

Contribution to the natural history of *Barbastella barbastellus* in Turkey (Chiroptera: Vespertilionidae)

Príspevek k biológii d'asíka černého (*Barbastella barbastellus*) v Turecku (Chiroptera: Vespertilionidae)

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Abstract. The western barbastelle, *Barbastella barbastellus* (Schreber, 1774) is a species protected by national and international agreements. The number of records on its occurrence in Turkey is very limited, and the species is not well-known. Records in literature, except for the ones from Adıyaman (owl pellet), Kırklareli, and Nevşehir, are from northeastern Turkey. Here presented new findings show that the species is distributed predominantly in the areas along the Black Sea coast. According to call recording analyses, it was found also in western regions of Turkey including the Çanakkale and Denizli provinces. This study provides the first records of the species from southern and southwestern Turkey, the Bartın, Çanakkale, Denizli, and Konya Provinces. With respect to morphometric data, Turkish specimens represent the nominotypical form of *B. barbastellus*. We analysed three female specimens with the diploid number of chromosomes $2n=32$, with $NF=54$ and $NFa=50$. We also provide some ecological remarks, along with analyses of echolocation calls.

Key words. *Barbastella barbastellus*, distribution, karyotype, ecology, systematics, Turkey.

INTRODUCTION

The Palaearctic bat genus *Barbastella* Gray, 1821 was traditionally considered to represent two species, with a distribution ranging from Europe and North Africa to China and Japan; the western barbastelle, *B. barbastellus* (Schreber, 1774), described from Burgundy (France), and the eastern barbastelle *B. leucomelas* (Cretzschmar, 1830), described from the southern Sinai Peninsula (present Egypt). The Caspian barbastelle, *Barbastella caspica* Satunin, 1908 was originally described from the Pirsagat river valley near Kubaly (= Hacıqabul, Qubalibalağlan) in present Azerbaijan as a subspecies of *B. barbastellus*, but is recently regarded as another species (KRUSKOP 2015). From Derjeeling (northeastern India), *Plecotus darjelingensis* Hodgson in Horsfield, 1855 was previously accepted as a race of *Barbastella leucomelas*, but

is now regarded as a valid species, *Barbastella darjelingensis*. Additionally, two new species were described in the known range of the genus *Barbastella*, namely the Beijing barbastelle, *B. beijingensis* Zhang, Han, Jones, Lin, Zhang, Zhu, Huang et Zhang, 2007 from San-Liu-Shui in the Fangshan District, southwestern Beijing (Pekin) Province of China and the Japanese barbastelle, *B. pacifica* Kruskop, Kawai et Tiunov, 2019 from the Kunashir Island of Russia. *Barbastella leucomelas* s.str. is restricted in its distribution to both sides of the Red Sea in Arabia and Africa (BENDA & MLÍKOVSKÝ 2008, LÓPEZ-BAUCELLS 2019).

Turkish records of the genus *Barbastella* were reviewed by BENDA & HORÁČEK (1998) and all of them referred to *B. barbastellus*. The species occurs mainly in Europe, from the north of the Iberian Peninsula to the Caucasus, and from southern Scandinavia and Latvia to some of the Mediterranean islands, Morocco, and the Canary Islands (MITCHELL-JONES et al. 1999, LÓPEZ-BAUCELLS 2019). Since only a low number of records exists, information about the species in Turkey is relatively limited. In this study, we aimed to provide a contribution to the distribution and karyology of *B. barbastellus* in Turkey, along with some ecological observations, description of echolocation, and the evaluation of its conservation status.

MATERIAL AND METHODS

Sampling and morphology

During our field trips between 2000 and 2020, a total of 14 individuals of *Barbastella barbastellus* were captured by mist-nets and hand-nets at five different localities in Turkey (Fig. 1), and examined with respect to morphological and karyological characteristics. Two females from Ülkü (Rize Province) and one female from Çamlık (Konya Province) were karyotyped following the colchicine hypotonic citrate technique of FORD & HAMERTON (1956). The diploid number of chromosomes (2n), the fundamental number of chromosomal arms (NF), and the number of autosomal arms (Nfa) were determined by examining the photographs of about 30 metaphase cells from each specimen. Centromere positions (metacentric, submetacentric, and acrocentric) were also recorded.

Eleven bats were prepared as standard museum specimens, dry skins with extracted skulls, while some individuals were released after taking their external measurements. Three bacula were extracted following TOPÁL (1958). The skins, skulls, bacula, and karyotype preparations are deposited in the collection at the Department of Zoology, Niğde University (ZDNU).

All the adult individuals were weighed and measured (see Table 1). According to the ossification of wing fingers, all specimens were identified as adults, with the exception of a subadult female from the Balatini Cave. Along with the body weight (in grams), the external and cranial measurements (in millimetres) were taken by calliper with an accuracy of 1 mm and 0.1 mm, respectively.

Abbreviations used in the text: W = weight, TB = total body length, TL = tail length, HF = hindfoot length, EL = ear length, FA = forearm length, TA = tibia length, TrL = tragus length, TbL = thumb length, GLS = greatest length of skull, CbL = condylobasal length, MB = mastoid breadth, BB = braincase breadth, ZB = zygomatic breadth, IC = interorbital constriction, RB = rostral breadth, HS = height of skull, ML = mandible length, C-M³ = maxillary tooth row length, C-M₃ = mandibular tooth row length.

Echolocation calls

Ultrasound recordings were obtained using D500X Ultrasound Detector/Recorder Mk I (Pettersson Elektronik AB, Uppsala, Sweden), hanging on average 3 meters above ground. Triggering system of the detector automatically detected sounds and recorded ultrasound calls during acoustic surveys in Elmalı (Antalya Province) on 26–27 October 2019, Üçpınar (Çanakkale Province) on 19–24 June 2019 and 21–25 May 2020, and also Babadağ (Denizli Province) on 28–30 October 2019 and 8 June 2020.

More than 5,000 call sequences were recorded and analysed. A part of the recorded ultrasounds contains background noises including those of insects and mechanical sounds. The majority of ultrasounds suitable for analysis belonged to other bat species such as *Eptesicus serotinus* (Schreber, 1774) and *Nyctalus leisleri* (Kuhl, 1817). Fifty sequences with 124 bat call pulses were evaluated, and the presence of the western barbastelle was determined via sound recordings with sufficient (90–99%) quality, taken only in Üçpınar and Babadağ.

BatExplorer 2.1 (Elekon AG, Switzerland) and BatSound 4.0 (Pettersson) software packages were used for the analysis of recorded echolocation sounds. In the analysis, four bioacoustic parameters were measured for each call: F_{start} (start frequency at the onset of the call), F_{max} (peak frequency: frequency of maximum energy), F_{end} (finish frequency measured at the end of the call), and pulse duration (call length). Nevertheless, we did not take inter-pulse intervals (from the start of one call to the start of the next call, i.e. the duration between two consecutive calls in a sequence), since it was variable (83.8–113.0 ms).

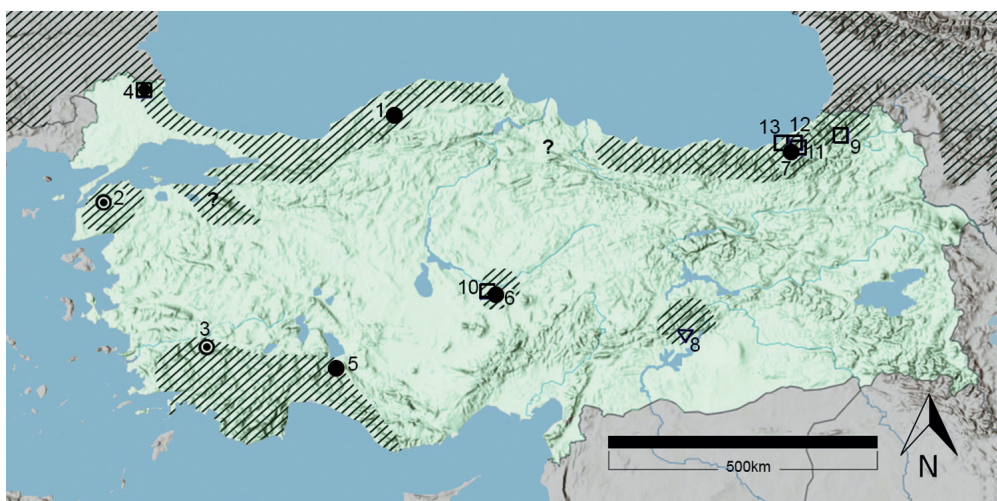


Fig. 1. Records of *Barbastella barbastellus* in Turkey (● – new sampling localities, ⊙ – new echolocation recordings); literature data (□ – sampling, ▽ – owl pellet findings) after VON HELVERSEN (1989), OBUCH (1994), STEINER & GAISLER (1994), and BENDA & HORÁČEK (1998): 1. Bartın Province: Uluyayla; 2. Çanakkale Province: Üçpınar; 3. Denizli Province: Babadağ; 4. Kırklareli Province: Sarpdere, Dupnisa Cave; 5. Konya Province: Çamlık, Balatini Cave; 6. Nevşehir Province: Mustafapaşa; 7. Rize Province: Ülkü; 8. Adıyaman Province: Karadut; 9. Artvin Province: Ardanuç; 10. Nevşehir Province: Göreme; 11. Rize Province: Köprübaşı; 12. Rize Province: Şenyuva; 13. Rize Province: Çamlıtepe. The distribution range in the Caucasus and Balkans was modified after BENDA et al. (2003) and KRUSKOP (2015).

Obr. 1. Nálezů d'asika černého (*Barbastella barbastellus*) v Turecku (● – nové nálezy netopýřů, ⊙ – nové záznamy echolokačních hlasů); publikované nálezy (□ – nálezy netopýřů, ▽ – nálezy z vývržků sov) podle VON HELVERSENA (1989), OBUCHA (1994), STEINERA & GAISLERA (1994) a BENDY & HORÁČKA (1998): 1. Parthenijská provincie: Uluyayla; 2. Dardanelská provincie: Üçpınar; 3. Denizelská provincie: Babadağ; 4. Kırklarelská provincie: Sarpdere, jeskyně Dupnisa; 5. Ikonijská provincie: Çamlık, jeskyně Balatini; 6. Neapolská provincie: Mustafapaşa; 7. Rizenská provincie: Ülkü; 8. Adijamanská provincie: Karadut; 9. Artvinská provincie: Ardanuç; 10. Neapolská provincie: Göreme; 11. Rizenská provincie: Köprübaşı; 12. Rizenská provincie: Şenyuva; 13. Rizenská provincie: Çamlıtepe. Areál rozšíření na Kavkaze a Balánském poloostrově byl pozmeněn podle BENDY et al. (2003) a KRUSKOPA (2015).

Table 1. The external and cranial measurements, and weight of adult *Barbastella barbastellus* specimens; n = number of examined specimens, SD = standard deviation; for the character acronyms see Methods Tab. 1. Vnější a lebeční míry, včetně hmotnosti, dospělých jedinců ďasíka černého (*Barbastella barbastellus*) z Turecka; n = počet šetřených jedinců, mean = průměr, range = rozmezí hodnot, SD = standardní odchylka; zkratky rozměrů viz Methods

character	n	Ülkü (Rize Province), 7 ♀♀			Dupnisa (Kırklareli Province), 3 ♂♂			
		mean	range	SD	n	mean	range	SD
TB	7	103.0	99.0–108.0	3.16	3	103.0	102.0–104.0	1.00
TL	7	50.7	49.0–55.0	2.21	3	47.7	46.0–49.0	1.53
HF	7	7.6	7.0–8.0	0.35	3	7.7	7.5–8.0	0.29
EL	7	15.86	14.5–17.5	0.94	3	15.17	14.5–15.5	0.58
W	7	6.97	6.3–8.0	0.54	3	7.94	7.3–9.0	0.92
FA	7	41.00	40.0–42.5	0.96	5	39.10	38.2–40.5	0.89
TA	7	20.71	20.0–22.0	0.81	3	20.17	20.0–20.5	0.29
TrL	6	9.25	9.0–10.0	0.42	3	9.00	9.0–9.0	0.00
TbL	7	5.36	5.0–5.5	0.24	3	5.67	5.5–6.0	0.29
GLS	7	14.74	14.6–14.9	0.11	3	14.60	14.6–14.6	0.00
CbL	7	13.60	13.2–13.9	0.24	3	13.50	13.5–13.5	0.00
MB	7	8.17	8.1–8.3	0.08	3	8.25	8.1–8.4	0.21
BB	7	7.19	7.1–7.2	0.04	3	7.30	7.2–7.4	0.14
ZB	7	7.36	7.2–7.5	0.14	3	7.60	7.4–7.8	0.28
IC	7	3.60	3.5–3.7	0.06	3	3.65	3.6–3.7	0.07
RB	7	3.81	3.7–3.9	0.09	3	3.90	3.9–3.9	0.00
HS	7	6.80	6.6–7.0	0.14	3	6.80	6.8–6.8	0.00
ML	7	9.54	9.4–9.7	0.10	3	9.45	9.4–9.5	0.07
C-M ³	7	4.61	4.5–4.7	0.09	3	4.55	4.4–4.7	0.21
C-M ₃	7	5.11	5.0–5.3	0.12	3	5.15	5.1–5.2	0.07

For the identification of calls of *B. barbastellus*, we used sound recordings from Europe and the descriptions given in literature (RYDELL & BOGDANOWICZ 1997, SCHÖBER & GRIMMBERGER 1997, VAUGHAN et al. 1997, DENZINGER et al. 2001, OBRIST et al. 2004). In addition, the calls we recorded were compared to those of a related species, *B. leucomelas*, given by BENDA et al. (2010) and HACKETT et al. (2016).

RESULTS AND DISCUSSION

External and cranial characters

The fur is dense and woolly, with hair dark grey or blackish at the base. The back is light smoky-grey, partially with yellowish (brownish beige or greyish light brown) tinge above. The underside is pale and yellowish dirty white or light grey, with beige tips. Base of hair is dark grey. The muzzle is pink-brown or flesh pink, the ears and wing membranes are grey-brown. Dental formula is 2.1.2.3 / 3.1.2.3 = 34.

The western barbastelle is a medium-sized vespertilionid bat species, with a maximum TBL of 108 mm. External measurements along with weights are given in Table 1. Ears are long, with a maximum value of 17.5 mm. A long, triangular and pointed tragus reaches up to more than half the length of pinna (Fig. 2).

According to LÓPEZ-BAUCELLS (2019), females are larger than males. However, females in our collection were slightly larger than males in terms of some measurements such as TL, EL, FA, TA, TrL; but smaller than males in terms of other measurements such as HF, RB, IC, and W, with respect to our collection. Although differences between females and males are not statistically significant, external and cranial measurements in Table 1 were given separately for comparison of sexes.

Barbastella barbastellus is represented by the nominate form in its whole distribution range, with the exceptions of the Canary Islands (ssp. *guanchae*) and Iran (undescribed subspecies). The size parameters of the Turkish samples are consistent with *B. barbastellus barbastellus* (Schreber, 1774) characteristics, according to MACDONALD & BARRETT (1993), RYDELL & BOGDANOWICZ (1997), SCHOBER & GRIMMBERGER (1997), and LÓPEZ-BAUCELLS (2019).

B a c u l u m

The baculum in Turkish *Barbastella barbastellus* is basally wide and laterally thin (Fig. 3). The mean length of baculum is 0.80 mm (range 0.75–0.85 mm; n=3), and the mean width of the proximal epiphysis is 0.30 mm. The metric characters of bacula from Turkish *B. barbastellus* were consistent with those given in TOPÁL (1958), HILL & HARRISON (1987), and RYDELL & BOGDANOWICZ (1997).



Fig. 2. An adult male *Barbastella barbastellus* caught at Mustafapaşa (Nevşehir Province, central Turkey) on 9 October 2011.

Fig. 2. Dospělý samec ďasíka černého (*Barbastella barbastellus*) odchycený a vypuštěný 9. října 2011 u vsi Mustafapaşa v Neapolské provincii, střední Turecko.

Karyology

The diploid number of chromosomes ($2n$) is 32. The autosomal set consists of eight (seven large and one small) pairs of metacentric, two large pairs of submetacentric, and five small pairs of acrocentric chromosomes. Two pairs of acrocentric chromosomes are dot-like. The X chromosome is large metacentric, and the Y chromosome is dot-like acrocentric / punctiform. The NF and NFa were found as 54 and 50, respectively (Fig. 4).

Karyological studies of *B. barbastellus* were made by BOVEY (1949) in Switzerland, CAPANNA et al. (1968) in Italy, ZIMA (1978) in former Czechoslovakia, and VOLLETH (1985) and KARATAŞ et al. (2004) in northern Turkey. A banded chromosome study on this species was published by VOLLETH (1987).

The morphology of sexual chromosomes is submetacentric for the X, and acrocentric for the Y. BOVEY (1949), CAPANNA et al. (1968), and KARATAŞ et al. (2004) found the same results, except for one pair of the microchromosomes that was considered as biarmed by ZIMA (1978), and the X as submetacentric by FEDYK & RUPRECHT (1983) (Table 2). With respect to the numbers of diploid chromosomes and autosomal chromosomal arms, this karyotype is almost identical to those of the Turkish *Plecotus* species (KARATAŞ et al. 2003). VOLLETH (1985) also reported that the banding patterns of *B. barbastellus* were almost identical with those of *Plecotus auritus* (Linnaeus, 1758). Similar results for banding patterns of chromosomes of *B. barbastellus* and *P. auritus* were given by FEDYK & RUPRECHT (1983) as well as VOLLETH & HELLER (1994).

Distribution

New records of *Barbastella barbastellus* in Turkey came from seven different localities (Fig. 1). Most of them were made in the Bartın, Çanakkale, Kırklareli, and Rize Provinces, all of which are located in the northern part of the country. Only one was from Central Anatolia, made in the



Fig. 3. Dorsal view (a), ventral view (b), and lateral view (c) of the baculum of *Barbastella barbastellus* from Turkey.

Obr. 3. Hřbetní (a), břišní (b) a stranový (c) pohled na penisovou kost ďasíka černého (*Barbastella barbastellus*) z Turecka.

Table 2. Comparison of the results of chromosome analysis of *Barbastella barbastellus* from Turkey with those given in previously published studies; 2n = diploid number of chromosomes, NF = fundamental number of chromosomal arms, NFa = number of autosomal arms, M+SM = number of metacentric and submetacentric chromosomes, A = number of acrocentric chromosomes, X, Y = type of the sex chromosome

Tab. 2. Srovnání výsledků analýzy chromosomů d'asíka černého (*Barbastella barbastellus*) z Turecka s výsledky uvedenými v publikovaných studiích; 2n = diploidní počet chromosomů, NF = základní počet chromosomálních ramen, NFa = počet autosomálních ramen, M+SM = počet metacentrických a submetacentrických chromosomů, A = počet akrocentrických chromosomů, X, Y = typ pohlavního chromosomu

2n	M+SM	A	D _M	D _A	NFa	X	Y	reference / zdroj
32	20	6	–	4	50	M	A	BOVEY 1949, CAPANNA et al. 1968, KARATAŞ et al. 2004
32	20	6	2	2	52	M	A	ZIMA 1978
32	20	6	–	4	50	SM	A	FEDYK & RUPRECHT 1983
32	20	6	–	?	52	SM	A	VOLLETH 1985
32	20	6	–	4	50	M	–	this study / tento spis

Nevşehir Province. The other two localities (in Konya and Denizli Provinces) lie in southwestern Anatolia. The records of *B. barbastellus* from Sarpdere (Kırklareli Province) and Ülkü (Rize Province) were already reported previously by BENDA & HORÁČEK (1998) and STEINER & GAISLER (1994), respectively. Other records represent new occurrence sites.

In addition to our distributional records, this species was previously recorded in Turkey by VON HELVERSEN (1989), STEINER & GAISLER (1994), and BENDA & HORÁČEK (1998). However, STEINER & GAISLER (1994) did not publish their records from 1967 and 1968 for a long time and ÇAĞLAR (1969) gave a record from Hemşin (as H. STEINER, unpublished) without exact locality. The southernmost point of distribution for *Barbastella barbastellus* in Turkey was reported by OBUCH (1994) from an owl pellet collected in the Adıyaman Province. BENDA & HORÁČEK (1998) reviewed all published records, with the exception of Köprübaşı (Rize Province) by STEINER & GAISLER (1994).

Distribution records are presented below, with the province names in *italics*.

NEW DATA. *Bartın*: **Uluyayla**, Karlık Cave [1] (in border with *Karabük*: Eflani), 20 January 2001: 1 ♂ ad. (leg. A. ÖZGÜL). – *Çanakkale*: **Üçpınar** [2], 19–24 June 2019: echolocation calls (rec. Ş. Ö. ÖZKURT). – *Denizli*: **Babadag** [3], 26–30 October 2019: echolocation calls (rec. Ş. Ö. ÖZKURT). – *Kırklareli*: **Sarpdere**, Dupnisa Cave [4], 22 September 2001: net. 3 ♂♂ ad. (ZDNU 2001/197–198, 2001/199 [ND1 haplotype KF218433 in the GenBank]); 13 June 2003: 1 ♂ ad., 14 June 2003: 1 ♂ ad. (leg. C. DIETZ & I. SCHUNGER). – *Konya*: **Çamlık**, Balatini Cave [5], 7 March 2008: 1 ♀ ad. (leg. Ş. BULUT). – *Nevşehir*: **Mustafapaşa** [6], 9 October 2011: 1 ♂ ad. (released [ND1 haplotype KF218431 in the GenBank]; leg. A. KARATAŞ, E. ÇORAMAN & E. ÇELİK). – *Rize*: **Ülkü** [7], house, 25 August 2001: colony of 20 inds., incl. 7 ♀♀ ad. (ZDNU 2001/118–123, 2001/117 [ND1 haplotype KF218432 in the GenBank]).

PUBLISHED RECORDS. *Adıyaman*: **Karadut** [8], cave, 1300 m a. s. l., 7 June 1992: remains of 1 ind. from *Strix aluco* pellets (OBUCH 1994). – *Artvin*: north of **Ardanuç** [9], cave in a canyon, 12 August 1983: 1 ♀ ad. (VON HELVERSEN 1989, cf. VOLLETH 1985). – *Kırklareli*: **Sarpdere** [4], Dupnisa Cave, 16 October 1993:

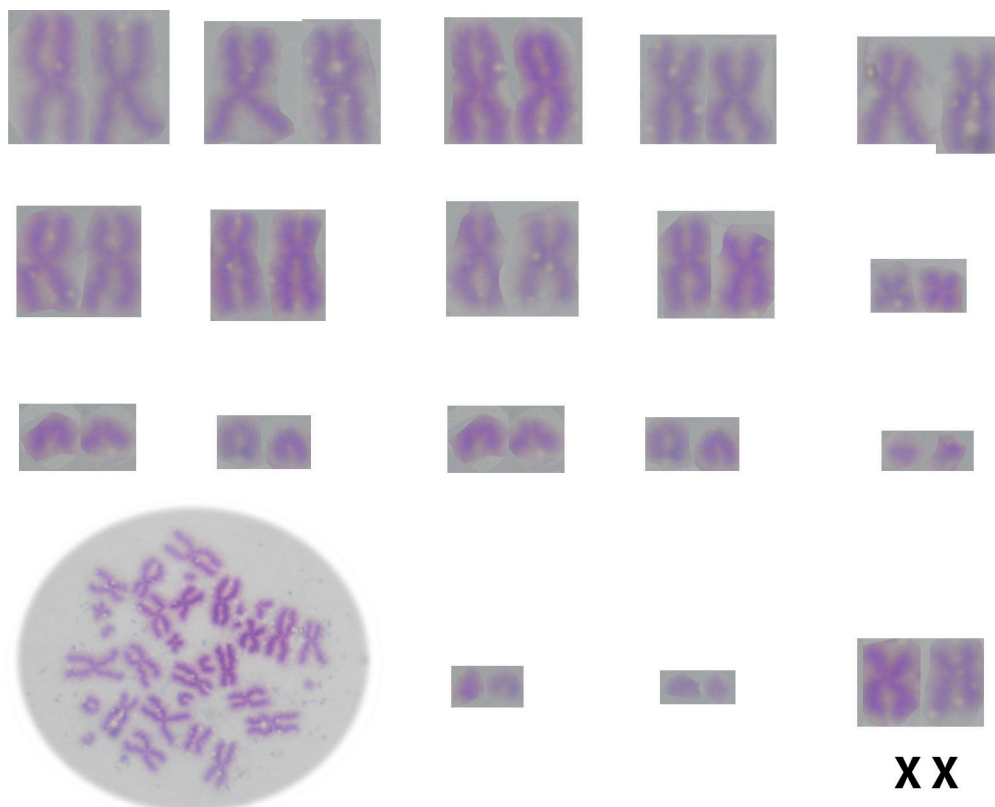


Fig. 4. Karyotype of female *Barbastella barbastellus* from the Balatini Cave near Çamlık (Konya Province); for details see Table 2.

Obr. 4. Karyotyp samice ďasika černého (*Barbastella barbastellus*) odchycené v jeskyni Balatini u Āamlıku v İkonijské provincii; podrobnosti viz tab. 2.

net. 5 ♂♂ ad., 5 ♀♀ ad. (BENDA & HORÁĀEK 1998). – *Nevşehir*: 500 m northeast of **Göreme** [10], cave, 26 July 1996: net. 1 ♀ ad. (BENDA & HORÁĀEK 1998). – *Rize*: **Köprübaşı** [11], 450 m a. s. l., 1 ind. (STEINER & GAISLER 1994); – **Şenyuva** [12], house, 24 August 1967: 2 ♂♂ (STEINER & GAISLER 1994); – **Ülkü** [7], house, 31 August 1967: 2 ♂♂, 2 ♀♀, 1 September 1967: 2 ♂♂, 6 September 1968: 1 ♂, 10 September 1968: 1 ♂ (STEINER & GAISLER 1994); – **Çamlıtepe** “SoĀa (= Zua)” (near Akyamaç “Tezine”) [13], house, 6 September 1968: 1 ♂ (STEINER & GAISLER 1994, cf. KUMERLOEVE 1975, ĀAĀLAR 1969; given as “Hemşin (= Ortaköy)” by the latter author).

So far, the western barbastelle has been very rarely found along the easternmost Black Sea and the Turkish Thrace (VON HELVERSEN 1989, STEINER & GAISLER 1994, BENDA & HORÁĀEK 1998). Since its main range is centered to the European temperate broadleaf and mixed forests, *Barbastella barbastellus* is more common in the northern forested parts of Turkey. Distributional

records show that there are isolated and quite inabundant vicariant populations in the central and southern regions of the country.

Ecological remarks

The western barbastelle lives in woodlands, and is a predominantly tree-dwelling species associated with old mature forests with dead or storm-damaged trees. It also roosts in caves near water and buildings, and hibernates in caves, tunnels, and cellars (SCHOBER & GRIMMBERGER 1997, MITCHELL-JONES et al. 1999, SIERRA 1999, LÓPEZ-BAUCELLS 2019). Three of our six records (in the Bartın, Kırklareli, and Konya Provinces) were from natural caves, and one from the Nevşehir Province was from an ancient artificial cave. As the record from the Bartın Province was taken in mid-January and the record from the Konya Province was taken in the beginning of March, bats were possibly hibernating inside the caves. The record from the Nevşehir Province was made at night on 9 October. The bat was found in a deep end of a cave, in the state of torpor, and thus might have entered the cave for the purpose of an early hibernation. However, the bats from the Kırklareli Province were captured on 22 September, a date when bats are in their active period, and even the mating behaviour is still ongoing. The Dupnisa Cave, hosting the highest number of bat species in Turkey was scanned thoroughly during the day, from the bottom entrance until the top entrance but not a single barbastelle was encountered inside the cave system. A net was set at the cave entrance towards evening, before the bats came out, and three individuals were captured trying to exit the cave. The fact that they came to the entrance from the inside made us think that they spent the day hours in the cave, increasing the possibility



Fig. 5. The Balatini Cave near Çamlık in the Taurus Mts., Konya Province, southern Turkey.
Obr. 5. Jeskyně Balatini u Çamlıku v pohoří Taurus, İkonijjská provincie, jižní Turecko.

that they roosted in the cave. Only in the Rize Province, we also found a summer roost of about 20 individuals behind the wooden window shutters of an old house.

The locality in central Anatolia was in a steppe habitat, apart from sparse woodlands such as poplar (*Populus* spp.) stands in the valleys. However, record localities from the northeastern and western parts of Turkey are largely inside forests (unlike the steppe habitat in the Nevşehir Province). The Dupnisa Cave is located in a deciduous forest (predominantly oaks – *Quercus* spp.); Ülkü (Rize Province) is situated in a mixed forest of broad-leaved trees (oaks – *Quercus* spp., hornbeam – *Carpinus betulus*, and beech – *Fagus orientalis*) with conifers (Caucasian spruce – *Picea orientalis*); Üçpınar (Çanakkale Province) lies also in a mixed forest composed predominantly of oaks – *Quercus* spp. and the Turkish pine – *Pinus brutia*; Uluyayla (Bartın Province) has a coniferous forest mainly with the Caucasian fir – *Abies nordmanniana*; Babadağ (Denizli Province) is a bare mountainous terrain about 500 m away from a black pine (*Pinus nigra*) forest, at an altitude of 1,595 m a. s. l.; and the Balatini Cave (Konya Province) has a vegetation predominantly consisting of the cedar (*Cedrus libani*) and juniper (*Juniperus* spp.), at an altitude of 1,407 m a. s. l. (Fig. 5). These findings showed that the species has a wide habitat tolerance in Turkey, at the southern limits of its distribution range.

The altitudes of 13 localities in Turkey (including the literature data) range from 389 m to 1,595 m a. s. l., the median being 810.0 m a. s. l. and mean 868.2 m a. s. l. The approximate altitudes of Turkish records are as follows: Sarpdere 389 m a. s. l., Köprübaşı 400 m a. s. l., Şenyuva 480 m a. s. l., Çamlıtepe 490 m a. s. l., Artvin 500 m a. s. l., Ülkü 710 m a. s. l., Üçpınar 810 m a. s. l., Uluyayla 975 m a. s. l., Göreme 1,070 m a. s. l., Mustafapaşa 1,160 m a. s. l., Karadut 1,300 m a. s. l., Çamlık 1,407 m a. s. l., Babadağ 1,595 m a. s. l.

In Austria, the known localities range from 170 to 1,990 m a.s.l., but are concentrated in the submontane and montane belt (MITCHELL-JONES et al. 1999). Similarly, SCHOBER & GRIMMBERGER (1997) noted that the species prefers forested foothills and mountains, but also occurs in towns. In summer, it has been recorded at the altitudes up to 1,923 m a. s. l. in the Alps, and the highest maternity roost was reported at 1,100 m a. s. l. in the Czech Republic. However, LÓPEZ-BAUCELLS (2019) gave the altitude range for this bat from the sea level up to 2,260 m a. s. l.

It was observed near the Dupnisa Cave that the barbastelles emerged from the roosts in early evening, and that the bat typically flew low above the ground, while sometimes feeding at the treetop height. This bat feeds mainly on Lepidoptera; but its diet also consists of Diptera in very low proportions, as well as Trichoptera, Neuroptera, Homoptera, and Hymenoptera, while Coleoptera and Araneae are even less frequent (RYDELL & BOGDANOWICZ 1997, SCHOBER & GRIMMBERGER 1997, SIERRO 1999, MITCHELL-JONES et al. 1999, LÓPEZ-BAUCELLS 2019). In Turkey, its feeding biology was previously unknown. Therefore, faeces belonging to a female captured in the Rize Province on 25 August and two males obtained in the Kırklareli Province on 22 September were analysed (WHITAKER & KARATAŞ 2009). Accordingly, the faeces of the males contained 100% Lepidoptera, while those of the female contained 95% of Lepidoptera and 3% of Coleoptera, possibly Curculionidae.

In the single day roost discovered in the Rize Province, barbastelles formed a cluster of about 20 individuals at the end of August. All of them were adult females. There is a high probability it was a remnant of a maternity colony, but no juvenile or subadult was found among them. One solitary barbastelle was found hibernating in each of the Karlık Cave (Bartın-Karabük Provinces border) and the Balatini Cave (Konya Province).

Since a simultaneous flight was observed near the Dupnisa Cave on 22 September, we may say that the mating probably took place in autumn. In three males captured at the entrance to

the cave, the testicles were quite swollen, and the measurements for testicle length and width from these specimens were 5×3 mm, 6×3 mm, and 6×3 mm, respectively.

Echolocation calls

The sounds belong to bats that fly in an open area at an average height of 7–8 m and are of two FM types. According to this, the average values for *Barbastella barbastellus* echolocation calls (Fig. 6) recorded in Üçpınar (Çanakkale Province) and Babadağ (Denizli Province) were as follows: the maximum frequency (F_{start}) varied between 30.7 and 57.1 kHz, minimum frequency (F_{end}) between 22.9 and 32.7 kHz, peak frequency (F_{max}) between 24.1 and 42.5 kHz, and call duration between 1.6 and 7.8 ms.

Barbastella barbastellus is one of the easiest European species to identify based on its echolocation calls. It emits alternative calls of two different signal types at different frequencies and amplitudes, similarly as *B. leucomelas* and *B. caspica* in the Middle East (RYDELL & BOGDANOWICZ 1997, SCHÖBER & GRIMMBERGER 1997, VAUGHAN et al. 1997, DENZINGER et al. 2001, OBRIST et al. 2004, BENDA et al. 2006, 2010, 2012, HACKETT et al. 2016, LÓPEZ-BAUCELLS 2019). These differences are partially caused by head movements and activity types in various habitats. Therefore we divided these acoustic parameters into two groups, giving average, minimum and maximum values. As shown in Table 3, the values of the call type I lie at ca. 57–23 kHz, with 1.6–3.9 ms of pulse durations, and the second type at ca. 49–25 kHz, with 4.1–7.8 ms of pulse durations. LÓPEZ-BAUCELLS (2019) stated that the first call was always louder and ranged at 37–30 kHz, with ca. 46 kHz of F_{start} , ca. 28.4 kHz of F_{end} , and 1–5 ms of pulse durations; while the type II ranged at 43–30 kHz. VAUGHAN et al. (1997) gave the following average values for the western barbastelle echolocation calls: F_{start} 46.0 kHz, F_{max} 36.8 kHz, F_{end} 28.4 kHz, and call duration 4.4 ms.

All of these values fall within the range of our minimum–maximum values. SCHÖBER & GRIMMBERGER (1997) wrote that type I was a loud, short CF/FM call of 35–28 kHz, with a duration of 4 ms; whereas the signal type II was a soft, short CF/FM call of 43–33 kHz, with a duration of 5.2 ms. Both calls began with a CF component of 1–1.5 ms duration. The maximum impulse intensity for the two types was at 35–30 kHz and 43 kHz, respectively. Calls were repeated at 110–120 ms intervals. With respect to our recordings, the mean values of the duration of intervals were 102.4 ms for the call type I and 122.3 ms for the call type II. On the other hand,

Table 3. Parameters of echolocation calls of *Barbastella barbastellus* from Turkey; F_{start} = start (maximum) frequency (kHz), F_{max} = maximum energy (peak) frequency (kHz), F_{end} = end (minimum) frequency (kHz), pulse length = call duration (ms)

Tab. 3. Parametry echolokačních výkřiků d'asika černého (*Barbastella barbastellus*) z Turecka; F_{start} = počáteční (nejvyšší) frekvence (kHz), F_{max} = maximální energii obdařená (vrcholová) frekvence (kHz), F_{end} = koncová (nejnižší) frekvence (kHz), pulse length = délka výkřiku (ms)

call	n	F_{start}	F_{max}	F_{end}	pulse length
type I	88	40.00±6.46	33.21±4.40	27.71±1.89	2.87±0.56
		(30.7–57.1)	(24.10–42.50)	(22.90–32.70)	(1.60–3.90)
type II	36	39.84±3.25	31.82±0.01	27.73±1.35	5.23±1.21
		(34.60–49.30)	(26.40–40.50)	(24.90–31.20)	(4.10–7.80)

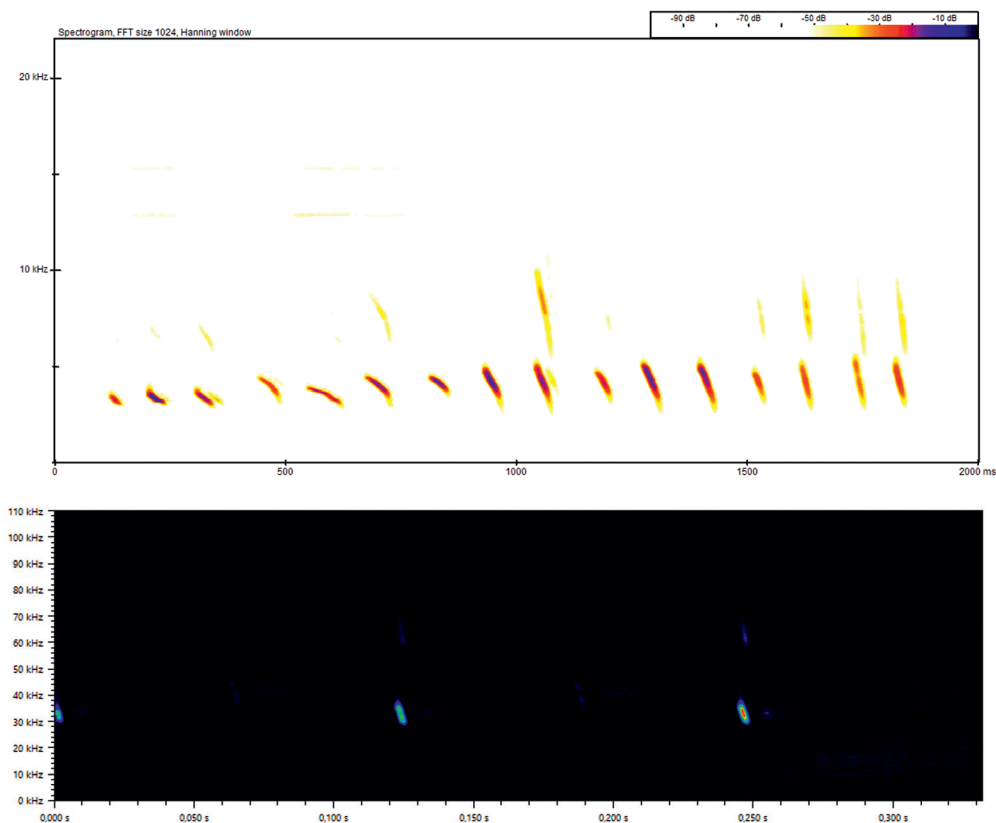


Fig. 6. The echolocation calls of *Barbastella barbastellus* from Turkey; spectrogram of a call recorded at Üçpinar (Çanakkale Province) on 19 June 2019 (top), sonogram of a call recorded at Babadağ (Denizli Province) on 30 October 2019 (bottom).

Obr. 6. Echolokační hlas d'asika černého (*Barbastella barbastellus*) z Turecka; spektrogram výkřiku zaznamenaného 19. června 2019 u Üçpinaru v Dardanelské provincii (nahore), sonogram hlasu nahraného 30. října 2019 u Babadagu v Denizelské provincii (dole).

DENZINGER et al. (2001) reported that the call type II started at ca. 45 kHz and ended at ca. 32 kHz, with a call duration of 6 ms. However, their parameters varied according to habitat type. For example, the mean (min–max) values of duration were 6.79 ± 1.36 ms (2.75–10.92 ms) above roads, but 5.18 ± 0.56 ms (2.88–9.38 ms) in clearings. The same values for the signal type I were 2.7 ± 0.53 ms (1.42–4.17 ms) and 2.45 ± 0.62 ms (1.46–4.38 ms), respectively. Both recording localities in the Çanakkale and Denizli Provinces were openings surrounded by forests, with extensive vegetation clearings for wind farms. Therefore, DENZINGER et al. (2001) would be more appropriate to compare with the measurements given for clearings. According to the values given above, the echolocation calls we recorded in the Çanakkale and Denizli Provinces show similarity with those of *B. barbastellus* from Europe.

Threats

The western barbastelle is globally listed as Near Threatened (NT) in the IUCN Red List (IUCN 2016); however, it is regionally listed as Vulnerable (VU) in Europe. Although its population size and trends are unknown in Turkey, major threats exist to this species and other bats, including *Nyctalus noctula* (Schreber, 1774), *N. leisleri* (Kuhl, 1817), and *Myotis brandtii* (Eversmann, 1845), which use forested areas as roost sites. These threats include habitat loss (cutting of old trees, renovation or demolition of old traditional buildings and their wooden window shutters that serve as the most popular roosting sites in the northern parts of the country, especially in the Rize Province, where the highest number of records comes from), fragmentation (caused by forestry, plateau tourism, and facility construction, mining etc.), disturbance (Dupnisa Cave is one of the most popular sites for cave tourism in Turkey and is visited by thousands of people every year; localities in the Nevşehir Province are artificial ancient caves, many of which are used by the local people as depositories and barns), and also wind turbines. Considering the above mentioned threats, this bat species should be listed as Vulnerable for Turkey.

SOUHRN

Ďasik černý, *Barbastella barbastellus* (Schreber, 1774) je druh netopýra chráněný mezinárodními dohodami a tureckými zákony. Počet záznamů o jeho rozšíření v Turecku je velmi omezený a tento netopýr není v zemi příliš známý. Většina nálezů uváděných v literatuře, s výjimkou nálezu ze soviho vývržku v provincii Adijaman a nálezů v provinciích Kırklareli a Neapolis (Nevşehir), pochází ze severovýchodního Turecka. Nově shromážděné nálezy dokládají, že je tento netopýr rozšířen převážně v provinciích podél jižního pobřeží Černého moře. Podle záznamů echolokačních hlasů byl však také prokázán v intravilánech v západním Turecku, v Dardanelské a Denizelské provincii. Poprvé byli jedinci ďasíka černého nalezeni v provinciích Parthenia (Bartın), Dardanely (Çanakkale), Denizli a Ikonium (Konya). Podle morfometrických údajů lze turecké populace zařadit k nominotypické (evropské) formě *B. barbastellus barbastellus*. Byly také analyzovány karyotypy několika jedinců, diploidní počet chromozomů činil $2n=32$, s počty ramen $NF=54$ a $NFa=50$. V textu jsou uvedeny také některé ekologické poznámky, spolu se analysou echolokačního hlasu.

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