

The first record of alpine long-eared bat *Plecotus macrobullaris* in Serbia

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Abstract: An inventory of bat species in the Mileševka river gorge (southwestern Serbia) was conducted in July 2013. There were six bat species recorded in the cave at the Četanica plateau using a mist-netting technique. In this paper we report the first finding of *Plecotus macrobullaris* in Serbia, contributing to the knowledge of its distribution area. The bat fauna of Serbia now contains 30 species.

Key words: *Plecotus macrobullaris*, Serbia, distribution, Četanica plateau

The members of the genus *Plecotus* (long-eared bats) are widely distributed in the Palearctic (Spitzenberger et al., 2006), and six European species have been confirmed to date. Phylogenetic analyses revealed the existence of two major lineages of long-eared bats in Europe: the 'auritus group' (*P. auritus*, *P. macrobullaris*, and *P. sardus*), and the 'austriacus group' (*P. austriacus*, *P. kolombatovici*, and *P. teneriffae*) (Mucedda et al., 2003; Juste et al., 2004).

The alpine long-eared bat *Plecotus macrobullaris* Kuzzyakin, 1965 was confirmed as a separate species in 2002 (Kiefer and Veith, 2002; Spitzenberger et al., 2002). It is present in the Pyrenees (Garin et al., 2003; Alberdi et al., 2013), the Alpine ridge (Kiefer and Veith, 2002; Spitzenberger et al., 2002; Trizio et al., 2005; Presetnik et al., 2009), the Dinarides (Pavlinić and Tvrtković, 2004; Tvrtković et al., 2005; Sachanowicz and Ciechanowski, 2006; Karapandža et al., 2014; Presetnik et al., 2014), the Pindos Mountains (Kiefer et al., 2002), Crete (Juste et al., 2004), Anatolia (Karataş and Sözen, 2006), and mountainous regions in the Middle East and the Caucasus (Benda et al., 2006; Spitzenberger et al., 2006; Kiefer, 2008), showing an alpine distribution pattern and being the most common bat species in the alpine area in Europe (Alberdi et al., 2013).

The gorge of the Mileševka river is located in southwestern Serbia, between Jadovnik and Zlatar mountains, near the town of Prijepolje, and it is represented by a mosaic of various vegetation types (forests, rock, and scree vegetation). Higher elevations of the Zlatar and

Jadovnik mountains slopes are mainly covered with spruce and subalpine beech forests (Mišić, 1983). The greatest part of the gorge is covered with thermophilous forests and shrublands, while mesophilous beech, beech-spruce-fir, and even chestnut forests are found at lower elevations (Mišić, 1983; Ostojić and Zlatković, 2010).

A bat fauna survey of the Mileševka river gorge was carried out in July 2013. The cave at Četanica plateau is located on the cliff above Milošev Do village (43°19'11.80"N, 19°49'9.66"E, 1335 m a.s.l.) (Figure 1) and it was visited in the daylight, but no bats were observed there (in July 2012, a nursery colony of *Rhinolophus ferrumequinum* was found in that cave; personal data). Mist-netting was carried out at the cave entrance for three nights. A mist-net (7 × 2.5 m) was set up at sunset and remained open until sunrise, and it was checked continuously. The trapped individuals were removed immediately and held in cotton bags until processed. Bats were identified following Dietz et al. (2009), aged, sexed, measured, banded, and released. Capture in the field was carried out under a license provided by the Ministry of Energetics, Development, and Environmental Protection of the Republic of Serbia, license number: 353-01-685/2013-08.

During our research, we recorded a total of six bat species at the entrance of the Četanica cave: *Rhinolophus ferrumequinum*, *Rhinolophus euryale*, *Rhinolophus hipposideros*, *Myotis emarginatus*, *Hypsugo savii*, and *Plecotus macrobullaris*. All specimens were trapped at the outer side of the mist-net when flying into the cave.

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Figure 1. Locality of the *Plecotus macrobullaris* record (black dot). Shaded parts of the map represent its distribution after the IUCN (Hutson et al. 2008). *This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the International Court of Justice advisory opinion on Kosovo's declaration of independence.

The only existing data on bat fauna for this cave are unpublished and were collected during a bat fauna survey in 2012. The results presented herein represent the first data on bat fauna in this region.

One adult male of *Plecotus macrobullaris* was captured on 26 July 2013. Its taxonomic identification was based on measurements and external characters, e.g., obvious triangular pad on the lower lip (Figure 2A) and penis shape (Figure 2B) (Tvrtković et al., 2005; Dietz et al., 2009). External measurements (FA – forearm length, TH – thumb, CL – claw length, HF – hind foot, E – ear length, TL – tragus length, TW – tragus width) were taken using a digital caliper accurate to 0.01 mm: FA 38.75, TH 6.85, CL 3.07, HF 8.44, E 34.60, TL 16.45, TW 5.32. The coloration of the tragus, facial mask, and pelage correspond with these characters in specimens from Croatia (Tvrtković et al., 2005). The specimen was collected and deposited

in the Mammal Study collection of the Natural History Museum in Belgrade (col. no. 01/14). Seventeen measurements of the skull (Figure 3) were taken following Spitzenberger et al. (2006): Gsl – greatest skull length, Ccl – condylocanine length, Cbl – condylobasal length, Bh – height of braincase, Bb – breadth of braincase, Mb – mastoid breadth, Zb – zygomatic breadth, Iob – breadth of interorbital constriction, C-C – anterior palatal breadth, M³-M³ – maxillary breadth, I¹-M³ – length of upper tooth row from first incisor to third molar, C-M³ – length of upper tooth row from canine to third molar, M – length of mandible from symphysis to condylar process, I₁-M₃ – length of lower tooth row from first incisor to third molar, C-M₃ – length of lower tooth row from canine to third molar, Corh – height of coronoid process, Dbt – diameter of tympanic bulla. These measurements were taken from images (digital images were obtained using a Nikon



Figure 2. External characters used for species identification: face and ears with tragus (A) and penis shape (B).

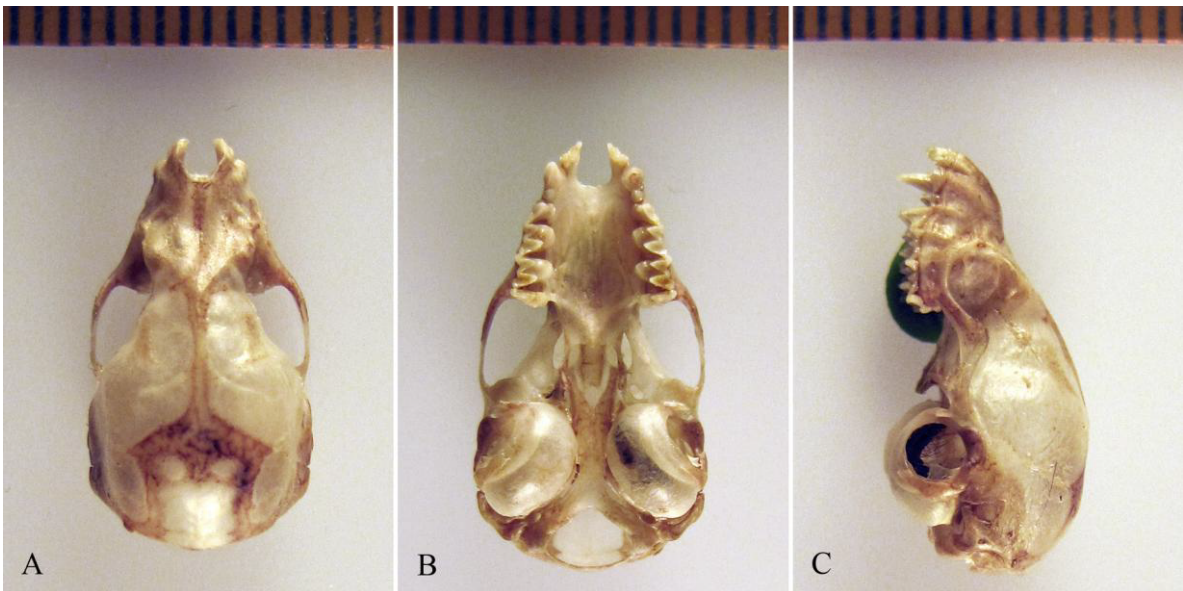


Figure 3. Photographs of skull in dorsal (A), ventral (B), and lateral (C) view.

SMZ800 stereomicroscope), and linear distances between the landmark pairs were calculated using the TmorphGen6 program, Integrated Morphometrics Program (IMP) series (Sheets, 2000). Cranial measurements of collected *P. macrobullaris* specimen (in millimeters) are: Gsl 16.85, Ccl 14.87, Cbl 15.64, Bh 6.45, Bb 8.54, Mb 8.80, Zb 8.74, Iob 3.63, C-C 3.81, M3-M3 6.29, I1-M3 6.56, C-M3 5.58, M 10.86, I1-M3 6.84, C-M3 5.98, Corh 3.12, Dbt 4.58.

The presence of the alpine long-eared bat in southwestern Serbia was expected, and it confirms a

continuous distribution of this species along the Dinaric Mountains (Tvrtković et al., 2005; Sachanowicz and Ciechanowski, 2006; Karapandža et al., 2014; Presetnik et al. 2014). Originally, it was thought to be a montane species (Kiefer and Veith, 2002), but the elevational distribution spans from sea level (Pavlinić and Tvrtković, 2004) to 2800 m a.s.l. (Garin et al., 2003). The location of the *P. macrobullaris* record in Serbia is at 1335 m a.s.l. and it is very close to the border with Montenegro, where this bat was found in northwestern parts, at altitudes from

650–1700 m a.s.l. (Presetnik et al., 2014). The majority of nursery roosts in Slovenia and Montenegro were found below 660 and 800 m a.s.l., respectively. In Croatia *P. macrobullaris* was found from sea level up to 1800 m a.s.l., with more than half of the sites below 800 m a.s.l. (Pavlinić and Tvrtković, 2004).

Alberdi et al. (2015) reported that in the Pyrenees, alpine long-eared bat used various roost types, either natural (rock crevices and scree deposits) or artificial (buildings). On the other hand, the majority of known roosts in the Alps are located in buildings (Spitzenberger, 2002; Presetnik et al., 2009; Rutishauser et al., 2012). During our fieldwork, we did not check for potential roosts in buildings in nearby villages. A further investigation of roosts is desirable in order to find a nursery colony and to get insight into roost preferences of this species in Serbia. Previous studies on habitat use showed that in the Alps *P. macrobullaris* favored deciduous and mixed forests and avoided meadows (Rutishauser et al., 2012; Ashrafi et al., 2013), while the analyzed specimens from Lombardy avoided woodlands (Preatoni et al., 2011). Moreover, no alpine long-eared bats have been captured in forest areas in the Pyrenees, where bats forage in alpine meadows (Alberdi et al., 2015). Diverse vegetation of the Mileševka river gorge is represented by a variety of deciduous and mixed forests, but also by vegetation of rocks and scree,

so the habitat requirements of *Plecotus macrobullaris* in Serbia are not clear yet and a radiotracking study is needed in order to identify them.

Tvrtković et al. (2005) concluded that *P. macrobullaris* is restricted to karst areas. Apart from western Serbia, limestone is also widespread in eastern Serbia, in bordering regions with Bulgaria. So far, this species has not been found in spite of extensive survey efforts both in Bulgaria (Benda and Ivanova, 2003; Popov and Petrov, 2010) and eastern Serbia (Paunović, 2000, 2004; Karapandža and Paunović, 2010). Nevertheless, survey efforts should be increased and focused towards suitable habitats of alpine long-eared bat in that region.

Herein, we report the first record of *Plecotus macrobullaris* on the territory of Serbia, contributing to the knowledge of its distribution area in Europe. Altogether with this species, the bat fauna of Serbia includes 30 species in total.

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