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Distribution and status of *Myotis bechsteinii* in Bulgaria (Chiroptera: Vespertilionidae)

Rozšíření a statut netopýra velkouchého (*Myotis bechsteinii*) v Bulharsku (Chiroptera: Vespertilionidae)

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Abstract. The first record of *Myotis bechsteinii* in Bulgaria dates from 1935. Since then, a total of 55 females, 141 males and two individuals of unknown sex have been recorded. Up to now only three breeding colonies have been found in Bulgaria. At present, the Bechstein's bat is known from 34 localities (33 UTM squares) situated from sea level up to 1650 m. Since its first discovery, only two males have been found hibernating in caves. Besides that no data are available on wintering sites of the species in Bulgaria. Although most localities were at altitudes below 300 m, the highest number of individuals during summer was found in mountain beech and mixed coniferous woodlands at an elevation between 800 m and 1450 m a. s. l. During the swarming period, some individuals were found to make vertical migrations of ca. 770 m between their roosts and the site of the capture. *Myotis bechsteinii* was found in Pleistocene and Early Holocene deposits of only two caves in Bulgaria. However, it was one of the most abundant and common species during that time. At present, conservation of mature forests (i.e. sustainable forest management), maintenance of their connectivity and further planting of new forest clearings are considered the most important factors that could promote the occurrence of the species.

INTRODUCTION

There are comparatively less records of bats from the southern (both eastern and western) parts of Europe than those from its central and western parts. This is especially true for the Bechstein's bat, *Myotis bechsteinii* (Kuhl, 1817). This species is considered to be distributed continuously in most Central European countries, but has a scattered distribution in Southern Europe and further to the east. Its occurrence in the south and east was reviewed for Portugal and Spain (Benzal & de Paz 1991), Italy (Vergari et al. 1998), Croatia (Dulić 1959, Kovačić & Dulić 1989), Slovenia (Kryštufek & Cerveny 1997), former Yugoslavia (Petrović et al. 1985), Albania (Uhrin et al. 1996), Bulgaria (Benda et al. 2003, Petrov 1997), Romania (Nagy et al. 2005), Greece (Hanák et al. 2001, Helversen & Weid 1990), European Turkey (Kahmann 1962, Furman & Özgül 2004), Asia Minor (Benda & Horáček 1998, Albayrak 2003), the Caucasus region (Rakhmatulina 1990, Tsytsulina 1999) and by DeBlase (1980) who provided data from the easternmost locality of the species in Iran. The Bechstein's bat is considered a typical species of the temperate humid zone whose range is centred mainly in the western part of the Palaearctic region (Horáček et al. 2000). The distribution of the species is only well known in

the western and northern parts of its range. Southeastern records are often quite isolated from the main distribution range. Therefore, additional information on the occurrence at the margins of its range is needed to understand the recent scattered distribution of *Myotis bechsteinii* in Europe. Furthermore, new records coming from the poorly studied regions, incl. Bulgaria, may allow us to better understand what limits Bechstein's bats in their occurrence. Besides depicting precise maps of its distribution, chorological data are essential for the analysis of the species' ecological requirements. This is an important prerequisite to design up-to-date national and international conservation plans for the Bechstein's bat, which has been listed as vulnerable in the 'Red List of Threatened Species' since 1994 (IUCN 2004).

MATERIAL AND METHODS

This review is based mainly upon literature sources. However, new field records from the period 1997-2006 were added. Bechstein's bats were caught at cave or mine entrances, above streams and in forest clearings using 3 m, 6 m or 12 m long mistnets. At four sites (7, 18, 24, and 33), radio-telemetry (Regal 2000 telemetry receiver, Titley electronics Ltd.; LB-2 transmitter, Holohil Systems Ltd.) was used to discover the roosts of the tagged individuals. All captured bats were measured, aged, ringed and released afterwards. Additionally, since 1999 a small piece of the bat's wing membrane was collected, using a sterile biopsy-punch for future DNA analyses. All bats were captured under the license of the Ministry of the Environment and Waters (Bulgaria) and permissions from the local departments of forests (2001–2006).

RESULTS

Review of the records from Bulgaria

Heinrich (1936) was the first to record the Bechstein's bat in the Balkans and particularly on the Bulgarian Black Sea coast. Among other mammals, he reported six bat species, including *Myotis bechsteinii*, for the first time for the Bulgarian fauna. Later on, Hanak & Josifov (1959) added one locality, showing that the Bechstein's bat also occurs in the mountains (Rila Mts.). Beron (1961) found that this species hibernates in Bulgarian caves. After several field trips to Bulgaria, Czech zoologists reported new localities thereby showing that the species is not as rare as previously assumed (Horáček et al. 1974, Benda et al. 2003). Studies by Beshkov (1993) raised the number of Bulgarian localities to eight. Petrov (1997) summarized all previous records and added 4 new sites. Some recent regional bat surveys (Ivanova 1998, Pandurska & Beshkov 1998b, Pandurska et al. 1999, Petrov 2001, Popov et al. 2006) reported Bechstein's bats from eight new localities. The most recent review of the distribution of bats in Bulgaria (including *M. bechsteinii*) was published by Benda et al. (2003).

Only few papers deal with the historical evidence of this bat species in Bulgaria. Wołoszyn (1982) first reported it in cave deposits from the Upper Pleistocene. Until today there has been no contemporary record of the Bechstein's bat from this locality (Bacho Kiro cave), although environmental conditions are still suitable. Popov (2000) found abundant remains of this species in sediments dated to originate from the Upper Pleistocene and Holocene (cave 15 and 16, Karlukovo village). He also suggested that the species was common and widely distributed in periods with mild and humid climate, when forests still covered larger areas of the Balkans and elsewhere. Recent occurrence of the Bechstein's bat in the caves close to Karlukovo was supported with field data by Benda et al. (2003).

In summary, the current knowledge of the distribution of *Myotis bechsteinii* shows that in Bulgaria, the species inhabits diverse habitats, covering a broad altitudinal range. However, at

most places only single individuals were caught. A higher population density was estimated for some of the localities (e. g., 7, 17, 18, and 33, see below) but only three maternity colonies have been found so far in Bulgaria.

Distribution of the Bechstein's bat in Bulgaria

The Bechstein's bat is known to occur at 34 localities (33 UTM squares of 10×10 km) from sea level up to 1650 m a. s. l. (Fig. 1, Table 1). All records before 1971 were more or less accidental findings. With few exceptions, density of the records from the mountainous regions (e.g. Stara Planina, Rhodopes, Pirin) is higher compared to the scattered distribution in the lowlands. There are no records of *Myotis bechsteinii* from the Bulgarian part of Dobrogea or the upper parts of the Thracian plain where open agricultural landscape is prevailing. Occurrence of the species in the lowlands is mostly associated with larger forested areas (e.g. Strandja Mts., 6, 7, 24, 26, and 34) or presence of a diverse mosaic of habitats (e.g. 10, 19, 21, 23, etc.). In many regions, the species has not yet been found or has been only occasionally proved. For example, no records are available from the northern slopes of the Rhodopes, eastern slopes of the Pirin and Rila, Slavyanka, Belasitsa and other mountain ranges, which all offer suitable environmental conditions.

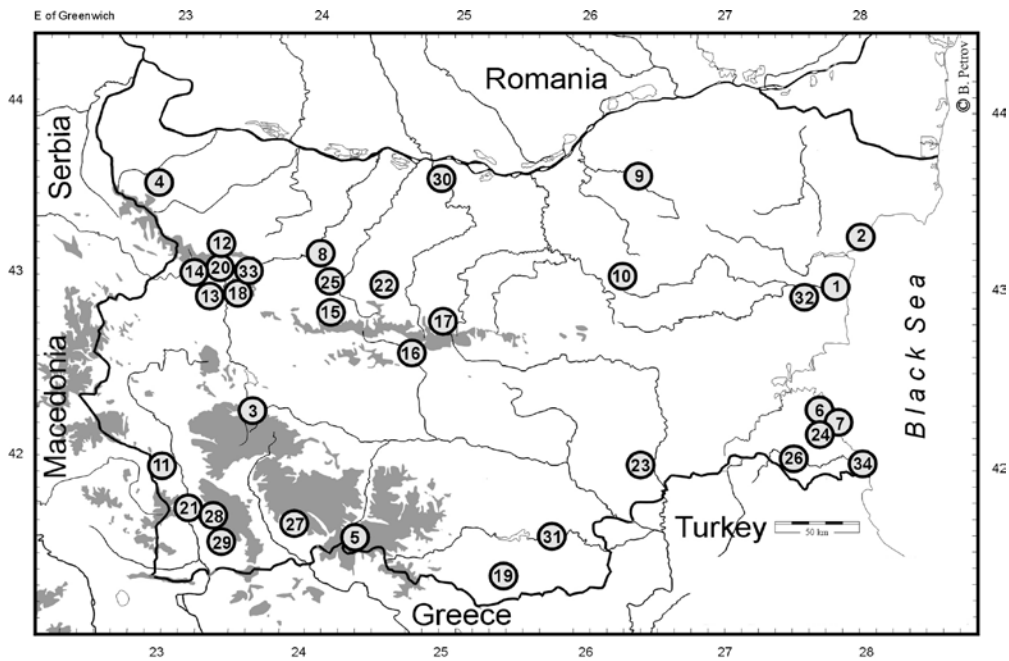

Fig. 1. Records of the Bechstein's bat (*Myotis bechsteinii*) in Bulgaria (1935–2006), see Table 1 for explanation of numbers. Shaded are mountains above 1200 m a. s. l.
Obr. 1. Nálezy netopýra velkouchého (*Myotis bechsteinii*) v Bulharsku (1935–2006), vysvětlení čísel viz tab. 1. Stínována jsou horská území nad 1200 m n. m.

Table 1. List of record localities of the Bechstein's bat (*Myotis bechsteinii*) in Bulgaria (1935–2006)
Tab. 1. Přehled lokalit nálezů netopýra velkouchého (*Myotis bechsteinii*) v Bulharsku (1935–2006)

No.	village	district	site	m a. s. l.	method	m	f	date	reference	UTM
1	Kamtchiya	Dolni Chiflik	lower course of the river	10	shot-gun	1	1	June 1935	Heinrich 1936	NH75
2	Varna	Varna	pallace Evksinovgrad	10	hand	1	2	3. 8. 1935	Hanak & Josifov 1959	NH78
3	Samokov	Sofia	Borovetz	1350	hand			18. 7. 1950	Hanak & Josifov 1959	GM18
4	Belogradchik	Montana	Gornata propast cave	600	hand	1		6. 2. 1960	Beron 1961	FP33
5	Yagodina	Devin	Yagodinskata peshtera cave	1015	mist-net	1		2. 8. 1971	Horáček et al. 1974	KG71
5	Yagodina	Devin	Yagodinskata peshtera cave	1015	mist-net	1		15. 8. 1978	Benda et al. 2003	KG71
5	Yagodina	Devin	Yagodinskata peshtera cave	1015	mist-net	1		4. 8. 1997	B. Petrov, present paper	KG71
5	Yagodina	Devin	Yagodinskata peshtera cave	1015	mist-net	5		14. 9. 2001	B. Petrov, G. Kerth & B. Koenig, present paper	KG71
5	Yagodina	Devin	Yagodinskata peshtera cave	1015	mist-net	2		17. 9. 2005	B. Petrov, present paper	KG71
6	Primorsko	Bourgas	Arkutino swamp	10	mist-net		2	6. 6. 1972	Benda et al. 2003	NG69
7	Primorsko	Bourgas	Ropotamo Reserve, Veliov vir	10	mist-net	1		12. 9. 2001	B. Petrov, G. Kerth & B. Koenig, present paper	NG69
7	Primorsko	Bourgas	Ropotamo Reserve	10	mist-net	3		20. 4. 2002	B. Petrov, G. Kerth & D. Dechmann, present paper	NG69
7	Primorsko	Bourgas	Ropotamo Reserve	10	bat-box	2		4. 6. 2002	B. Petrov, present paper	NG69
7	Primorsko	Bourgas	Ropotamo R., entrance gate	5	mist-net	1	1	25. 4. 2003	B. Petrov & G. Kerth, present paper	NG69
7	Primorsko	Bourgas	Ropotamo Reserve, Veliov vir	10	funnel trap		5	26. 4. 2003	B. Petrov & G. Kerth, present paper	NG69
7	Primorsko	Bourgas	Ropotamo Reserve, Veliov vir	10	mist-net	1		25. 9. 2003	B. Petrov & T. Stoyanov, present paper	NG69
7	Primorsko	Bourgas	Ropotamo Reserve, entrance gate	5	mist-net	1		7. 5. 2004	B. Petrov & T. Stoyanov, present paper	NG69
7	Primorsko	Bourgas	Ropotamo Reserve, entrance gate	5	mist-net	1	1	11. 6. 2004	B. Petrov, G. Kerth & T. Ivanova, present paper	NG69
7	Primorsko	Bourgas	Ropotamo Reserve, mouth of the Ropotamo river	3	funnel trap		11	15. 6. 2004	B. Petrov, G. Kerth & T. Ivanova, present paper	NG69
8	Karlukovo	Cherven bryag	rocky amphitheatre	200	mist-net	1		15. 6. 1977	Benda et al. 2003	KH68
8	Karlukovo	Cherven bryag	rocky amphitheatre	200	mist-net	1		6. 8. 1978	Benda et al. 2003	KH78
8	Karlukovo	Cherven bryag	cave behind the monastery	200	mist-net	2		8. 8. 1978	Benda et al. 2003	KH68
8	Karlukovo	Cherven bryag	cave behind the monastery	200	mist-net	1		9. 8. 1978	Benda et al. 2003	KH68
8	Karlukovo	Cherven bryag	cave in the monastery	200	mist-net		4	9. 8. 1978	Benda et al. 2003	KH68

9	Krivnya	Razgrad	Bozkova dupka cave	200	hand	1		15. 3. 1989	Beshkov 1993	MJ54
10	Buhovtsi	Targovishte	Prilepnata dupka cave	200	hand	1		25. 4. 1989	Beshkov 1993	MH89
11	Leshko	Blagoevgrad	Leshtanskata peshtera cave	1000	mist-net	1		7. 6. 1996	Pandrurska & Beshkov 1998a	FM64
12	Gorna Bela	Varshets	mine	1000	mist-net	1		3. 4. 1996	Pandurska & Beshkov 1998b	FN98
13	Breze	Svoge	Travninata cave	1050	mist-net	1		15. 9. 1996	Pandurska & Beshkov 1998b	FN86
14	Gintzi	Godech	Dinevata peshtera cave	1200	mist-net	1		5. 9. 1994	Pandurska 1999	FN77
15	Divchovoto	Teteven	Grazdenitza cave	800	mist-net	1		28. 9. 1997	Ivanova 1998	KH64
15	Divchovoto	Teteven	Grazdenitza cave	800	mist-net	3		19. 9. 2001	B. Petrov, G. Kerth & B. Koenig, present paper	KH64
16	Karnare	Karlovo	Mazata cave	1350	mist-net	1		25. 9. 1997	Ivanova 1998	LH04
17	Vidima	Aprilitsi	Pleven hut, Vodnite dupki c.	1400	mist-net	9		15. 8. 1997	Ivanova 1998	LH23
17	Vidima	Aprilitsi	Pleven hut, Vodnite dupki c.	1400	mist-net	10	1	28. 8. 2001	Schunger et. al. 2004	LH23
17	Vidima	Aprilitsi	Pleven hut, Vodnite dupki c.	1400	mist-net	4		16. 8. 2003	Schunger et. al. 2004	LH23
18	Bov	Svoge	Izdremets, mine	1450	mist-net	5		11. 9. 1998	R. Pandurska & V. Beshkov present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	7		14. 9. 1999	B. Petrov, V. Beshkov & Y. Gorelov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	9	2	16. 9. 2001	B. Petrov, G. Kerth & B. Koenig, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	2		2. 10. 2001	B. Petrov & S. Beshkov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	2		3. 8. 2002	B. Petrov & V. Beshkov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	2	2	2. 9. 2002	B. Petrov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	3		18. 9. 2002	B. Petrov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	10		22. 8. 2003	B. Petrov & V. Beshkov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	3		17. 9. 2003	B. Petrov & T. Stoyanov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	5		19. 9. 2003	B. Petrov & T. Stoyanov, present paper	FN97
18	Bov	Svoge	Izdremets, mine	1450	mist-net	1		22. 10. 2003	B. Petrov & T. Stoyanov, present paper	FN97
19	Ribino	Kroumovgrad	Samara cave	340	mist-net	1		20. 4. 1995	Petrov 1997	LF78

Table 1. (continued)
Tab. 1. (pokračování)

No.	village	district	site	m a. s. l.	method	m	f	date	reference	UTM
19	Ribino	Kroumovgrad	rocky bridge	320	hand	1		18. 9. 2002	C. Dietz & I. Schunger, present paper	LF78
20	Lakatnik	Svoge	Svinskata dupka cave	500	mist-net	1		24. 8. 1995	Petrov 1997	FN97
21	Kresna	Blagoevgrad	Kresna gorge, on the road	200	hand	1		5. 10. 1995	Petrov 1997	FM73
21	Kresna	Blagoevgrad	Kresna gorge, Sheitan dere	200	mist-net	1		2. 7. 1997	Petrov 2001	FM73
22	Golyama Jelyazna, Troyan		Toplya cave	700	hand	1		2. 2. 1997	Petrov 1997	KH95
23	Ustrem	Topolovgrad	Bozkite cave	200	mist-net	2		10. 4. 1998	Benda et al. 2003	MG55
24	Primorsko	Burgas	residence Perla	10	mist-net	1		18. 4. 1998	B. Petrov, present paper	NG78
24	Primorsko	Burgas	oak forest	95	mist-net		1	14. 6. 2004	B. Petrov, G. Kerth & T. Ivanova, present paper	NG69
25	Brestnitsa	Yablanitsa	Seeva dupka cave	500	mist-net	1		1. 5. 1999	Benda et al. 2003	KH58
25	Brestnitsa	Yablanitsa	Seeva dupka cave	500	mist-net	4		15. 5. 2003	B. Petrov & G. Stoyanov, present paper	KH58
26	Mladezko	Malko Tarnovo	Leyarnitzata cave ? 4	160	mist-net	1		25. 8. 1999	Benda et al. 2003	NG26
26	Mladezko	Malko Tarnovo	Leyarnitzata cave ? 4	160	mist-net	2		11. 6. 2003	C. Dietz & I. Schunger, present paper	NG26
27	Ribnovo	Gotse Deltchev	Manoilovata peshtera cave	1000	mist-net	2		22. 6. 2000	Benda et al. 2003	GM32
28	Kresna	Blagoevgrad	Peshterata, mine	1250	mist-net	2	1	25. 9. 2001	B. Petrov, present paper	FM92
29	Ilindentsi	Sandanski	Sharaliiskata peshtera cave	1650	hand	1	1	7. 4. 2002	B. Petrov, present paper	FM91
29	Ilindentsi	Sandanski	Sharaliiskata peshtera cave	1650	mist-net	1		25. 6. 2002	B. Petrov, present paper	FM91
30	Muselievo	Nikopol	Nanin kamuk cave	140	mist-net	1		10. 6. 2002	C. Dietz & I. Schunger, present paper	LJ23
31	Dolno Cherkovishte, Haskovo		Sedemte peshteri-Oreshari c.	320	observ.	1		30. 9. 2003	Benda et al. 2003	LG90
32	Golitsa	Dolni Chiflik	oak forest (*Quercus cerris*)	300	mist-net	4		13. 5. 2003	E. Tilova, present paper	NH45
33	Gabrovnitsa	Svoge	Sedemte prestola Monastery	650	mist-net		3	7. 5. 2003	B. Petrov & G. Kerth,	GN06
33	Gabrovnitsa	Svoge	Sedemte prestola Monastery	650	funnel trap		5	9. 5. 2003	B. Petrov & G. Kerth,	GN06
33	Gabrovnitsa	Svoge	Sedemte prestola Monastery	650	mist-net		1	15. 4. 2006	B. Petrov & G. Kerth,	GN06
33	Gabrovnitsa	Svoge	Sedemte prestola Monastery	650	funnel trap		9	16. 4. 2006	B. Petrov & G. Kerth,	GN06
33	Gabrovnitsa	Svoge	Sedemte prestola Monastery	650	funnel trap		2	19. 4. 2006	B. Petrov & G. Kerth, all five records by the present paper	GN06
34	Sinemorets	Tsarevo	Silistar Reserve	3	mist-net	1		August 1998	Popov et al. 2006	NG85

Table 2. Vertical distribution of the localities of the Bechstein's bat (*Myotis bechsteinii*) in Bulgaria (1935–2006)
Tab. 2. Vertikální rozšíření lokalit nálezů netopýra velkouchého (*Myotis bechsteinii*) v Bulharsku (1935–2006)

altitude (m)	sites (see Table 1)	total sites	rel. share [%]
0–300	1, 2, 6, 7, 8, 9, 10, 21, 23, 24, 26, 30, 32, 34	14	41.2
301–600	4, 19, 20, 25, 31	5	14.7
601–900	15, 22, 33	3	8.8
901–1200	5, 11, 12, 13, 14,	6	17.6
1201–1500	3, 16, 17, 18, 28	5	14.7
1501–1800	29	1	2.9

New data

In this study I report new data from eight previously unknown localities. The species was proved to occur in the Pirin Mts. (loc. 28, 29), close to the Danube (loc. 30), in the western Stara Planina east of the Iskar river gorge (loc. 18, 33), in the Ropotamo Reserve at the Black Sea coast (loc. 7, 24) and in the eastern Stara Planina Mts. (loc. 32). At the localities Ropotamo Reserve (Loc. 7), Vodnite dupki cave (loc. 17), Izdremets (loc. 18) and Sedemte Prestola monastery (loc. 33), Bechstein's bats were captured more than twice. These sites (among others) were therefore supposed to hold higher population density and bat boxes (Scwengler 2 FN) have recently been installed at localities No. 7, 18 and 33 (2001–2002, Petrov & Kerth unpubl.). Localities No. 18, 28 and 29 broaden the altitudinal range where *Myotis bechsteinii* was found in Bulgaria (see below). Furthermore, at four localities that were already known before (5, 15, 19, and 25), the presence of the species was confirmed.

While the majority of the other papers (cf. Benda et al. 2003) deal with the geographic distribution of the species, the present survey analyses some details of its occurrence. To provide better description of the habitats where the species was found, 32 localities (out of 34 known) were personally visited. Among many other bat localities in the country visited by the author, mistnetting was also attempted at some previously known sites (e.g. loc. 8, 11, 12) but no Bechstein's bats were captured. Some of the known sites were visited in winter as well (e.g. loc. 9, 14, 17, 20, 22, 27, 29) but the species was not found. The maximum number of Bechstein's bats captured per night was 11 specimens (loc. 18, 17; Schunger et. al. 2004). Since its first discovery in 1935, 55 females, 141 males and 2 specimens (loc. 3) of unknown sex have been captured. Out of these numbers, 129 males and 46 females (i.e. 89% of the total number) were caught between 1994 and 2006 (i.e. in a period when intensive regional bat surveys in Bulgaria were carried out mostly by local researchers including the author of this paper).

Altitudinal distribution

Most of the localities (n=14; 41.2%) are situated between sea level and 300 m a. s. l. (Table 2). This high rate of occurrence at lowland sites is partly due to the fact that numerous bat surveys in Bulgaria were carried out in this altitudinal range. On the other hand, Bulgarian bat fauna reaches its greatest species diversity per area between 100 m and 300 m (Pandurska 1996, Petrov 2001, Popov & Ivanova 1995) and regional fauna can consist of 17–20 bat species, which inhabit these

Table 3. List of the localities of the Bechstein's bat (*Myotis bechsteinii*) in Bulgaria sorted by altitude. Composition of the dominant vegetation cover is after Bondev (1991). Temporal water presence is abbreviated as "temp."
Tab. 3. Přehled lokalit nálezů netopýra velkouchého (*Myotis bechsteinii*) v Bulharsku řazený podle nadmořské výšky. Složení dominujícího vegetačního pokryvu podle Bondeva (1991). Nestálá přítomnost vody je naznačena zkratkou "temp."

No.	village, site	m a. s. l.	dominant vegetation cover	water	m	f
34	Sinemorets, Silistar Reserve	3	*Quercus cerris*, *Q. frainetto* with Mediterranean elements	river	1	
1	Kamtchiya, river	10	*Quercus cerris*, *Q. freinetto*	river	1	1
2	Varna, Evksinovgrad pallace	10	*Quercus pubescnes*, *Q. virgiliana*, *C. orientalis*	sea	1	2
6	Primorsko, Arkutino swamp	10	*Quercus* spp., *Acer campestre*	swamp		2
7	Primorsko, Ropotamo Reserve	10	*Quercus* spp., *Acer campestre*	river	10	18
24	Primorsko, Rerla residence	10–95	*Querceta freinetti* with Mediterranean elements	sea	1	1
30	Muselievo, Nanin kamuk cave	140	arable lands, *Quercus* spp., *Carpinus orientalis*	river	1	
26	Mladezko, Leyarnitzata N 4 cave	160	*Quercus cerris*, *Q. frainetto* with Mediterranean elements	river	3	
8	Karlukovo, caves, ridge	200	*Paliureta spina-christi*, *Quercus cerris*, *Q. frainetto*	river	5	4
9	Krivnya, Bozkova dupka cave	200	*Carpinus betulus*, *Q. cerris*, *Q. dalechampii*	river	1	
10	Buhovtsi, Prilepnata dupka cave	200	*Carpinus betulus*, *Q. cerris*, *Q. dalechampii*	lake	1	
21	Kresna, Kresna gorge	200	*Platanus orientalis*, *Alnus glutinosa*	river	2	
23	Ustrem, Bozkite cave	200	*Qurcus dalechampii*, *Carpinus orientalis*	river	2	
32	Golitsa, oak forest (*Q. cerris*)	300	*Querceta polycarpae*	river	4	
31	Dolno Cherkovishte, Sedemte peshteri-Oreshari cave	320	*Carpitneta orientalis* with Mediterranean elements	river river	1 2	
19	Ribino, Samara cave	340	*Carpitneta orientalis* with Mediterranean elements	river	2	
20	Lakatnik, Svinskata dupka cave	500	*Carpinteta orentalis*	river	1	
25	Brestnitza, Seeva dupka cave	500	*Carpinteta orentalis*	temp.	5	
4	Belogradchik, Gornata propast cave	600	*Quercus cerris*, *Q. freinetto*	none	1	
33	Gabrovnitsa, Sedemte prestola Mon.	650	*Fagus sylvatica moesiaca*	river		20
22	Golyama Jelyazna, Toplya cave	700	*Fagus sylvatica moesiaca*	river	1	
15	Divchovoto, Grazdenitza cave	800	*Fagus sylvatica moesiaca*	river	4	
11	Leshko, Leshtanskata peshtera cave	1000	*Quercus dalechampii* (+ *Carpinus orientalis*)	temp.	1	
12	Gorna Bela rechka, mine	1000	*Fageta sylvaticae*	river	1	
27	Ribnovo, Manoilovata peshtera cave	1000	*Pinus sylvestris*, *Fagus sylvatica*	river	2	
5	Yagodina, Yagodinska peshtera cave	1015	*Pinus sylvestris*, *Fagus sylvatica*	river	10	

13	Breze, Travninata cave	1050	*Carpineta orientalis* (+ *Fagus sylvatica*)	none	1	
14	Gintsi, Dinevata peshtera cave	1200	*Carpineta orientalis* (+ *Fagus sylvatica*)	river	1	
28	Kresna, Peshterata, mine	1250	*Fagus sylvatica moesiaca*	river	2	1
3	Samokov, Borovetz	1350	*Picea abies*, *Fagus sylvatica* (+ *Pinus sylvestris*)	river		
16	Karnare, Mazata cave	1350	*Fageta sylvaticae*	none	1	
17	Vidima, Vodnite dupki cave	1400	*Fageta sylvaticae*	river	23	1
18	Bov, Izdremets, mine	1450	*Fagus sylvatica moesiaca*, *Carpinus betulus*	lake	49	4
29	Ilindentsi, Sharaliiskata peshtera cave	1650	*Pinus heldreichi*, *P. sylvestris*	none	2	1

areas seasonally or permanently. Higher population density of Bechstein's bats in the lowlands was reported also from Switzerland (Zingg 1982), Germany (Kerth 1997, Weishaar 1996) and the Czech Republic (Červený & Bürger 1989). The high number of localities in the lowlands of Bulgaria does not correlate with the species abundance. Considering all captured bats (n= 196), the average number of individuals from the 22 localities below 1000 m a. s. l. is 4.3 specimens per site, versus 8.2 from 12 localities between 1000 m and 1650 m (Table 1).

Two male Bechstein's bats were caught and radio-tracked at the swarming site of Izdremets (loc. 18) at 1450 m in August and September. On the next day after capture, both were found to roost in beeches (*Fagus sylvatica*) at lower altitudes (630–680 m, loc. 33). These individuals thus migrated vertically about 770 m (2.7 km one way straight distance) for swarming and turned back to their roosts. These observations are the first that demonstrate short-distance vertical flights in the species.

The highest altitude at which *Myotis bechsteinii* was recorded in Bulgaria is 1650 m a. s. l. (loc. 29). The species (1 female, 2 males) was encountered at this location twice in three months. Other findings at comparable altitudes in central Spain (1500 m, Benzal & de Paz 1991), in the Swiss Alps at Montreux (1560 m, Chapuisat & Ruedi 1993), Jumelles (grotte au Tichodrome, 1750 m) (Arlettaz et al. 1993) indicate that the species can be occasionally found near the timberline. However in most of these high-altitude cases, bats probably went so high for swarming or feeding rather than for seasonal roosting. A skull was found at 1950 m (Pigna, cave No. F 7-813) in Italy (Liguria, Amelio 1973). Holocene findings of the Bechstein's bat in Austria in caves from 1800 m (Bauer & Walter 1977) up to 2100 m (Spitzenberger 2001) show its historic occurrence in this region. The subfossil Italian locality 'Pigna' together with the record from 2100 m in Austria are the highest ever recorded localities for *Myotis bechsteinii*.

Seasonal occurrence and wintering

The highest number of Bechstein's bats was captured in September, followed by August. At that time, 100 males were caught (i.e. 71% of all males reported in this study) versus only 12 females. The highest number of females was recorded in late April (19 ind.) and in early June (16 ind.) due to the discovery of three breeding colonies (Loc. No. 7, 33) found by radio-tracking of female bats. Bechstein's bats were caught only twice in July (1950, 1997), though at the

locality No. 7 mistnetting in the forest was performed for 10 nights in 2002 and no Bechstein's bats were captured.

It is worth mentioning that since 1935, only two specimens have been found to hibernate in caves (loc. 4: 6 February 1960, loc. 22: 2 February 1997). Both were male and were found in crevices in the wall near the entrance. Only one of those records comes from the last ten years even though bat research in the country has been relatively intensive during this period. *Myotis bechsteinii* has never been observed during recent winter censuses of bats in numerous caves (about 60), mines (about 10) and other underground roosts, which host hibernating colonies of various vespertilionid species (cf. Benda et al. 2003).

Habitat and roost preferences

Forests and scrubs dominated mainly by *Quercus* spp., *Carpinus* spp. and occasionally by *Platanus orientalis* cover all lowland localities (i.e. 0–600 m) where the species was found in Bulgaria. In many cases (e.g. loc. 13, 17, 18, 28) the Bechstein's bats were not caught in a roost but at a swarming site. Thus our knowledge on the preferred habitats is biased by the seasonal activity patterns.

Oak and oriental plane forests offer relatively thick trees and Bechstein's bats are thought to occupy mostly tree holes and crevices (cf. von Helversen & Weid 1990). Findings of the Bechstein's bat in the *Carpinus* forests, where suitable trees are much less common could suggest that the species uses alternative roosts such as caves, mines, bunkers, tunnels, rock fissures, etc. Male specimens were occasionally recorded in a crevice between bricks of a rocky bridge (loc. 19) and in a rock crevice (loc. 31).

Roosts of male Bechstein's bats and two breeding colonies have recently been found in tree holes (2001–2006, Petrov & Kerth, new records). In the lowland forest of the Ropotamo Reserve, most of the used roosts were discovered in the common maples (*Acer campestre*) and rarely in *Quercus cerris* or *Q. polycarpa*. In the area of the Sedemte Prestola monastery (western Stara Planina Mts.), where the third breeding colony was found, all roosts were in beeches (*Fagus sylvatica*), though oak trees were also present. Single individuals were found in shallow cavities in relatively slender trees (DBH = 13–20 cm) at the height of 0.7–5 m above the ground (Table 4). Roosting groups (5–55 ind.) were found in thicker trunks (DBH = 40–55 cm) at the height of 5–10 m above the ground. A colony of 55 individuals has recently been observed emerging at dusk in this region but none of the bats was captured and included in the present analysis. This colony however is the largest known so far from the southeastern Europe.

Bechstein's bats were found only once (4 June 2002) in a bat box (Schwegler 2FN) in the Ropotamo Reserve. The two individuals were the first bats found in a bat box in Bulgaria, only a year after the boxes were installed. Since then no Bechstein's bats have been found in the boxes (n=55) at this site but temporal roosting seems possible at times when no census was made.

The majority of the capture sites were situated next to a permanent water body: river (n=23), sea (n=2), lake (n=2) and swamp (n=1). Only few of the localities lacked water (n=4) or had only temporal water sources (n=2) (Table 3).

Climatic features of the localities: In Bulgaria, *Myotis bechsteinii* was found at sites with high average diurnal temperature during summer (22–25 °C) and very little annual precipitation (550 mm and lower) (loc. 21, 23), as well as at sites with low summer diurnal temperature (12–16 °C) and heavy precipitation (1000 mm and higher) (loc. 5, 17). Abundance was higher at the latter sites, where temperatures are moderate and the climate is clearly humid throughout the year.

Table 4. Tree roosts of the Bechstein's bat (*Myotis bechsteinii*) in Bulgaria (2001–2006). CF – circumference of the trunk [cm]; DBH – trunk diameter at breast height [cm]; DG – distance to the ground [m]
Tab. 4. Stromové úkryty netopýra velkouchého (*Myotis bechsteinii*) v Bulharsku (2001–2006). CF – obvod kmene [cm]; DBH – průměr kmene ve výši prsou [cm]; DG – vzdálenost od země [m]

site date	tree species	CF	DBH	DG	number of bats
Ropotamo (7)					
13 September 2001	*Acer campestre*	44	14	3.0	1 male
18 April 2002	*Quercus cerris*	78	25	1.5	1 male
20 April 2002	*Acer campestre*	62	19	1.6	1 male
22 April 2002	*Acer campestre*	48	15	2.5	1 male
23 April 2002	*Acer campestre*	40	13	0.7	1 male
26 April 2003	*Quercus polycarpa*	170	54	9.0	6 females
27 April 2003	*Acer campestre* (dead trunk)	121	39	6.0	1 female
28 Sept. 2003	*Acer campestre*	76	24	3.5	1 male
15 June 2004	*Carpinus betulus*	161	51	2.5	11 females
Monastery (33)					
September 2001	*Fagus sylvatica*	95	30	3.5	1 male
9 May 2003	*Fagus sylvatica*	131	42	5.0	5 females
16 April 2006	*Fagus sylvatica*	87	28	5.0	10 females
17 April 2006	*Fagus sylvatica*	153	49	10.0	1 female
18 April 2006	*Fagus sylvatica*	139	44	8.0	55 individuals

Capture methods

Almost all specimens reported during the last 30 years in Bulgaria were caught using mistnets at cave and mine entrances. Captures at cave mouths (20 cases) make up the majority of the samples. The highest abundance of male bats was found during the swarming season (late summer and early autumn), while mistnetting at caves and mines in old growth mesophile mountain forests (e.g. loc. 17, 18).

In the recent years (after 2001), females from several breeding groups/colonies have been caught at tree holes using a funnel trap. When the latter was set well, almost no escapes were observed. Captures with bare hands happened only occasionally. Bechstein's bat has been found killed on the road only once in Bulgaria (Loc. No. 21), though many other species (some of them in high numbers) have been found in a road mortality survey in the Kresna gorge (SW Bulgaria, B. Petrov, unpubl.). The highest capture success of mistnetting in forests was proved when the net was set above a stream or shallow riverbed. In the latter case, captures of males were slightly prevailing (9 males, 7 females, loc. 7, 24, 33, and 34) compared to strongly male dominated catches at the swarming sites (see below).

DISCUSSION

Few studies on *Myotis bechsteinii* provide detailed data on the vegetation and habitat type in the surroundings of its roosts. The existing data suggest that this bat is a typical inhabitant of the old growth forests in western Europe (Kerth 1997, Schlapp 1990). In central parts of the continent, the Bechstein's bat also occurs in open river valleys with groves in their vicinity,

and in small woodland patches, which alternate with arable and parklands (Červený & Bürger 1989, Harmata 1969). In southern Europe, *Myotis bechsteinii* was found in more or less dense xerophile forests of the Mediterranean type in Portugal and Spain (Benzal & de Paz 1991), Greece (Hanák et al. 2001, von Helversen & Weid 1990) and Corsica (Libois & Franken 1981). In Bulgaria, the habitats vary with altitude, ranging from dry mixed lowland oak forests to humid mountain beech and mixed coniferous woodlands. As Bechstein's bats feed mostly on non-airborne invertebrates and water independent flying insects (Dondini & Vergari 1999b, Krochko 1990, Wolz 1993), the presence/absence of water (streams, lakes, etc.) probably does not restrict the species distribution. On the other hand, water availability favours insect diversity, which is presumed to promote the occurrence of bats.

The Bechstein's bat is known as a non-migratory species. Most local movements cover less than 10 km and the females exhibit extreme philopatry (Kerth et al. 2000, 2002). The longest known dispersal flights reach 39 km (Haensel 1991), 43 km (Rudolf et al. 2004) and exceptionally up to 60 km (Kerth & Petit 2005). The maximum flights proved so far by radiotracking in Bulgaria are between 2 and 3 km (loc. 7, 18, 24, and 33).

At the swarming sites with the highest capture rate in Bulgaria, more males than females were captured. At loc. 17 only one of the 24 specimens was a female (4.2%). At loc. 18, only 4 out of 54 specimens were females (7.5%). This could indicate higher mobility or longer dispersal flights of the males during the pre- and postmating period compared to the females (cf. Kerth et al. 2003).

The high number of records in late summer probably reflects both the bat research activity, which usually is at its maximum during these months, and the fact that the intensity of bat swarming at caves and mines is highest during this period. The latter was proved in many countries (cf. Parsons et al. 2003, Kerth et al. 2003), including Bulgaria (cf. Schunger et al. 2004).

The scarce winter records of *Myotis bechsteinii* in Bulgaria suggest that the species rarely uses underground roosts in this part of its life cycle. In the Czech Republic (Šumava Mts.), Bechstein's bats were frequently found to hibernate in caves and galleries only during harsh winters (Červený & Bürger 1989). In Great Britain, more records of this bat from underground sites have been reported during severe winters (Harrington et al. 1995).

Findings of the Bechstein's bat all over Europe are relatively rare compared to records of the other species of the continental bat fauna (Baagøe 2001). Many of the recent peripheral localities remain isolated from each other and presumably some marginal populations could become allopatric. Only in a few regions of Central Europe (e.g. parts of Germany and the Czech Republic) it occurs in higher population density and substantial signs of a dramatic decline are not yet recognised (Červený & Bürger 1989, Kerth 1997, Schlapp 1990, Weishaar 1996). In Bulgaria, the Bechstein's bat ranks among the common bat species with a continuous distribution in regions with larger forest coverage (e.g. Strandja Mts. along the Black Sea coast). On the other hand, only single individuals were caught in majority of the other sites. At present, the species could be considered "rare but locally common" with regard to distribution and "vulnerable" with regard to its environmental sensitivity and low colonisation abilities.

Subfossil evidence from Austria (Bauer & Walter 1977, Rabeder 1972, Spitzenberger 2001), Great Britain (Yalden 1999), Bulgaria (Popov 2000), Czech Republic (Kowalski 1962), Hungary (Topál 1959), France (Mein 1975, Sevilla 1990), Italy (Kotsakis & Petronio, 1980), Poland (Kowalski 1956, Ochman 1999), Spain (Sevilla 1989) and Ukraine (Krochko 1990) show that *Myotis bechsteinii* was one of the most common bat species in the Pleistocene and Early Holocene deposits. Milder, humid climate and the presence of continuous deciduous wo-

odlands all over the continent and particularly in Bulgaria presumably favoured this abundance especially during the Interpleniglacial and the Early Holocene (Peshev et al. 2004). Since then the climate has changed many times and forests were cut in vast regions including clearance of deciduous woodlands in Europe during the post-Neolithic (Yalden 1999). This probably led to the present fragmentation of the species range and population decline.

One possible reason of the current rarity of the Bechstein's bat in most parts of Europe may be the limited distribution and size of old growth forests as well as their low connectivity. Deforestation and unsustainable forest management practices led to a reduction of roost availability, which seems to be the most important environmental factor for the species occurrence (Harrington et al. 1995, Hutson et. al. 2001). Another possible reason could be the concentration of bat research activities, which are not evenly spread over the species range. Although the research coverage varies from year to year, it probably plays a significant role in accuracy of the population assessments at local and national level.

The Bechstein's bat is protected by law in at least 31 of the European countries, which have joined the EUROBATS agreement, including Bulgaria. Considering the global fragmentation of forest habitats preferred by the species, its low population density and poor dispersal abilities, *Myotis bechsteinii* was also classified as a "vulnerable" species in the new edition of the Bulgarian Red Data Book (Petrov in press). Because of its sedentary life style, a "colony-orientated" conservation approach was suggested in Germany (Meschede & Heller 2000). Bat box projects in Europe, e.g. in Italy (Dondini & Vergari 1999a), Germany (Kerth 1997, Taake & Hildenhagen 1989), United Kingdom (Schofield et al. 1997) and recently in Bulgaria (Petrov & Kerth, unpublished) proved that *Myotis bechsteinii* is among the first bat species, which occupy these artificial shelters, especially those that resemble woodpecker's holes (e.g. 2 FN Schwegler's boxes). Furthermore, restoration and planting of new forest clearings will contribute to the connectivity of suitable habitats and thus to spreading of the Bechstein's bat at least in the centre of its range.

SOUHRN

První nález *Myotis bechsteinii* v Bulharsku pochází z roku 1935 a od té doby bylo zaznamenáno celkem 55 samic, 141 samců a dva jedinci neznámého pohlaví, avšak do současné doby byly v Bulharsku nalezeny jen tři mateřské kolonie. Netopýr velkouchý je znám z Bulharska z celkem 34 lokalit (33 čtverců UTM) ležících v nadmořské výšce od hladiny moře po 1650 m. Jen dva jedinci (samci) byli dosud nalezeni zimující v jeskyních, jiné nálezy ze zimovišť nejsou známy. Většina lokalit leží ve výšce do 300 m n. m., nejvyšší počet jedinců byl ale zaznamenán v horských bukových a smíšených lesích ve výšce mezi 800 a 1450 m n. m. V průběhu "swarmovacího" období byly zaznamnány vertikální migrace o zhruba 770 m mezi denním úkrytem a místem odchytu. *Myotis bechsteinii* byl doložen z pleistocénních a spodnoholocénních vrstev dvou jeskyní v Bulharsku, ovšem v těchto údobích představoval jednoho z nejhojnějších a nejběžnějších netopýrů. Ochrana původních lesních porostů (tj. udržitelné lesnické hospodaření), udržování jejich propojení a obnova hospodářských lesů jsou faktory v současné době nejvíce považovány za nezbytné pro ochranu druhu v Bulharsku.

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