TÜBİTAK

Research Article

Turk J Zool
2011; 35(3) 357-365
© TÜBİTAK
doi:10.3906/zoo-0803-4

Taxonomic status of *Myotis myotis* (Borkhausen, 1797) and *Myotis blythii* (Tomes, 1857) in Turkey (Mammalia: Chiroptera)*

Nursel AŞAN**, İrfan ALBAYRAK

University of Kırıkkale, Faculty of Science and Arts, Department of Biology, 71451 Yahşihan, Kırıkkale - TURKEY

Received: 07.03.2008

Abstract: Morphometrical, biological, ecological, and karyological data of 156 *Myotis myotis* and 149 *M. blythii* specimens collected from various provinces of Turkey between 1974 and 2007 were evaluated. Specimens from Turkish Thrace were referred to as *M. m. myotis* and the Mediterranean part as *M. m. macrocephalicus.* Specimens from the rest of Anatolia were assigned to an intermediate form. Due to a steady increase in body and cranial size detected in *Myotis blythii* from western to eastern Anatolia, we did not assign a subspecific name for the *M. blythii* populations in Turkey. In addition, body and cranial measurements of this species lie between those given for the smaller subspecies *M. b. oxgnathus* from Europe and the larger *M. b. omari* from the Near East and the Middle East. In both species, the karyotype was similar to that of the other *Myotis* species having a 44 chromosome with a NFa 50. The X chromosome was a medium-sized metacentric while the Y was a minute acrocentric.

Key words: *Myotis myotis, Myotis blythii,* taxonomy, karyology, Turkey

Türkiye'deki *Myotis myotis* (Borkhausen, 1797) ve *Myotis blythii* (Tomes, 1857) türlerinin taksonomik durumu (Mammalia: Chiroptera)

Özet: Türkiye'nin çeşitli illerinden 1974 ila 2007 yılları arasında toplanan 156 *Myotis myotis* ile 149 *M. blythii* örneklerinin morfometrik, biyolojik, ekolojik ve karyolojik verileri değerlendirilmiştir. Türk Trakya'sından alınan örnekler *M. m. myotis*'e, Akdeniz bölgesinden alınan örnekler *M. m. macrocephalicus*'a, Anadolu'nun geri kalanındaki örnekler ise bir ara forma atfedilmiştir. *M. blythii*'nin vücut ve kafatası ölçülerinde batıdan doğuya doğru gidildikçe değişmeyen bir artış tespit edildiğinden, Türkiye'deki populasyonlarına bir alttür ismi atfedilmedi. Ayrıca, bu türün vücut ve kafatası ölçüleri Avrupa'daki küçük *M. b. oxgnathus* ile Yakın ve Orta Doğu'daki büyük *M. b. omari* alttürleri için verilen değerler arasında kalmaktadır. Her iki türün karyotipleri 44 kromozoma sahip ve NFa'nın 50 olmasıyla diğer *Myotis* türleri ile benzerdir. X kromozomu orta boylu bir metasentrik Y kromozomu ise küçük akrosentriktir.

Anahtar sözcükler: *Myotis myotis, Myotis blythii*, taksonomi, karyoloji, Türkiye

* This study is a part of the PhD thesis of Nursel AŞAN.

** E-mail: nurselasan@yahoo.com

Introduction

Myotis is one of the most diverse genera, represented by 103 species in the Holoarctic region (Simmons, 2005; Stadelmann et al., 2007). Of these, the taxonomic status and distributions of 2 cryptic taxa, *Myotis myotis* (Borkhausen, 1797) and *Myotis blythii* (Tomes, 1857), are still unclear and controversial. The greater mouse-eared bat, *M. myotis*, originated in the western Mediterranean, is distributed from central, eastern, and southern Europe (being extinct in the British Isles, Iceland, and most of Scandinavia), Asia Minor, south-western Ukraine to Syria, Israel, Lebanon, and Palestine, while the lesser mouse-eared bat, *M. blythii*, which originated from Asia, has a longer distributional range from southern and central Europe, Asia Minor, Cyprus, Israel, the Near East, Iran, Iraq to Crimea, Transcaucasia, central Asia, the Himalayas, Mongolia, India, and China and on Sicily, Crete, and many Greek islands (Benda and Horacek, 1998; Mitchell-Jones et al., 1999; Dietz and Helversen, 2004; Simmons, 2005; Benda et al., 2006; Benda et al., 2007).

The identities of the 2 cryptic mouse-eared bats have been taxonomically, karyologically, and genetically evaluated by various authors in the Palearctic region (Strelkov, 1972; Baker et al., 1974; Felten et al., 1977; Bickham and Hafner, 1978; Zima, 1978, 1979; Iliopoulou-Georgudaki and Giagia, 1984; Zima and Horacek, 1985; Benda and Horacek, 1995a, 1995b; Spitzenberger 1996; Albayrak and Aşan, 1998; Benda and Horacek, 1998; Castella et al., 2000; Karataş et al., 2004; Berthier et al., 2006). Strelkov (1972), Felten et al. (1977), and Bogan et al. (1978) referred to the North African populations as *Myotis blythii punicus*; however, Arlettaz et al. (1997), and Benda and Horacek (1995a) evaluated it as *M. myotis punicus*. Castella et al. (2000) identified a new species, *Myotis cf. punicus* (Felten, 1977) (Maghrebian bat), distributed in northern Africa and on the islands of Corsica, Sardinia, Malta, and Gozo. This species clearly differs in size and ecology, from both *M. myotis* and *M. blythii*. In contrast, recently Shehab et al. (2007) included the north-western Africa population in the distributional range of *M. blythii*.

Spitzenberger (1996) reported that *Myotis myotis* preferred the moderate temperature climate and humidity of the Mediterranean and Black Sea regions, while *M. blythii* was widespread in semiarid Eastern and South-eastern Anatolia. However, both species occurred sympatrically in Central Anatolia, which has a temperate and arid climate (Aşan et al., 2010). To date, many authors have mentioned that the subspecies *M. m. myotis* and *M. m. macrocephalicus* as well as *M. b. oxygnathus* and *M. b. omari* do occur in Turkey (Strelkov, 1972; Felten et al., 1977; Harrison and Bates, 1991; Steiner and Gaisler, 1994; Benda and Horacek, 1995a, 1995b; Spitzenberger, 1996; Albayrak and Aşan, 1998; Benda and Horacek, 1998). Recently, *macrocephalicus* has been treated as a synonym by Simmons (2005).

The aim of this study was to make a contribution to the distribution and taxonomic status of *Myotis myotis* and *M. blythii* in Turkey.

Materials and methods

Localities and number (n) of the specimens examined:

***Myotis myotis* (88 ♂♂, 68 ♀♀):** Edirne (41°50′N, 26°43′E) (n = 12 ♀♀, 1 ♀), Eskişehir (39°45′N, 30°57′E) (n = 12 ♂♂), Ankara (40°05′N, 33°24′E) (n = 6 ♂♂, 23 ♀♀), Konya (39°35′N, 30°37′E) (n = 3 ♂♂), Nevşehir (38°22′N, 34°44′E) (n = 1♂), Niğde (37°59′N, 34°46′E) (n = 2 ♂♂), Antalya (36°53′N, 30°40′E) (n = 2 ♂♂, 4 ♀♀), Sinop (41°27′N, 34°46′E) (n = 4 ♀), Mersin (36°55′N, 34°54′E) (n = 4 ♂♂, 4 ♀♀), Amasya (40°52′N, 35°27′E) (n = 1 ♂), Adana (37°00′N, 35°18′E) (n = 5 ♂♂), Hatay (36°13′N, 36°12′E) (n = 23 ♂♂, 2 ♀), Kahramanmaraş (37°35′N, 36°55′E) (n = 4 ♂♂, 2 ♀♀), Tokat (40°13′N, 36°17′E) (n = 2 ♂♂, 4 ♀♀), Ordu (40°58′N, 37°49′E) (n = 3 ♂♂, 15 ♀♀), Diyarbakır (38°08′N, 39°27′E) (n = 4 ♂♂, 3 ♀♀), Batman (37°42′N, 41°24′E) (n = 3 ♂♂), Artvin (41°07′N, 42°03′E) (n = 1 ♂, 6 ♀♀).

***Myotis blythii* (68 ♂♂, 81 ♀♀):** Kırklareli (41°44′N, 27°13′E) (n = 2 ♂♂, 1 ♀), Edirne (41°50′N, 26°43′E) (n = 2 ♂♂), İzmir (38°04′N, 27°01′E) (n = 3 ♂♂, 1 ♀), Balıkesir (39°39′N, 27°52′E) (n = 2 ♂♂), Kütahya (39°25′N, 29°59′E) (n = 2 ♂♂, 1 ♀), Bolu (40°27′N, 31°12′E) (n = 1 ♀), Eskişehir (39°45′N, 30°57′E) (n = 1 ♂), Ankara (40°05′N, 33°24′E) (n = 4 ♂♂, 5 ♀♀), Konya (39°35′N, 30°37′E) (n = 2

♂♂, 1 ♀), Niğde (37°59′N, 34°46′E) (n = 2 ♂♂, 1 ♀), Antalya (36°53′N, 30°40′E) (n = 1 ♀), Mersin (36°55′N, 34°54′E) (n = 2 ♂♂, 2 ♀♀), Hatay (36°13′N, 36°12′E) (n = 26 ♀♀), Tokat (40°13′N, 36°17′E) (n = 9 ♀♀), Ordu (40°58′N, 37°49′E) (n = 2 ♀♀), Trabzon (41°00′N, 39°43′E) (n = 1♀), Artvin (41°07′N, 42°03′E) (n = 1 ♀), Adıyaman (37°45′N, 38°16′E) (n = 2 ♂♂), Siirt (37°55′N, 41°56′E) (n = 1♀), Bitlis (38°23′N, 42°06′E) (n = 3 ♂♂), Diyarbakır (38°08′N, 39°27′E) (n = 4 ♂♂), Erzincan (39°46′N, 40°23′E) (n = 11 ♂♂, 10 ♀♀), Erzurum (39°57′N, 41°46′E) (n = 3 ♂♂), Elazığ (38°40′N, 39°13′E) (n = 1 ♂, 1 ♀), Muş (38°43′N, 41°29′E) (n = 12 ♂♂, 4 ♀♀), Van (38°39′N, 43°20′E) (n = 10 ♂♂, 12 ♀♀).

This study is based on morphometric, biological, ecological, and karyological data of 156 *Myotis myotis* and 149 *M. blythii* specimens caught by Japanese mist net, aerial trap, and hand from various provinces in Turkey between 1974 and 2007. For every specimen, sex, age, and reproductive status were recorded. The specimens were divided into 3 categories (juvenile, young, and adult) according to the criteria reported by Baagøe (1977). External and cranial measurements along with the weight of the specimens were taken with a digital dial calliper (with greatest accuracy up to 0.01 mm) according to Harrison and Bates (1991). Only external and cranial measurements of male and female adult specimens are given in tables and were used in morphometric evaluations. Statistical analyses were performed using SPSS 11.5 (SPSS Inc., Chicago, IL, USA). Results that yielded $P < 0.05$ were considered statistically significantly different (Campbell, 1990).

Karyological analysis was performed according to Baker et al. (1982). The slides were stained in 4% Giemsa-phosphate solution for 10 min. A total of 7 slides were prepared for each specimen and at least 10 well stained metaphase spreads were analysed. Diploid chromosome number (2n) and fundamental autosomal number (NFa) were detected. The centromeric index of the chromosomes was calculated according to Müdespacher-Ziehl et al. (2005).

Karyotype preparations, skulls, and the specimens skinned and stuffed according to the standard museum type are deposited at the Department of Biology, Kırıkkale University.

Results

Myotis myotis (Borkhausen, 1797)

This is a common bat in Turkey. No differences were determined with respect to ecological, biological, or karyological characteristics between the *Myotis myotis* specimens collected.

Habitat: *Myotis myotis* prefers natural and anthropogenic roosts and occurred sympatrically with *M. blythii*, *Miniopterus schreibersii*, and *Rhinolophus mehelyi* in the ceilings and crevices on the walls of caves, hans, ruins, tunnels, castles, and deep wells.

Pelage colour: Dorsal colour of adult specimens was pale greyish brown and ventral colour was greyish dirty yellow.

Measurements: External and cranial measurements along with weight of 123 adult *Myotis myotis* specimens are given in Table 1.

Myotis myotis is represented by 2 subspecies in Turkey: *M. m. myotis* and *M. m. macrocephalicus* Harrison and Lewis, 1961. Morphometric data of specimens from Antalya, Mersin, Adana, and Hatay are significantly greater than those of specimens from Edirne, in Turkish Thrace, in terms of forearm length, greatest length of skull, condylobasal length, zygomatic breadth, mastoid breadth, maxillary toothrow length, mandibulary toothrow length, and mandible length. Therefore, the specimens from Turkish Thrace are referred to as the nominate subspecies, *M. m. myotis,* and those from the Mediterranean part as *M. m. macrocephalicus.* Body and cranial measurements of the specimens from the rest of Anatolia (Eskişehir, Ankara, Konya, Nevşehir, Niğde, Kahramanmaraş, Sinop, Tokat, Amasya, Ordu, Diyarbakır, and Artvin) lie between those of *M. m. myotis* and *M. m. macrocephalicus.* Consequently, these specimens are assigned to an intermediate form (Figure 1).

We also determined differences in the measurements of condylobasal length, zygomatic breadth, maxillary toothrow length, and mandible length of *Myotis myotis* from Turkey. The significance values are $P < 0.05$; therefore, the specimens from Turkish Thrace, the Mediterranean region of Turkey, and the rest of Anatolia are significantly different with respect to the mandible length, F (2, 121) =

Table 1. External and cranial measurements (mm) with weight (g) of male and females specimens of *Myotis myotis* (n = number of specimens, s = standard deviation).

	males				**females**			
Measurements	n	range	mean	s	n	range	mean	s
Total length	68	123.0-148.0	138.9	5.05	41	126.0-148.0	138.4	5.41
Tail length	68	46.0-58.0	50.6	2.87	42	44.0-60.0	52.8	4.03
Hind foot length	67	15.0-18.0	17.2	0.62	42	12.0-19.0	17	1.24
Ear length	65	17.0-31.0	27.2	1.93	42	21.0-30.0	27.3	2.01
Forearm length	49	55.9-65.0	60.9	2.15	24	57.0-66.5	62.2	2.15
Tibia length	28	20.2-24.8	23.2	1.07	9	22.0-23.8	23.3	0.54
Greatest length of skull	69	22.6-26.8	25.5	0.80	49	24.2-26.8	25.4	0.48
Total length of skull	70	22.1-26.1	24.7	0.76	52	23.6-26.1	24.7	0.46
Condylobasal length	69	20.9-24.9	23.6	0.73	53	22.7-24.8	23.6	0.45
Zygomatic breadth	68	13.6-16.5	15.6	0.51	53	15.1-16.1	15.6	0.25
Interorbital constriction	70	5.0-5.6	5.2	0.15	53	4.9-5.5	5.1	0.13
Breadth of braincase	70	9.7-11.4	10.7	0.39	53	9.9-11.3	10.4	0.43
Mastoid breadth	64	10.2-11.8	11.1	0.26	53	10.4-11.7	11.1	0.26
Height of skull	58	9.3-11.3	10.2	0.34	42	9.5-10.7	10.1	0.32
C-M^3	66	8.8-11.6	10.5	0.39	49	10.0-11.1	10.4	0.23
C-M_3	64	9.8-11.9	11.3	0.38	50	10.7-11.8	11.2	0.25
Mandible length	67	16.8-20.3	19.3	0.62	50	18.5-20.2	19.2	0.36
Weight	66	21.0-35.0	27.4	3.31	43	20.0-38.5	27.3	4.77

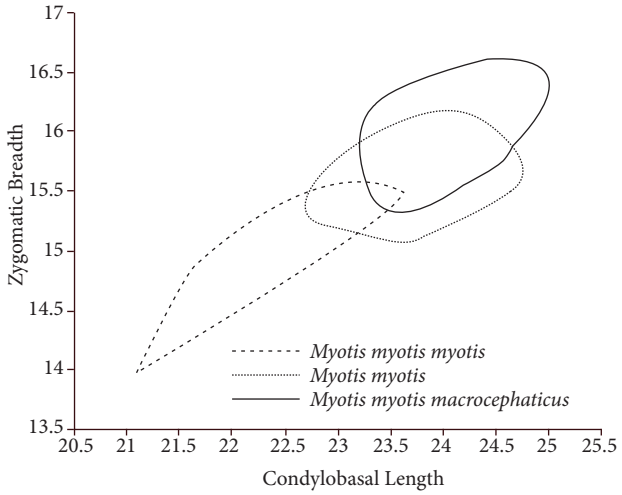

Figure 1. Scatter diagram of zygomatic breadth (n = 116) against condylobasal length of skull (n =116) of *Myotis myotis* from Turkey.

82.45, $P < 0.05$ as well as zygomatic breadth, and condylobasal and maxillary toothrow length.

Karyology: In all specimens studied, 2n and NFa were 44 and 50, respectively. The chromosome set consisted of 3 large pairs and 1 small pair of metacentrics, and 17 pairs of acrocentrics ranging in size from medium to small. The largest acrocentric pair possessed a tiny heterochromatic arm. The X was a medium-sized metacentric and the Y a minute acrocentric (Figure 2).

In the karyotypes of all specimens representing *Myotis myotis* populations in Turkey we did not encounter any differences with respect to the shape of the chromosomes. However, in the long arms of the largest acrocentric pair, a secondary constriction near the centromere was encountered in specimens

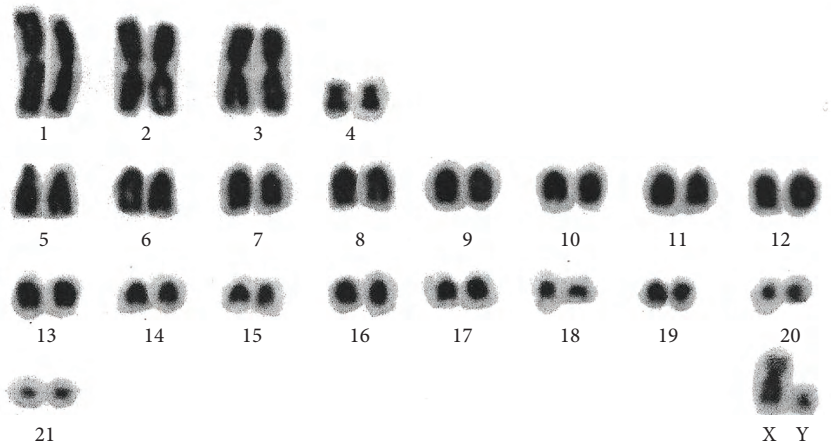

Figure 2. Karyotype of a male *Myotis myotis.*

from Artvin and Hatay provinces only. In addition, in a specimen captured from Edirne province only, a biarmed dot-like chromosome pair was clearly pronounced.

***Myotis blythii* (Tomes, 1857)**

This is also a common bat in Turkey. Again no differences were determined with respect to ecological, biological, and karyological characteristics between the *Myotis blythii* specimens collected.

Habitat: *Myotis blythii* existed sympatrically with *M. myotis*, *Miniopterus schreibersii*, and *Rhinolophus mehelyi* in caves, ruins, bridges, mine galleries, hans, Turkish hamams, tunnels, castles, and deep wells.

Pelage colour: Dorsal colour of adult specimens varies from greyish brown tinged yellow to grey tinged dark brown. Ventral colour varies from very slightly dirty white to greyish white. In some examined specimens, a whitish tuft of hairs between the ears is encountered (Figure 3).

Measurements: External and cranial measurements along with weight of 86 adult *Myotis blythii* specimens are given in Table 2.

A steady increase in the morphometric data of *Myotis blythii* specimens was detected from west to east (Figure 4).

Specimens from the western part of Turkey were significantly different from those from the central and eastern parts of Turkey with respect to the mandible length, F (2, 98) = 35.31 $P < 0.05$, as well as zygomatic breadth, and condylobasal and maxillary toothrow length. However, specimens from central and eastern Turkey did not differ ($P > 0.05$). Therefore, we did not decide to assign subspecific names for the *M. blythii* populations in Turkey without any molecular studies on this species.

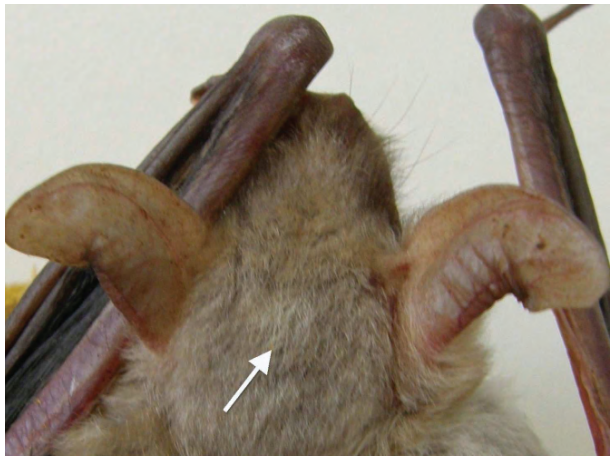

Figure 3. Whitish tuft of hairs between the ears of *Myotis blythii* from Kırıkkale province.

Karyology: The karyotype of *Myotis blythii* is identical to that of *M. myotis*. A clear secondary constriction near the centromere was encountered in the largest acrocentrics in all metaphases of one specimen obtained from Ankara province. Furthermore, in a female specimen obtained from Tokat province, the long arm of one of the X chromosomes was longer than that of the other X

Table 2. External and cranial measurements (mm) with weight (g) of male and females specimens of Myotis blythii (n = number of specimens, s = standard deviation).

	males				**females**			
Measurements	n	range	mean	s	n	range	mean	s
Total length	52	125.0-146.0	136.5	5.0	27	128.0-149.0	137.7	5.25
Tail length	52	47.0-61.0	53.0	3.1	27	48.0-61.0	54.1	3.94
Hind foot length	52	14.0-18.0	16.6	0.91	27	12.0-19.0	16.4	1.31
Ear length	53	20.0-28.0	23.7	1.79	28	19.0-28.0	24.0	1.77
Forearm length	51	51.8-58.4	55.2	1.57	22	55.1-60.2	57.6	1.68
Tibia length	31	21.9-24.6	23.4	0.64	18	22.0-25.3	23.7	0.93
Greatest length of skull	52	21.9-23.7	22.8	0.41	31	21.5-23.5	22.6	0.45
Total length of skull	55	21.2-22.9	22.1	0.44	31	20.8-22.8	22.0	0.48
Condylobasal length	55	19.9-21.8	21.1	0.41	31	19.8-21.9	20.9	0.46
Zygomatic breadth	54	13.4-14.8	14.2	0.33	30	13.3-14.9	14.0	0.39
Interorbital constriction	53	5.1-5.7	5.3	0.17	30	4.8-5.8	5.2	0.20
Breadth of braincase	55	9.7-10.7	10.2	0.22	30	9.3-10.7	10.0	0.35
Mastoid breadth	53	9.9-10.8	10.3	0.20	28	9.8-10.9	10.2	0.29
Height of skull	45	8.7-10.1	9.4	0.26	24	8.8-9.9	9.3	0.28
C-M^3	54	8.9-9.6	9.2	0.19	30	8.7-9.6	9.1	0.25
C-M_3	53	9.4-10.3	9.9	0.24	31	9.4-10.3	9.8	0.23
Mandible length	54	16.4-17.9	17.2	0.35	31	16.2-18.0	17.1	0.39
Weight	49	17.5-31.0	23.8	3.01	25	20.0-32.0	25.4	3.54

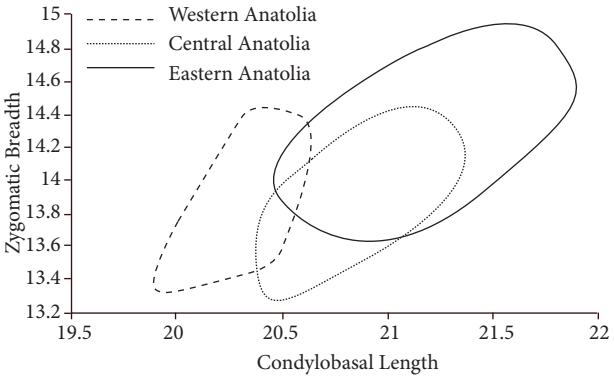

Figure 4. Scatter diagram of zygomatic breadth (n = 115) against condylobasal length of skull (n = 115) of *Myotis blythii* from western (---- Edirne, Kırklareli, Balıkesir, İzmir, Kütahya, Eskişehir, Bolu and Antalya provinces), central (... Konya Ankara, Niğde, Mersin, Tokat, and Hatay provinces) and eastern (– Ordu, Trabzon, Artvin, Adıyaman, Erzincan, Diyarbakır, Elazığ, Erzurum, Muş, Bitlis, Siirt, and Van provinces) parts of Anatolia.

(heteromorphic). In a specimen caught in Antalya province only, a biarmed dot-like chromosome pair was clearly pronounced (Figure 5).

Discussion

To date, *Myotis myotis* has been recorded from different parts of Turkey by various authors (Kahmann and Çağlar, 1960; Harrison and Lewis, 1961; Strelkov, 1972; Felten et al., 1977; Albayrak, 1990, 1993, 2003; Steiner and Gaisler, 1994; Spitzenberger, 1996; Albayrak and Aşan, 1998; Benda and Horacek, 1998; Karataş et al., 2004; Benda et al., 2006). Harrison and Lewis (1961) reported that an intermediate form between the subspecies *M. myotis myotis* and *M. myotis macrocephalicus* occurred in the Balkans and Asia Minor. Kahmann and Çağlar (1960) and Harrison (1964) included Hatay province in the distribution area of *M. myotis macrocephalicus*. Felten et al. (1977)

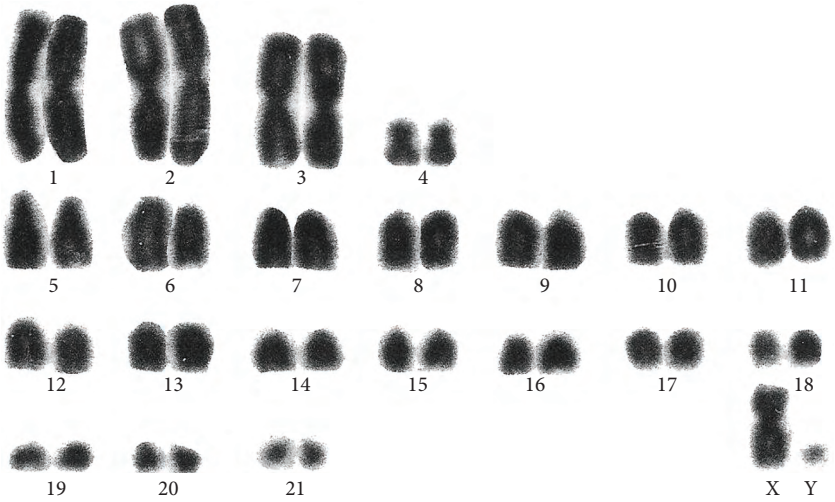

Figure 5. Karyotype of a male *Myotis blythii*.

stated that the subspecies *macrocephalicus* existed in western and probably in eastern Anatolia. Albayrak and Aşan (1998) determined that the distribution areas of *M. m. myotis* and *M. m. macrocephalicus* were not definite; according to them, measurements of the specimens from Edirne were similar to those of the nominate form, while specimens from the Mediterranean region were similar to *M. m. macrocephalicus*. In addition, Benda and Horacek (1995a, 1995b) described a cline increase in cranial and body size from west to east in Europe.

Spitzenberger (1996) stated that Diyarbakır is the easternmost documented record of *M. myotis*. According to the author, Satunin did not distinguish *M. blythii* from Aralık, Iğdır (39°52′N, 44°31′E) in 1913 and named the specimen erroneously as *M. myotis*. Benda and Horacek (1998) stated that *M. myotis* did not exist to the east of the Rize-Erzurum-Diyarbakır-Antakya line. In addition, Benda et al. (2006) enlarged the distribution range of this species to an approximate line, Artvin-Diyarbakır-Şanlıurfa. We recorded *Myotis myotis* from Hasankeyf district, Batman province, in 2007. Therefore, *M. myotis* has enlarged its distribution to the Artvin-Erzurum-Batman-Şanlıurfa line (Aşan et al., 2010).

In the present study, comparing the morphometric data of mouse-eared specimens collected from Artvin with those of *M. myotis* and *M. blythii,* it was determined that measurements of these specimens laid within the variation range of *M. myotis* as stated by Albayrak (2003) and Benda et al. (2006). According to Benda et al. (2006), the taxonomic situation of Anatolian populations of *M. myotis*, besides in the Mediterranean region, remains unclear. The view of those authors is in accordance with Albayrak and Aşan (1998) with respect to an intermediate form in central Anatolia.

The karyotype of the genus *Myotis* is conservative with 2n = 44, NFa = 50 in the Holoarctic region (Zima 1978, 1979, 1982; Bickham and Haffner, 1978; Iliopoulou-Georgudaki and Giagia, 1984; Zima and Horacek, 1985; Volleth, 1987; Volleth and Heller, 1994). Recently, Karataş et al. (2004) examined the karyotype of *Myotis myotis* specimens from the Asiatic part of Turkey without giving any subspecific rank. They did not find a regional variation between the karyotypes. In contrast, in the present study we determined a secondary constriction near the centromere in the specimens from Artvin and Hatay provinces.

Çağlar (1965) and Simmons (2005) evaluated *Myotis oxygnathus* as a separate species. In addition, Iliopoulou-Georgudaki and Giagia (1984) referred to a new subspecies, *M. blythii lesviacus,* from Lesvos island in respect to its intermediate size. However, Simmons (2005) regarded *lesviacus* as a synonym.

To date, *Myotis blythii* has also been recorded from different parts of Turkey (Çağlar, 1965;

Albayrak, 1990, 1993, 2003; Steiner and Gaisler, 1994; Spitzenberger, 1996; Benda and Horacek, 1998; Karataş et al., 2004; Benda et al., 2006). According to Strelkov (1972), Asia Minor is inhabited by *M. b. omari*; however, Felten et al. (1977) stated that the western part of Anatolia is inhabited by *M. b. oxygnathus* and the eastern part by *M. b. omari*. Steiner and Gaisler (1994) examined *M. blythii* specimens from western and eastern Anatolia and found no clear differences in cranial measurements or skin colour. Therefore, they did not specify the subspecies rank. Benda and Horacek (1995a) and Spitzenberger (1996) stated that a gradual body size increase in *M. myotis* from W-European Mediterranean through Central Europe, SE Europe and E Turkey was obvious in contrast to *M. blythii* and geographic variation is much less pronounced in latter species. In addition, it was impossible to specify *M. b. omari* in eastern Anatolia as the range of this subspecies has not been defined exactly yet. Furthermore, body and cranial measurements of our specimens lie between those given for the smaller subspecies *M. b. oxgnathus* from Europe and the larger *M. b. omari* from the Near East and the Middle East (Miller, 1912; Harrison and Lewis, 1961; Beaucournu, 1965; Felten et al., 1977; Spitzenberger, 1988; Harrison and Bates, 1991; Benda and Horacek, 1995b). In the present study, we also do not use the name *M. b. omari*, like Steiner and Gaisler (1994) and Spitzenberger (1996), for the eastern population in spite of a steady increase in size detected in all specimens from west to east.

Karataş et al. (2004) have not reported a variation in the karyotype of *Myotis blythii*. In the present study, secondary constriction and heteromorphism in the X chromosome were detected. Moreover, the only differences detected in the karyotypes of both taxa were from the standpoint of the size of the metacentric X and the minute Y chromosome.

With recent studies on the microsatellite data and the molecular tree, *Myotis myotis* and *M. blythii* are found to be closely related to each other. Berthier et al. (2006) reported that no hybrid genotypes are found in a population that consisted of 300 individuals examined in Europe. Moreover, some alleles are shared by both sibling taxa. According to the authors, sympatric populations of *M. myotis* and *M. blythii* could only be separated at the nuclear DNA level. Consequently, detailed molecular studies on the nDNA and mtDNA of the both species, which resemble each other morphologically, karyologically, and genetically, are required for the discrimination of their geographic variation in Turkey.

References

Albayrak, İ. 1990. Doğu Anadolu yarasaları (Mammalia: Chiroptera) ve yayılışları. Doğa-Tr. J. of Zoology. 14: 214-228.

Albayrak, İ. 1993. Batı Anadolu yarasaları ve yayılışları (Mammalia: Chiroptera). Doğa-Tr. J. of Zoology. 17: 237-257.

Albayrak, İ. 2003. The bats of the Eastern Black Sea region in Turkey (Mammalia: Chiroptera). Turk J. Zool. 27: 269-273.

Albayrak, İ. and Aşan, N. 1998. Taxonomic status and geographic variations of *Myotis myotis* (Borkhausen, 1797) from Turkey (Chiroptera: Vespertilionidae). Tr. J. of Zoology. 22: 1-9.

Arlettaz, R., Ruedi, M., Ibanez, C., Palmeirim, J. and Hausser, J. 1997. A new perspective on the zoogeography of the sibling mouse-eared bat species *Myotis myotis* and *Myotis blythii*: morphological, genetical and ecological evidence. J. Zool. Lond. 242: 45-62.

Aşan, N., Albayrak, İ. and Yorulmaz, T. 2010. Noteworthy records of *Myotis myotis* and *Myotis blythii* in Turkey (Chiroptera: Vespertilionidae). Lynx, n.s. 41: 145-150.

Baagøe, H.J. 1977. Age determination in bats (Chiroptera). Vid. Med. Dansk. Nat. For. 140: 53-92.

Baker, R.J., Davis, B.L., Jordan, R.G. and Binous, A. 1974. Karyotypic and morphometric studies of Tunisian mammals: Bats. Mammalia. 38: 695-710.

Baker, R.J., Haiduk, M.W., Robbins, L.W., Cadena, A. and Koop, B.F. 1982. Chromosomal studies of South American bats and their systematic implications. In: Mammalian Biology in South America. (eds. M.A. Mares and H.H. Genoways). Pymatuning Laboratory of Ecology. Pennsylvania, pp. 303-327.

Beaucournu, J.C. 1965. Captures de *Myotis blythii oxygnathus* (Monticelli, 1885) en anjou et en tourane confirmation de sa presence en Corse. Mammalia. 29: 54-60.

Benda, P. and Horacek, I. 1995a. Biometrics of *Myotis myotis* and *Myotis blythii*. Myotis. 32-33: 45-55.

Benda, P. and Horacek, I. 1995b. Geographic variation in three species of *Myotis* (Mammalia: Chiroptera) in south of the western Palearctics. Acta. Soc. Zool. Bohem. 59: 17-39.

Benda, P. and Horacek, I. 1998. Bats (Mammalia: Chiroptera) of the Eastern Mediterranean. Part 1. Review of distribution and taxonomy of bats in Turkey. Acta. Soc. Zool. Bohem. 62: 255-313.

Benda, P., Andreas, M., Kock, D., Lučan, R.K., Munclinger, P., Nová, P., Obuch, J., Ochman, K., Reiter, A., Uhrin, M. and Weinfurtová, D. 2006. Bats (Mammalia: Chiroptera) of the Eastern Mediterranean. Part 4. Bat Fauna of Syria: Distribution, Systematics, Ecology. Acta Soc. Zool. Bohem. 70: 1-329.

Benda, P., Hanak, V., Horacek, I., Hulva, P., Lučan, R.K. and Ruedi, M. 2007. Bats (Mammalia: Chiroptera) of the Eastern Mediterranean. Part 5. Bat Fauna of Cyprus: Review of records with confirmation of six species new for the island and description of a new subspecies. Acta Soc. Zool. Bohem. 71: 71-130.

Berthier, P., Excoffier, L. and Ruedi, M. 2006. Recurrent replacement of mtDNA and cryptic hybridization between two sibling bat species *Myotis myotis* and *Myotis blythii*. Proc. Biol. Sci. 273: 3101-3109.

Bickham, J.W. and Hafner, J.C. 1978. A chromosomal banding study of three species of vespertilionid bats from Yugoslavia. Genetica. 48: 1-3.

Bogan, M.A., Setzer, H.W., Findley, J.S. and Wilson, D.E. 1978. Phenetics of *Myotis blythii* in Morocco. Proceedings of the fourth International Bat Conference, Nairobi, 4: 217-230.

Campbell, R.C. 1990. Statistics for Biologists. Cambridge University Press, London.

Castella, V., Ruedi, M., Excoffier, L., Ibánez, C., Arlettaz, R. and Hausser, J. 2000. Is Gibraltar Strait a barrier to gene flow for the bat *Myotis myotis* (Chiroptera: Vespertilionidae)? Molecular Ecology, 9: 1761-1772.

Çağlar, M. 1965. Die Chiropteranfauna der Turkei. İst. Üniv. Fen. Fak. 30: 125-135.

Dietz, C. and Helversen, O. von 2004. Illustrated identification key to the bats of Europe. Electronic version 1.0. Electronic Publication, Tuebingen & Erlangen.

Felten, H., Spitzenberger, F. and Storch, G. 1977. Zur Kleinsäugerfauna West Anatoliens Teil III a. Senckenbergiana Biol. 58: 1-44.

Harrison, D.L. 1964. The Mammals of Arabia. Insectivora, Chiroptera, Primates. Lakeside Printing, London.

Harrison, D.L. and Lewis, R.E. 1961. The large mouse-eared bats of the Middle East with description of a new subspecies. J. Mamm. 42: 372-380.

Harrison, D.L. and Bates, P.J.J. 1991. The Mammals of Arabia. Lakeside Printing, London.

Iliopoulou-Georgudaki, J. and Giagia, E. B. 1984. Distribution notes on *Myotis myotis* (Borkhausen, 1797) (Chiroptera: Vespertilionidae) from Greece, including the karyotype of specimen from Lesvos island. Säugetierkdl. Mitt. 31: 135-139.

Kahmann, H. and Çağlar, M. 1960. Türkiye Memelileri Hakkında 1- Hatay bölgesinden yarasalar. İstanbul Üniversitesi Fen Fakültesi Mecmuası. Seri B. 25: 1-21.

Karataş, A., Yiğit, N., Kankılıç, T. and Çolak, E. 2004. Contribution to the distribution and karyology of some vespertilionid bats (Mammalia: Chiroptera) from Turkey. Zoology in the Middle East. 31: 5-12.

Miller, G.S. 1912. Catalogue of the Mammals of western Europe in the Collection of the Museum. Brit. Mus. Nat. Hist. London.

Mitchell-Jones, A.J., Amori, G., Bogdanowicz, W., Kryštufek, B., Reijnders, P.H.H, Spitzenberger, F., Stubbe, M., Thissen, J.B.M., Vohralík, V. and Zima, J. 1999. The Atlas of European Mammals. Academic Press. USA.

Müdespacher-Ziehl, C., Espiritu-Mora, R., Martinez-Coronel, M. and Gaona, S. 2005. Chromosomal studies of two populations of *Penomyscus difficilis felipensis* (Rodentia: Muridae). Cytologia. 70: 243-248.

Shehab, A., Karataş, A., Amr, Z., Mamkhair, İ. and Sözen, M. 2007. The Distribution of Bats (Mammalia: Chiroptera) in Syria. Vertebrate Zoology. 57: 103-132.

Simmons, N.B. 2005. Order Chiroptera. In: Mammal Species of the World. A Taxonomic and Geographic Reference. Third edition (eds. D. E. Wilson, and D. M. Reeder). The Johns Hopkins University Press, Baltimore, pp. 500-518.

Spitzenberger, F. 1988. Groβes und kleines mausohr *Myotis myotis* (Borkhausen, 1797) and *Myotis blythii* (Tomes, 1857) (Mammalia: Chiroptera) in Österreich. Mitt. Abt. Zool. Landesmus. 42: 1-68.

Spitzenberger, F. 1996. Distribution and subspecific variation of *Myotis blythii* and *Myotis myotis* in Turkey (Mammalia: Vespertilionidae). Ann. Naturhist. Mus. 98: 9-23.

Stadelmann, B., Lin, L.K., Kunz, T.H. and Ruedi, M. 2007. Molecular phylogeny of New world *Myotis* (Chiroptera, Vespertilionidae) inferred from mitochondrial and nuclear DNA genes. Molecular Phylogenetics and Evolution. 43: 32-48.

Steiner, H.M. and Gaisler, J. 1994. On a collection of bats (Chiroptera) from NE Turkey and Iran. Acta. Sc. Brno. 4:1-56.

Strelkov, P.P. 1972. *Myotis blythii* (Tomes, 1857): Distribution, geographical variability and differences from *Myotis myotis.* Acta Theriologica. 17: 355-380.

Volleth, M. 1987. Differences in the location of nucleolus organizer regions in European vespertilionid bats. Cytogenet. Cell Genet. 44: 186-197.

Volleth, M. and Heller, K.G. 1994. Phylogenetic relationships of vespertilionid genera (Mammalia: Chiroptera) as revealed by karyological analysis. Zeitschrift für Zoologische Systematik und Evolutionsforschung. 32: 11-34.

Zima, J. 1978. Chromosome charecteristics of vespertilionidae from Czechoslovakia. Acta Sc. Nat. Brno. 12:1-38.

Zima, J. 1979. Chromosomal homology in the complements of bats of the family vespertilionidae I. Karyometric analysis of chromosomal complements of 20 species. Folia Zool. 28: 329-336.

Zima, J. 1982. Chromosomal homology in the complements of bats of the family vespertilionidae II. G-band karyotypes of some *Myotis, Eptesicus* and *Pipistrellus* species. Folia Zool. 31:31-36.

Zima, J. and Horáček, I. 1985. Synopsis of karyotypes of vespertilionid bats (Mammalia: Chiroptera). Acta Universitatis Carolinae-Biologica. 1981: 311-329.