Acta zoologica cracoviensia, **51A**(1-2): 59-64, Kraków, 25 July, 2008
doi:10.3409/azc.51a_1-2.59-64

The northern distribution limits of the lesser mouse-eared bat *Myotis oxygnathus* (Chiroptera:Vespertilionidae) in Central Europe

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Received: 10 March 2008
Accepted: 28 April 2008

BACHANEK J. 2008. The northern distribution limits of the lesser mouse-eared bat *Myotis oxygnathus* (Chiroptera:Vespertilionidae) in Central Europe. *Acta zoologica cracoviensia*, **51A**(1-2): 59-64.

Abstract. A single specimen of *Myotis oxygnathus* was collected in 1932, in Sucha valley, Western Tatra Mts., the Carpathians (Poland). The northern distribution limits of *M. oxygnathus* in Central Europe is discussed on the basis of recent records of *M. oxygnathus* and *M. myotis* in this area.

Key words: *Myotis oxygnathus*, *Myotis myotis*, cranial measurements, PCA.

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In Europe, the lesser mouse-eared bat *Myotis oxygnathus* (MONTICELLI, 1885) is distributed throughout its southern and central part (SIMMONS 2005). The westernmost localities are located in Portugal, the northernmost are in Slovakia, whereas in the east it is found up to the Ukraine (GÜTTINGER et al. 2001; TOPAL and RUEDI 2001) *. In Slovakia, this species is widespread throughout the country except for the northernmost Carpathian ranges (MITCHELL-JONES et al. 1999). The presence of a single specimen in the Slovakian Tatras during hibernation was recorded in 1964 in Belianska cave (GAISLER and HANÁK 1972) and another possibly in Lućivianska cave, however, the latter record was questioned by PJENČÁK et al. (2003).

In Poland *M. oxygnathus* was first recorded in 2005, at the entrance to Czarna cave in the Western Tatra Mountains, during field-work on swarming activity (PIKSA 2006). An adult male, identified only on the basis of external morphological features (the proportions of the ear and forearm length), was captured in a mist net. However, the lesser mouse-eared bat *Myotis oxygnathus* can often be misidentified in the field due to confusion with the greater mouse-eared bat *Myotis myotis*.

*The European populations of *Myotis oxygnathus* are often listed under the name *Myotis blythii* (TOMES, 1857) (e.g. BERTHIER et al. 2006; SACHANOWICZ et al. 2006).

The distinguishing criteria described by ARLETTAZ et al. (1991), are sometimes questioned and instead the recommended useful key feature is the tooth-row length (DIETZ and HELVERSEN 2004; DIETZ et al. 2007). The greater mouse-eared bat *Myotis myotis* is widespread in Poland, except for the northeastern part of the country (SACHANOWICZ et al. 2006) (Fig. 1). *M. oxygnathus* and *M. myotis* are closely related, and the genetic distance in mtDNA between the European populations of these species is cryptic (RUEDI and MAYER 2001; BERTHIER et al. 2006). The external features are also very similar, sometimes leading to incorrect identification of specimens in collections.

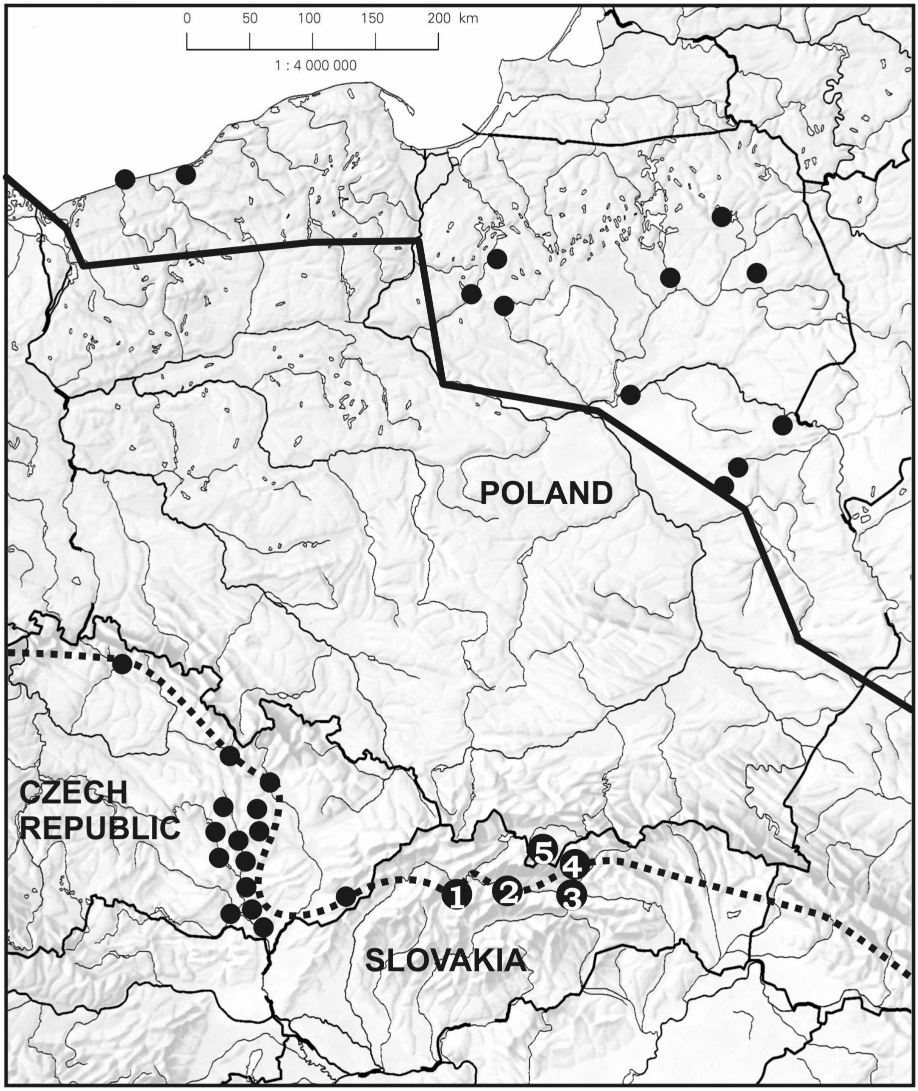

Fig. 1. The northern distribution limits of *Myotis myotis* (solid line) and *Myotis oxygnathus* (dott line) in east-central Europe (MICHELL-JONES et al. 1999, TOPÁL and RUEDI 2001, supplemented). Records of *M. myotis* in NE Poland (solid dots) are scattered (SACHANOWICZ et al. 2006). In the Czech Republic *M. oxygnathus* is very rarely found, and no maternity colony has been recorded. All records are hibernating bats or individuals netted in the autumn transient period (solid dots) (HANÁK and ANDĚRA 2006). 1-5: the most northern localities of *M. oxygnathus* in Slovakia and Poland. 1 – Izbica cave, Dolný Harmanec, Greater Fatra Mts. (BOBÁKOVÁ and HAPL 2002, collection DZCUP and DZHNM), 2 – Bystrianska cave, Lower Tatra Mts. (collection DZCUP), 3 – Dobšinská Ice Cave, Slovenský Raj Mts. (BOBÁKOVÁ 2002, collection DZCUP), 4 – Belianska cave, Belianske Tatry Mts. (GAISLER and HANÁK 1972), 5 – Czarna Cave (PIKSA 2006) and a new record from Sucha valley, Polish Western Tatra Mts.

Only some cranial measurements distinguish these two species. The condylobasal length of the skull (CBL) appears to be the best discriminating feature (HORÁČEK 1985; BENDA 1994; BENDA 1996; BENDA and HORÁČEK 1995), although, for adult individuals only.

One of individuals stored in the collection of the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, seems to belong to *M. oxygnathus* on the basis of the abovementioned cranial measurements. The examined individual (No. M/1500/59), originally identified as *M. myotis*, is an adult female, collected by W. KUŹNIAR, and captured in Sucha valley, Western Tatra Mts., Poland, in 1932. The skull is relatively short and low, no distinct fronto-nasal flexure is observed, the braincase is low, interorbital construction is narrow, the sagittal crest is not well developed, the coronoid process of the mandible is vertical, of medium height, and the dentition is similar to *Myotis oxygnathus*. The main cranial measurements of the studied specimen are as follows: CBL – 21.29 mm, GL – 22.96 mm, LC^1-M^3 – 8.93 mm, IW – 4.59 mm, WC^1-C^1 – 5.63 mm (for abbreviations used see below). The studied specimen was compared with populations of *M. myotis* and *M. oxygnathus* from the Western Tatra Mts., Zimna and Czarna caves, Poland, (N=12); Krakowsko-Częstochowska Upland, Studnisko and Koralowa caves, Poland, (N=13); Greater Fatra

Table I

Ranges and mean values of the most significant skull measurements (in mm) of *Myotis myotis* (N=34) from Western Tatra Mts., Poland, Greater Fatra Mts., Slovakia, Krakowsko-Częstochowska Upland, Poland and *Myotis oxygnathus* (N=34) from Greater Fatra Mts., Slovakia, Western Tatra Mts., Poland. CBL – condylobasal length; GL – greatest length of skull; LC^1- M^3 – length of C^1- M^3; IW – interorbital width; WC^1-C^1 – width of C^1-C^1

Measurements	*M. myotis* (N=34)		*M. oxygnathus* (N=34)	
Males	mean±SD	Min-Max	mean±SD	Min-Max
CBL	22.8±0.43	22.01-23.54	20.4±0.60	19.02-21.02
GL	24.8±0.48	23.27-24.93	21.8±0.76	20.50-22.82
LC^1-M^3	9.9±0.22	9.49-10.20	7.9±0.34	8.10-9.32
IW	5.31±0.22	4.98-5.73	5.17±0.15	4.90-5.45
WC^1-C^1	6.26±0.16	5.97-6.46	5.54±0.35	5.00-6.45
Females	mean±SD	Min-Max	mean±SD	Min-Max
CBL	22.8±0.34	22.82-23.07	20.2±0.45	19.72-21.50
GL	24.0±0.47	23.11-24.71	21.4±0.57	20.62-22.50
LC^1-M^3	9.8±0.31	9.38-10.42	8.5±0.26	8.10-8.90
IW	5.26±0.19	4.93-5.53	5.09±0.17	4.70-5.34
WC^1-C^1	6.21±0.14	5.94-6.33	5.45±0.33	5.10-5.90
All individuals	mean±SD	Min-Max	mean±SD	Min-Max
CBL	22.8±0.33	22.01-23.54	20.3±0.53	19.02-21.47
GL	24.1±0.48	23.11-24.93	21.6±0.70	20.50-22.80
LC^1-M^3	9.8±0.26	9.38-10.42	8.62±0.30	8.10-9.32
IW	5.28±0.20	4.93-5.73	5.14±0.16	4.70-5.45
WC^1-C^1	6.24±0.15	5.94-6.46	5.50±0.34	5.00-6.45

Mts., Izbica and Dolný Harmanec cave, Slovakia, (N=43) stored in collections of the Institute of Systematics and Evolution of Animals PAS in Kraków, ISEA (Poland), National Museum Department of Zoology in Prague, DZCUP (Czech Republic), and Hungarian Natural History Museum Department of Zoology in Budapest, DZHNM (Hungary). The following measurement were taken on each specimen: (HS) – height of the skull, (GL) – greatest length of skull, (ZYW) – zygomatic width, (IW) – interorbital width, (MB) – mastoid breadth, (CBL) – condylobasal length, (W C^1-C^1) – width of C^1-C^1, (W M^3- M^3) – width of M^3- M^3, (L M^1- M^3) – length of M^1- M^3, (L C^1-P^3) – length of C^1 - P^3, (L C^1 - M^3) – length of C^1 - M^3. Only adult specimens were measured.

The cranial measurements were made with a NIKON Measurescope MM-11 microscope. Before analysis all data were logarhytmically transformed (log 10). Principal Component Analysis (PCA) was performed to establish the morphological separation among the two species and reclassify each specimen into groups.

The 1st principal component explained 84.4% of the total variance, and had high positive loadings (0.174 to 0.549) of all 11 measurements. The most significant skull measurements are (CBL), (GL), (LC^1- M^3), (IW), (WC^1-C^1) (Table I). Five measurements had relatively high loadings on the 2nd principal component, and explained only 4.7% of total variance, a further 6 measurements had relatively low loadings. The 1st principal component generally represents differences in size, whereas the 2nd principal component generally represents differences in shape. The biplot of PCA axis 1 versus PCA axis 2 with reference to the intrapopulation variability was examined. Individuals assigned in the museum collection as *M. myotis* and *M. oxygnathus* were separated and appropriately classified into two groups corresponding to *M. oxygnathus* and *M. myotis* on the 1st size-

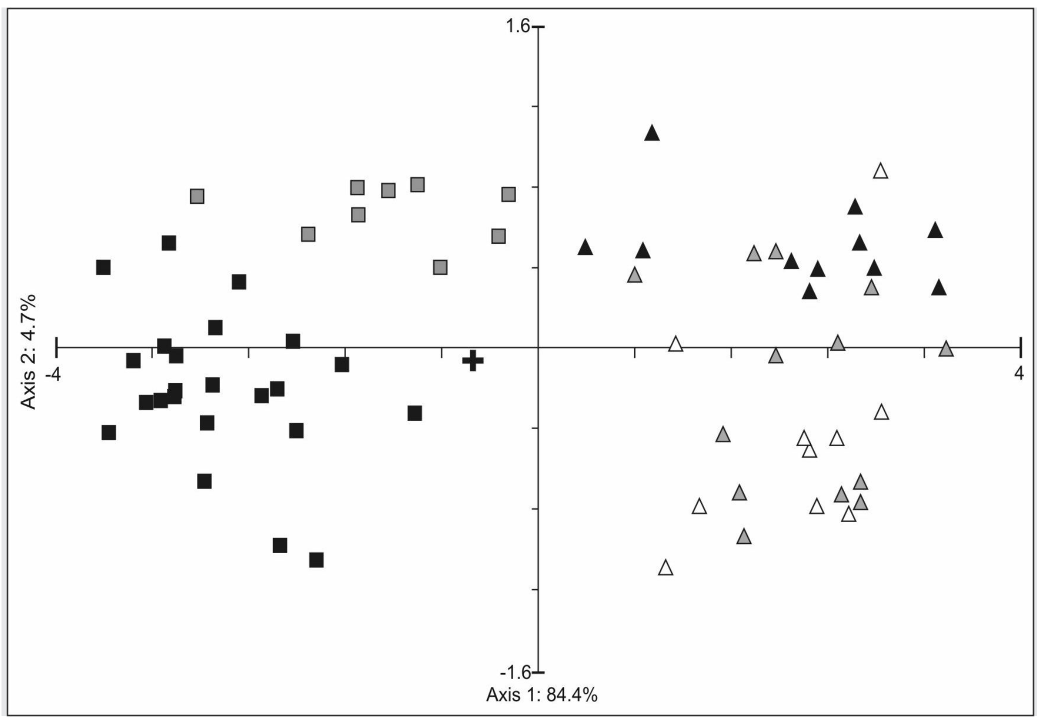

Fig. 2. Projection of the studied specimens onto the first two Principal Component Analysis (PCA) axes. ■ – *Myotis oxygnathus* from Dolný Harmanec cave, Greater Fatra Mts., Slovakia, □ – Izbica cave, Greater Fatra Mts., Slovakia, ✚ – *Myotis oxygnathus* from Sucha valley, Western Tatra Mts., Poland, △ – *Myotis myotis* from Zimna and Czarna caves, Western Tatra Mts., Poland, ▲ – *Myotis myotis* from Izbica cave, Greater Fatra Mts., Slovakia, – ▲ *Myotis myotis* from Studnisko and Koralowa caves, Krakowsko-Częstochowska Upland, Poland.

related rather than the shape-related principal component axis. The specimen from Sucha valley in Western Tatra Mts. was classified as *Myotis oxygnathus* (Fig. 2).

It is obvious that in Central Europe the Sudetes and Carpathian mountain ranges are natural geographic barriers for the expansion of *M. oxygnathus* to the north. The question arises whether this barrier is effective. Recent intensive studies on swarming activity of bats in various parts of the Slovakian (PJENČÁK et al. 2003) and Polish Carpathians (SACHANOWICZ et al. 2006) did not confirm the presence of *M. oxygnathus* in this region, except for a single, rather uncertain record described by PIKSA (2006). At present *M. oxygnathus* does not extend its distribution to the north, like the reports from Central Europe of other Mediterranean bats, such as *Myotis emarginatus* (GEOFFROY, 1806), *Hypsugo savii* (BONAPARTE, 1837) and *Pipistrellus kuhlii* (NATTERER, 1819). A single record from 1932, located at the northern slopes of the Tatra Mountains, supports this opinion.

A c k n o w l e d g e m e n t s. I would like to express thanks to P. BENDA of the National Museum, Department of Zoology in Prague as well as G. CSORBA and M. GASPARIK from the Hungarian Natural History Museum, Department of Zoology in Budapest for permission to work with collections. Also, I am grateful to A. NADACHOWSKI and T. POSTAWA for help with statistical analyses and P. BENDA and an anonymous reviewer for important comments on the manuscript.

REFERENCES

ARLETTAZ R., RUEDI M., HAUSSER J. 1991. Field morphological identification of *Myotis myotis* and *Myotis blythii*: a multivariate approach. *Myotis*, **29**: 49-57.

BENDA P. 1994. Biometric of *Myotis myotis* and *Myotis blythii*: age variation and sexual dimorphism. *Folia Zoologica*, **43**: 297-306.

BENDA P. 1996. To the suitability of some cranial criteria for the determination of mouse-eared bats (*Myotis myotis* and *Myotis blythii*). *Lynx*, **27**: 5-12.

BENDA P., HORÁČEK I. 1995. Geographic variation in three species of *Myotis* (Mammalia: Chiroptera) in South of the Western Palearctics. *Acta Societatis Zoologicae Bohemicae*, **59**: 17-39.

BERTHIER P., EXCOFFIER L., RUEDI M. 2006. Recurrent replacement of two mtDNA and cryptic hybridization between two sibling bat species *Myotis myotis* and *Myotis blythii*. *Proceedings of the Royal Society* B, **273**: 3101-3109.

BOBÁKOVÁ L. 2002. Zimovanie netopierov v jaskynnom systéme Dobšinská ľadová jaskyňa – jaskyňa Duča. *Vespertilio*, **6**: 245-248. [In Slovak].

BOBÁKOVÁ L., HAPL E. 2002. Zimoviská netopierov Veľkej Fatry. *Vespertilio*, **6**: 303-309. [In Slovak].

DIETZ CH., HELVERSEN O. 2004. Illustrated Identification Key to the Bats of Europe, 1st edn, Tuebingen & Erlangen. Electronic publication. Available at: http://www.uni-tuebingen.de/tierphys/Kontakt/mitarbeiter_seiten/dietz.htm (accessed May 2008).

DIETZ CH., HELVERSEN O., NILL D. 2007. Handbuch der Fledermäuse Europas und Nordwestafrikas. Kosmos Verlag, Stuttgart, pp. 399.

GAISLER J., HANÁK V. 1972. Netopýři podzemních prostoj v Československu. *Sbornik Západočes Muzea v Plzeni, Příroda*, **7**: 1-46. [In Czech]

GÜTTINGER R., ZAHN A., KRAPP F., SCHOBER W. 2001. *Myotis myotis* (BORKHAUSEN, 1797) – Grosses Mausohr. In: *Handbuch der Säugetiere Europas Bd 4/I (Fledertiere),* 4/I (ed. KRAPP F.), AULA-Verlag, GmbH, Wiebelsheim, pp: 123-207.

HANÁK V., ANDĚRA M. 2006. Atlas of the mammals of the Czech Republic: a provisional version. V. Bats (Chiroptera) – Part 2. Vespertilionid bats (Vespertilionidae – genus *Myotis*). Národní Muzeum, Praha, pp. 187.

HORÁČEK I. 1985. Population ecology of *Myotis myotis*. Central Bohemia (Mammalia: Chiroptera). *Acta Universitatis Carolinae-Biologica*, **8**: 161-267.

HORÁČEK I., HANÁK V., GAISLER J. 2000. Bats of the Palearctic region: A taxonomic and biogeographic review. Proceedings of the VIII th European Bat Reserch Symposium. Vol. I, pp: 11-157.

MITCHEL-JONES A. J., BOGDANOWICZ W., AMORI G., KRYŠTUFEK B., REIJNDERS P. J. H., SPITZENBERGER F., STUBBE M., THISSEN J. B. M., VOHRALIK V., ZIMA J. 1999. *The Atlas of European mammals*. Poyser, London.

PIKSA K. 2006. First record of *Myotis blythii* in Poland (Chiroptera: Vespertilionidae). *Lynx*, **37**: 197-199.

PJENČÁK P., DANKO S., MATIS S. 2003. Bats of the Tatra National Park and its wider surroundings (northern-central Slovakia). *Vespertilio*, **7**: 139-160.

RUEDI M., MAYER F. 2001. Molecular systematics of bats of the genus *Myotis* (Vespertilionidae) suggests deterministic ecomorphological convergences. *Molecular Phylogenetics and Evolution*, 2**1**: 436-448.

SACHANOWICZ K., CIECHANOWSKI M., PIKSA K. 2006. Distribution patterns, species richness and status of bats in Poland. *Vespertilio*, **9-10**: 151-173.

TOPAL G., RUEDI M. 2001. *Myotis blythii* (TOMES, 1857) – Kleines Mausohr. [In:] F. KRAPP (ed.) – *Handbuch der Säugetiere Europas. Bd 4/I (Fledertiere).* 4/I, AULA-Verlag, GmbH, Wiebelsheim. Pp: 209-255.

SIMMONS N. B. 2005. Order Chiroptera. [In:] D. E. WILSON, D. M. REEDER (eds) – Mammal Species of the World. A Taxonomic and Geographical Reference (third edition), John Hopkins, University Press, Baltimore. Pp: 312-529.