelophylax ridibundus* is a common species, and that he recorded it in the Trebišnjica River near Trebinje. Lelo *et al*. (2015) listed records of this species for the following sites: Hum, Grmljani, Mrkonjići, Poljice, the Trebišnjica River and the entire Popovo Polje.

Genus: *Rana* Linnaeus, 1758

8. *Rana graeca* (Boulenger, 1891) – Greek Stream Frog

Greek Stream Frog is an endemic species for the southern part of the Balkan Peninsula (Jablonski *et al*., 2021), while Bosnia and Herzegovina represents the north-western limit of its range (Šukalo *et al*., 2015). More extensive data on range of Greek Stream Frog in Bosnia and Herzegovina were provided by Šukalo *et al*. (2015) and Šunje *et al*. (2017), while biological and ecological data on populations of this species in Bosnia and Herzegovina were completely absent. Greek Stream Frog was the least commonly recorded amphibian during our fieldwork survey. One adult individual was recorded in May (Figure 3d) in a smaller stream with cold water and rocky substrate at the Orovac site (Figure 2c). There are no data in herpetological literature on presence of Greek Stream Frog in the territory of Trebinje. According to data provided by Werner (1904), the closest published record of this species for the area of Bosnia and Herzegovina is the Avtovac site.

All eight amphibian species inhabiting the region of the City of Trebinje are included in the global and European IUCN Red Lists – one species have the status of Vulnerable (VU) and all the others are in the category Least Concern (LC). Six species are listed in the Annexes II, IV or V of the European Habitats Directive, while four species are included in the Appendix II and Appendix III of Bern Convention. At the national level (Official Gazette of the Republic of Srpska, 65/20), four species have the status of "strictly protected" (Table 1).

Table 1. Conservation status of batrachofauna at the international and national levels

Species	**Global & European IUCN category**	**Habitats Directive**			**Bern Convention**		**National protection status (Official Gazette of the Republic of Srpska, 65/20)**
		Annex II	Annex IV	Annex V	Appendix II	Appendix III	
Lissotriton graecus	LC					+	strictly protected
Proteus anguinus	VU	+	+		+		strictly protected
Bombina variegata	LC	+	+		+		*strictly protected
Bufo bufo	LC					+	
Bufotes viridis	LC		+		+		
Hyla arborea	LC		+		+		

Pelophylax ridibundus	LC		+	+	
Rana graeca	LC	+		+	strictly protected

* *Bombina variegata scabra*

All amphibian species recorded in the territory of the City of Trebinje are included in the Regulation on Red List of Protected Species of Flora and Fauna of the Republic of Srpska (Official Gazette of the Republic of Srpska, 124/12). However, the included Red List does not contain the usual data on threat categories for each taxon. One of the main reasons is insufficient level of research on many groups of organisms in the territory of the Republic of Srpska, including the amphibians. Therefore, the results of batrachological studies such as the one presented in this paper are filling in the missing knowledge and this will be important for future assessments of threat status of amphibians. The activities on realization of this goal are ongoing, and the results of this and other similar studies represent a scientific foundation for realistic assessment of threat status of amphibians. The intensive long-term study of reptiles (see Šukalo, 2022) was similarly used to assess their threat status in the territory of the Republic of Srpska (Šukalo and Tomović, 2024).

CONCLUSION

The original field research at the territory of the City of Trebinje have resulted in data on eight amphibian species, which is 38% of the total number of recorded species of this vertebrate class in Bosnia and Herzegovina. Three of the recorded taxa (*Rana graeca*, *Hyla arborea*, *Bombina variegata scabra*) were recorded in the area of the City of Trebinje for the first time, so the range of these taxa was extended to the extreme south of the Republic of Srpska (SE Bosnia and Herzegovina). Among the recorded taxa, two species (*Rana graeca* and *Lissotriton graecus*) and one subspecies (*Bombina variegata scabra*) are endemic for the Balkan Peninsula, while Olm (*Proteus anguinus*) is endemic to the Dinarides, assigning a large significance for environmental conservation to the study area. These endemics, including the subspecies *Bombina variegata scabra*, have the status of strictly protected species in the Republic of Srpska. All species recorded in the area of the City of Trebinje are included in the Red List of protected species of flora and fauna of the Republic of Srpska, but without any accompanying data on threat status of each taxon. In order to overcome this challenge, it is necessary to continue the studies and collect more precise data on the range of the recorded species, as well as on different aspects of their biology and ecology.

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VODOZEMCI GRADA TREBINJA – POPIS SA EKOLOŠKIM I KONZERVACIONIM PODACIMA

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Sažetak

Batrahofaunistička istraživanja grada Trebinja, koji se nalazi u južnom dijelu Republike Srpske (jugoistočna Bosna i Hercegovina) ranije su bila prilično zapostavljena. Cilj ovog rada bio je da se napravi faunistički spisak vodozemaca grada Trebinja, prema originalnim terenskim istraživanjima i literaturnim podacima, sa pregledom određenih aspekata ekologije i konzervacionim statusom zabilježenih vrsta. Pregled literature, kombinovan sa šestogodišnjim terenskim istraživanjima autora, pokazao je da batrahofauna grada Trebinja obuhvata osam vrsta vodozemaca (*Proteus anguinus*, *Lissotriton graecus*, *Bufo bufo, Bufotes viridis, Bombina variegata, Hyla arborea*, *Pelophylax ridibundus* i *Rana graeca*), sistematizovanih u osam rodova, šest porodica i dva reda. Tri vrste (*Bombina variegata*, *Hyla arborea* i *Rana graeca*) prvi put su zabilježene na području istraživanja. Četiri zabilježena taksona endemični su za Balkan/Dinaride. Ovaj rad takođe uključuje određene ekološke podatke (koji su oskudni u literaturi koja se odnosi na područje istraživanja) i uporedni pregled konzervacionog statusa zabilježenih vrsta.

Ključne riječi: batrahofauna, ekologija, zaštita biodiverziteta, Trebinje, Bosna i Hercegovina.

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