ALTITUDINAL DISTRIBUTION OF FOUR PLECOTUS SPECIES (MAMMALIA, VESPERTILIONIDAE) OCCURRING IN CROATIA

IGOR PAVLINIĆ & NIKOLA TVRTKOVIĆ

Department of Zoology, Croatian Natural History Museum, Demetrova 1, HR-10000 Zagreb, Croatia


The altitudinal distribution of bats of four Plecotus species in Croatia was analysed. P. austriacus and P. kolombatovici are restricted to lower altitudes, under 800 m a.s.l.. P. auritus inhabits continental forest habitats, preferably beech forests, with the exception of Pannonian lowland riparian forests of common oak which also lie under 100 m a.s.l.. As distinct from the other three Plecotus species, Croatian specimens of P. macrobullaris have an extremely wide altitudinal distribution, ranging from sea level to mountain tops, but with most localities under 800 m a.s.l.

Key words: Plecotus macrobullaris, P. auritus, P. austriacus, P. kolombatovici, altitudinal range, Croatia

INTRODUCTION

Hanak (1969) was the first to report differences in the altitudinal distribution of Plecotus austriacus Fischer, 1829 and P. auritus Linnaeus, 1758 in central Europe. Horaček et al. (2004) summarized observations which characterise P. austriacus as a species that lives in the lowlands of Europe. The altitudinal range extends from the...
mountain to the submontane belt (600/800 m a.s.l.), with individual exceptions of up to 1350 m a.s.l. (hibernacula – SPITZENBERGER, 2002). In Bulgaria, 80% of a total of 75 sites of *P. austriacus* are situated below 1000 m a.s.l. (BENDA & IVANOVA, 2003).

HORAČEK & DULIĆ (2004) stated that *P. auritus* is a planar/colline to subalpine species of mesophile mixed broadleaved forests, with most findings ranging in elevation from 200 to 1920 m a.s.l., and winter findings reaching up to 2350 m in the Alps. Findings across northeast Europe are generally within the planar belt, mostly in boreal coniferous forests. From 22 sites in Bulgaria, 86% lie in altitudes over 1000 m a.s.l. (BENDA & IVANOVA, 2003). The Iberian subspecies, *P. auritus* begognae (PAZ, 1994) has a similar distribution pattern in supra-Mediterranean forests lying higher than 1000 m a.s.l. The lowest nursery roost of *P. auritus* reported for Austria was known from 150 m a.s.l. (SPITZENBERGER, 2002).

Like *Plecotus austriacus*, *P. kolombatovici* Dulić, 1980 is restricted to the planar / colline belt (DULIĆ, 1980; HANAK et al., 2001; SPITZENBERGER et al., 2002), but in the European East Mediterranean. *P. macrobullaris* Kuzyakin, 1965, newly discovered to occur in Croatia (KIEFER & VEITH, 2002; SPITZENBERGER et al., 2003) is distributed in the Caucasus, Alps (SPITZENBERGER 2002; KIEFER & VEITH, 2002), Greek mountains (KIEFER & VEITH; 2002; SPITZENBERGER et al., 2003), Pyrenees (GARIN et al., 2003; KIEFER & HELVERSEN, 2004), and mountains of Crete, Syria and Iran (JUSTE et al., 2004). KIEFER & VEITH (2002), relying on a small sample of specimens from the Western Alps, maintained that this species was restricted exclusively to the montane and alpine belt ranging from 800 to 1800 m a.s.l.. As exceptions, KIEFER & HELVERSEN (2004) noted findings from 480 m (Pesina near Verona, N-Italy; KIEFER & VEITH, 2002) and 688 m (Lienz, Austria; SPITZENBERGER et al., 2001). SPITZENBERGER (2002) reported an altitudinal range of this species in the Austrian Alps from 670 to 1221 m a.s.l., and GARIN et al. (2003) found the summer population in the rocky bare ground of Brecha de Rolando (Pyrenees) at an altitude of 2807 m.

The aim of this paper is, to describe the altitudinal distribution of these four *Plecotus* species in Croatia, using revised and new material from Croatia. Special attention is given to *P. macrobullaris*.

**MATERIAL AND METHODS**

The total sample of altitudinal data of *Plecotus* in Croatia consists of findings from 75 localities. *Plecotus kolombatovici* was found in 20 localities, *P. macrobullaris* in 28, *P. austriacus* in 16 and *P. auritus* in 18 localities. Most of the data were collected during intensive field work in 2001 – 2004, investigating the distribution and identification of *P. macrobullaris*. Altitudes were noted with GPS devices, and the results were proved on state geographical maps on a scale of 1:25.000. A list of localities and the method of species identification are presented in another paper (TVRTKOVIĆ et al., in press). Preserved specimens are housed in the mammal collections of the Croatian Natural History Museum in Zagreb; the Zoological Department of Faculty of Science, University of Zagreb; Natural History Museum Wien; Zoological Museum Berlin; Zoological Museum Budapest; Senckenberg Museum, Frankfurt am
Main; Zoological Museum St. Petersburg, and the British Museum /Natural History). The most intensive investigation was conducted in the region of Mt Velebit. Description of altitudinal belts and their connections with regional vegetation of this mountain are in TVRTKOVIĆ & KLETEČKI (1993).

RESULTS

Only _P. macrobullaris_ occurred in all altitudinal zones in Croatia (Fig. 1), findings ranging from sea level to the top of mountains (max. 1800 m asl; subalpine belt). The greater part of our findings (19 out of 28 localities) are from altitudes lower than 800 m a.s.l. (Fig. 1). According to our results, most _P. austriacus_ and _P. kolombatovici_ were restricted to the planar or colline belt, and occurred just occasionally in the submontane or montane belt. In the case of _P. austriacus_, the highest findings were recorded in caves (Lokve in Gorski kotar area, 740 m a.s.l.; Barića pećina, Ličko Petrovo Selo, 400 m a.s.l.). _P. austriacus_ is restricted to areas with continental influences (Istria, Kvarner Bay, part of Gorski Kotar and Lika, the Pannonian lowland). _P. kolombatovici_ inhabits only the Mediterranean area near the Adriatic coast (from Istria to Dubrovnik) and is restricted completely to xerophilous habitats. Fif-

![Fig. 1. Distribution of four Plecotus species findings in different altitudinal belts in Croatia.](image-url)
teen records of the Dinaric subpopulation of *P. auritus* are distributed between 200 to 1600 m a.s.l., but the Pannonian findings (3 sites) ranged from 90 to 900 m a.s.l. There is only one finding of this species from southern slopes (Fig. 2) near the Adriatic coast (Živa voda, N Velebit, 1240 m a.s.l.)

**DISCUSSION**

In case of *Plecotus austriacus* and *P. kolombatovici* our results corresponded with data from Đulić (1980) and Hanak et al. (2001). While populations of *Plecotus auritus* from the Dinaric Alps and Medvednica mountains had a similar altitudinal and ecological pattern to that described in Horaček & Đulić (2004), populations from the southwest part of Pannonian lowlands inhabited planar riparian forests of common oak situated at altitudes from 90 to 110 m a.s.l. (Turopolje forests, Drenov Bok; both near Sava river). One *P. auritus* specimen was found wintering in the Uviraljka swallow-hole; Tvrtković et al., 2001) in the isolated Pannonian mountain Papuk at 855 m a.s.l.. This distribution is actually the same as in Austria (Spitzenberger, 2002).

Records of *P. macrobullaris* from the planar and colline belts of the northern Adriatic coast in Croatia as well those from the southern slopes of Alps in northern Italy (Spitzenberger et al., 2001; 2002; 2003) contradict the assumptions of Kiefer & Veith (2002) and Kiefer & Helversen (2004) about the altitudinal distribution of
this species only »at heights above 800 m«. All along the Adriatic coast, *P. macro-
bullaris* occupies Mediterranean pubescent oak woods with hop-hornbeam and orien-
tal hornbeam that cover the southern slopes of the coastal mountains from the sea
level to 800 m a.s.l.. From here, the altitudinal range of this species extends to the
subalpine belt consisting of beech or mountain pine scrub at elevations of 1550 to
1800 m a.s.l..

JUSTE et al. (2004) suggested that the small genetic differentiation within the *P.
macrobullaris* lineage corresponds to a recent recolonization from a refuge east of the
montane areas in western Europe that were not covered by glaciers during the Ice
Ages. JUSTE et al. suggested the Middle East as a potential refuge, but they noted
that the finding of two differentiated »western« and »eastern« clades (SPITZENBERGER
et al., 2003) would indicate the existence of more than one refuge. The recent distrib-
ution of *P. macrobullaris* suggests a glacial refuge along the northern and eastern
Adriatic coast.

In Croatia, *P. macrobullaris* has a distribution pattern similar to that of some other
karst rock-dwelling species, for example the voles *Chionomys nivalis* (KRYSTUF
EK & KOVAČIĆ, 1989) and the endemic *Dinaromys bogdanovi* (KRYSTUFEK, 1999).
Unlike other species, these rodents inhabit all altitudinal belts, but only in karstic limestone ar-
reas with crevices and caves. Also most of the Austrian range of *P. macrobullaris*
(SPITZENBERGER, 2002) lies in areas of Alpine karst or very close to it (BOBEK, 1961).
Nursery roosts (SPITZENBERGER, 1993; 2002) are situated in churches mostly in the up-
per Drau valley (Carinthia) within a few kilometres of the karst slopes. The same
situation with nursery roosts can be found in Croatia, particularly in Istria (Boljun), the
Lika region (Ogulin, Stajnica, Smiljan), Žumberak Mt. (Lijese, Sošice, Kašt, Mrzlo
Polje) and Mt Medvednica (Podsused) (position of localities shown in TVRTKOVIĆ et
al., in press).

ACKNOWLEDGEMENTS

The field work was supported by Project 183007 of Croatian Ministry of Science,
Education and Sport, and by three projects on the inventory of bats: PINMATRA
project, Project of the Plitvička Jezera National Park and Project of Žumberak Na-
ture Park – Samoborsko gorje. We would also like to thank D. Holcer, B. Jalzić, E.
Kletečki, Z. Tadić, D. Vukušić, A. Vukušić, Š. Tomajić, BIUS, D. Radović, O. Vuku-
dinović, D. Peći, M. Čaleta, K. Čivić and V. Obersnel for collecting material. M.
Šašić, Z. Šajbl, M. Vuković and K. Lattinger helped during field work. We are grate-
ful to F. Spitzenberger for providing data from mammal collections in the Natural
History Museums in Berlin, London, St. Petersburg and Vienna.

Received November 20, 2004
REFERENCES


