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Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 11. On the bat fauna of Libya II

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Abstract. A complete list of bat records available from Libya was compiled from literature and from new records, based on field studies and examination of museum specimens. The record review is complemented by distribution maps, summaries of distributional status of the particular species, files of field data, findings on feeding ecology, observations of morphology and variation, and records of arthropod ectoparasites. From the territory of Libya, at least 138 records of 18 bat species belonging to six families are known; viz. *Rhinopoma cystops* Thomas, 1903 (1 record site), *Rhinolophus ferrumequinum* (Schreber, 1774) (2), *R. clivosus* Cretzschmar, 1828 (6), *R. horaceki* Benda et Vallo, 2012 (7), *R. mehelyi* Matschie, 1901 (5), *Asellia tridens* (Geoffroy, 1813) (6), *Myotis punicus* Felten, 1977 (2), *Eptesicus isabellinus* (Temminck, 1840) (11), *Pipistrellus hanaki* Hulva et Benda, 2004 (12), *P. kuhlii* (Kuhl, 1817) (45), *Vansonia rueppellii* (Fischer, 1829) (1), *Nyctalus lasiopterus* (Schreber, 1780) (5), *N. leisleri* (Kuhl, 1817) (1), *Otonycteris hemprichii* Peters, 1859 (3), *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004 (14), *P. christii* Gray, 1838 (1), *Miniopterus schreibersii* (Kuhl, 1817) (4), and *Tadarida teniotis* (Rafinesque, 1814) (12). *Rhinolophus ferrumequinum* is here reported from the country for the first time. Since the species status of *Pipistrellus deserti* Thomas, 1902 has been reasonably doubted, this taxon is no more included in the faunal list of Libya. Reviews of taxonomic opinions concerning the Libyan populations of the particular species, supplemented in some cases by original analyses, are added. Arthropod ectoparasites were newly collected from eight species of bats in Libya; at least 19 species of ectoparasites belonging to nine families were recorded in total. The following taxa are here reported from the country for the first time: *Argas vespertilionis* (Latreille, 1802) (from *Rhinopoma cystops*, *Eptesicus isabellinus*, *Pipistrellus kuhlii* and *Plecotus christii*), *Araeopsylla gestroi* (Rothschild, 1906) (from *Tadarida teniotis*), *Steatonyssus occidentalis* (Ewing, 1933) (from *Myotis punicus*), *S. periblepharus* Kolenati, 1858 (from *Pipistrellus kuhlii*), *Parasteatonyssus hoogstraali* (Keegan, 1956) (from *Tadarida teniotis*), and *Spinturnix myoti* (Kolenati, 1856) (from *Myotis punicus* and *Tadarida teniotis*); and additionally also unidentified specimens of the family Trombiculidae (from *Tadarida teniotis*) and of the superorder Acariformes (from *Plecotus gaisleri*).

Key words. Distribution, ecology, taxonomy, bat diet, ectoparasites, Rhinopomatidae, Rhinolophidae, Hipposideridae, Vespertilionidae, Miniopteridae, Molossidae, Cimicidae, Ischnopsyllidae, Nycteribiidae, Streblidae, Argasidae, Macronyssidae, Spinturnicidae, Trombiculidae, Libya, North Africa, Palaearctic.

CONTENTS

INTRODUCTION

The State of Libya (1,760,000 km^2; Fig. 1) lies in the middle of the southern part of the Mediterranean basin and in the middle of North Africa. It is the westernmost country which could be considered as a part of the Eastern Mediterranean, although only a small part of Libya belongs to this biogeographic region (some 2% of the country's area). Most of the territory of Libya is covered by arid steppes and deserts of the Sahara, while only very limited areas along the Mediterranean Sea coast represent Mediterranean steppes and woodlands and show the mild Mediterranean climate. This belt of Mediterranean habitats is almost completely interrupted by the Gulf of Syrte, which penetrates more to the south close to desert areas. This Gulf divides the Mediterreanean areas of Libya into the western part, biogeographically associated with the Maghreb (and thus, belonging to the Western Mediterranean), and the eastern part, which is very peculiar from the biogeographical point of view and shows the most biogeographical affinities to regions of the Eastern Mediterranean (Blondel & Aronson 1999). Anyway, since about three quarters of the bat records known from Libya come from its Mediterranean parts, the bat fauna of this country could be formally considered as Mediterranean within the scope of the presented series.

The bat fauna of Libya has never been studied thoroughly and systematically. Regarding the enormous area of this country, the knowledge of bats has always been only fragmentary. However, the first notes on bats of Libya were published as early as from other comparatively remote areas (from the perspective of the European explorers). The bat specimens collected in Tripolitania by the consul of the Netherlands in Tripoli (= Tarabulus), Clifford C. de Breugel, were mentioned by Temminck (1835–1841). He reported these bats under the names *Vespertilio marginatus* and *V. isabellinus*. While the former name represents a synonym of *Pipistrellus kuhlii* (Kuhl, 1817) and indicates the first record of this bat in Libya, the latter name represents a part of description of a new species, now known as *Eptesicus isabellinus* (Temminck, 1840). To these specimens collected by de Breugel are associated also the subsequent mentions of *Eptesicus isabellinus* and *Pipistrellus kuhlii* by Jentink (1887, 1888) and perhaps also those by Blasius (1857) and Dobson (1878). With most probability, the findings reported by Temminck (1835–1841) thus remained the only original bat records from the today's territory of Libya for the rest of the nineteenth century.

New records of bats from contemporary Libya appeared in the early twentieth century. Thomas (1902) described a small-sized bat from Murzuq, Fezzan (today's southern Libya), as a new species, *Pipistrellus deserti*. Klaptocz (1909) reported a specimen of *Pipistrellus kuhlii* collected in Tarabulus.

Thomas' (1902) report was one of the first of a series of papers, publishing results of new explorations of the Sahara carried out mainly in the period between WWI and WWII, see e.g. Thomas & Hinton (1921, 1923), Thomas (1925), De Beaux (1928, 1932), Krüger (1928), Heim de Balsac (1934), Scortecci (1935, 1937), Dalloni (1936), Hayman (1949), etc. On the other hand, Klaptocz's (1909) paper was one of the earliest of a series of papers dealing with fauna of Tripolitania and Cyrenaica, viz. Ghigi (1920), Festa (1921, 1925), Hartert (1923), De Beaux (1938), Schmidt-Hoensdorf (1943), and Toschi (1951). However, despite this high number of reports and the enormous effort in the field surveys, these expeditions brought very few findings of bats from the contemporary area of Libya. Although the records of other mammals were rather numerous (see the reviews by Zavattari 1934, 1937, Toschi 1954, Masseti 2010), only two species of bats from eight localities were reported in this period, viz. *Pipistrellus kuhlii* (Festa 1921, De Beaux 1928, 1932, 1938, Krüger 1928) and *Plecotus christii* (under *P. auritus*) (De Beaux 1928).

To four bat species known from Libya in the early 1950s (*Eptesicus isabellinus*, *Pipistrellus kuhlii*, *P. deserti*, and *Plecotus christii*), Chiesa (in litt. 1952, in Toschi 1954) added three species from undefined sites of Fezzan, *Rhinolophus clivosus* (under *R. acrotis*), *Asellia tridens* and *Otonycteris hemprichii*. As a result, the contemporary compendia of the Libyan mammals (Toschi 1954, Setzer 1957) summarised thirteen records of seven bat species from the present territory of the country (Table 1).

With the exception of rodents, only few new records of Libyan mammals were reported in the subsequent period of ca. twenty years (Osborn & Krombein 1969, Hufnagl 1972, Missone 1977, Vesmanis 1977); Ranck (1968) published a comprehensive review of the distribution and taxonomy of Libyan Rodentia resulting from an extensive field survey as well as from studies of collection materials, altogether more than 2000 specimens. However, Ranck's field research brought also records of at least two bat specimens, which were published somewhat later, viz. *Pipistrellus hanaki* (under *P. pipistrellus*) (Qumsiyeh & Schlitter 1982) and *Otonycteris hemprichii* (Nader & Kock 1983). In this period, several records of bats were published; Jany (1960) and Kock (1969) reported an observation and a collection specimen of *Asellia tridens* from Fezzan, Kahmann & Çağlar (1960) and Corbet (1978) mentioned specimens of *Rhinolophus mehelyi* from Cyrenaica, and Hufnagl (1972) added new records of *Rhinolophus clivosus*, *Eptesicus serotinus*, *E. isabellinus*, and *Pipistrellus kuhlii* from various parts of Libya.

The knowledge of the bat fauna of Libya sharply changed at the turn of the 1970s and 1980s, when several groups made surveys of bats during at least four trips to the northern parts of Libya. For the first time, these surveys brought detailed data on bats of the Cyrenaican plateau or the Jebel Al Akhdar Mts. (Qumsiyeh 1981, Qumsiyeh & Schlitter 1982, Spitzenberger 1982, Hanák

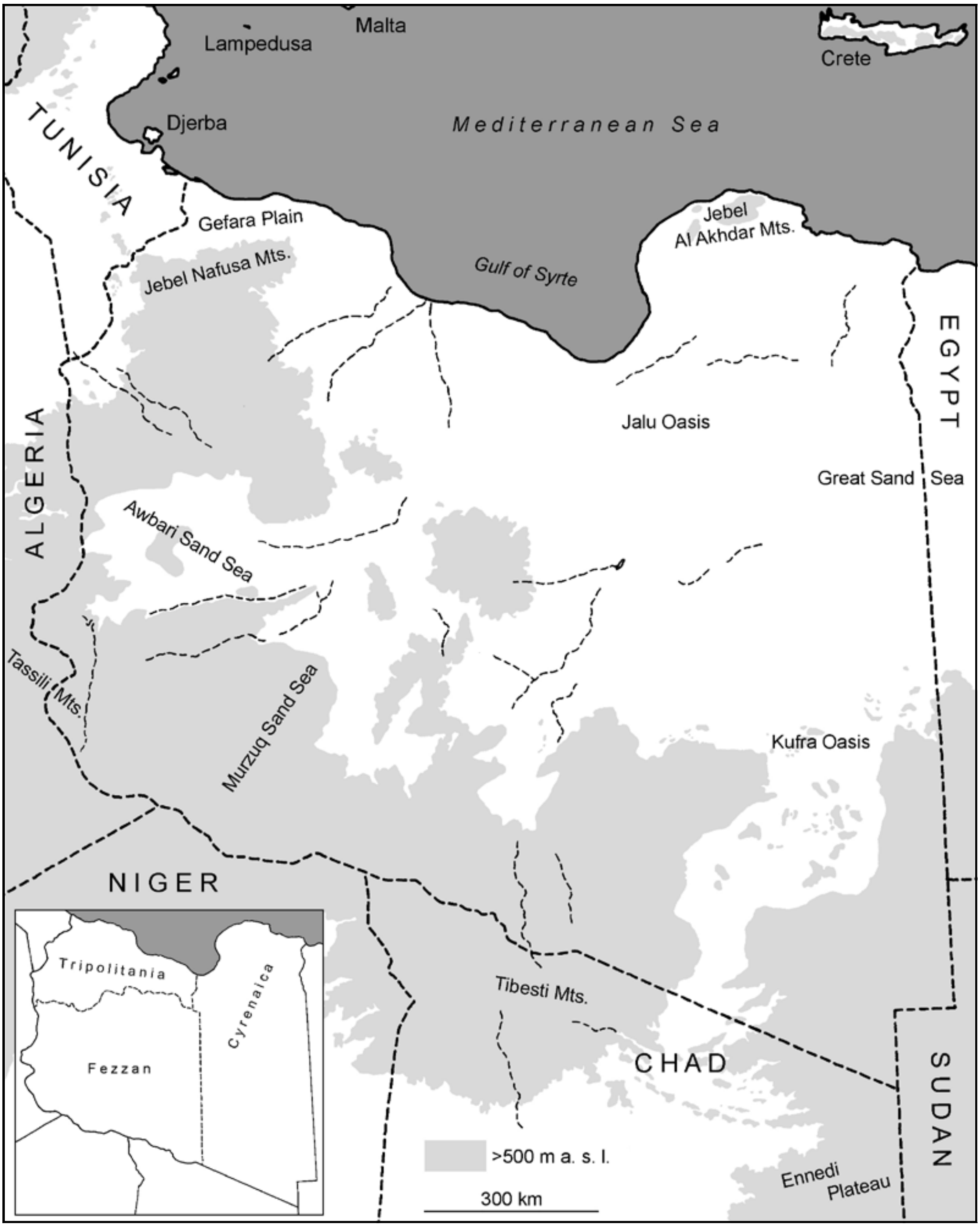


Fig. 1. General map of Libya showing the main geographical features; for political divisions of Libya see the small map in inset. The maps are based on Hajjaji (1985).

Table 1. Composition of the bat fauna of Libya and the number of records of the particular species according to subsequent reviews (numbers of records are expressed as the number of record sites, similarly as in species maps). Numbers in brackets refer to the records given under a different taxonomic arrangement than that used in the present review

species	Toschi 1954, Setzer 1957	Qumsiyeh & Schlitter 1982, Hanák & Elgadi 1984	this review
Rhinopoma cystops	–	–	1
Rhinolophus ferrumequinum	–	–	2
Rhinolophus clivosus	[1]	6	6
Rhinolophus horaceki	–	[2]	7
Rhinolophus mehelyi	–	2	5
Asellia tridens	1	2	6
Myotis punicus	–	[1]	2
Eptesicus isabellinus	1	[4]	11
Pipistrellus hanaki	–	[5]	12
Pipistrellus kuhlii	8*	20*	45
Vansonia rueppellii	–	–	1
Nyctalus lasiopterus	–	3	5
Nyctalus leisleri	–	1	1
Otonycteris hemprichii	1	2	3
Plecotus gaisleri	–	[4]	14
Plecotus christii	[1]	[1]	1
Miniopterus schreibersii	–	2	4
Tadarida teniotis	–	1	12
total number of records (at minimum)	13	56	138
total number of species	7	14	18
average number of records per species	1.9/2.2	3.7/4.0	7.7

* including the record originally assigned to *Pipistrellus deserti*

& Gaisler 1983, Hanák & Elgadi 1984) and some new records of bats of Tripolitania were also added (Qumsiyeh 1983, Hanák & Elgadi 1984, Qumsiyeh 1985). Altogether, these field works brought records of 13 bats species and the first Libyan records of *Myotis punicus* (under *M. blythii*), *Pipistrellus hanaki* (under *P. pipistrellus*), *Nyctalus lasiopterus*, *N. leisleri*, *Plecotus gaisleri* (under *P. austriacus*), *Miniopterus schreibersii*, and *Tadarida teniotis*; in total, 56 records of 14 bat species were known from Libya at that time (Table 1).

In the latter period, also the first records of bat ectoparasites from Libya were published (Hufnagl 1972, Hůrka 1982, Amr & Qumsiyeh 1993); however, all these reports concerned only insect parasite species. Hufnagl (1972) mentioned a record of the bed bug *Cimex lectularius* from *Pipistrellus kuhlii*; Hůrka (1982) reported also the bat bug *Cacodmus vicinus* from this host species, and besides that, also numerous findings of bat fleas (Ischnopsyllidae) and bat flies (Streblidae, Nycteribiidae); viz. *Ischnopsyllus consimilis* (collected from *Pipistrellus kuhlii*), *I. intermedius* (from *Eptesicus isabellinus*) and *Rhinolophopsylla unipectinata* (from *Rhinolophus mehelyi* and *Myotis punicus*) (Ischnopsyllidae), *Brachytarsina flavipennis* (from *Rhinolophus mehelyi*) (Streblidae), and *Nycteribia latreillii* (from *Myotis punicus*), *N. vexata* (from *M. punicus*), *Phthiridium biarticulatum* (from *Rhinolophus mehelyi*), and *Basilia mediterranea* (from *Pipistrellus hanaki*) (Nycteribiidae); Amr & Qumsiyeh (1993) added several records of bat flies (Streblidae, Nycteribiidae), viz. *Brachytarsina flavipennis* and *Phthiridium biarticulatum* collected from *Rhinolophus mehelyi*, and *Basilia daganiae* from *Pipistrellus hanaki*.

The effort in bat faunal works in Libya in the early 1980s resulted in the first comprehensive review of the Libyan bat fauna (Hanák & Elgadi 1984; see Table 1). However, besides others, these authors stressed that the knowledge of the fauna was still not sufficient, namely in comparison with the faunas of the surrounding countries. At the turn of the 1990s and 2000s, two additional expeditions to Libya were made, which documented new records of bats mostly from the Mediterranean parts of the country. However, although only short trips to some Saharan oases were conducted during these journeys, they brought rather significant bat findings, a part of which have been already published. Benda et al. (2004a) reported on the collections of two new species for the fauna of Libya from the Al Jaghbub (Giarabub) oasis, *Rhinopoma cystops* (under *R. hardwickii*) and *Vansonia rueppellii* (under *Pipistrellus rueppellii*), and Benda et al. (2004d) presented a series of *Pipistrellus deserti* from four localities of Fezzan. Perhaps the last field survey of bats in Libya was carried out in 2004 by Rebelo & Brito (2006), who compared bat flight activity in various parts of the Sahara by using bat detectors; however, their results are not useful for faunal studies as they did not recognise bat taxa but only the types of echolocation calls.

The material of bats collected during the recent years was mainly used for phylogenetic and taxonomic revisions of several bat taxa. Hulva et al. (2004) and Benda et al. (2004b) revised the status of bats of the *Pipistrellus pipistrellus* group and described a new endemic species from Libya, *P. hanaki* Hulva et Benda, 2004. Juste et al. (2004), Benda et al. (2004c) and Spitzenberger et al. (2006) examined the Libyan material of the genus *Plecotus* Geoffroy, 1818 at various scales, which also brought a description of a new form from Libya, *P. teneriffae gaisleri* Benda, Kiefer, Hanák et Veith, 2004. The revision of bats of the *Rhinolophus clivosus* group by Benda & Vallo (2012) showed the Cyrenaican populations assigned to this group to represent a separate species, described as *R. horaceki* Benda et Vallo, 2012.

Despite the surveys focused directly on bats carried out in the last 35 years, the bat fauna of Libya cannot be regarded as sufficiently known. Although the state of the bat knowledge has improved in comparison with the last review by Hanák & Elgadi (1984) (Table 1), the information on bats still remains rather fragmentary, considering the enormous area of the country (see also Masseti 2010). On the other hand, under the contemporary security conditions in Libya, it is impossible to carry out any field activities in Libya. Therefore, we regard publishing a new review of the bat fauna of Libya, based mainly on unpublished data from several field trips and the examinations of most of the available museum material as well as on the complete published evidence, as useful. Considering the current political (dis-)arrangements of Libya, we believe that such a review – although only temporary and in a limited extent – could represent the only up-to-date source of information on bats from Libya for a long time.

MATERIAL AND METHODS

Records

The lists of records (arranged in alphabetical and/or chronological orders) include, for each item, the following information: name of the locality (each record is primarily listed by a name of the nearest settlement or notable physical feature) [in brackets, number of locality is given as indicated in the map], and/or description of the record site, date, number of recorded bats with indication of their sex, age and physiological condition (for details see Abbreviations below), and a reference to museum specimen/s.

Note. The geographical names of settlements or physical features were adopted from the respective sheets of the Geological Map of Libya 1:250,000 (Industrial Research Centre, Tripoli, 1974).

Since the administrative division of the nowadays State of Libya is not clear at the present time, we use the traditional division of the country to three provinces, Tripolitania, Cyrenaica and Fezzan. These units existed as historical territories for a long time before the geographical/political unit of Libya was established under the Italian colonial rule in 1927 and remained as the Libyan provinces still a long time after. Regarding the bat fauna diversity and record numbers, we consider this arrangement appropriate for the presentation of the particular findings. Affiliations of the localities to the administrative units valid after the last division of the country to 22 districts (2007) is available in Gazetteer (Appendix I).

For detailed physical and ecological descriptions of Libya see Ranck (1968: 6–26).

Morphological analysis
For morphological comparisons, we used museum specimens which were examined as described in previous studies (see e.g. Benda et al. 2006). The specimens were measured in a standard way with the use of mechanical or optical callipers. Horizontal dental dimensions were taken on cingulum margins. The examined museum material is mentioned in the respective species chapters, the list of comparative material is given in Appendix II. For the evaluated external and cranial measurements see Abbreviations. Statistical analyses were performed using the Statistica 6.0 software. Other methodological details or aspects are described in the respective chapters giving the statistics.

Genetic analysis
Material for genetic analyses was obtained from pectoral muscles or wing punches preserved in alcohol. Genomic DNA was extracted using commercial kits following manuals provided by the manufacturers. Targeted markers with corresponding primers and their sequences are listed below separately for each analysis. Sequence quality control and assembly of contigs were carried out in Geneious v.6.1.8 (Biomatters Ltd.). Uncorrected (*p*) genetic distances were for all data sets calculated using MEGA 6.0 (Tamura et al. 2013) with the pairwise deletion option selected. Independent analyses of three genera/species groups were performed:

(1) To assess the relationships between the Libyan and other Mediterranean populations of bats of the *Pipistrellus pipistrellus* complex, we reconstructed the phylogeny of the complex based on mtDNA D-loop sequences. We used the dataset by Hulva et al. (2010), who sequenced 331 samples (6 *P. hanaki* s.str. from Libya, 22 *P. h. creticus* from Crete, 158 *P. pygmaeus* s.str., 17 *P. pygmaeus cyprius*, and 128 *P. pipistrellus*). The sequences were aligned using MAFFT (Katoh & Toh 2008) with 1000 iterations of the iterative refinement algorithm. Ambiguously alignable regions were eliminated with Gblocks (Castresana 2000) with the low stringency options applied (Talavera & Castresana 2007). The final trimmed alignment was 321 bp long compared to the original length of 349 bp. The HKY+G+I nucleotide evolution model was selected as the most appropriate for this data set by both AIC and BIC criteria in jModelTest v.2.1.3 (Darriba et al. 2012). Maximum likelihood analysis of unique haplotypes (172 individuals) was performed in RAxML v.7.0.3 (Stamatakis 2014) using raxmlGUI v.1.2 interface (Silvestro & Michalak 2012) with GTRGAMMAI model selected as the closest to HKY+G+I. The ML Heuristic search was run with 100 random addition replicates and 1000 bootstrap pseudoreplications.

(2) The genealogical relationships between the *kuhlii* and *deserti* morphotypes within *Pipistrellus kuhlii* and the position of the Libyan populations were assessed by reconstructing the haplotype network based on partial sequences of the mitochondrial gene for cytochrome *b* (cyt *b*). For this analysis, 182 specimens were sequenced. Details on the specimens with corresponding GenBank numbers are given in Table 14. We amplified 724 bp of the cyt *b* gene and 26 bp of the flanking tRNA-Thr region using the internal forward primer L15162 (5'- GCAAGCTTCTACCATGAGGACAAATATC-3'; Taberlet et al. 1992) and flanking reverse primer H15915 (5'- AACTGCAGTCATCTCCGGTTTACAAGAC-3'; Irwin et al. 1991). PCR conditions used for this primer pair were: initial step for 3' at 94 °C, 36 cycles of 94 °C for 45", 50 °C for 45", 72 °C for 1', and a final elongation step of 72 °C for 5'. The alignment was performed as described above. Haplotype network was constructed using the median-joining algorithm implemented in Network v.4.6 (Fluxus Technology Ltd.).

(3) To assess the position of the Libyan populations of *Miniopterus* within the phylogeny of the *M. schreibersii* group, we analysed complete sequences of the cyt *b* gene. For this analysis we assembled previously published cyt *b* sequences deposited in GenBank (Ruedi & Mayer 2001, Ibáñez et al. 2006, Furman et al. 2010, Puechmaille et al. 2014) and combined them with newly obtained sequences from one specimen of *Miniopterus schreibersii* from Libya and three specimens of *M. maghrebensis* from Morocco. See Table 23 for details on newly sequenced specimens and the corresponding GenBank accession numbers. The complete cyt *b* was amplified and sequenced using the forward primer mtDNAR3-F (5'-TGGCATGAAAAATCACCGTTGT-3'; Puechmaille et al. 2011) and the reverse CytB-H (5'-CTTTTCTGGTTTACAAGACCAG-3'; Weyeneth et al. 2008). PCR conditions were modified after Puechmaille et al. (2010) as follows: initial step at 95 °C for 5'; 2×10 cycles at 95 °C for 30", 60 °C (reduction of 1 °C every cycle) for 1'45", and 72 °C for 1'; 30 cycles at 95 °C for 30", 50 °C for 30", and 72 °C for 1'; and a final elongation step at 72 °C for 10'. A total of 54 assembled sequences were aligned as described above. The final alignment length was 1140 bp, but the majority of sequences were shorter due to different primers used in the aforementioned studies, the shortest being 456 bp long. Also, the Libyan sample (NMW 30149) was only 602 bp long due to low quality of sequencing. No stop codons were detected when translated into amino acids. Both AIC and BIC model selection criteria as implemented in jModelTest v.2.1.3 recognised HKY as the best substitution model of nucleotide evolution. Maximum likelihood (ML) analysis was performed in RAxML v.7.0.3 using raxmlGUI v.1.2 interface, with GTR model selected as the closest alternative to HKY and only unique haplotypes (35 individuals) included for the analysis. Other settings were identical to those described below for *P. pipistrellus*.

Diet composition analysis
We collected sets of faecal pellets during the field trip in 2002 for further examination. Moreover, the content of digestive tracts was analysed from museum specimens. The pellets were disassembled in a Petri dish filled with water under a binocular microscope. Particular pieces of prey were identified to the order or family level and the percentage volume of prey categories was estimated for each pellet. The total volume of each diet item in a sample was counted as a mean

value per sample. Digestive tracts were dissected in a Petri dish filled with water and the percentage volume of particular prey categories was estimated for each tract. The number of pellets or digestive tracts analysed are mentioned in the corresponding chapters and/or figure captions of the particular species.

Ectoparasites

Most ectoparasites were collected from the captured bats in the field and preserved in alcohol during the field trips in 1999 and 2002. These primary collections were passed to Professor Karel Hůrka for identification and description. However, K. Hůrka passed away in 2004 and the respective collections of the Libyan parasites were lost. The ectoparasites mentioned below were collected from the bat specimens preserved in alcohol and from jars containing the collected bats.

Bat flies of the family Ischnopsyllidae were subjected to the preparation procedure following Benda et al. (2012). Soft ticks (Argasidae) and mites (Macronyssidae, Spinturnicidae, Trombiculidae) were mounted as permanent preparations in the Liquid de Swan solution.

The parasites were determined with the help of identification keys (Ischnopsyllidae: Traub 1954, Hopkins & Rothschild 1956; Nycteribiidae: Theodor 1967; Argasidae: Filippova 1966, Hoogstraal 1956; Spinturnicidae: Advani & Vazirani 1981, Rudnick 1960, Uchikawa et al. 1994; Macronyssidae: Till & Evans 1964, Radovsky 1967, Micherdziński 1980, Stanyukovich 1997; Trombiculidae: Kudrâšova 1992). In insect parasites (Nycteribiidae, Streblidae, Ischnopsyllidae), we identified sex and stage of the life cycle (ma – adult male, fa – adult female); in ticks (Argasidae) sex and stage (larva, nymph, and adult – see insects); in mites (Spinturnicidae, Macronyssidae) sex and stage (protonymph, deutonymph, and adult – see insects), in Trombiculidae larvae.

The lists of ectoparasite records (arranged in taxonomic, alphabetical and/or chronological orders) include, for each item, the following information: name of the family, species name, number and stage/sex of the specimens recorded, number and sex of hosts, name of the locality and date of collection; according to these data the record is detectable in the Records paragraph, where other circumstances of the record are available. Taxonomy and nomenclature of ectoparasites follow Maa (1965), Theodor (1968) and Guglielmone et al. (2010).

ABBREVIATIONS

Collection acronyms

AUB = American University Beirut, Lebanon; – BMNH = Natural History Museum, London, United Kingdom; – CMŠ = Martin Ševčík private collection, Nitra, Slovakia; – CUP = Department of Zoology, Faculty of Science, Charles University, Prague, Czech Republic; – IVB = Institute of Vertebrate Biology, Academy of Sciences of the Czech Republic, Brno, Czech Republic; – ISEA = Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Cracow, Poland; – MHNG = Natural History Museum, Geneva, Switzerland; – MNHN = National Museum of Natural History, Paris, France; – MSNG = Municipal Museum of Natural History Giacomo Doria, Genoa, Italy; – MUB = Institute of Botany and Zoology, Masaryk University, Brno, Czech Republic; – MZUF = Natural History Museum, Zoology Section "La Specola", Florence, Italy; – NMNHS = National Museum of Natural History, Sofia, Bulgaria; – NMP = National Museum (Natural History), Prague, Czech Republic; – NMW = Natural History Museum, Vienna, Austria; – PMS = Natural History Museum of Slovenia, Ljubljana, Slovenia; – RMR = Regional Museum, Ruse, Bulgaria; – RMNH = Royal Museum of Natural History, Leiden, the Netherlands; – RMO = Regional Museum, Olomouc, Czech Republic; – RSCN = Royal Society for the Conservation of Nature, Amman, Jordan; – SMF = Senckenberg Institute and Museum, Frankfurt am Main, Germany; – USNM = National Museum of Natural History, Washington D.C, United States of America; – WIC = Willy Issel Private Collection, Augsburg, Germany; – ZFMK = Zoological Institute and Museum Alexander Koenig, Bonn, Germany; – ZMB = Zoological Museum, Humboldt University, Berlin, Germany; – ZMM = Zemplín Museum, Michalovce, Slovakia.

Measurements

External dimensions. G = body weight; – LC = body length; – LCd = tail length; – LAt = forearm length; – LA = ear length; – LT = tragus length; – LPl = thumb length (without claw).

Cranial dimensions. LCr = greatest length of skull (incl. the praemaxilla in *Rhinolophus* and *Asellia*); – LOc = occipito-canine length; – LCb = condylobasal length; – LCc = condylocanine length; – LaZ = zygomatic width; – LaI = width of interorbital constriction; – LaInf = infraorbital witdth; – LaN = neurocranium width; – LaM = mastoidal width; – ANc = neurocranium height; – LBT = largest horizontal length of tympanic bulla; – CC = rostral width between canines (incl.); – M^3M^3 = rostral width between the third upper molars (incl; – CM^3 = length of upper tooth-row between C and M^3 (incl.); – LMd = condylar length of mandible; – ACo = height of coronoid process; – CM_3 = length of lower tooth-row between C and M_3 (incl.).

Dental dimensions. LCs = mesio-distal length of the upper canine; – LaCs = labio-palatal width of the upper canine.

Others

a = adult; – A = alcoholic specimen; – B = stuffed skin (balg); – coll. = collected; – det. = detected by a bat detector; – exam. = examined; – f = female; – G = pregnant; – j = juvenile; – m = male; – M = mean; – max., min. = dimension range margins; – net. = netted; – obs. = observed; – P = slide preparation; – s = subadult; – S = skull; – SD = standard deviation; – Sk = skeleton; – W = wing bones.

LIST OF SPECIES

Rhinopoma cystops Thomas, 1903

Record. **Original data**: C y r e n a i c a: Al Jaghbub [1], ruins of Italian fort (Figs. 3, 4), 13 May 2002: obs. a colony of ca. 40 inds., coll. 7 ma, 2 ms, 5 fa, NMP (cf. Benda et al. 2004a [under *R. hardwickii*], Hulva et al. 2007a).

Distribution. *Rhinopoma cystops* has been recorded in Libya only once, in the oasis of Al Jaghbub (Giarabub) in the north-eastern part of the country (Fig. 2; Benda et al. 2004a). Although *R. cystops* ranks among the bats best adapted to desert conditions, in Libya it is one of the most rarely documented species. The Al Jaghbub oasis is a relatively small fertile site, isolated from other similar oases by enormous areas of sand and/or soil deserts (Fig. 66). It is situated approximately 240 km southwards of the coast of the Mediterranean Sea, close to the Egyptian border (Fig. 2). The oasis is found on the western margin of the Siwa basin adjacent to the Qattara depression in north-western Egypt.

R. cystops has the widest distribution among three *Rhinopoma* species of Africa, its range covers deserts and dry steppes of almost the whole northern part of Africa and western part of Arabia (Koch-Weser 1984, Harrison & Bates 1991, Van Cakenberghe & De Vree 1994). In Africa, there are many records spread over the Sahara and in the Sahel zone. The most abundant records are available from the Nile valley of Egypt and the Sudan (Kock 1969, Koopman 1975, Qumsiyeh 1985); scattered records are known from the Maghreb (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Puechmaille et al. 2012), and from the arid steppe belt stretching from Mauritania and Mali to Ethiopia and Somalia (Koch-Weser 1984, Van Cakenberghe & De Vree 1994).

The only known Libyan site of *R. cystops* occurrence in Al Jaghbub interconnects the findings adjacent to the Nile valley of Egypt in the east with the record sites documented in the Maghreb

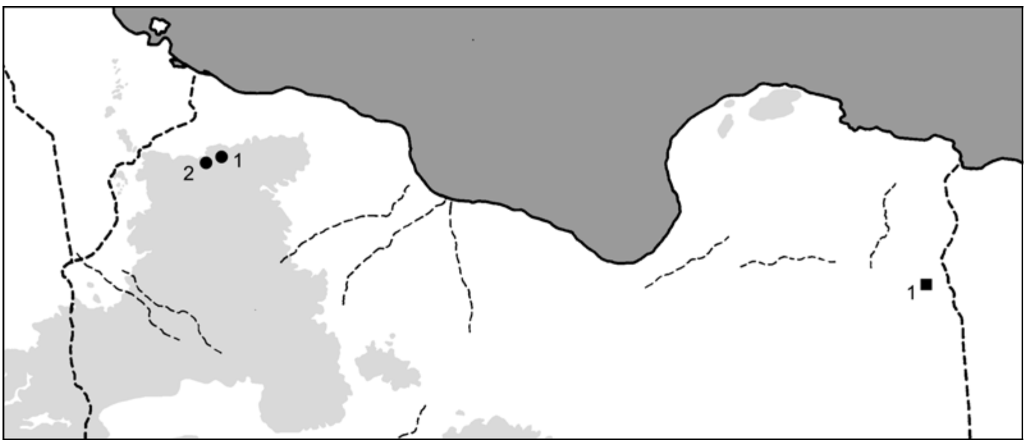


Fig. 2. Records of *Rhinopoma cystops* Thomas, 1903 (square) and *Rhinolophus ferrumequinum* (Schreber, 1774) (circles) in Libya.

in the west (more than 2000 km of aerial distance between the Egyptian and Tunisian localities). A continuation of the distribution range along the African coast of the Mediterranean Sea including that of Libya was previously assumed by Kock (1969), Qumsiyeh & Knox Jones (1986), Van Cakenberghe & De Vree (1994), and Aulagnier (2013). In their published maps of (presumed) distribution ranges, these authors assumed *R. cystops* (under *R. hardwickii* s.l.) to occur throughout the whole Libyan territory except for the northernmost coastal areas. However, such a continuous distribution has not been proven so far.

Rather surprisingly, an occurrence of *R. cystops* has not yet been documented from the western oases of Egypt (Benda et al. 2014). The Libyan finding from Al Jaghbub represents the only record from the vast Libyan desert that stretches over areas of Egypt, Libya and Sudan. The nearest record in Egypt is available from Wadi El Natrun (Hoogstraal 1962), ca. 100 km north-west of Cairo and some 550 km east of Al Jaghbub. In the Maghreb, the known records of *R. cystops* are distributed along the northern margin of the Sahara from Morocco to Tunisia, or along the southern Atlantic areas, respectively (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Dieuleveut et al. 2010, Puechmaille et al. 2012). Nearest to the Libyan territory, the species was documented from the Jebel Morra Mts. in the Chott region of central Tunisia (Gharaibeh 1997, Dalhoumi et al. 2011, Puechmaille et al. 2012), less than 300 km west of the Libyan border. This suggests an occurrence of *R. cystops* also in the ajacent part of Tripolitania.

On the other hand, Saharan sites of *R. cystops* situated close to the territory of Libya are available also from Algeria, Niger and Chad. From Algeria, two localities of *R. cystops* were reported from the Hoggar Mts. in the south-eastern corner of the country (Kock 1969, Koch-Weser 1984, Van Cakenberghe & De Vree 1994), including Oued Igharghar (20 km N Idelès) lying about 400 km from the Libyan border. Thomas (1925), Vogel (1977) and Van Cakenberghe & De Vree (1994) reported records of *R. cystops* from the Aïr Mts. of north-eastern Niger, ca. 600 km south-west of the Libyan border. Van Cakenberghe & De Vree (1994) mentioned two specimens from the Tibesti Mts., northern Chad, 100–200 km south of the Libyan territory. All these findings in volcanic mountain massives of the central Sahara indicate a possible occurrence of *R. cystops* also in the mountain areas of Fezzan and/or the southern part of Cyrenaica (Jebel Akakus, Jebel Nuqay, Jebel Al Awaynat, Al Hulayq Mts., etc.), see also Rebelo & Brito (2006).

In general, an occurrence of *R. cystops* in various oases of the continental part of Libya is presumable. These places possess habitats very similar to those of the Al Jaghbub oasis and are situated close to the areas of documented occurrence of *R. cystops* in other parts of North Africa.

Field notes. A colony of approximately 40 individuals of *Rhinopoma cystops* was observed in two ground floor rooms of the ruins of the Italian fortress in the centre of the Al Jaghbub oasis (Figs. 3, 4, 66). These rooms were dark, partially filled with fallen material of broken walls and ceilings, without windows and accessible from outside only by one door opening (permanently open). The space was inhabited solely by the *R. cystops* colony, while in another room of the fortress, one roosting *Plecotus christii* was found. During a day inspection on 13 May 2002, 13 individuals were collected from the colony. After this disturbance, the bats dispersed all over the ruins into numerous rooms in two above-ground floors. One additional adult female – most probably a member of the colony inhabiting the fortress – was netted in the inner yard of the fortress (Fig. 44) in the evening of the same day. None of the examined females was pregnant or lactating.

Material examined. 9 ♂♂, 5 ♀♀ (NMP 49864–49869, 49872–49877 [S+A], 49870, 49871 [A]), Al Jaghbub, 13 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Rhinopoma cystops* are shown in Table 2. For the material examined see above.

Figs. 3, 4. Ruined Italian fort in the Al Jaghbub oasis, Libyan desert (Cyrenaica); the roost of a colony of *Rhinopoma cystops* and of a solitary *Plecotus christii*; see also Fig. 66. Photos by A. Reiter (May 2002).

The Libyan individuals of *R. cystops* collected in Al Jaghbub are very pale in comparison with representatives of the populations from the Nile valley and the Middle East (see also Benda et al. 2004a). In the Libyan individuals (Figs. 5, 6), the naked parts of skin range from creamy--white (muzzle, ears, margins of wing membranes) to very pale greyish-brown (main parts of wing membranes). The distal parts of dorsal hairs are pale greyish-brown, the proximal parts are whitish, the ventral hairs are whitish.

In comparison to other populations of *R. cystops* from Africa, the body and skull size of the Libyan samples is large (Table 3, Fig. 7), resembling in this character only the specimens from north-eastern Somalia. On average, the Libyan samples largely exceed the specimens from Upper and Lower Egypt, from northern Sudan and southern Algeria (Table 3). Unfortunately, no comparative material was available from Tunisia and northern Algeria to evaluate whether the

Table 2. Basic biometric data on the examined Libyan samples of *Rhinopoma cystops* Thomas, 1903, *Rhinolophus ferrum-equinum* (Schreber, 1774), and *R. horaceki* Benda et Vallo, 2012. For abbreviations see p. 8

	Rhinopoma cystops					*Rhinolophus ferrumequinum*					*Rhinolophus horaceki*				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	14	**60.52**	58.4	62.6	1.475	2	**52.95**	52.6	53.3	0.495	8	**48.74**	47.7	50.2	0.857
LCr	12	**18.52**	17.60	18.94	0.392	2	**21.72**	21.61	21.82	0.149	5	**20.54**	20.17	20.88	0.260
LCO	12	**18.07**	17.63	18.47	0.315	2	**21.00**	20.98	21.02	0.028	8	**20.02**	19.41	20.47	0.372
LCc	12	**16.47**	15.65	16.94	0.388	2	**18.55**	18.43	18.67	0.170	8	**17.73**	17.48	18.11	0.239
LaZ	12	**11.01**	10.53	11.27	0.232	2	**11.06**	10.90	11.21	0.219	8	**10.80**	10.67	10.98	0.115
LaI	12	**2.50**	2.38	2.61	0.085	2	**2.48**	2.48	2.48	0.000	8	**2.35**	2.22	2.48	0.108
LaInf	12	**5.03**	4.92	5.31	0.133	2	**5.71**	5.69	5.72	0.021	8	**5.71**	5.64	5.77	0.054
LaN	12	**7.62**	7.19	7.89	0.170	2	**8.74**	8.59	8.89	0.212	8	**8.56**	8.26	8.69	0.142
LaM	12	**9.17**	8.82	9.33	0.169	2	**9.70**	9.67	9.72	0.035	8	**9.46**	9.29	9.64	0.127
ANc	12	**5.90**	5.64	6.31	0.215	2	**6.52**	6.37	6.67	0.212	8	**6.25**	6.02	6.41	0.125
LBT	12	**5.11**	4.92	5.38	0.163	2	**3.28**	3.24	3.31	0.050	8	**3.50**	3.24	3.73	0.172
CC	12	**4.69**	4.41	5.08	0.187	2	**6.03**	5.88	6.18	0.212	8	**5.94**	5.81	6.09	0.102
M^3M^3	12	**8.29**	8.02	8.58	0.163	2	**8.05**	7.98	8.12	0.099	8	**7.85**	7.70	8.09	0.126
CM^3	12	**6.43**	6.06	6.74	0.205	2	**7.89**	7.88	7.90	0.014	8	**7.41**	7.31	7.60	0.101
LMd	12	**12.70**	12.22	13.19	0.300	2	**14.45**	14.36	14.53	0.120	8	**13.50**	13.23	13.93	0.271
ACo	12	**5.03**	4.68	5.26	0.157	2	**3.78**	3.75	3.80	0.035	8	**3.42**	3.28	3.63	0.120
CM_3	12	**6.86**	6.38	7.18	0.225	2	**8.55**	8.48	8.61	0.092	8	**8.12**	7.91	8.30	0.128

Libyan population is exceptional in the northernmost part of Africa or whether it rather follows a more general trend existing in these areas. Compared with the whole set of examined samples (Fig. 7), bats from Morocco were medium-sized and on average markedly smaller than the bats

Figs. 5, 6. *Rhinopoma cystops* Thomas, 1903 from Al Jaghbub (Cyrenaica). Photos by A. Reiter.

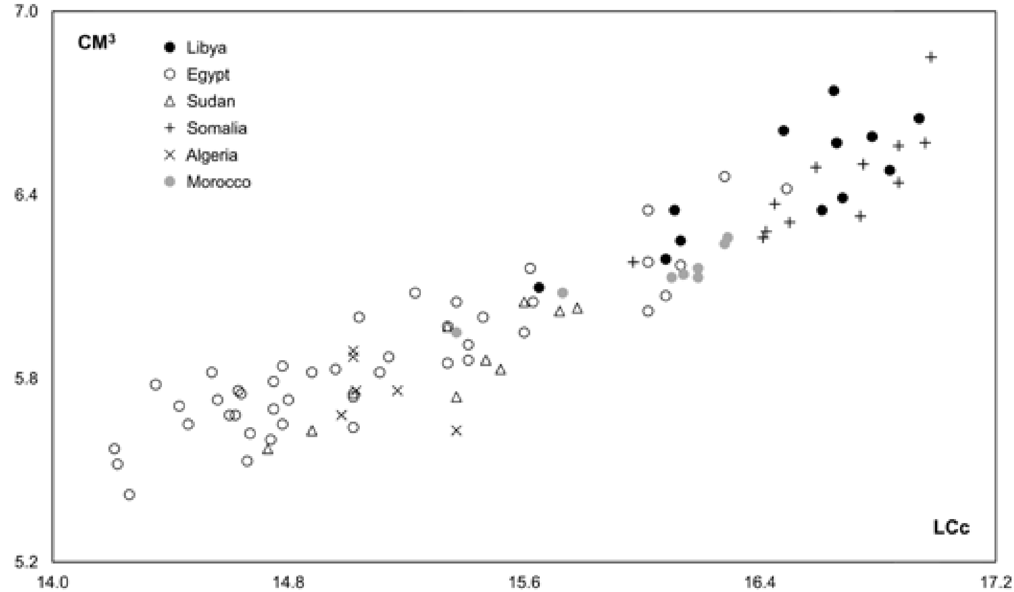


Fig. 7. Bivariate plot of the examined Libyan and comparative samples of *Rhinopoma cystops* Thomas, 1903: condylocanine length of skull (LCc) against the length of the upper tooth-row (CM^3).

from Libya. The Libyan specimens are thus the largest in size among the (compared) North African populations (Table 3).

An assessment of the only known Libyan population of *R. cystops* with respect to the geographical variation of the species was made by Benda et al. (2004a). However, this evaluation was made in accordance with the taxonomic opinion of that time, when *R. cystops* was regarded as

Table 3. Biometric data on comparative sample sets of *Rhinopoma cystops* Thomas, 1903. For abbreviations see p. 8

	Nile Valley					Somalia					Maghreb				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	57	**54.72**	50.0	62.0	2.666	12	**62.92**	59.7	67.0	2.826	17	**57.64**	51.9	61.9	3.688
LCr	53	**17.13**	15.76	18.49	0.658	12	**18.75**	17.91	19.34	0.350	15	**17.76**	16.87	18.75	0.692
LCc	54	**15.14**	14.21	16.49	0.570	12	**16.63**	15.97	16.98	0.294	14	**15.63**	14.98	16.29	0.544
LaZ	52	**9.97**	9.23	11.02	0.421	10	**10.67**	10.17	11.07	0.261	15	**10.19**	9.38	10.89	0.420
LaI	54	**2.44**	2.13	2.75	0.156	12	**2.62**	2.28	2.87	0.147	15	**2.54**	2.34	2.84	0.163
LaN	54	**7.26**	6.67	7.87	0.285	12	**7.99**	7.75	8.37	0.195	15	**7.57**	7.01	7.95	0.298
ANc	54	**5.47**	5.01	5.98	0.206	12	**5.86**	5.60	6.07	0.122	15	**5.63**	5.17	6.02	0.271
CC	53	**4.16**	3.68	4.64	0.215	12	**4.44**	4.14	4.74	0.206	15	**4.30**	3.74	4.76	0.350
M^3M^3	53	**7.59**	7.09	8.38	0.273	12	**8.12**	7.76	8.50	0.226	15	**7.82**	7.27	8.45	0.361
CM^3	54	**5.86**	5.42	6.46	0.225	12	**6.43**	6.18	6.85	0.182	15	**5.98**	5.63	6.26	0.205
LMd	54	**11.61**	10.61	12.73	0.489	12	**12.70**	12.29	13.15	0.274	15	**11.83**	11.10	12.56	0.502
ACo	54	**4.46**	4.03	4.98	0.221	12	**4.82**	4.57	5.18	0.167	15	**4.47**	3.83	4.91	0.384
CM_3	54	**6.36**	5.92	6.94	0.263	12	**6.97**	6.82	7.17	0.135	15	**6.37**	5.02	6.78	0.403

a part of *R. hardwickii* Gray, 1831 (Kock 1969, Hill 1977, Koch-Weser 1984, Qumsiyeh & Knox Jones 1986, Koopman 1994, Van Cakenberghe & De Vree 1994, Simmons 2005). Under this currently abandoned taxonomic concept, four subspecies of this more widespread species were recognised based on morphological traits, mostly on body size (Van Cakenberghe & De Vree 1994). From Africa, two forms were reported: the small-sized *R. h. cystops* Thomas, 1903 in the most arid parts of the central Sahara and the large-sized *R. h. arabium* Thomas, 1913 in the more mesic areas at the margins of the Sahara. Based on the relatively very large size of body and skull, the population occurring in north-eastern Libya was identified as *R. h. arabium* by Benda et al. (2004a). However, the latter authors mentioned also some other characters, in which the Libyan bats differed from the other populations: the shape of the braincase (relatively narrower and higher than in bats from the other areas) and the length of rostrum (the molar rows were relatively short). The statistical analysis separated the set of Libyan specimens as the most deviating among the compared samples from Africa and Asia (Benda et al. 2004a: 117).

Nevertheless, a comparison of short sequences (402 bp) of the mitochondrial gene for cytochrome *b* from the *Rhinopoma* populations of north-eastern Africa and the Middle East (Hulva et al. 2007a) showed the Libyan samples to possess an identical haplotype with a specimen from Upper Egypt (Luxor), i.e. with the population identified as *R. hardwickii cystops*. Hence, Hulva et al. (2007a) suggested to split the former species *R. hardwickii* into two allopatric species, *R. hardwickii* s.str. in Asia and *R. cystops* in Africa and the western Middle East (see also Benda et al. 2012). As a consequence, the concept of two size-defined subspecies of the newly defined species *R. cystops* in Africa was abandoned. Instead, it has been suggested that the Arabian populations pertain to *R. c. arabium*, a sister form to the African *R. c. cystops*, to which the extremely large--sized Libyan population belongs.

The current taxonomic arrangement of the African populations conforms with the conclusions drawn by Benda et al. (2004a: 119); they speculated that "the morphologic differences [among various *R. cystops* population samples] may be also caused by isolation of the sampled populations by vast areas of deserts and therefore by bottle-neck effect resulting in different physical features of the respective samples. But this relatively shortly persisting insulation of the species range in different climatic conditions would not affect the real species status."

Feeding ecology. *Rhinopoma cystops* belongs to the medium-sized representatives of the genus (along with *R. hardwickii* Gray, 1831 and *R. hadramauticum* Benda, 2009), it is a slightly built bat, which captures food in a rapid swallow-like flight (Habersetzer 1981). The diet of *R. cystops* was studied in various parts of its African-Arabian range of distribution. Whitaker & Yom-Tov (2002) examined the diet in northern Israel, where beetles (Coleoptera) and ants (Hymenoptera: Formicoidea) prevailed in the diet composition. Remarkable variation was recorded within the diet samples collected in Jordan by Benda et al. (2010a); however, the principal prey categories recorded were Coleoptera, Heteroptera and Hymenoptera (mainly Formicoidea). The diet samples of *R. cystops* collected in Jordan, Oman, Sudan, and Yemen (Žďárská 2013) were dominated by ants (Hymenoptera: Formicoidea) and beetles (Coleoptera: Scarabaeidae); Auchenorrhyncha, Heteroptera and Orthoptera were found as other substantial food items in these samples. The high geographical variation in the diet indicates flexible foraging behaviour of *R. cystops*.

From Libya, we analysed 40 faecal pellets of *R. cystops* from the Al Jaghbub oasis. The diet was dominated by ants (Hymenoptera: Formicoidea; 81% of volume) and complemented by beetles (Coleoptera), mostly of the family Tenebrionidae. These results correspond well with the previous findings.

Records of ectoparasites. **Original data**: A r g a s i d a e: *Argas vespertilionis*: 1 larva (CMŠ [P]) from 12 host inds. (NMP 49864, 49866–67, 49869–77), Al Jaghbub, 12 May 2002.

Comments on ectoparasites. From Libyan *Rhinopoma cystops* only one specimen of a parasite is available, the soft-tick *Argas vespertilionis* (Latreille, 1802). Hoogstraal (1956) reported records of this tick from this host from several countries of Africa, it seems to represent a common parasite of *Rhinopoma*. However, this soft-tick is known to parasitise also bats of the families Nycteridae, Emballonuridae, Molossidae, and Vespertilionidae. The distribution range of this tick extends over almost the whole Old World (Filippova 1966), from Libya it is here reported for the first time though. However, it was simultaneously collected in this country from several bat species (see below).

Rhinolophus ferrumequinum **(Schreber, 1774)**

Records. **Original data**: T r i p o l i t a n i a: Ain Az Zarqa [1], above a pool (Figs. 8, 9), 9 May 2002: net. 1 ma, NMP (cf. Benda & Vallo 2012); – Nanatalah [2], above a pool (Fig. 80), 27 May 2002: net. 1 faG, NMP (cf. Benda & Vallo 2012).

Distribution. *Rhinolophus ferrumequinum* ranks among the rare bats of Libya, only two record sites are known from the north-western part of Tripolitania (Fig. 2). Occurrence of this species in Libya is here reported for the first time (although it was briefly mentioned already by Benda & Vallo 2012); two individuals of *R. ferrumequinum* were netted at two localities associated with the northern escarpment of the Jebel Nafusa Mts.

R. ferrumequinum shows the Mediterranean type of distribution, it occurs in an interrupted range stretching from England and Morocco through the southern part of Europe, the Maghreb, Middle

Figs. 8, 9. Small oasis of Ain Az Zarqa situated in the escarpment of the Jebel Nafusa Mts. (Tripolitania). At the pool and at rock walls, individuals of *Rhinolophus ferrumequinum*, *Eptesicus isabellinus* and *Plecotus gaisleri* were netted, and calls of *Pipistrellus kuhlii* were detected. Photos by A. Reiter (May 2002).

East and Transcaucasia, to West Turkestan and the Himalayas (Corbet 1978, Koopman 1994, cf. Benda & Vallo 2012). In Africa, it is widely distributed throughout the Mediterranean part of the Maghreb, from western Morocco to Tunisia, and belongs to the most common bats of all three countries (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Puechmaille et al. 2012). The Libyan range represents the easternmost part of distribution of *R. ferrumequinum* in the southern Mediterranean, which continues right into the known range in Tunisia (Puechmaille et al. 2012). As the only *Rhinolophus* species, it was recorded in the Jebel Dahar Mts. in the south--eastern part of this country; Baker et al. (1974) reported records from 2 km S Foum Tatahouine and from 3 km NW Toujane, and Cockrum (1976) made a finding at Tatahouine. Foum Tatahouine lies less than one hundred kilometres away from the Libyan border and around 180 km away from Nanatalah, the western locality of *R. ferrumequinum* in the Libyan Jebel Nafusa Mts.

The crescent-shaped mountain chain surrounding the Gefara plain from west and south, composed of the Jebel Dahar in Tunisia and the Jabal Nafusa in Libya, represents perhaps the only area of suitable roosting and foraging habitats for *R. ferrumequinum* in the easternmost part of the Maghreb. The absence of records in lowland north-western Tripolitania and a similar adjacent part of south-eastern Tunisia (in spite of numerous records of other similarly conspicuous bat species) suggests unsuitabilty of this dry steppe region for an occurrence of *R. ferrumequinum*. Hence, the distribution of this species in Libya seems to be limited to the northern rocky margin of the Jebel Nafusa Mts., where other records can be expected in the whole belt between Nalut and Gharyan (similarly as e.g. in *Plecotus gaisleri* in Tripolitania, see Fig. 81).

Field notes. Both known Libyan individuals of *Rhinolophus ferrumequinum* were caught in nets installed close to the open water surface of two lakes surrounded by dense riparian vegetation and a limited rim of trees in May 2002 (Figs. 8, 9, 80). The lakes are filled from springs situated in desert landscape of the northern escarpment of the Jebel Nafusa Mts. covered by very sparse vegetation or almost barren. The escarpment seems to provide sufficient roosting habitats for *R. ferrumequinum* (see Figs. 8, 80). At both sites, the individuals of *R. ferrumequinum* were a part of larger bat communities representing both the Mediterranean and desert faunas. Calls of *Pipistrellus kuhlii* were detected and individuals of *Eptesicus isabellinus* and *Plecotus gaisleri* were netted together with *R. ferrumequinum* at Ain Az Zarqa, while *Eptesicus isabellinus*, *Pipistrellus kuhlii*, *Otonycteris hemprichii*, and *Plecotus gaisleri* were netted along with this bat species at Nanatalah.

The individual of *R. ferrumequinum* collected at the latter site (on 28 May) was a pregnant female containing a single foetus with the crown-rump length of 12.3 mm. This suggests the parturition period of the Tripolitanian population of *R. ferrumequinum* to occur at the turn of May-June, which conforms to the situation known also from other Mediterranean countries (see the review by Benda et al. 2012).

Material examined. 1 ♂ (NMP 49856 [S+A]), Ain Az Zarqa, 9 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (NMP 49967 [S+A]), Nanatalah, 27 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Rhinolophus ferrumequinum* are shown in Table 2. For the material examined see above, for face and noseleaf of Libyan *R. ferrumequinum* see Figs. 10, 11.

The Libyan individuals are very small in size, the absolutely smallest within the Mediterranean range of *R. ferrumequinum* (Fig. 12). The skull dimensions of these bats fall into and the external dimensions approach the variation ranges of dimensions of *R. clivosus* s.l. from the northern part of Africa and from Arabia (see Benda & Vallo 2012). For this reason, the Libyan individuals of *R. ferrumequinum* were preliminarily identified as *R. clivosus* and this information was included

Figs. 10, 11. Face and noseleaf of *Rhinolophus ferrumequinum* (Schreber, 1774) from Ain Az Zarqa (Tripolitania). Photos by A. Reiter.

into the distribution map of the latter species in Africa by Bernard & Happold (2013a). The Libyan specimens of *R. ferrumequinum* are markedly smaller than samples from the Maghreb, which were known to be the smallest in size in the whole Mediterranean basin (Fig. 12; Benda et al. 2006), and smaller than the bats from Mesopotamia and Transcaucasia (Benda et al. 2012). The skull dimensions of the two Libyan specimens lie below the variation ranges of the respective dimensions of all these small-sized populations (Table 4). The only populations comparable in size were reported by Strelkov (1971) from a restricted area of the western part of the Karakum desert in the Turkmenistan-Uzbekistan-Kazakhstan borderland.

The correct species identification of the Libyan individuals of *R. ferrumequinum* was achieved by a profound examination of morphological characters (noseleaf shape, tooth size and shape; Figs. 10, 11) and a molecular genetic study (Benda & Vallo 2012). The analysis of a mitochondrial gene (complete gene for cytochrome *b*) from both specimens from Tripolitania revealed an identical haplotype, which grouped with the Maghrebian, European and Cypriot haplotypes into a common clade. The Tripolitanian haplotype differed by three substitutions only (0.26% of uncorrected genetic distance) from the nearest haplotype of *R. ferrumequinum* obtained from Morocco and Cyprus (an identical haplotype from these most distant sides of the Mediterranean basin) and by 4–6 substitutions (0.35–0.52%) from European haplotypes (Slovakia, Crete, Montengro, Kosovo; Benda & Vallo 2012, P. Vallo, unpubl.).

Despite the exceptional body size, the Libyan population of *R. ferrumequinum* seems to be a result of a relatively recent radiation of the species in the western and central part of the Mediterranean and thus, there is no reason to consider this population as a taxon separate from the

Table 4. Biometric data on comparative sample sets of *Rhinolophus ferrumequinum* (Schreber, 1774). For abbreviations see p. 8

	Maghreb					Balkans & Crete					Levant				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	21	**55.43**	53.5	58.5	1.258	126	**57.32**	54.3	62.0	1.585	97	**57.56**	53.6	61.2	1.747
LCr	21	**22.63**	22.17	22.96	0.213	96	**23.70**	22.70	24.82	0.410	87	**23.83**	22.79	24.98	0.453
LCc	21	**19.59**	19.23	20.02	0.216	125	**20.65**	19.88	21.76	0.335	94	**20.62**	19.77	22.01	0.425
LaZ	21	**11.73**	11.33	12.11	0.208	127	**12.12**	11.27	12.86	0.292	94	**12.19**	11.47	12.81	0.296
LaI	21	**2.67**	2.47	2.81	0.092	131	**2.50**	2.09	3.04	0.186	96	**2.49**	2.08	2.93	0.170
LaN	21	**9.25**	9.07	9.41	0.124	128	**9.40**	8.05	10.18	0.234	95	**9.37**	8.93	9.94	0.207
ANc	21	**6.68**	6.29	7.12	0.226	125	**6.91**	6.19	7.58	0.257	93	**7.00**	6.47	7.76	0.276
CC	21	**6.34**	6.09	6.67	0.132	129	**6.58**	5.89	7.22	0.197	95	**6.57**	6.11	7.36	0.244
M^3M^3	21	**8.38**	8.11	8.66	0.146	130	**8.64**	7.95	9.07	0.199	95	**8.67**	8.21	9.98	0.240
CM^3	21	**8.23**	7.97	8.47	0.132	131	**8.64**	8.31	9.08	0.153	96	**8.68**	8.28	9.24	0.218
LMd	21	**14.99**	14.63	15.41	0.228	131	**15.70**	14.94	16.48	0.299	96	**15.76**	14.98	16.67	0.374
ACo	21	**3.81**	3.44	4.19	0.172	131	**3.99**	3.43	4.40	0.161	96	**4.02**	3.48	4.41	0.193
CM_3	21	**8.84**	8.62	9.09	0.133	131	**9.28**	8.72	9.73	0.183	96	**9.34**	8.75	9.91	0.249

nominotypical European form. The same is true for all North African populations of *R. ferrumequinum* (Corbet 1978, Koopman 1994, Horáček et al. 2000, Csorba et al. 2003, Benda & Vallo 2012, Gaisler 2013, contra e.g. Hayman & Hill 1971, Felten et al. 1977, Benda et al. 2006).

The exceptional size of the Libyan individuals of *R. ferrumequinum* seems to follow a general trend, known from several other bat species occurring in the Sahara. In these species, populations

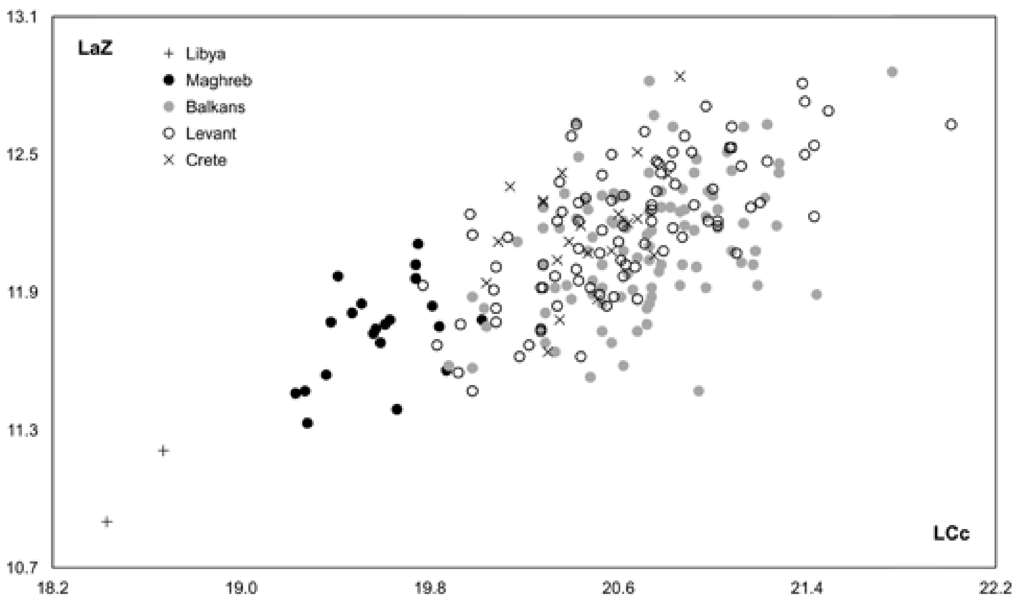


Fig. 12. Bivariate plot of the examined Libyan and comparative samples of *Rhinolophus ferrumequinum* (Schreber, 1774): condylocanine length of skull (LCc) against the zygomatic width (LaZ).

occurring in arid environments are small in size, in comparison with populations living in more mesic or even Mediterranean habitats (such trend was observed in *R. ferrumequinum* also in West Turkestan and Mesopotamia; Strelkov 1971, Benda et al. 2006). The influence of dry conditions results in morphological adaptations, most pronounced in body size (see also under *Rhinopoma cystops*, *Rhinolophus clivosus*, *Aselia tridens*, and *Pipistrellus kuhlii*).

Feeding ecology. *Rhinolophus ferrumequinum* is a medium-sized bat with variable foraging behaviour. This bat hunts its prey in cluttered environments close to foliage or other surfaces and applies "flycatching" from perches; possibly sometimes also picks up insect prey from the foliage or from the ground (Norberg & Rayner 1987, Jones & Rayner 1989). *R. ferrumequinum* is known to feed on Lepidoptera, Coleoptera, Diptera, and Hymenoptera in Europe (Jones 1990, Beck 1995, Flanders & Jones 2009, Andreas et al. 2013, Žďárská 2013). Coleoptera and Lepidoptera were recorded as the most important prey items in the diet of *R. ferrumequinum* in the Middle East (Benda et al. 2006, 2010a, 2012, Whitaker & Karataş 2009, Žďárská 2013). Rather surprisingly, Ahmim & Moali (2013) found Diptera to prevail over Lepidoptera in the analysed diet of this bat from Algeria.

From Libya, we analysed sets of faecal pellets from both available individuals of *R. ferrumequinum*. The sample set collected at Ain Az Zarqa (20 pellets) contained larger moths (84% of volume), ants (9%) and scarabaeid beetles (7%). The sample set from Nanatalah (8 pellets) contained solely larger Lepidoptera (wingspan length ca. 40 mm). The diet composition recorded in Libya corresponds well with results of previous studies from most of the species distribution range.

Rhinolophus clivosus Cretzschmar, 1828

Records. **Published data**: F e z z a n: Brak [1] (Hufnagl 1972); – Ghat [2] (Fig. 26) (Hufnagl 1972); – Murzuk [3] (Hufnagl 1972); – Traghen [4] (Hufnagl 1972); – Umm el-Araneb [5] (Hufnagl 1972); – Wadi Ajal [6] (Fig. 14) (Hufnagl 1972); – Fezzan [udefined] (Toschi 1954).

Distribution. The records of *Rhinolophus clivosus* in Libya are restricted to the desert areas of Fezzan (Fig. 13). However, with an exception of the older and geographically uncertain mention by Toschi (1954), all particular record sites were published by Hufnagl (1972), who did not specify whether any individual of this species from Libya was actually observed or even examined, but only enumerated the localities (see Records). Hence, it is not quite clear whether these localities are real collection/observation sites or, e.g., only sites of potential occurrence. Moreover, besides these relatively numerous records of *R. clivosus* from Fezzan, Hufnagl (1972) reported findings of only two other, rather common bat species (*Eptesicus isabellinus*, *Pipistrellus kuhlii*), originating solely from the coastal areas of Libya. Anyway, here we follow the opinion by Hanák & Elgadi (1984) who accepted Hufnagl's (1972) records as possible.

According to the published data, *R. clivosus* represents a rather common bat in Fezzan, belonging to the most frequently documented species of the region, along with *Asellia tridens* and *Pipistrellus kuhlii*. Most of the accurately defined localities are desert oases/settlements (see Fig. 14) and suggest synathropic occurrence of the species, or at least, data collection from anthropogenic habitats.

The small-sized central Saharan populations of *R. clivosus* occur in two regions that are situated more than 1500 km from each other; one region is a narrow belt of the Nile valley of Egypt* and

* Hoogstraal (1962) reported a record of *Rhinolophus clivosus* from 20 miles west of Mersa Matruh on the coast of north-western Egypt. However, this site seems to be rather exceptional considering the known range of this species in Egypt. There remains a possibility, that the finding represents *R. horaceki*, known from the relatively closely situated locality Al Bardiyah in north-eastern Cyrenaica (less than 200 km away), rather than *R. clivosus* s.str.

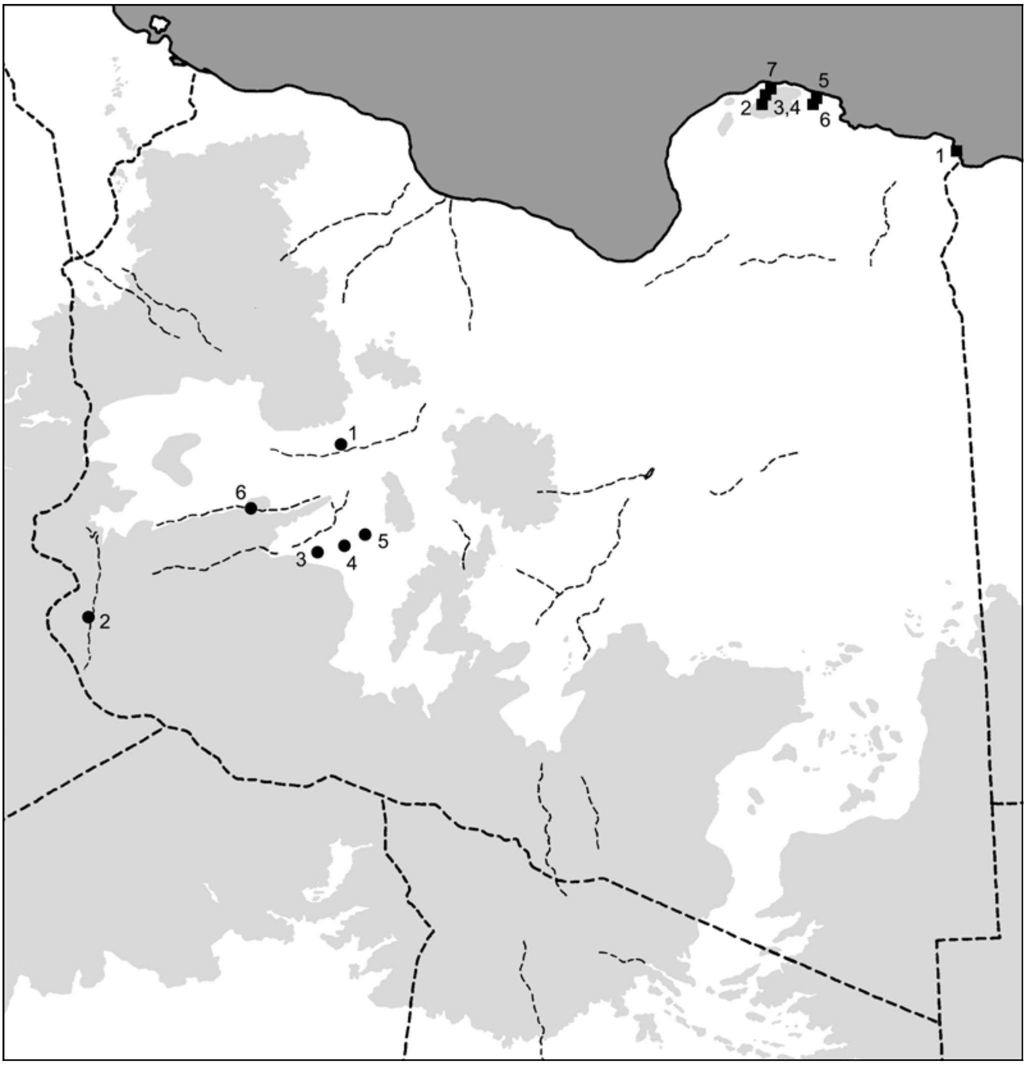


Fig. 13. Records of *Rhinolophus clivosus* Cretzschmar, 1828 (circles) and *R. horaceki* Benda et Vallo, 2012 (squares) in Libya.

northern Sudan, while the other region is situated in south-eastern Algeria and south-western Libya (Bernard & Happold 2013a). The Algerian part of the latter region of occurrence is composed of two sites only (Kowalski & Rzebik-Kowalska 1991); Tamanrasset in the Hoggar Mts. and Djanet in the Tassili n'Ajjer Mts. The latter site is situated only 73 km away from the Libyan border. Although the Algerian records are less numerous than the Libyan ones, the geographical span of both parts of this Saharan region of *R. clivosus* occurrence is similar and each represents ca. 500 km in the west-east direction. On the other hand, it remains a question whether *R. clivosus* is present also in the "empty" area of the Libyan desert between Fezzan and the Nile valley, where no records and also almost no suitable habitats (settled oases) are available.

Field notes. No field data are available concerning the Fezzan records of *Rhinolophus clivosus*.

Morphology and variation. Since no specimens were available for examination from the Fezzan populations of *Rhinolophus clivosus*, their taxonomic affiliation can be discussed only with respect to the Algerian samples (Heim de Balsac 1934, Kowalski & Rzebik-Kowalska 1991). Based on geographical grounds, the Algerian and Libyan populations presumably represent one taxon.

According to Kowalski & Rzebik-Kowalska (1991), there are four specimens known to originate from two sites of south-eastern Algeria (see Distribution). Based on three of these bats, Heim de Balsac (1934) described a new subspecies of *R. acrotis* von Heuglin, 1861 (currently a name of an Ethiopian *Rhinolophus* species), *R. a. schwarzi* Heim de Balsac, 1934. This name has been subsequently considered valid for the central Saharan populations of *R. clivosus* (Allen 1939, Ellerman & Morrison-Scott 1951, Toschi 1954, Setzer 1957, Koopman 1966, 1975, 1994, Kock 1969, Hayman & Hill 1971, Anciaux de Faveaux 1976, Corbet 1978, Qumsiyeh & Schlitter 1982, Horáček et al. 2000, Csorba et al. 2003, Simmons 2005, etc.). Toschi (1954) was the first who assigned the populations from Libyan Fezzan to this form and this opinion was subsequently accepted by a series of authors (Setzer 1957, Hayman & Hill 1971, Qumsiyeh 1985, Csorba et al. 2003, Bernard & Happold 2013a).

Benda & Vallo (2012) examined the (MNHN) type series of *R. a. schwarzi* from south-eastern Algeria in detail and found it to conform in all evaluated morphological characters with the Egyptian form *R. c. brachygnathus* Andersen, 1905 distributed in the Saharan part of the Nile valley (Egypt, northern Sudan; Hayman & Hill 1971, Koopman 1975, 1994, Qumsiyeh 1985). Results of a morphological analysis of dental traits and of a molecular genetic analysis (1.1% of uncorrected genetic distance) showed, however, that the latter form was closely related to the populations from the Holy Land (Benda & Vallo 2012), which represent the nominotypical subspecies, *R. c. clivosus* Cretzschmar, 1828. In accordance with this arrangement, Benda & Vallo (2012) considered all populations from North Africa to represent a single taxon, the nominotypical subspecies. The Saharan populations (originally named *brachygnathus* and *schwarzi*) are smaller in body size than the Holy Land populations (originally *clivosus* s.str.), despite their close

Fig. 14. Wadi Awbari (Fezzan) at the southern margin of the Awbari sand sea (on the background); an area of occurrence of *Rhinolophus clivosus*, *Asellia tridens* and *Pipistrellus kuhlii*. Photo by P. Benda (October 1999).

genetic relationship (Qumsiyeh 1985, Benda & Vallo 2012). However, this size bimodality is a general phenomenon in the Saharan bat populations, well comparable with the situation in the North African populations of *Rhinopoma cystops*, *Rhinolophus ferrumequinum*, *Asellia tridens*, or *Pipistrellus kuhlii* (see under these species for further discussion) and thus, there is no need to express such difference taxonomically.

Rhinolophus horaceki Benda et Vallo, 2012

Records. **Original data**: C y r e n a i c a: Al Bardiyah [1], wadi beneath the village (Fig. 16), cellar, 12 May 2002: coll. 1 ma, NMP (cf. Benda & Vallo 2012); – Qasr Ash Shahdayn [2], underground spaces of the ruins (Figs. 82, 83), 20 May 2002: exam. 1 ma; – Wadi Al Kuf [3], two caves in the western slope of the wadi, 20 May 2002: obs. 4 roosting inds., coll. 1 faG, NMP (cf. Benda & Vallo 2012); – Wadi Al Kuf [4], a large cave at the SE side of the valley, 22 August 1981: net. 1 ms, 1 fa, 1 fs, NMW; – Wadi Darnah [5], 6 km S of Darnah, at entrance of a gallery, 15 May 2002: net. 2 ma, NMP (cf. Benda & Vallo 2012); – Wadi Darnah [6], a cave in the wadi slope ca. 10 km S of Darnah (Fig. 15), 16 May 2002: coll. 1 faG, NMP (cf. Benda & Vallo 2012). – **Published data** [under *R. clivosus*]: C y r e n a i c a: Kufanta (= Kaf Ash Shaluh) [7], Roman aquaduct, 1981: 2 m, 1 f (Qumsiyeh & Schlitter 1982, Qumsiyeh 1985); – 6 km SE Qasr Maqdam, ruins (= Qasr Ash Shahdayn) [2], 1981: 2 m (Qumsiyeh & Schlitter 1982, Qumsiyeh 1985).

Distribution. *Rhinolophus horaceki* is an endemic of the Mediterranean part of Cyrenaica (Benda & Vallo 2012), where it pertains to the group of the medium frequent bat species (Table 1). However, its records were made not only in the forested Jebel Al Akhdar Mts., where about a half of the sites of occurrence was documented. *R. horaceki* has a relatively broad range in Cyrenaica, stretching approximately 360 km across its Mediterranean zone, from Qasr Ash Shahdayn in the west to Al Bardiyah in the east* (Fig. 13). The range of this bat thus covers not only the rather humid Mediterranean arboreal habitats of the northern margin of the Cyrenaican plateau (situated at altitudes above 300 m a. s. l.), but also drier steppe habitats adjacent to Wadi Darnah and Al Bardiyah at altitudes between the sea level and 220 m a. s. l. The whole area of the known range of this endemic bat represents no more than approximately 4000 square kilometres.

Field notes. *Rhinolophus horaceki* was found solely in or at its roosts, no foraging bats were recorded. The majority of records are represented by solitary bats, groups were found only exceptionally.

A group of four bats was found in a cave situated in the northern slope of the side valley of the western part of Wadi Al Kuf on 20 May 2002; since the only examined bat of this group was a pregnant female, the group perhaps represented a part or an establishing core of a maternity colony. The cave was some 40 m long, the bats roosted in its dark depth where only traces of daylight were visible. Individuals of *Tadarida teniotis* were observed in a fissure above the cave entrance (Fig. 96).

Qumsiyeh & Schlitter (1982) reported (without providing any closer data) a collection of three specimens of *R. horaceki* (under *R. clivosus*) from a Roman aqueduct at Kaf Ash Shaluh in the spring 1981. These bats were probably collected from their roost. Qumsiyeh & Schlitter (1982) also reported two male specimens of *R. horaceki* (under *R. clivosus*) collected from the ruined Byzantine fortress of Qasr Ash Shahdayn in the spring 1981; unfortunately they did not give any field details on the collection, although it is very likely that the bats were collected from their roost in the underground of the ruins. From the same locality, a male of *R. horaceki* was examined on 20 May 2002; the solitary bat roosted in the underground room of the ruins (Figs. 82, 83). These records indicate a preffered use of dark spaces of ruins as a roost of the species. The underground of the fortress is three-storeyed and composed of corridors and rooms dug in the rock. During the latter visit of the ruins, one *Plecotus gaisleri* was also found to roost there.

* see also the footnote on p. 19

Three individuals of *R. horaceki* (two of them subadult) were netted at a large cave in a side valley of the south-eastern slope of Wadi Al Kuf on 22 August 1981, this record probably gives an indirect evidence of a colony inhabiting the cave. The cave was ca. 40 m long, built along a cleft in the rock, containing a large oval and completely dark chamber (ca. 15 m in diameter and 12 m high). During the respective netting session, a rich bat community was recorded at the cave, as the individuals of *Pipistrellus hanaki*, *P. kuhlii*, *Plecotus gaisleri*, and *Tadarida teniotis* were netted there along with *R. horaceki*.

A single individual of *R. horaceki* was observed in a relatively deep (ca. 60 m) cave situated in the northern slope of a side valley of the western part of Wadi Al Kuf on 20 May 2002; the bat roosted in the completely dark part of the cave that was situated near the cave described in the first paragraph above. Another solitary bat was found in a cave in the western slope of Wadi Darnah some 10 km south of Darnah on 16 May 2002 (Fig. 15); this cave was ca. 30 m long, situated high above the wadi bottom and the whole cave contained a certain part of daylight. An adult male of *R. horaceki* was found in a cellar/bunker, ca. 20 m in depth, situated in a wadi beneath the Al Bardiyah village on 12 May 2002 (Fig. 16). This site could be considered as the only real anthropogenic roost of this bat species – the present conditions of the above described ancient ruins resemble natural caves more than any artificial work does. At Al Bardiyah, the calls of foraging *Pipistrellus kuhlii* and *Tadarida teniotis* were also recorded.

Two male individuals of *R. horaceki* were netted at the entrance to a gallery situated in Wadi Darnah ca. 6 km south of Darnah on 15 May 2002; the gallery for water collection was 1000 m long and the bats approached it from outside, it perhaps did not represent their day roost but only a temporary roost used during the night. Along with these two male *R. horaceki*, also one indivi-

Fig. 15. Wadi Darnah in the relatively dry eastern part of the Jebel Al Akhdar Mts. (Cyrenaica); type locality of *Rhinolophus horaceki* Benda et Vallo, 2012. A foraging and roosting area of *Rhinolophus horaceki*, *R. mehelyi*, *Pipistrellus kuhlii*, and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

Fig. 16. Wadi beneath Al Bardiyah (Cyrenaica); a site of occurrence of *Rhinolophus horaceki*, *Pipistrellus kuhlii* and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

dual of *Rhinolophus mehelyi* was captured in the same net, and *Pipistrellus kuhlii* and *Tadarida teniotis* were recorded at the same locality and night.

At two sites, pregnant females of *R. horaceki* were collected; the female collected in the cave in Wadi Darnah on 16 May contained a foetus with a crown-rump length of 17.6 mm, the female collected from the cave in the western part of Wadi Al Kuf on 20 May contained a foetus 18.8 mm long. These findings suggests the occurrence of parturitions in *R. horaceki* in the last decade of May.

Material examined. 1 ♂ (NMP 49861 [S+A]), Al Bardiyah, 12 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (NMP 49915 [S+A]), Wadi Al Kuf, 20 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 2 ♂♂ (NMP 49879, 49880 [S+A], incl. the holotype of *Rhinolophus horaceki* Benda et Vallo, 2012), Wadi Darnah, 15 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (NMP 49882 [S+A]), Wadi Darnah, 10 km S of Darnah, 16 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂, 2 ♀♀ (NMW 30106–30108 [S+B]), Wadi Kuf, Prov. Beida, 22 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Rhinolophus horaceki* are shown in Table 2. For the material examined see above, for face, noseleaf and skull of the holotype specimen of *R. horaceki* see Figs. 17–20, for teeth of this specimen see Benda & Vallo (2012: 86, Figs. 9, 10), for the holotype dimensions see Table 5, for depictions of the bacula of *R. horaceki* see Benda & Vallo (2012: 87, Fig. 11).

Populations of medium-sized horseshoe bats occurring in Cyrenaica were discovered by Qumsiyeh & Schlitter (1982) and identified as *R. clivosus*; concerning characteristics of these bats, Qumsiyeh & Schlitter (1982: 384) noted: “The specimens from Jabal Al Akhdar are larger than those examined from the Algerian Sahara (*R. c. schwarzi*) and Egypt (*R. c. brachygnathus*)”. Subsequently, Qumsiyeh (1985) compared the respective specimens with population samples of

Table 5. Basic biometric data on type (holotype, lectotype) specimens of bat taxa described from Libya. For abbreviations see p. 8; * after Harrison (1963)

	*Vespertilio isabellinus** RMNH 17648	*Pipistrellus deserti* BMNH 2.11.4.1.	*Plecotus teneriffae gaisleri* NMP 49911	*Pipistrellus hanaki* NMP 49897	*Rhinolophus horaceki* NMP 49880
sex	♀	♂	♀	♀	♂
LAt	51.3	29.7	40.2	32.5	48.4
LCr	–	11.77	17.08	12.47	20.17
LCb	18.2	11.43	16.07	12.17	–
LCc	–	–	–	–	17.48
LaZ	12.0	–	8.93	8.09	10.71
LaI	4.2	3.08	3.47	3.14	2.44
LaInf	–	3.50	4.33	3.84	5.68
LaN	8.8	6.06	8.07	6.51	8.45
LaM	–	7.02	9.36	7.37	9.31
ANc	–	4.37	5.48	4.52	6.22
LBT	–	–	4.48	2.93	3.24
CC	–	3.68	4.02	4.08	5.87
M^3M^3	–	5.07	6.34	5.19	7.70
CM^3	6.7	4.40	5.83	4.53	7.49
LMd	15.2	8.22	11.07	8.77	13.24
ACo	–	2.83	3.17	2.76	3.28
CM_3	8.1	4.62	6.25	4.76	8.14

Figs. 17, 18. Face and noseleaf of *Rhinolophus horaceki* Benda et Vallo, 2012 from Wadi Darnah (Cyrenaica). Photos by A. Reiter.

R. clivosus from North Africa and found the Cyrenaican bats to be similar in size to the samples from the Sinai and eastern Sudan, i.e. to the form he affiliated to *R. c. clivosus*. Koopman (1994), Horáček et al. (2000) and Csorba et al. (2003) assigned the Cyrenaican horseshoe bats to *R. c. brachygnathus*. Finally, Benda & Vallo (2012) found substantial differences between the Cyrenaican bats and other horseshoe bats of the *ferrumequinum/clivosus* complex, both in morphological and molecular genetic traits, which clearly indicated the Cyrenaican form to represent a separate species.

R. horaceki is an endemic of a limited area of the Mediterranean part of Cyrenaica (ca. 4000 km^2, see Distribution), where no geographical variation has been documented (cf. Benda & Vallo 2012). The dimensional data on three bats given by Qumsiyeh & Schlitter (1982: 380, 382) correspond with those presented here (Table 2).

Feeding ecology. *Rhinolophus horaceki* is a small to medium-sized representative of the genus. There are no available observations concerning its foraging strategy, but according to its morphology we can suppose that the species exhibits a similar foraging behaviour as other Mediterranean species of this genus, e.g. *R. ferrumequinum* or *R. clivosus*.

We analysed three sample sets of the diet of *R. horaceki*. The digestive tract of the individual collected in Wadi Al Kuf contained only medium-sized moths (Lepidoptera, wingspan length ca. 30–35 mm). The set of 26 faecal pellets collected from the individual from the cave in Wadi Darnah contained predominantly medium-sized moths (99.8% of the volume) and a mimimum amount (0.2%) of small nematoceran Diptera. An analysis of 18 pellets collected from two bats captured at the gallery in Wadi Darnah showed the following volumes of particular food items: medium-sized Lepidoptera (54%), Blattodea (38%), Formicoidea (4%), Auchenorrhyncha (2%), and Coleoptera (2%). Similarly, as indicated by analyses of the diets of other *Rhinolophus* speci-

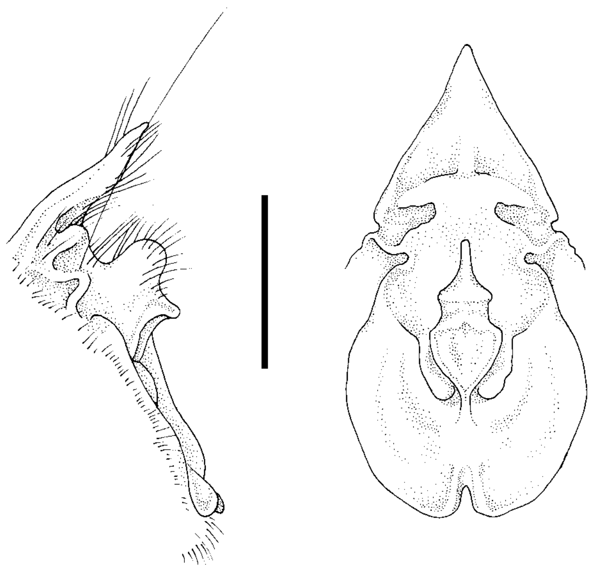


Fig. 19. Noseleaf – in lateral and frontal views – of the holotype specimen of *Rhinolophus horaceki* Benda et Vallo, 2012 (NMP 49880); scale bar = 5 mm (after Benda & Vallo 2012).

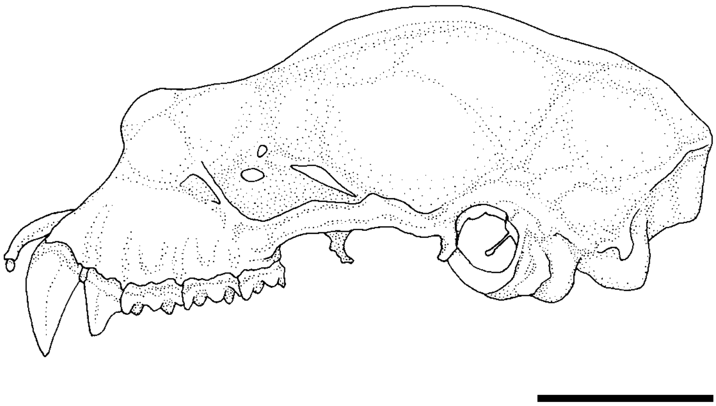


Fig. 20. Skull of the holotype specimen of *Rhinolophus horaceki* Benda et Vallo, 2012 (NMP 49880); scale bar = 5 mm (after Benda & Vallo 2012).

es in the southern Palaearctic (Benda et al. 2006, 2010a, 2012, Ahmim & Moali 2013, Žďárská 2013), *R. horaceki* seems to feed predominantly on moths.

Rhinolophus mehelyi Matschie, 1901

Records. **Original data**: C y r e n a i c a: Al Bayda, a cave W of post-office [1], 6 January 1978: coll. 1 fa, NMW (leg. H. J. Herbert); – Ar Rajmah [2], wadi ca. 2 km W of the village, at a rocky overhang, 22 May 2002: obs. & det. calls of 3 foraging inds.; – Wadi Al Kuf [3], small cave, 23 April 1980: obs. a colony of ca. 50 inds., coll. 17 ma, 1 ms, 4 fa, 1 fs, NMP, NMW (cf. Hůrka 1982, Hanák & Elgadi 1984, Benda et al. 2006); – Wadi Al Kuf, a cave at the SE side of the valley [4], 9 August 1981: obs. a group of ca. 10 inds., coll. 1 ma, NMW, 15 August 1981: obs. a group of ca. 30 inds. in torpor, exam. 2 m, 2 f; – Wadi Darnah [5], 6 km S of Darnah, at entrance of a gallery, 15 May 2002: net. 1 faL. – **Published data**: C y r e n a i c a: Wadi Al Kuf [3], unnamed cave, 1981 (incl. 13 March): 6 m, 4 f (Qumsiyeh & Schlitter 1982, Amr & Qumsiyeh 1993); – Achdar-Gebirge (= Jebel Al Akhdar Mts.), Cyrenaica (Kahmann & Çağlar 1960); – Cyrenaica, specimens, BMNH (Corbet 1978).

Distribution. In Libya, *Rhinolophus mehelyi* is known only from the Mediterranean part of Cyrenaica (Fig. 21). With five known localities, *R. mehelyi* belongs to the rarest bat species in this region. Three localities are situated in the forested northern slopes of the Cyrenaican plateau (Jebel Al Akhdar Mts.), the other two sites lie in drier steppe areas at the margins of the Mediterranean zone.

R. mehelyi shows the Mediterranean type of distribution, it occurs in an interrupted belt from the Maghreb and Iberia through southern Europe to the Middle East (Corbet 1978, Koopman 1994). The only discontinuation of the species occurrence in the circum-Mediterranean area is found in north-eastern Africa, between the Cyrenaican part of range and the neighbouring parts in Egypt and the Maghreb, respectively. In Egypt, *R. mehelyi* was documented in the Cairo region and the western part of the Nile delta (Qumsiyeh 1985); records situated nearest to the Cyrenican range are available from Ramleh near Alexandria (Anderson 1902) and Burg El Arab (Hoogstraal 1962), the latter one lying ca. 700 km east of Wadi Darnah in Cyrenaica. In the Maghreb, *R. mehelyi* occurs in the whole belt of the Mediterranean zone from western Morocco to eastern Tunisia (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Puechmaille et al. 2012). It is the second most common *Rhinolophus* species of Tunisia (Puechmaille et al. 2012); however, all 18 localities lie in the northern part of the country with mostly Mediterranean vegetation and

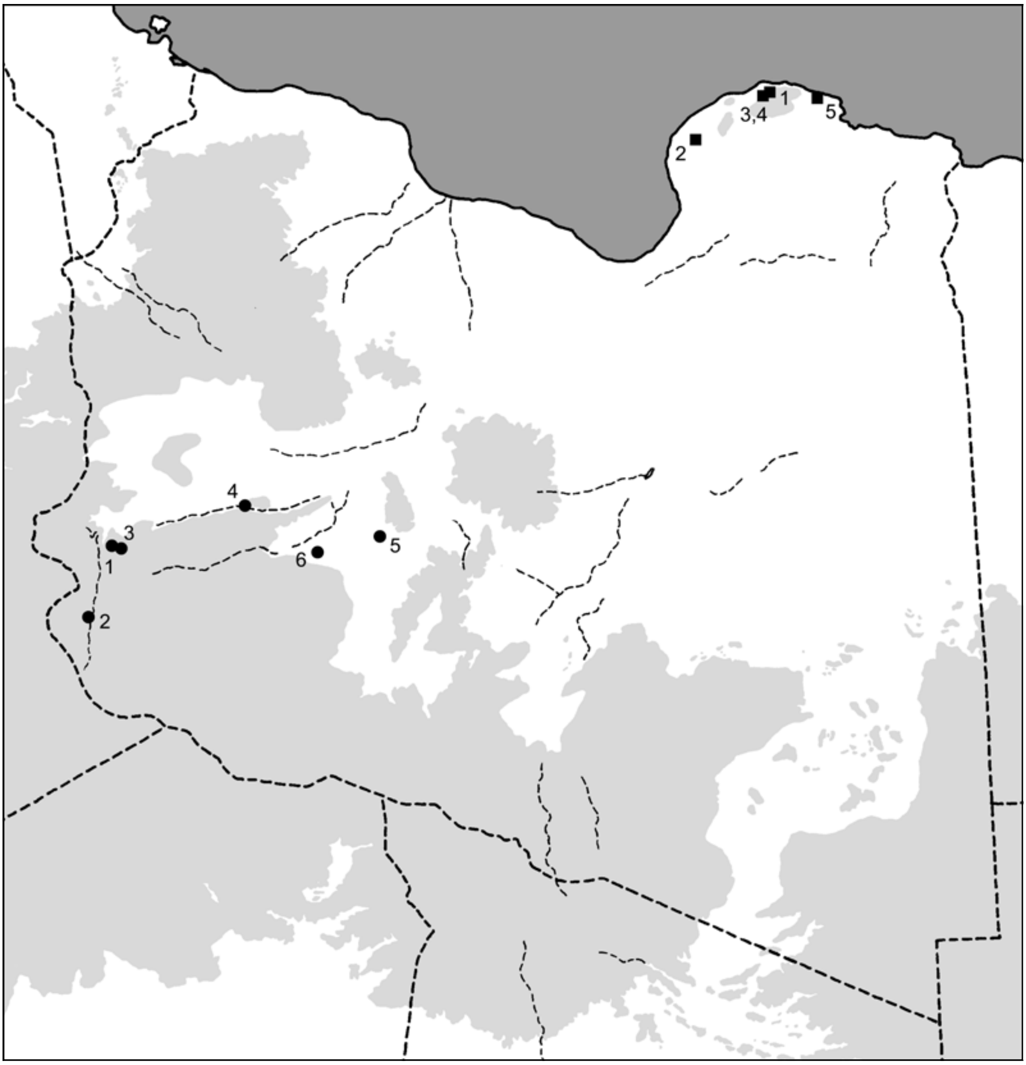


Fig. 21. Records of *Rhinolophus mehelyi* Matschie, 1901 (squares) and *Asellia tridens* (Geoffroy, 1813) (circles) in Libya.

this distribution does not suggest a possible occurrence also in Tripolitania. The southernmost Tunisian locality of *R. mehelyi* is Djebel Orbata (Kahmann 1958) situated ca. 300 km north-west of the Libyan border, together with Bou Hedma (Dalhoumi et al. 2011) which lies only slightly eastward, around 240 km away from the western Tripolitanian border. Anyway, the Tunisian distribution spots of *R. mehelyi* are more than a thousand kilometres away from the western margin of its Cyrenaican range.

Field notes. In Libya, *Rhinolophus mehelyi* was found mostly in or at its roosts, although some foraging bats were also recorded. The largest aggregation of this species was discovered in a small cave in the western side valley of Wadi Al Kuf, where a colony of ca. 50 individuals was observed on 23 April 1980. However, this group perhaps did not represent a maternity colony – among 23 examined individuals, only four adult females were found, while 17 bats were adult males. The cave was some 40 m long, the bats roosted in its dark depth where only traces of daylight were visible. Most probably, from the identical aggregation in this cave (or very close one), Qumsiyeh & Schlitter (1982) collected ten specimens of *R. mehelyi* in spring 1981; the majority of these bats were also males. While in 1980 only the group of *R. mehelyi* was recorded in the cave, Qumsiyeh & Schlitter (1982) found there also *Miniopterus schreibersii* in 1981.

A smaller aggregation of *R. mehelyi* was documented in a cave situated on the slope of the south-eastern side valley of Wadi Al Kuf, 0.8 km south-east of the Ar Ruba road bridge in August 1981. On 9 August, a group of ten bats was observed in this cave, while six days later, roughly 30 individuals were counted there. The cave was ca. 40 m long, with three chambers (up to 8 m high) and with a heap of guano in the last chamber. *Miniopterus schreibersi* was recorded there along with *R. mehelyi* during both visits.

A single individual of *R. mehelyi*, perhaps a hibernating bat, was found in a cave situated west of the post office of Al Bayda on 6 January 1978. It is the only winter record of a cave bat from Libya, which may indicate hibernation.

One female of *R. mehelyi* was netted at the entrance to a gallery situated in Wadi Darnah ca. 6 km south of Darnah on 15 May 2002 (Figs. 15, 22, 23); the gallery for water collection was

Figs. 22, 23. Face and noseleaf of *Rhinolophus mehelyi* Matschie, 1901 from Wadi Darnah (Cyrenaica). Photos by A. Reiter.

1000 m long and the bat approached it from outside. The gallery perhaps did not represent a day roost of this individual but only its temporary roost used during the night. Along with one *R. mehelyi*, also two individuals of *Rhinolophus horaceki* were caught in the same net, and *Pipistrellus kuhlii* and *Tadarida teniotis* were recorded at the same locality on the same night.

Three individuals of *R. mehelyi* were observed (and their calls detected at ~104 kHz, confirming their identification) foraging along cliffs with overhangs in a wadi near Ar Rajmah on 22 May 2002. The main habitat there is a dry steppe/pasture with very sparse bush vegetation, dominated by barren rocky outcrops; one cave was found in the area, however, no bats were indside. During the same night, numerous foraging *Pipistrellus kuhlii* were recorded at the site.

Reproduction of *R. mehelyi* was documented once in Libya; a lactating female was netted at the gallery in Wadi Darnah on 15 May. This record suggests the occurrence of parturitions in *R. mehelyi* around mid-May or earlier, i.e. some two weeks earlier than in the other two horseshoe bats of the Mediterranean Libya.

Material examined. 1 ♀ (NMW 27350 [S]), W Beida Post-Office, Kouf Nat. Park, 6 January 1978, leg. H. J. Herbert; – 18 ♂♂, 4 ♀♀ (NMP 90240–90242 [S+B], 90237, 90245–90247, 90249, 90250, 90254, 90255 [S+W], 90236, 90238, 90239, 90243, 90244, 90248, 90251–90253 [S], NMW 27351, 27352 [S+A]), Wadi Al Kuf, 23 April 1980, leg. V. Hanák & K. Hůrka; – 1 ♂ (NMW 30105 [S+B]), Wadi Kuf, Prov. Beida, 9 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Rhinolophus mehelyi* are shown in Table 6. For the material examined see above, for face and noseleaf of *R. mehelyi* from Libya see Figs. 22, 23, for depiction of the baculum from Libyan *R. mehelyi* see Hanák & Elgadi (1984: 177, Fig. 5).

The existence of Cyrenaican populations of *R. mehelyi* was first published by Kahmann & Çağlar (1960) and Corbet (1978). The former authors did not mention any opinion concerning the geogra-

Table 6. Basic biometric data on the examined Libyan samples of *Rhinolophus mehelyi* Matschie, 1900, *Asellia tridens* (Geoffroy, 1813) and *Myotis punicus* Felten, 1977. For abbreviations see p. 8

	Rhinolophus mehelyi					*Asellia tridens*					*Myotis punicus*				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	24	**47.20**	45.7	49.0	0.868	4	**46.85**	45.5	49.5	1.863	10	**59.88**	57.6	61.7	1.309
LCr	21	**19.77**	19.02	20.27	0.315	4	**17.87**	17.18	18.69	0.647	6	**22.06**	21.41	22.58	0.476
LCO	23	**19.27**	18.59	19.78	0.298	4	**17.78**	17.28	18.51	0.564	–	–	–	–	–
LCc/b	24	**16.95**	16.18	17.38	0.296	4	**15.86**	15.41	16.56	0.507	6	**20.92**	20.35	21.24	0.396
LaZ	24	**10.32**	9.97	10.68	0.156	4	**9.82**	9.29	10.22	0.434	5	**14.14**	13.88	14.48	0.226
LaI	24	**2.57**	2.41	2.87	0.093	4	**2.34**	2.19	2.46	0.111	6	**5.19**	5.04	5.29	0.110
LaInf	24	**5.14**	4.98	5.37	0.119	4	**5.55**	5.42	5.68	0.108	6	**5.50**	5.17	5.78	0.215
LaN	24	**8.60**	8.42	8.85	0.108	4	**7.21**	7.14	7.28	0.070	6	**9.84**	9.64	10.04	0.146
LaM	23	**9.69**	9.57	9.86	0.088	4	**8.58**	8.47	8.66	0.088	6	**10.38**	10.26	10.48	0.087
ANc	23	**6.16**	5.71	6.38	0.181	4	**5.30**	5.07	5.51	0.225	6	**7.60**	7.11	7.85	0.261
LBT	24	**3.07**	2.76	3.31	0.142	4	**2.96**	2.82	3.07	0.115	6	**4.22**	4.08	4.48	0.146
CC	24	**5.14**	4.84	5.39	0.129	4	**4.93**	4.76	5.21	0.198	6	**5.66**	5.48	5.94	0.161
M^3M^3	24	**7.29**	7.07	7.62	0.136	4	**7.14**	7.02	7.28	0.140	6	**9.08**	8.82	9.27	0.162
CM^3	24	**6.78**	6.47	7.03	0.115	4	**6.69**	6.61	6.81	0.094	6	**9.25**	9.04	9.33	0.110
LMd	24	**12.50**	12.02	12.81	0.227	4	**11.99**	11.64	12.66	0.457	6	**16.65**	16.14	16.97	0.290
ACo	24	**2.95**	2.74	3.17	0.106	4	**3.65**	3.48	3.84	0.166	6	**5.64**	5.32	5.85	0.194
CM_3	24	**7.21**	6.93	7.58	0.151	4	**7.27**	7.03	7.51	0.201	6	**9.97**	9.84	10.08	0.109
CM^3/LCc	24	**0.401**	0.393	0.406	0.005	–	–	–	–	–	–	–	–	–	–
LaZ/LCc	24	**0.609**	0.595	0.624	0.008	–	–	–	–	–	–	–	–	–	–

Table 7. Biometric data on comparative sample sets of *Rhinolophus mehelyi* Matschie, 1900. For abbreviations see p. 8

	Maghreb					Balkans					Levant				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	21	**50.03**	48.2	52.5	1.116	51	**50.91**	47.4	53.6	1.442	31	**49.82**	48.1	52.5	1.020
LCr	39	**20.13**	19.54	20.82	0.303	51	**20.16**	19.53	20.64	0.289	15	**19.88**	19.40	20.43	0.286
LCc	39	**17.31**	16.78	17.84	0.215	60	**17.24**	16.71	17.74	0.239	22	**17.07**	16.68	17.37	0.186
LaZ	41	**10.60**	10.27	11.06	0.202	61	**10.41**	9.98	10.89	0.178	23	**10.39**	10.07	10.78	0.167
LaI	41	**2.58**	2.14	2.77	0.120	61	**2.51**	2.19	2.91	0.152	23	**2.45**	2.20	2.62	0.109
LaN	41	**8.74**	8.30	9.08	0.187	61	**8.81**	8.22	9.34	0.196	23	**8.53**	8.18	8.86	0.187
ANc	39	**6.31**	5.95	6.60	0.173	61	**6.21**	5.93	6.61	0.145	6	**6.12**	5.87	6.32	0.150
CC	41	**5.22**	5.02	5.42	0.100	57	**5.03**	4.66	5.28	0.144	9	**5.01**	4.68	5.17	0.156
M^{3}M^3	41	**7.45**	7.21	7.68	0.108	61	**7.25**	6.96	7.45	0.122	9	**7.23**	6.85	7.55	0.190
CM^3	41	**6.89**	6.74	7.12	0.104	60	**6.77**	6.50	7.02	0.124	26	**6.80**	6.55	6.95	0.112
LMd	41	**12.87**	12.44	13.42	0.218	61	**12.65**	12.18	13.07	0.202	23	**12.61**	12.25	13.13	0.196
ACo	41	**3.07**	2.69	3.35	0.146	61	**2.92**	2.68	3.17	0.114	6	**2.95**	2.87	3.04	0.073
CM$_3$	41	**7.34**	7.11	7.63	0.118	60	**7.18**	6.84	7.39	0.132	23	**7.26**	7.07	7.50	0.111
CM^3/LCc	39	**0.398**	0.389	0.411	0.005	60	**0.393**	0.382	0.408	0.006	22	**0.397**	0.390	0.406	0.004
LaZ/LCc	39	**0.612**	0.589	0.635	0.010	60	**0.603**	0.586	0.625	0.009	22	**0.609**	0.595	0.625	0.009

phical variation of the bats from Cyrenaica and Corbet (1978) regarded the species as monotypic. Qumsiyeh & Schlitter (1982: 384), who collected ten specimens of *R. mehelyi* in Wadi Al Kuf and compared them with some museum specimens, pointed out that the bats: "originating from

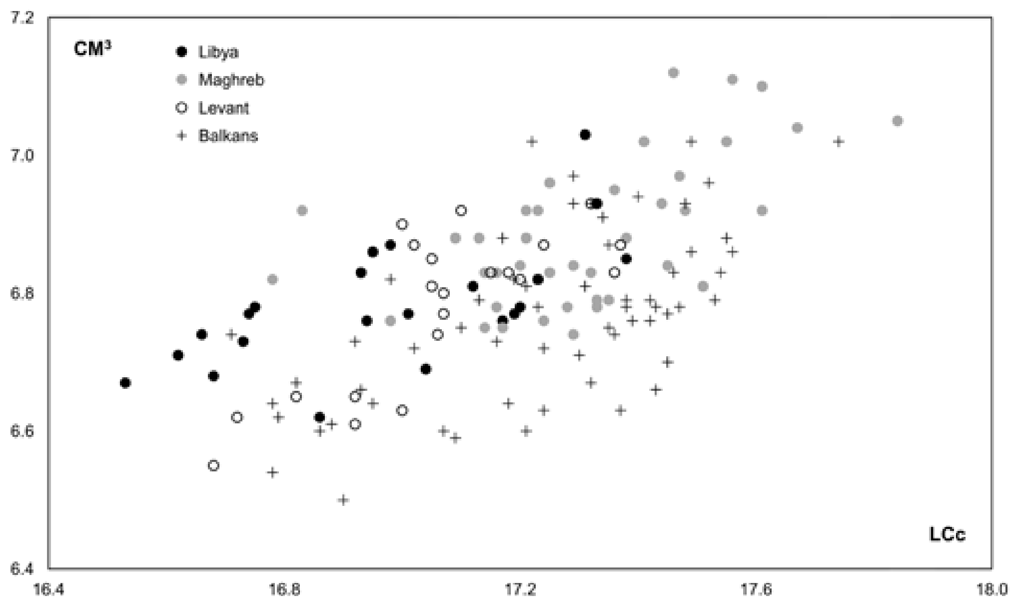


Fig. 24. Bivariate plot of the examined Libyan and comparative samples of *Rhinolophus mehelyi* Matschie, 1901: condylocanine length of skull (LCc) against the length of the upper tooth-row (CM^3).

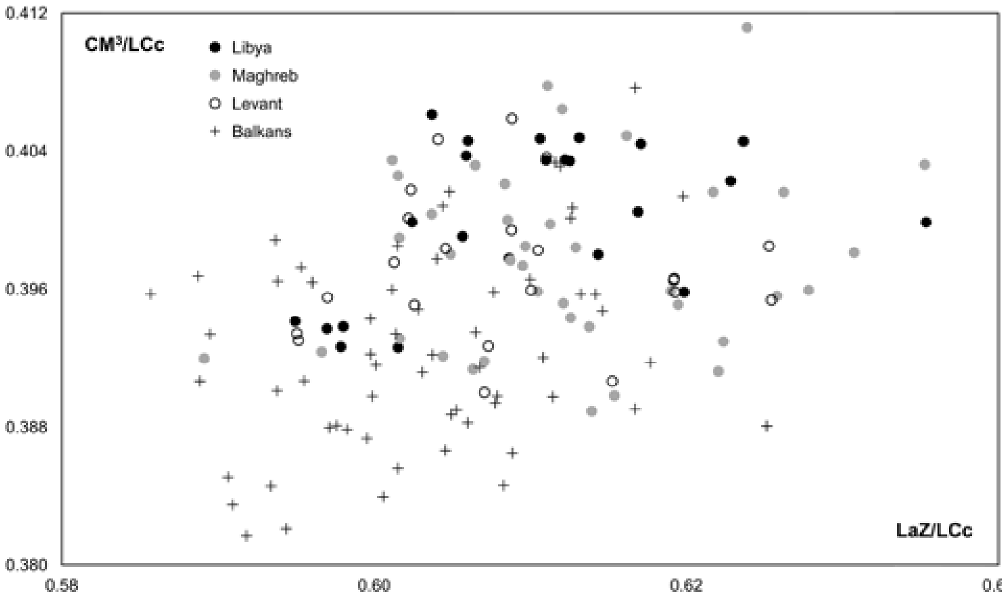


Fig. 25. Bivariate plot of the examined Libyan and comparative samples of *Rhinolophus mehelyi* Matschie, 1901: relative width of skull (LaZ/LCc) against the relative length of rostrum (CM^3/LCc).

eastern Libya and Egypt are small in many cranial and external measurements when compared to those of the Eastern Mediterranean region and northwestern Africa (Algeria, Morocco, Tunisia)". Later, Qumsiyeh (1985: 40) noted: "I could find no distinctions between European specimens and specimens I examined from North Africa and tend to consider all those as belonging to the nominate subspecies. There is a trend towards a decrease in body size around the Mediterranean from north to south and west to east; the smallest specimens come from Egypt." The dimensional data on ten bats given by Qumsiyeh & Schlitter (1982: 380, 382) roughly correspond with those presented here (Table 6).

The geographical variation within a larger set of *R. mehelyi*, which included most of the above mentioned Libyan specimens, was briefly assessed by Benda et al. (2006). They reported two morphotypes based on body size within the species range, smaller bats from Cyrenaica and the Levant and larger bats from Europe and the Maghreb. This result corresponds with that mentioned by Qumsiyeh & Schlitter (1982) and Qumsiyeh (1985). Benda et al. (2006) suggested subspecies statuses for the two morphotypes; the large bats from Europe and the Maghreb to represent the nominotypical form, and the small bats from Cyrenaica, Egypt and the Levant to be assigned to *R. m. judaicus* Andersen et Matschie, 1904, described from the Adullam Cave (= Mogharet Khureitun Cave) near Jerusalem (Andersen & Matschie 1904).

A slightly more profound comparison of cranial dimensions of several population sets from the Mediterranean basin (Table 7, Figs. 24, 25) shows a mosaic of groups of specimens differing in skull size and shape, whose dimensional ranges, however, mostly overlap: (1) bats from Cyrenaica, with small but relatively wide skulls and relatively long and wide rostra, (2) bats from the Maghreb, with large and relatively wide skulls and relatively long and wide rostra, (3) bats from the Levant, with small and rather medium-wide skulls and relatively long but narrow rostra, and (4) bats from the Balkans, with medium-sized and relatively narrow skulls and relatively short and narrow rostra. On average, the Cyrenaican bats represented the smallest form of *R. mehelyi* among the compared sets, although there were no Egyptian specimens available for comparison.

This mosaic-like distribution of morphotypes, combined with a decrease in body size from the western and northern parts of the distribution range to its south-eastern corner classifies *R. mehelyi* among bat species with a rather uncertain taxonomic situation. Various opinions concerning its taxonomy are available, varying between monotypic status to a group of several forms. The description of phylogenetic relationships in *R. mehelyi* seems to be possible only with the help of a molecular genetic analysis of a geographically representative set of samples.

Feeding ecology. *Rhinolophus mehelyi* is a small bat that catches its prey close to foliage and uses hawking and flycatching (Gaisler 2001). The composition of the diet of this bat was studied in Spain and Iran; Lepidoptera prevailed in the diet from both countries; other food items were Neuroptera, Coleoptera, Diptera, and Homoptera (Salsamendi et al. 2008, Sharifi & Hemmati 2001, 2004).

From Libya, we analysed 22 faecal pellets from the individual of *R. mehelyi* netted in Wadi Darnah. Surprisingly, the overwhelming majority of the amount (99.1% of the volume) consisted of remnants of cockroaches (Blattodea), while moths (Lepidoptera) represented only a small proportion (0.9%). This result suggests a certain flexibility in the foraging strategy and ability of *R. mehelyi* to hunt other prey types than moths. It concurs with the notes concerning the diet of this bat in Bulgaria (Dietz et al. 2007), where a seasonally significant role of several other diet items (Diptera, Coleoptera, Neuroptera) is mentioned.

Records of ectoparasites. **Published data**: I s c h n o p s y l l i d a e: *Rhinolophopsylla unipectinata*: 1 ma from 23 host inds., cave in Vadi el Kuf, Cyrenaica, 23 April 1980 (Hůrka 1982). – N y c t e r i b i i d a e: *Stylidia biarticulata* [= *Phthiridium biarticulatum*]: 3 ma, 4 fa from 23 host inds., cave in Vadi el Kuf, Cyrenaica, 23 April 1980 (Hůrka 1982); – 1 ma from 9 host inds., Kuf National Park, 13 March 1991 (Amr & Qumsiyeh 1993). – S t r e b l i d a e: *Brachytarsina flavipennis*: 17 ma, 23 fa from 23 host inds., cave in Vadi el Kuf, Cyrenaica, 23 April 1980 (Hůrka 1982); – 6 ma from 9 host inds., Kuf National Park, 13 March 1991 (Amr & Qumsiyeh 1993).

Comments on ectoparasites. In Libya, Hůrka (1982) recorded the bat flea *Rhinolophopsylla unipectinata arabs* Jordan et Rothschild, 1921 from *Rhinolophus mehelyi* and also from *Myotis punicus*. This North African subpecies of this parasite was reported also from Tunisia (Vermeil 1961, Beaucornu & Hellal 1977), Algeria (Hopkins & Rothschild 1956), and Morocco (Beaucornu et al. 1975, Hastriter & Tipton 1975) as well as from Spain (Quetglas et al. 2014). Although the bats of the genus *Rhinolophus* rank among the principal hosts of this bat flea, its records are known also from bats of the genera *Myotis*, *Plecotus* and *Miniopterus* (Hastriter & Tipton 1975, Quetglas et al. 2014).

The recorded bat fly species, *Brachytarsina flavipennis* Macquart, 1851 (Streblidae) and *Phthiridium biarticulatum* (Hermann, 1864) (Nycteribiidae), restrict their parasitation to the genus *Rhinolophus*. Both bat flies have the circum-Mediterranean type of distribution (Hůrka 1982).

Asellia tridens (Geoffroy, 1813)

Records. **Original data**: F e z z a n: Al Awaynat [1], small oasis ca. 17 km WNW of the town, 2 October 1999: obs. & det. 3–5 foraging inds.; – Ghat [2], touristic camp on the southern edge of the town (Fig. 26), 3 October 1999: net. 1 ms, NMP (cf. Benda et al. 2006, 2011b); – Serdeles (= Al Awaynat) [3], March 1934: 1 ind. ad, MSNG (leg. G. Scortecci; cf. Benda et al. 2011b); – Ubari (= Awbari) (Fig. 14) [4], Fezzar (= Fezzan), October 1932: 1 fa, MSNG (leg. L. Cipriani; cf. Benda et al. 2011b); – Zuila (= Zuwaylah) [5], September 1933: 1 fa, MSNG (leg. E. Zavattari; cf. Benda et al. 2011b). – **Published data**: F e z z a n: Murzuk [6], 1 ind., SMF (Kock 1969, Hanák & Elgadi 1984); – Serdeles (= Serir [= Al

Awaynat]) [3], old fort, 2 May 1955: obs. foraging inds. (Jany 1960), 7 May 1955: 2 ma, WIC (Hanák & Elgadi 1984); – Fezzan [undefined] (Toschi 1954).*

Distribution. Records of *Asellia tridens* in Libya are restricted to the desert areas of Fezzan (Fig. 21). This species is rather common in south-western Libya, it belongs to the most frequently documented bat species of Fezzan. All known localities of *A. tridens* in Libya are oases surrounded by rocky and sand deserts of the central Sahara.

The exclusive Libyan distribution of *A. tridens* in Fezzan is surprising, this species is known to occur in desert and dry steppe areas of most countries of the Saharan belt of Africa. Already Kock (1969) suggested an existence of a continuous range spreading throughout the whole desert and dry steppe zones of North Africa from south-western Morocco and northern Senegal to northern Egypt and Eritrea, including almost the entire territory of Libya, except for the northern Mediterranean and steppe areas along the sea coast.

Considering the distribution of records in the countries bordering Libya, the occurrence of *A. tridens* could be actually awaited in almost the whole Libyan territory. In Egypt, *A. tridens* is perhaps the most widespread bat species (see Qumsiyeh 1985); it occurs in the whole Nile valley between Abu Simbel and Cairo, at the Red Sea coast (including Sinai) and, as the only bat species, it was documented in all Western Desert oases, including Siwa, Bahariya, Farafra, Dakhla, and Kharga (see the review by Benda et al. 2014). In the oasis of Siwa, about only 50 km away from the Libyan border, this bat was documented at least three times (Hayman 1949, Benda et al. 2006, 2014). Therefore, *A. tridens* could be expected to occur in all Libyan oases situated closely to the Egyptian border (Al Jaghbub, Jalu, Kufra). The same is true for the south-Libyan areas adjacent to the northern part of Chad; two findings are known from this part of that country, from Zouar in the south-western Tibesti Mts. (Toschi 1954, Benda et al. 2011b) and from Wanyanga (= Ounianga/Oumianga) in the north-eastern corner of the country (Booth 1961). These records suggest a possible occurrence of *A. tridens* in mountains and oases of southernmost Libya.

In the western part of North Africa, numerous records of *A. tridens* are spread across the whole desert and Sahel zones. The northernmost localities are known from the Saharan Atlas of Algeria (Biskra; Andersen 1918) and the Chott region of central Tunisia (Redeyef and M'dhila; Cockrum 1976), the southernmost localities from the Aïr region of Niger (Agadez and Irabellaben; Dekeyser 1950) and the northernmost corner of Burkina Faso (Tambao and Tin-Ediar; Koch-Weser 1984). While the Algerian and Niger sites of *A. tridens* records are localised rather far from the Libyan territory (>500 km), some records in eastern Tunisia were made relatively nearby the Libyan border. Puechmaille et al. (2012) reported a finding of a colony in the Sidi Toui National Park, only some 20 km away from Libya. Cockrum (1976) mentioned a specimen originating from Zarzis and Dalhoumi et al. (2011) another specimen from Djerba, both sites are situated on the Mediterranean Sea coast and the former one ca. 60 km away from the Libyan border. These records suggest the occurrence of *A. tridens* in the Gefara plain of Libya to be well possible and very likely.

In conclusion, it can be assumed that – regarding the distribution of *A. tridens* in other parts of North Africa – this bat could be met in any part of Libya, including the coastal areas of Tripolitania, with the only presumable exception of the Mediterranean zone of northern Cyreniaca, despite the fact that hitherto known records proved an occurrence of this species solely in the south-western part of Libya, where the desert conditions are the harshest.

Field notes. Field data concerning the findings of *Asellia tridens* in Libya are very scarce, most of the available records represent museum specimens without any information attached. However, it

* Fain (1967: 32) reported a record of *Asellia tridens* from "Oumianga, Désert de Libye (Sud)", i.e. from the eastern part of the Tibesti Mts. in northern Chad. However, this report was attributed to Libya by Fain (1967: 34), Anciaux de Faveaux (1984: 30) and Lanza (1999: 105), and perhaps also some others.

could be expected that a majority of the museum specimens was collected in roosts – *A. tridens* is typically and frequently found in artificial shelters in Egypt or in the Middle East (own observations). Nevertheless, two records in which circumstances are available represent foraging bats. One bat was caught in a hand-net as it foraged over a touristic campsite (only slightly illuminated by street lights) on the southern edge of the town of Ghat on the night of 3 October 1999 (Fig. 26). A group of 3–5 foraging individuals was observed and their calls were detected in a small oasis near the town of Al Awaynat on the night of 2 October 1999; the area was covered by a sandy desert in which small gardens with temporal pools of shallow water from a well were available.

No data on reproduction of *A. tridens* are available from Libya.

Material examined. 1 ♀ (NMP 48317 [S+A]), Ghat, 3 October 1999, leg. P. Benda; – 1 ♂ (SMF 11787 [S]), Mur-zuck, Fezzan, 1937, leg. O. Wohlbereit; – 1 ind. (MSNG 54783 [A]), Serdeles (Tripolitania), March 1934, leg. G. Scortecci; – 1 ♀ (MSNG 33222 [S+B]), Zuila, Fezzan, September 1933, leg. E. Zavattari; – 1 ♀ (MSNG 32180 [S+B]), Ubari, Fezzar, October 1932, leg. L. Cipriani.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Asellia tridens* are shown in Table 6. For the material examined see above.

Setzer (1957: 48) assigned the Fezzan populations of *A. tridens* to the nominotypical subspecies (described from Thebes, Luxor, Egypt; Kock 1969), but added the following note: "In view of the geographic location, these specimens might represent *Asellia tridens diluta*, whose type locality is El Golea, Algeria". In his analysis of the taxonomic position of the African populations of *A. tridens*, however, Kock (1969) failed to assign specimens from south-western Libya and other parts of the central Sahara to any specific taxon. Corbet (1978), Owen & Qumsiyeh (1987) and Koopman (1994) referred the Libyan part of the range of *A. tridens* to the nominotypical form. Based on a morphometric analysis, Benda et al. (2006) assigned a single evaluated Fezzan specimen from Ghat to *A. t. tridens*, due to its small size.

The available Libyan specimens were included in a revision of the genus *Asellia* by Benda et al. (2011b). Despite the morphometric variation in *A. tridens* (see below), the authors identified all African populations of this bat as its nominotypical form, with the excepion of the Somalian populations, which were shown to represent a separate species, *A. italosomalica* De Beaux, 1931.

Fig. 26. The oasis of Ghat (Fezzan); a foraging and roosting area of *Rhinolophus clivosus* and *Asellia tridens*. Photo by P. Benda (October 1999).

Table 8. Biometric data on comparative sample sets of *Asellia tridens* (Geoffroy, 1813). For abbreviations see p. 8

	Egypt & Sudan					Algeria & Tunisia					Morocco & West Africa				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	68	**49.09**	44.7	52.7	1.793	41	**50.67**	47.7	53.5	1.368	19	**51.55**	49.6	53.0	0.853
LCr	72	**18.49**	17.16	19.64	0.454	40	**19.12**	18.36	19.78	0.340	15	**19.13**	18.39	19.86	0.393
LCc	74	**16.26**	15.08	17.27	0.395	41	**16.90**	16.14	17.54	0.309	16	**16.73**	15.90	17.48	0.385
LaZ	75	**10.34**	9.48	11.13	0.337	42	**10.59**	9.92	11.12	0.273	16	**10.61**	9.61	11.28	0.416
LaI	76	**2.29**	2.05	2.72	0.140	42	**2.37**	2.11	2.57	0.106	16	**2.49**	2.31	2.67	0.119
LaN	76	**7.30**	6.67	7.87	0.213	42	**7.57**	7.08	7.98	0.196	16	**7.54**	6.87	8.11	0.292
ANc	74	**5.53**	5.16	6.13	0.219	41	**5.68**	5.16	6.08	0.183	16	**5.73**	5.32	6.13	0.196
CC	76	**5.20**	4.78	5.74	0.201	42	**5.40**	5.05	5.70	0.168	16	**5.47**	5.16	5.68	0.132
M^3M^3	76	**7.33**	6.81	7.85	0.233	42	**7.54**	7.08	7.98	0.207	16	**7.65**	6.97	8.14	0.234
CM^3	76	**6.70**	6.29	7.08	0.183	42	**6.89**	6.61	7.22	0.126	16	**6.95**	6.49	7.28	0.206
LMd	74	**12.50**	11.62	13.42	0.363	42	**12.92**	12.21	13.48	0.286	16	**12.94**	12.09	13.58	0.341
ACo	73	**3.99**	3.48	4.42	0.190	42	**4.08**	3.67	4.37	0.155	16	**4.22**	3.98	4.54	0.158
CM_3	74	**7.39**	7.02	8.01	0.213	42	**7.59**	7.14	7.93	0.152	16	**7.68**	7.32	8.02	0.192

The size variation in *A. t. tridens* from Africa is presented in Fig. 27 (see also Table 8). Specimens originating in the central parts of the Sahara, i.e. in southern Libya, southern Egypt, northern Chad and northern Sudan, are the smallest representatives of the species, whereas specimens originating in the desert and semi-desert parts of Tunisia, Algeria, Morocco, Mauritania, northern Egypt, and steppe areas of Senegal and Gambia, i.e. in the areas situated on the margins of the Sahara are large,

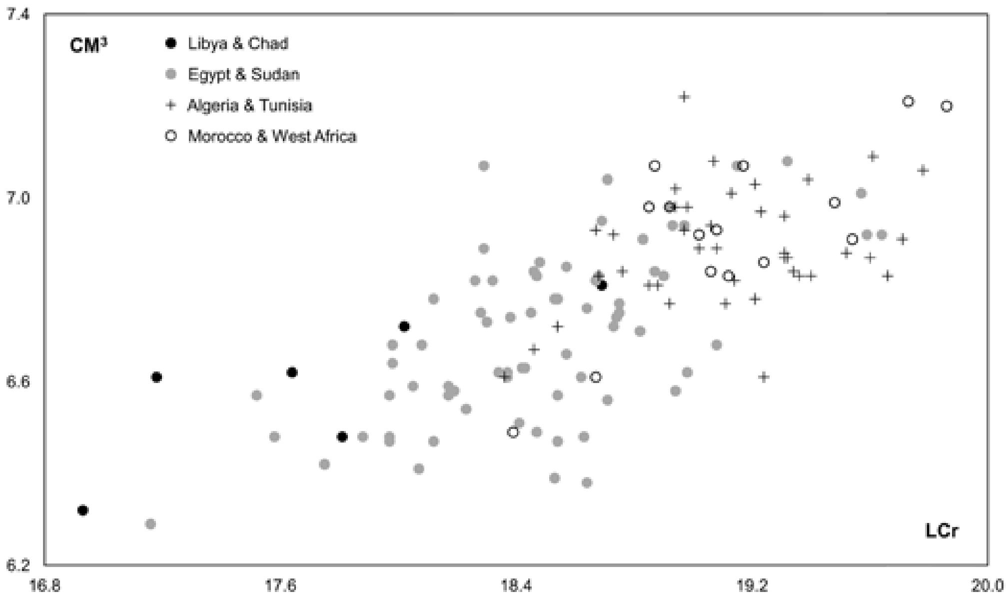


Fig. 27. Bivariate plot of the examined Libyan and comparative samples of *Asellia tridens* (Geoffroy, 1813): greatest length of skull (LCr) against the length of the upper tooth-row (CM^3).

although a certain overlap in dimensions with the small bats exists (Table 8). This size bimodality in *A. tridens* has been known for a long time and was discussed already by Harrison (1957), Kock (1969), Owen & Qumsiyeh (1987), Benda et al. (2006) and perhaps others. Traditionally, these two size morphs were regarded as separate subspecies (see Benda et al. 2006 for a review), the smaller bats including the south-Libyan populations as the nominotypical form and the larger bats as *A. t. murraiana* (Anderson, 1881), described from southern Pakistan and Iran.

However, the molecular genetic analysis by Benda et al. (2011b) demonstrated very close phylogenetic relationships of the African populations of *A. tridens*, irrespective of their geographic origin and size morphotype. The only evaluated Libyan specimen from Ghat, Fezzan, shared an identical haplotype with two bats from Morocco; another haplotype, differing from the former one in two substitutions only, was found in bats from Morocco, Egypt and the Sudan. This similarity in genetic traits indicates a very recent origin of the desert populations of *A. tridens*, which are spread over the Sahara, and a rapid evolution of their distinct morphotypes. The size bimodality can be considered as a general phenomenon in the Saharan bat populations, well comparable with the situation in the North African populations of other bat species, in which the customary taxonomy does not reflect the results of recent revisions (see *Rhinopoma cystops*, *Rhinolophus ferrumequinum*, *R. clivosus*, and *Pipistrellus kuhlii*).

FEEDING ECOLOGY. *Asellia tridens* is a small bat with a well manoeuvrable flight (Norberg & Rayner 1987, Amichai et al. 2013), its diet composition was studied in various parts of the range (Israel, Syria, Iran, Oman, Sudan). The species feeds mostly on Coleoptera, but Hymenoptera, Lepidoptera, Heteroptera, Orthoptera, Blattodea, and Diptera may also represent a substantial part of its diet (Whitaker et al. 1994, Mendelssohn & Yom-Tov 1999, Feldman et al. 2000, Whitaker & Yom-Tov 2002, Benda et al. 2006, 2012, Žďárská 2013).

From Libya, we analysed the content of one digestive tract of *A. tridens* from Ghat. It contained mainly the remains of beetles (Coleoptera: Scarabaeidae; 80% of volume) which were complemented by ants (Hymenoptera, Formicoidea; 20%). This composition – and namely the majority of Coleoptera – corresponds well with most of the results of previous studies of the diet of *A. tridens*.

Myotis punicus Felten, 1977

RECORDS. **Original data**: T r i p o l i t a n i a: Ain Sharshara [1], above a pool (Fig. 29), 26 May 2002: net. 2 ma, 1 fa, 3 fs, NMP; – Sabratha [2], ancient ruins (Fig. 30), 2 April 1979: 1 ma, 1 faG, 7 April 1979: 2 ma, 1 fa [SMF], 14 April 1979: 1 fj (cf. Hůrka 1982, Hanák & Elgadi 1984 [under *M. blythi*]), disused underground cistern, 13 October 1999: obs. 1 ind., small amphitheatre, 28 May 2002: net. 1 ma, NMP. – **Published data**: T r i p o l i t a n i a: Sabratha [2], ruins, 4 May 1981: obs. several inds., coll. 2 m (Qumsiyeh 1983 [under *M. blythi*]).

DISTRIBUTION. *Myotis punicus* ranks among rare bats of Libya, only two sites of occurrence are known from the north-western part of Tripolitania (Fig. 28). This bat was documented several times in various parts of the ancient ruins of Sabratha (1979, 1981, 1999, 2002), situated just on the Mediterranean Sea shore. One additional record was made at Ain Sharshara near Tarhunah, on an arid steppe plateau bordering the eastern parts of the Gefara plain and Jebel Nafusa Mts. at some 300 m a. s. l. (Fig. 29). The latter site represents the easternmost point of the continental range of *M. punicus*.

M. punicus is an endemic of the south-western part of the Mediterranean basin (Ruedi & Arlettaz 2013); it is widely distributed throughout the Mediterranean part of the Maghreb, from western Morocco to eastern Tunisia, and belongs to the most common species of all three countries (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Puechmaille et

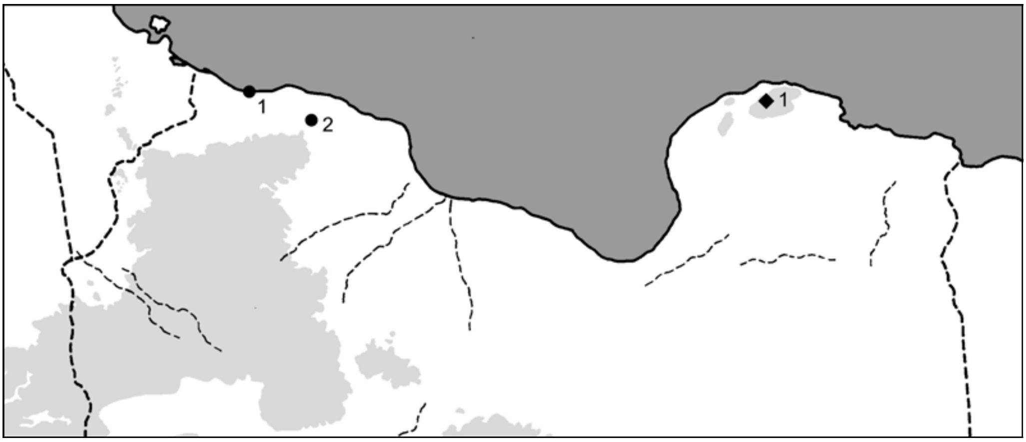


Fig. 28. Records of *Myotis punicus* Felten, 1977 (circles) and *Nyctalus leisleri* (Kuhl, 1817) (diamond) in Libya.

al. 2012). The Libyan range represents the easternmost part of the species distribution in North Africa; however, *M. punicus* was documented also in several Mediterranean islands, namely in Sardinia, Corsica, Lampedusa, and in the Maltese archipelago (Kock 1989, Borg 1998, Lanza 2012, Ruedi & Arlettaz 2013). Hence, only the occurrence in Malta is situated more to the east than the Tripolitanian range of this species.

The Libyan part of *M. punicus* range continues right into the known distribution in south--eastern Tunisia; at least three records are available from the Jebel Dahar Mts. Deleuil & Labbe (1955) published a finding from the "gouffre du Djebel Saïkra, près de Médenine", Baker et al. (1974) a record from "3 km NW Toujane (45 km. airline S Gabes)" and Puechmaille et al. (2012) reported an observation of an individual in Ghomrassen. These sites lie only 110–140 km away from the western border of Tripolitania.

Field notes. *Myotis punicus* was recorded in Libya several times in its roosts; however, all these findings were made in different parts of the extensive ruined Roman town of Sabratha (Fig. 30). The species was first recorded in Libya in April 1979, when altogether six individuals were discovered to roost in various sections of the ruins. Hanák & Elgadi (1984: 172) described these findings (under *M. blythi*) as follows: "Two solitary hiding individuals (1 ♂, 1 ♀), were extracted from crevices in the ceiling of a short space in a cellar (height roughly 4 m, length 20 m) with a wide entrance hole opening in the sloping shore of the sea [on 2 April]. Another male was hanging free from the ceiling of one of the galleries of an old Christian catacomb at about 1 km from the ruins town Sabratha [on 7 April]. The last two specimens (1 ♂, 1 ♀) were recovered from crevices in the ceiling of an abandoned entry to a Roman theatre in the centre of this ruins [on 7 April]. A point of interest worth emphasizing is the fact that all animals recovered were in a deeply torpid state, evidently associated with the unusually cool and windy weather […]." Aditionally, one male was found in the ruins by these authors on 14 April 1979.

Another roost finding of *M. punicus* (under *M. blythi*) from this site was described by Qumsiyeh (1983: 429) as follows: "On 4 May 1981, I collected two male specimens of this species from the ruins of Sabratha […]. Several individuals were roosting either solitary or in pairs in small (10–25 cm in diameter), but deep (30–100 cm in depth), crevices in the ceiling of cellers under the amphitheater at the Roman ruins of Sabratha." Two further records of *M. punicus* from the Sabratha ruins are known. A solitary bat was observed to roost in a disused underground cistern in the western excavation area on 13 October 1999; however, this bat was active and an attempt to examine it failed. Another solitary individual was found in a deep circular hole in the ceiling of a cellar of the amphitheatre situated east of the main ruin area on 28 May 2002 (this latter roost is perhaps the same space as described by Qumsiyeh 1983). The latter individual was subsequently caught in a net installed within the amphitheatre at the entrance to the cellar during the following night (in this space, one roosting *Pipistrellus kuhlii* was also found, while *Eptesicus isabellinus* and other *P. kuhlii* were caught in another net in the amphitheatre).

These circumstances indicate that the ruins serve as a system of temporal roosts for individuals and/or small groups of a larger population of *M. punicus* and perhaps also as a maternity roost (see below).

One record of foraging *M. punicus* is available from Libya, six bats were caught in a net installed above a pool at Ain Sharshara near Tarhunah on 26 May 2002 (Figs. 29, 31). The pool was filled from a spring surrounded by steppe landscape, with scattered fields, gardens, orchards,

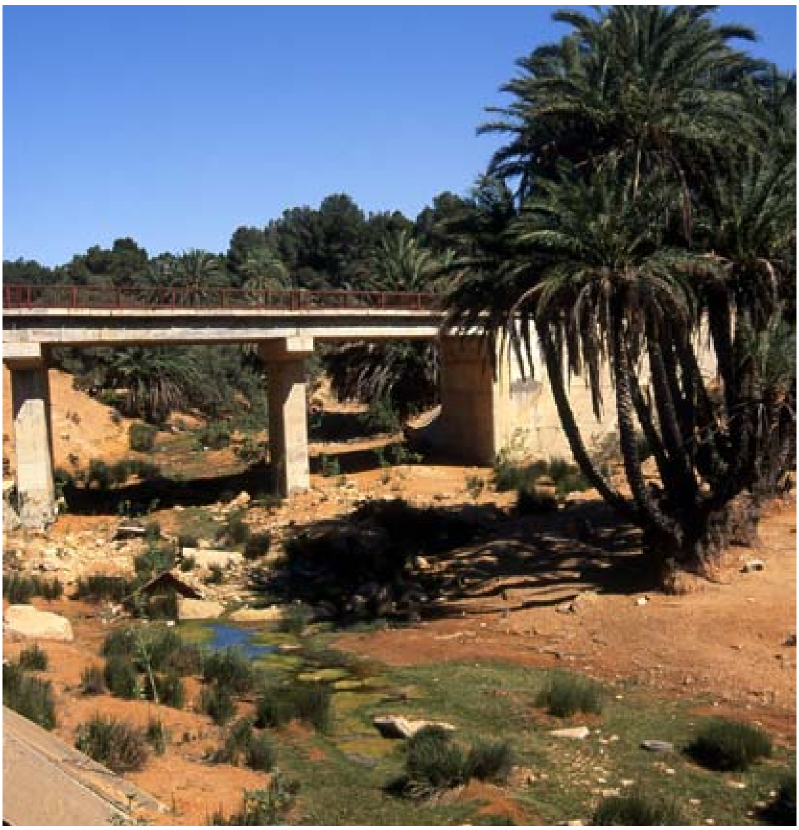


Fig. 29. A stream beneath the spring of Ain Sharshara (Tripolitania); a foraging habitat of numerous *Myotis punicus*, *Eptesicus isabellinus* and *Pipistrellus kuhlii* individuals. Photo by A. Reiter (May 2002).

Fig. 30. Ruins of the Roman city of Sabratha (Tripolitania); several individuals of *Myotis punicus*, *Eptesicus isabellinus* and *Pipistrellus kuhlii* were found to roost and/or to forage in various parts of the ruins. Photo by A. Reiter (May 2002).

and pastures. Besides *M. punicus*, also *Eptesicus isabellinus* and *Pipistrellus kuhlii* were caught at this site on the same night.

Reproduction of *M. punicus* was documented in the Sabratha population; a pregnant female was collected from the ruins on 2 April and a juvenile female weighing 5.5 g (roughly 25% of adult weight) was found there on 14 April; both were solitary (see above). These data clearly indicate the period of parturitions to occur in Tripolitania roughly in the first half of April.

Material examined. 2 ♂♂, 4 ♀♀ (NMP 49944–49947 [S+A], 49948, 49949 [A]), Ain Sharshara, 26 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (SMF 90872 [S+B]), Sabratha, 7 April 1979, leg. V. Hanák & K. Hůrka; – 1 ♂ (NMP 49980 [S+A]), Sabratha, 28 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Myotis punicus* are shown in Table 6. For the material examined see above, for depictions of the bacula from Libyan *M. punicus* see Hanák & Elgadi (1984: 177, Fig. 5).

The dimensions of the Libyan samples fall into the variation ranges of the Maghrebian populations (Table 9). There is no obvious trend in geographical variation through the North African range of the species (Fig. 32); the Maghrebian and Tripolitanian populations of *M. punicus* created one rather homogeneous morphotype (within the Maghrebian samples, only the most numerous set from Tunisia showed on average slightly large size of skulls). This conforms with the opinions given by Qumsiyeh (1983) and Ruedi & Arlettaz (2013).

Formerly, the Maghrebian populations of the large *Myotis* species were variously assigned to two species, *M. myotis* (Borkhausen, 1798) and/or *M. blythii* (Tomes, 1857), see the review by

Felten et al. (1977). Finally, the idea of a single occurring species prevailed and the respective form was described by Felten et al. (1977) as a subspecies, *M. blythii punicus* Felten, 1977. Qumsiyeh (1983) and Hanák & Elgadi (1984) assigned their findings from Sabratha, Libya, to this form. Castella et al. (2000) were the first who demonstrated an independent position of the Maghrebian mouse-eared bats and suggested species status for them.

Already Felten et al. (1977) noted certain morphometric differences between the Maghrebian and Corsican-Sardinian populations (of *M. blythii punicus* at that time), with insular bats being slightly larger in skull size. Separation of these two population groups was demonstrated also by Castella et al. (2000) by comparison of mtDNA sequences and an allozyme analysis. Evin et al. (2008) confirmed the size differences between the Maghrebian and Corsican-Sardinian bats (insular bats being larger) and reported also differences in their skull shapes (p. 535): "Compared to continental bats, insular bats exhibit a lower and shorter cranium, a narrower inter-orbital

Fig. 31. Portrait of *Myotis punicus* Felten, 1977 from Ain Sharshara (Tripolitania). Photo by A. Reiter.

Table 9. Biometric data on comparative sample sets of *Myotis punicus* Felten, 1977. For abbreviations see p. 8

	Tunisia					Algeria					Morocco				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	17	**59.49**	56.5	63.1	1.714	57	**59.75**	57.0	63.5	1.553	21	**58.64**	55.5	62.2	1.756
LCr	64	**22.41**	21.57	23.18	0.357	57	**21.98**	21.20	22.91	0.399	18	**22.13**	21.47	22.78	0.407
LCb	63	**21.34**	20.43	22.08	0.365	57	**20.92**	19.88	21.71	0.392	18	**21.07**	20.35	21.77	0.468
LaZ	56	**14.36**	13.65	14.98	0.291	54	**14.14**	13.40	14.98	0.299	16	**14.20**	13.68	14.63	0.244
LaI	62	**5.23**	4.78	5.93	0.173	57	**5.14**	4.82	5.48	0.157	18	**5.16**	4.89	5.41	0.148
LaN	64	**9.85**	9.22	10.22	0.205	57	**9.73**	9.33	10.17	0.187	18	**9.81**	9.41	10.17	0.214
ANc	63	**7.70**	7.35	8.09	0.189	57	**7.62**	7.22	7.95	0.187	18	**7.60**	7.32	7.98	0.194
CC	60	**5.74**	5.38	6.04	0.153	55	**5.59**	5.37	5.90	0.151	18	**5.62**	5.38	5.79	0.124
M^3M^3	63	**9.23**	8.83	9.58	0.187	57	**9.00**	8.47	9.92	0.242	18	**9.05**	8.68	9.35	0.187
CM^3	64	**9.36**	8.93	9.63	0.175	57	**9.18**	8.80	9.58	0.196	18	**9.31**	8.76	9.61	0.240
LMd	64	**16.90**	16.24	17.58	0.289	57	**16.59**	15.77	17.37	0.320	18	**16.55**	15.93	17.32	0.355
ACo	64	**5.81**	5.36	6.26	0.190	57	**5.71**	5.21	6.12	0.208	18	**5.71**	5.39	6.05	0.178
CM_3	63	**10.07**	9.59	10.47	0.219	56	**9.88**	9.35	10.27	0.212	18	**9.89**	9.42	10.17	0.234

constriction, and zygomatic arches forwardly shifted". The results of a molecular genetic analysis by Biolaz et al. (2010) conformed to this morphological evidence and separated the Maghrebian, Sardinian and Corsican populations; based on a microsatellite analysis, the Maghrebian samples from Tunisia and Morocco represented one group. All these records suggest separate taxonomic positions of the two *M. punicus* populations, one from continental North Africa (including

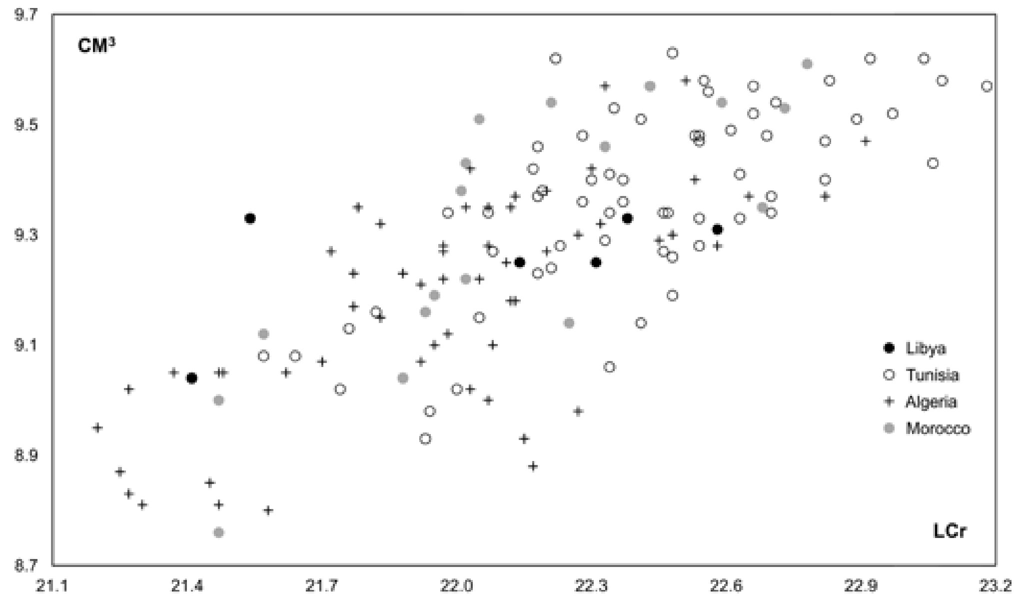


Fig. 32. Bivariate plot of the examined Libyan and comparative samples of *Myotis punicus* Felten, 1977: greatest length of skull (LCr) against the length of the upper tooth-row (CM^3).

Tripolitania) and the other one from the large Mediterranean islands of Corsica and Sardinia (in this respect, the position of Maltese populations remains unknown). Compared with intraspecific variation documented in other bats of the *Myotis myotis* group (see Evin et al. 2008: 533, Fig. 3), the differences between the two morphotypes of *M. punicus* have a similar level as those between two subspecies of *M. myotis*. Notwithstanding the final taxonomic arrangement of the Corsican--Sardinian and Maghrebian populations of *M. punicus*, the Tripolitanian populations should most certainly belong to the typical form, as the species was described from the El Haouaria cave, Cap Bon, northern Tunisia (Felten et al. 1977).

Feeding ecology. *Myotis punicus* is a medium-sized to large bat foraging in low flight and catching prey on the ground or in flight (Borg 1998, Beuneux 2004), its diet was studied in Morocco, Algeria, Corsica, Sardinia, and Malta. *M. punicus* is known to feed mostly on grass- and ground-dwelling insects; true crickets (Gryllidae), mole crickets (Gryllotalpidae), bush crickets (Tettigoniidae), cicadas (Cicadidae), ground beetles (Carabidae), scarab beetles (Scarabaeidae), spiders (Araneae), and moths (Lepidoptera) were identified in its diet (Arlettaz et. al. 1997, Borg 1998, Beuneux 2004).

The diet composition of *M. punicus* reported by Ahmim & Moali (2011) from northern Algeria is quite surprising; they recorded Diptera (mainly the smaller nematoceran groups, Culicidae and Chironomidae/Ceratopogonidae) as the principal items in the diet. However, these small dipteran taxa are foraged by aerial hawking and according to available data, these items do not occur in the diets of bats of the *M. myotis* group in any substantial volumes (see e.g. Bauerová 1978, Arlettaz et al. 1997, Benda et al. 2006, 2012, Whitaker & Karataş 2009, Graclik & Wasielewski 2012, etc.). Furthermore, Ahmim & Moali (2011) collected the faeces on the ground in the roosts and assigned them to *M. punicus* solely on the basis of the size of the pellets. Considering the other

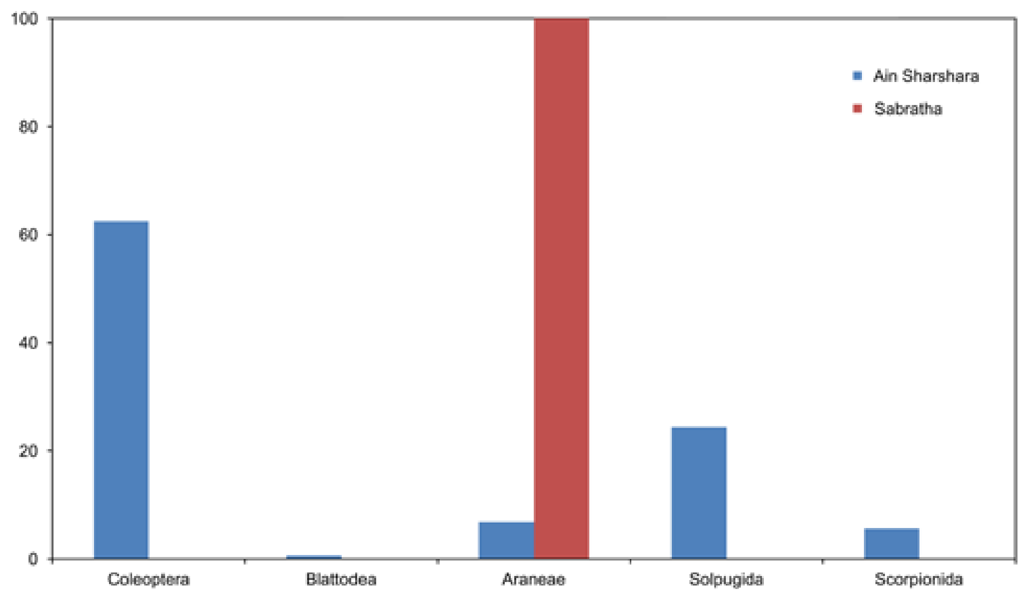


Fig. 33. Percentage volume of particular food items in the diet of *Myotis punicus* Felten, 1977 in Libya. Material analysed: Ain Sharshara (30 faecal pellets / from 6 individuals), Sabratha (7 / 1).

published results, the data on the diet of *M. punicus* presented by Ahmim & Moali (2011) seem to be somewhat questionable.

From Libya, two sample sets of faecal pellets were analysed (Fig. 33). One set from one individual collected at Sabratha contained only large spiders (Araneae), while the other set from six bats from Ain Sharshara was dominated by beetles (Coleoptera), mainly greater cockchafers (Scarabaeidae: Melolonthinae), and complemented by solifuges (Solpugida), cockroaches (Blattodea) and small scorpions (Scorpionida).

The results of our analyses correspond relatively well with the outcomes of previously published studies on *M. punicus* (Arlettaz et. al. 1997, Borg 1998, Beuneux 2004) and indicate the important role of ground gleaning in the foraging behaviour of this bat. On the other hand, the evidence of *M. punicus* feeding entirely on spiders seems to be unusual; however, the respective faeces were collected from one individual only. Anyway, spiders occur in the diet of *M. punicus* ordinarily, but they usually do not prevail (Arlettaz et. al. 1997). Similarly, scorpions were already recorded as a less important item in the diet of *M. punicus* from Morocco (Arlettaz et al. 1997). Regarding that the species regularly feeds on spiders on the ground, it is not surprising that we recorded also solifuges in the diet. From this point of view, the diet composition of *M. punicus* in Libya resembles that of another ground-gleaning bat occurring in arid habitats of the southern and eastern Mediterranean – *Otonycteris hemprichii* (see e.g. Benda et al. 2006, 2010a, 2012, etc.).

Records of ectoparasites. **Original data**: N y c t e r i b i i d a e: *Nycteribia vexata*: 1 ma (CMŠ [A]) from 2 ma, 1 fa, 3 fs (NMP 49944–49949), Ain Sharshara, 27 May 2002. – S p i n t u r n i c i d a e: *Spinturnix myoti*: 2 ma, 2 fa, 1 deutonymph, 1 protonymph (CMŠ [P]) from 2 ma, 1 fa, 3 fs (NMP 49944–49949), Ain Sharshara, 27 May 2002. – M a c r o n y s s i d a e: *Steatonyssus occidentalis*: 1 fa (CMŠ [P]; det. P. Mašán) from 2 ma, 1 fa, 3 fs (NMP 49944–49949), Ain Sharshara, 27 May 2002. – **Published data**: I s c h n o p s y l l i d a e: *Rhinolophopsylla unipectinata*: 20 ma, 12 fa from 5 host inds., Antique ruins of Sabratha, 2 and 7 April 1979 (Hůrka 1982). – N y c t e r i b i i d a e: *Nycteribia latreillii*: 1 ma, 1 fa from 1 fa, Antique ruins of Sabratha, 2 April 1979 (Hůrka 1982). – *Nycteribia vexata*: 2 ma, 1 fa from 5 host inds., Antique ruins of Sabratha, 7 April 1979 (Hůrka 1982).

Comments on ectoparasites. From *Myotis punicus* in Libya, only one bat flea species was collected, *Rhinolophopsylla unipectinata* (Taschenberg, 1880). *M. punicus* is a regular host species of

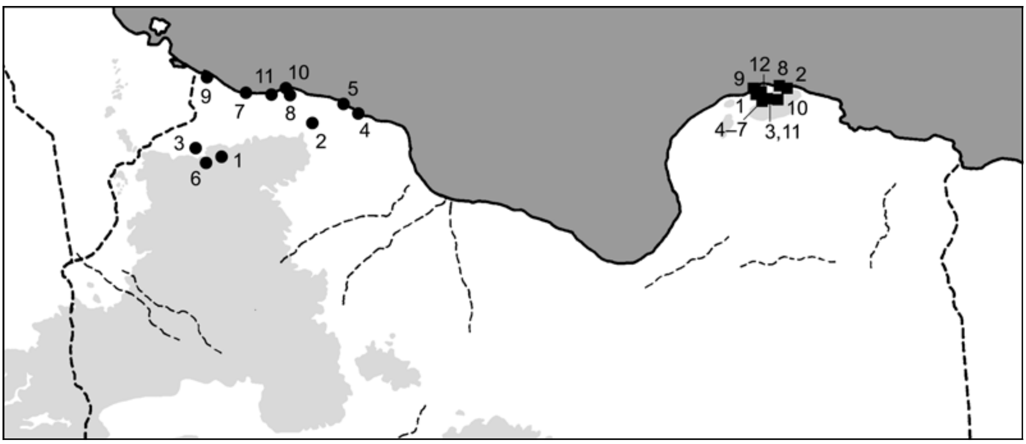


Fig. 34. Records of *Eptesicus isabellinus* (Temminck, 1840) (circles) and *Pipistrellus hanaki* Hulva et Benda, 2004 (squares) in Libya.

this parasite, its records are available also from the Maghreb (Beaucournu & Launay 1990); for distribution details see the comments on ectoparasites of *Rhinolophus mehelyi*.

Two nycteribiid flies are known to parasitise *M. punicus* in Libya. *Nycteribia latreillii* (Leach, 1817) is principally joined with hosts of the *Myotis myotis* group and its distribution range corresponds with the ranges of these bats (cf. Hůrka 1964); i.e. a large part of the western Palaearctic. Another bat fly species, *Nycteribia vexata* Westwood, 1835, shows an almost identical host preference as well as distribution range as the previous species (see Hůrka 1964).

The mite *Spinturnix myoti* (Kolenati, 1856) is a permanent parasite of several species of the genus *Myotis*, from *M. punicus* it was reported from Morocco, Corsica and Sardinia (Bruyndonckx et al. 2010). From Libya, this parasite is here reported for the first time (it was also collected from *Tadarida teniotis*, see below).

From *M. punicus*, one macronyssid mite was also collected, *Steatonyssus occidentalis* (Ewing, 1933), and this record represents the first evidence of this parasite in Libya. The subspecies *S. o. evansi* Micherdziński, 1980 is known to occur in Europe and West Turkestan, where it parasitises bats of the genera *Eptesicus*, *Myotis*, *Nyctalus*, *Pipistrellus*, and *Plecotus* (see the review by Lanza 1999). However, records also from other bats are not unusual (Stanyukovich 1997).

Eptesicus isabellinus (Temminck, 1840)

Records. **Original data**: T r i p o l i t a n i a: Ain Az Zarqa [1], above a pool (Figs. 8, 9), 9 May 2002: det. calls of min. 3 foraging inds., net. 1 ma, NMP (cf. Benda et al. 2006); – Ain Sharshara [2], above a pool (Fig. 29), 26 May 2002: net. 1 ma, 2 fa, NMP (cf. Benda et al. 2006, Juste et al. 2013); – Al Jawsh [3] (Fig. 37), ruined village, 6 May 2002: det. calls of 1 foraging ind.; – Ka'am [4], at a river (Fig. 57), 25 May 2002: det. calls of 1 foraging ind.; – Lebdah [5], Leptis Magna ancient ruins, ceiling crevices in corridors of Roman theatre (Fig. 35), 26 May 2002: coll. 2 ma, NMP (cf. Benda et al. 2006, Juste et al. 2013), ceiling crevices in a cellar under Severan Forum, 26 May 2002: coll. 2 ma, NMP (cf. Benda et al. 2006); – Nanatalah [6], above a pool (Fig. 80), 27 May 2002: net. 3 ma, NMP (cf. Benda et al. 2006, Juste et al. 2013); – Sabratha [7], ancient ruins, fissures in Roman theatre (Fig. 30), 28 May 2002: obs. 1 ind. juv., coll. 3 fa, NMP (cf. Benda et al. 2006, Juste et al. 2013), small amphitheatre, 27 May 2002: net. 1 ma, NMP (cf. Benda et al. 2006, Juste et al. 2013); – Tarabulus, Sidi Al Mesri [8], University Botanical Garden, 6 May 1980: net. 1 ma, NMP (cf. Hůrka 1982, Hanák & Elgadi 1984, Benda et al. 2006). – **Published data**: T r i p o l i t a n i a: Leptis Magna [5], May 1969: 1 ind. (Hufnagl 1972 [under *E. serotinus*]); – Pisida (= Abu Kammash) [9], 230 km W of Tripoli (= Tarabulus), 29 August 1937: 1 fa, MSNG (Hanák & Elgadi 1984 [under *E. serotinus*]); – l'Afrique septentrionale, […] les environs de Tripoli (= Tarabulus) [10] (Temminck 1835–1841 [= 1840]), Tripoli (= Tarabulus), 1 fa, RMNH (Jentink 1887, 1888), 2 fa, 1 ind. juv, RMNH (Harrison 1963 [under *E. serotinus*]), Tripoli (= Tarabulus), old part of town, June 1969: 1 ind. (Hufnagl 1972 [under *E. serotinus serotinus*]); – Tripoli-Zanzur (= Tarabulus, Janzur) [11], town outskirts, summer 1978: 2 fj (Hanák & Elgadi 1984 [under *E. serotinus*]).

Distribution. The distribution of *Eptesicus isabellinus* in Libya is restricted to the dry steppe areas of the Gefara plain in north-western Tripolitania, enclosed between the sea shore and the northern margin of the Nafusa plateau (Fig. 34). Most of the records were made in anthropogenic habitats just on the sea coast (towns, ancient ruins). The southernmost records originate from sites associated with the northern escarpment of the Jebel Nafusa Mts. (Ain Az Zarqa, Nanatalah). With eleven known localities, *E. isabellinus* represents the second most common bat species of Tripolitania (after *Pipistrellus kuhlii*) and belongs to one of the most frequently recorded bats of Libya as well (Table 1).

E. isabellinus is an endemic of the western part of the Mediterranean basin (Juste et al. 2013); it lives in the southern part of the Iberian peninsula and is widely distributed throughout the Maghreb, from western Morocco to eastern Tunisia. In the Maghrebian countries, it belongs to the most common species (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Puechmaille et al. 2012). The Libyan distribution represents the eastern part of the species range and the record at Ka'am is the easternmost known site of the whole *E. isabellinus* range.

Fig. 35. Ruins of the Roman city of Leptis Magna, Lebdah (Tripolitania); several individuals of *Eptesicus isabellinus* were found to roost in various parts of the ruins, including the Roman theatre. Photo by A. Reiter (May 2002).

The Libyan range of *E. isabellinus* continues into its known distribution in south-eastern Tunisia; although the majority of records (17) are available from the part of the country lying northwards of the Chott region (see Puechmaille et al. 2012), at least one finding was reported from the Jebel Dahar Mts. Baker et al. (1974) published a record from Foum Tatahouine, situated slightly less than a hundred kilometres west of the Libyan border.

Hanák & Elgadi (1984) expected the occurrence of *E. isabellinus* also in desert areas of North Africa; however, it has not been proved in any of the respective countries, and the range of this bat in the Maghreb is completely comparable with other Mediterranean faunal elements, not only among bats (see Aulagnier & Thevenot 1986, or Kowalski & Rzebik-Kowalska 1991); comp. also Figs. 2, 28, 34, and 81.

Field notes. *Eptesicus isabellinus* was recorded in Libya most frequently at its foraging grounds, although some records from roosts are also available.

Several solitary males of *E. isabellinus* were documented to roost in the ruined Roman town of Leptis Magna on 26 May 2002 (Fig. 35); two solitary individuals were found in fissures in the ceilings of two corridors of the great theatre (fully illuminated by daylight) and two additional solitary bats in crevices in the ceiling of a dark underground room under the Severan Forum. A record of *E. isabellinus* from this ancient town was reported also by Hufnagl (1972). Four individuals of *E. isabellinus* were found to roost solitarily in fissures between stones in the ceiling vault (some 3 m in height) or on walls in the basement corridor of the great theatre of the ruined Roman town of Sabratha on 28 May 2002 (Fig. 30).

At seven localities, foraging individuals of *E. isabellinus* were recorded. An adult male was netted in an orange grove in the botanical garden of the Tarabulus University on 6 May 1980 (cf. Hanák & Elgadi 1984, under *E. serotinus*); the site is a larger island of park vegetation surrounded by resident areas of Sidi Al Mesri in the southern part of the capital. An adult male of *E. isabellinus* was caught in a net installed witin the amphitheatre area of the ruined Roman town of Sabratha on 28 May 2002 (together with four *P. kuhlii*); the ancient site is situated just on the sea shore and represents a patchwork of ruins and bush vegetation or pastures. Three *E. isabellinus* were caught in a net installed above a pool at Ain Sharshara near Tarhunah on 26 May 2002 (Fig. 29). The pool is filled from a spring surrounded by extensively used steppe landscape with scattered fields, gardens, pastures and orchards. Besides *E. isabellinus*, also *Myotis punicus* and *Pipistrellus kuhlii* were caught at this site on the same night.

Several individuals of *E. isabellinus* were captured in mist-nets installed close to open waters of two lakes filled from springs situated in the arid landscape of the northern escarpment of the Jebel Nafusa Mts., viz. Ain Az Zarqa on 9 May 2002 (Figs. 8, 9, 36) and Nanatalah on 27 May 2002 (Fig. 80). The lakes are surrounded by a dense riparian vegetation and a limited rim of trees. These humid spots in the arid landscape of the escarpment represent the southernmost limit of the *E. isabellinus* distribution in Tripolitania. At both sites, the individuals of *E. isabellinus* were a part of larger bat communities representing both the Mediterranean and desert faunas. Calls of *Pipistrellus kuhlii* were detected and *Rhinolophus ferrumequinum* and *Plecotus gaisleri* were netted together with *E. isabellinus* at Ain Az Zarqa, while *Rhinolophus ferrumequinum*, *Pipistrellus kuhlii*, *Otonycteris hemprichii*, and *Plecotus gaisleri* were netted along with this bat species at Nanatalah.

Fig. 36. Portrait of *Eptesicus isabellinus* (Temminck, 1840) from Ain Az Zarqa (Tripolitania). Photo by A. Reiter.

Fig. 37. Steppe landscape at Al Jawsh, in the southern part of the Gefara plain (Tripolitania); a foraging area of *Eptesicus isabellinus* and *Pipistrellus kuhlii*. Photo by A. Reiter (May 2002).

Echolocation calls of foraging individuals of *E. isabellinus* were recorded at several sites where bats were also netted. Solely the calls were registered at two sites, at a river near Ka'am very close to sea shore and enclosed by built-up areas on 25 May 2002 (Fig. 57) and near a ruined village in a dry steppe landscape at Al Jawsh on 6 May 2002 (Fig. 37); calls of *Pipistrellus kuhlii* were also recorded at both sites.

Only limited data on reproduction of *E. isabelinus* in Libya are available. Hanák & Elgadi (1984) reported a record of two juvenile females (under *E. serotinus*) from Janzur, west of Tarabulus, in the spring 1978. A non-volant juvenile of *E. isabellinus* was observed to roost on the wall of a dark corridor in the great theatre of Sabratha on 28 May 2002. The latter record suggests the period of parturitions in Libya to occur roughly around mid-May.

Material examined. 1 ♂ (NMP 49855 [S+A]), Ain Az Zarqa, 9 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂, 2 ♀♀ (NMP 49950, 49951 [S+A], 49952 [A]), Ain Sharshara, 26 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 4 ♂♂ (NMP 49941–49943 [S+A], 49940 [A]), Leptis Magna, 26 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 3 ♂♂ (NMP 49961, 49962 [S+A], 49963 [A]), Nanatalah, 27 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (MSNG 46923 [S+A]), Pisida, 29 August 1937, leg. E. Moltoni; – 1 ♂, 3 ♀♀ (NMP 49977–49979 [S+A], 49976 [A]), Sabratha, 28 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (NMP 95039 [S+B]), Tripoli, 14 April 1979, leg. A. El Gadi; – 1 ♀ (NMP 95067 [S+W]), Tripoli, Sidi Mesri, 6 May 1980, leg. V. Hanák & K. Hůrka.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Eptesicus isabellinus* are shown in Table 10. For the material examined see above, for depictions of the type specimens of *Vespertilio isabellinus* see Harrison (1963: Plate vi), for the lectotype dimensions see Table 5, for depiction of the baculum of Libyan *E. isabellinus* see Benda et al. (2006: 166, Fig. 100).

E. isabellinus was originally described as and for a long time considered an independent species (Temminck 1840, Lataste 1885, Cabrera 1932, Heim de Balsac 1936, Ellerman & Morrison-Scott

1951, Monteil 1951, Panouse 1951, Strinati 1951, Toschi 1954, Deleuil & Labbe 1955, Setzer 1957, Brosset 1960). Based on a morphological examination of the (RMNH) type series, Harrison (1963) suggested it to represent a subspecies of *E. serotinus* (Schreber, 1774) – an idea proposed already by Klaptocz (1909), Zavattari (1937), Allen (1939), and Rode (1947). This opinion was broadly accepted (Hill 1964, Hayman & Hill 1971, Ancieaux de Faveaux 1976, Corbet 1978, Kowalski 1979, Hanák & Elgadi 1984, Aulagnier & Thevenot 1986, Gaisler & Kowalski 1986, Kowalski & Rzebik-Kowalska 1991, Koopman 1994, Horáček et al. 2000, Simmons 2005, etc.). Benda et al. (2006) compared a large set of these bats from the Maghreb and Tripolitania with sets of *E. serotinus* samples and found the North African bats to be the most diverse within the species s.l. (along with *E. s. turcomanus* from Central Asia). Ibáñez et al. (2006) and Mayer et al. (2007) demonstrated extremely deep divergences between the European (*E. s. serotinus*) and south Iberian / North African (*E. s. isabellinus*) populations (e.g. genetic distances >16% between sequences of two examined mitochondrial genes). This divergence clearly indicated species statuses for both forms and the species position of *E. isabellinus* was restored (García-Mudarra et al. 2009, Benda et al. 2010b, Dieuleveut et al. 2010, Dalhoumi et al. 2011, Puechmaille et al. 2012, Juste et al. 2013).

Within the North African populations of *E. isabellinus*, two morphotypes can be detected (Fig. 38, Table 11). One morphotype is represented by Tripolitanian bats, which have larger skulls and relatively longer rostra (Table 10) than the other morphotype, represented by bats from Algeria and Morocco (Table 11). This difference could be associated with the genetic divergence detected between the Tripolitanian and Ibero-Moroccan populations (Juste et al. 2013), representing two well supported lineages. However, these lineages diverged only in 0.9% of the corrected genetic distance (K2p) in the mitochondrial gene for cytochrome *b*. Juste et al. (2013) tentatively suggested subspecific statuses for these lineages, *E. i. isabellinus* from Libya (described from Tarabulus, Libya; Temminck 1840) and *E. i. boscai* (Cabrera, 1904) from Morocco and

Table 10. Basic biometric data on the examined Libyan samples of *Eptesicus isabellinus* (Temminck, 1840), *Pipistrellus hanaki* Hulva et Benda, 2004 and *P. kuhlii* (Kuhl, 1817). For abbreviations see p. 8

	Eptesicus isabellinus					*Pipistrellus hanaki*					*Pipistrellus kuhlii*				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	17	**49.05**	45.1	52.7	2.058	22	**32.19**	30.8	33.4	0.833	125	**33.49**	29.7	36.4	1.365
LCr	13	**19.58**	18.51	20.51	0.637	21	**12.29**	11.69	12.69	0.251	106	**12.96**	11.54	13.94	0.567
LCb	13	**19.23**	18.30	20.02	0.543	21	**11.80**	11.12	12.18	0.266	106	**12.57**	11.08	13.47	0.586
LaZ	13	**13.91**	12.77	14.42	0.448	21	**7.77**	7.43	8.12	0.169	88	**8.56**	7.49	9.27	0.418
LaI	13	**4.34**	4.13	4.58	0.131	21	**3.12**	2.98	3.35	0.099	107	**3.25**	2.74	3.55	0.166
LaInf	13	**6.53**	6.13	6.88	0.223	21	**3.64**	3.48	3.84	0.120	99	**3.99**	3.31	4.43	0.253
LaN	13	**9.24**	8.73	9.67	0.289	21	**6.21**	5.87	6.51	0.163	106	**6.43**	5.88	6.92	0.215
LaM	13	**10.99**	10.17	11.37	0.348	21	**7.04**	6.64	7.37	0.188	107	**7.49**	6.63	8.12	0.302
ANc	13	**6.67**	6.17	7.08	0.244	21	**4.44**	4.14	4.63	0.104	104	**4.66**	4.05	5.24	0.203
LBT	13	**4.20**	3.74	5.13	0.373	19	**2.79**	2.52	3.09	0.139	97	**2.96**	2.58	3.42	0.172
CC	13	**6.57**	6.14	6.83	0.197	21	**3.85**	3.62	4.08	0.106	106	**4.17**	3.58	4.75	0.264
M^3M^3	13	**8.58**	7.93	8.94	0.282	21	**5.10**	4.89	5.31	0.098	107	**5.66**	4.84	7.66	0.355
CM^3	13	**7.43**	7.07	7.76	0.251	21	**4.41**	4.27	4.53	0.084	108	**4.82**	4.17	6.04	0.297
LMd	13	**14.69**	13.93	15.36	0.417	20	**8.60**	8.23	8.92	0.195	106	**9.39**	8.22	10.13	0.464
ACo	13	**5.41**	4.98	5.75	0.254	20	**2.56**	2.47	2.76	0.071	107	**3.00**	2.56	3.31	0.167
CM_3	13	**8.21**	7.76	8.57	0.275	20	**4.68**	4.49	4.83	0.096	107	**5.15**	4.47	5.63	0.281
CM^3/LCb	13	**0.386**	0.369	0.403	0.009	–	–	–	–	–	–	–	–	–	–

Table 11. Biometric data on comparative sample sets of *Eptesicus isabellinus* (Temminck, 1840). For abbreviations see p. 8

	Algeria					Morocco				
	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	8	**47.16**	45.3	48.9	1.307	26	**49.47**	45.9	51.9	1.448
LCr	15	**18.89**	17.86	19.55	0.461	21	**19.01**	18.02	20.21	0.485
LCb	15	**18.43**	17.61	18.92	0.417	21	**18.64**	17.82	19.61	0.395
LaZ	14	**13.31**	12.42	13.83	0.392	19	**13.36**	12.18	14.14	0.448
LaI	15	**4.27**	3.92	4.54	0.195	21	**4.24**	3.89	4.51	0.208
LaN	15	**8.88**	8.18	9.52	0.343	21	**9.02**	8.64	9.42	0.214
ANc	15	**6.32**	5.91	6.76	0.224	19	**6.39**	5.93	6.84	0.254
CC	15	**6.11**	5.82	6.36	0.154	20	**6.15**	5.68	6.51	0.198
M^3M^3	15	**8.09**	7.56	8.37	0.224	19	**8.23**	7.64	8.61	0.231
CM^3	15	**6.97**	6.68	7.22	0.166	21	**7.12**	6.81	7.36	0.165
LMd	15	**14.07**	13.42	14.53	0.316	20	**14.21**	13.54	14.73	0.292
ACo	15	**5.28**	5.02	5.58	0.170	21	**5.28**	4.98	5.75	0.186
CM_3	15	**7.68**	6.94	7.98	0.272	21	**7.82**	7.54	8.07	0.152
CM^3/LCb	15	**0.378**	0.369	0.396	0.009	21	**0.382**	0.363	0.394	0.008

southern Iberia (described from Muchamiel, Alicante, Spain; Cabrera 1904). However, the link between the genetic divergence and morphological separation remains to be proven; there still exists a possibility that the smaller bats from Morocco and Algeria on one side and larger bats

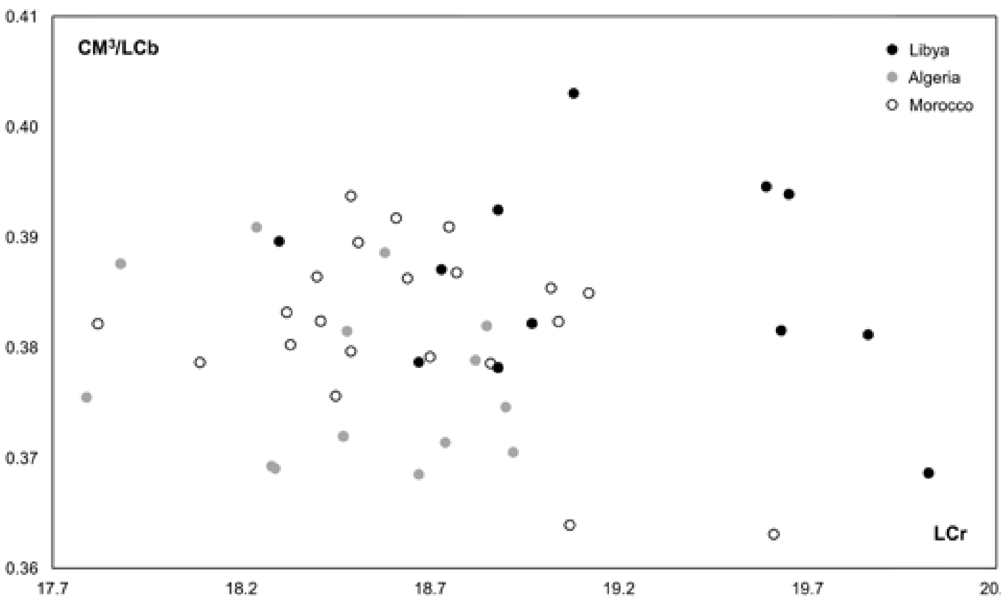


Fig. 38. Bivariate plot of the examined Libyan and comparative samples of *Eptesicus isabellinus* (Temminck, 1840): greatest length of skull (LCr) against the relative length of rostrum (CM^3/LCb).

from Tripolitania on the other side represent two margins of a cline instead of a step difference suggested by the genetic results.

Besides a record of *Eptesicus serotinus isabellinus* (= *E. isabellinus*) from Leptis Magna accompanied by a drawing and a photo, Hufnagl (1972: 32) reported a record of *E. serotinus serotinus* from Tarabulus. He distinguished the collected specimen from *E. s. isabellinus* by the absence of a black mask and by darker pelage. As the specimen, which was housed in the Zoological Museum of the University of Libya, is not available to us for examination and would be the only evidence from Libya, we refrain from listing *Eptesicus serotinus* as a species occurring in Libya. Thus, here we tentatively consider Hufnagl's report from Tarabulus as a record of *E. isabellinus*.

Feeding ecology. *Eptesicus isabellinus* is a medium-sized bat foraging in manoeuvrable flight around trees and rocks (Brosset 1955, Dietz et al. 2007). According to our best knowledge, the diet of this species has not been studied so far and its composition is probably here reported for the first time.

We analysed four sets of faecal pellets (Fig. 39) and a set of three digestive tracts of *E. isabellinus* from Libya. The diet composition was most frequently dominated by ants (Hymenoptera, Formicoidea) and beetles (Coleoptera). Within beetles, the families Scarabaeidae and Cerambycidae were the most abundant in the diet. Nevertheless, Carabidae, Curculionidae, Staphylinidae, and Tenebrionidae were also recorded. One sample set of five pellets from one individual from Ain Az Zarqa was dominated by moths (Lepidoptera).

The diet of *E. isabellinus* in Libya, in which important proportions are represented by beetles and ants, resembles more or less the diet of other *Eptesicus* species (e.g. *E. bottae* (Peters, 1869),

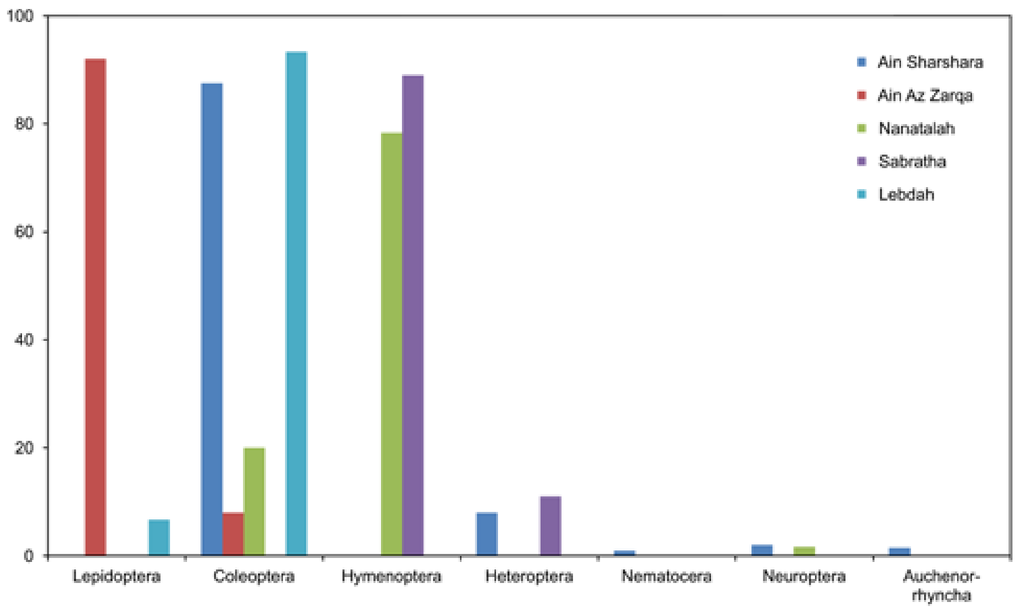


Fig. 39. Percentage volume of particular food items in the diet of *Eptesicus isabellinus* (Temminck, 1840) in Libya. Material analysed: Ain Sharshara (27 faecal pellets / from 3 individuals), Ain Az Zarqa (Tripolitania) (5 / 1), Nanatalah (18 / 3), Sabratha (20 / 4), Lebdah (three digestive tracts).

E. anatolicus Felten, 1971) occurring in arid parts of the Middle East (Benda et al. 2006, 2010a, 2012, Whitaker & Karataş 2009). The fact that *E. isabellinus* can feed predominantly on more types of prey (Coleoptera, Formicoidea, Lepidoptera) indicates a certain flexibility of the species' foraging behaviour.

RECORDS OF ECTOPARASITES. **Original data**: A r g a s i d a e: *Argas vespertilionis*: 1 larva (CMŠ [P]) from 1 fa (NMP 49952), Ain Sharshara, 26 May 2002. – **Published data**: I s c h n o p s y l l i d a e: *Ischnopsyllus intermedius*: 1 fa from 1 host ind., Tripoli – Sidi Mesra (= Tarabulus, Sidi Al Mesri), 6 May 1980 (Hůrka 1982).

COMMENTS ON ECTOPARASITES. The soft tick *Argas vespertilionis* (Latreille, 1802) is here reported for the first time from *Eptesicus isabellinus* and also for the first time from Libya (where it was simultaneously collected from several bat species). However, the finding from this bat is not surprising since this parasite is known to use more host species, not only among vespertilionid bats (Hoogstraal 1956, Filippova 1966), see also the comments on ectoparasites of *Rhinopoma cystops*. From the neighbouring Algeria, a closely related species, *A. transgariepinus* White, 1846, was collected from *E. isabellinus* (Beaucornu & Clerc 1968).

The bat flea *Ischnopsyllus intermedius* (Rothschild, 1898) was recorded from this host by Hůrka (1982). This parasite is distributed in the southern part of the western Palaearctic (Beaucornu & Launay 1990). From *E. isabellinus* it was collected also in Algeria (Beaucornu & Kowalski 1985). The bats of the *serotinus* group are regarded as principal hosts over the whole area of distribution of this flea; however, a variety of other vespertilionid bats was also recorded as its hosts (see Hůrka 1963).

Pipistrellus hanaki Hulva et Benda, 2004

RECORDS. **Original data**: C y r e n a i c a: 7 km NW of Massah [1], troughs for livestock watering near karstic spring, 31 July 1981: net. 1 ma, NMW; – Arqub Ash Shafshaf [2], above a stream (Fig. 40), 17 May 2002: net. 1 ma, 2 faG, NMP (cf. Benda et al. 2004b, Hulva et al. 2004, 2010, Mlíkovský et al. 2011, Herdina et al. 2014); – Wadi Al Kuf [3], 5 km SW of Al Bayda, at a small river (Fig. 41), 29 April 1980: net. 2 fa (cf. Hůrka 1982, Hanák & Elgadi 1984), 1 May 1980: net. 1 fa, NMP (cf. Hanák & Gaisler 1983, Hanák & Elgadi 1984), at a small river and at a rocky overhang, 18 May 2002: det. calls of numerous foraging inds., net. 1 fs, 3 faG, NMP (cf. Benda et al. 2004b, Hulva et al. 2004, 2010, Mlíkovský et al. 2011, Veith et al. 2011, Herdina et al. 2014); – Wadi Al Kuf, near a quarry [4], 12 August 1981: net. 1 fa, NMW, small cave, 19 May 2002: det. calls of numerous foraging inds., net. 1 ms, 2 faG, NMP (cf. Benda et al. 2004b, Hulva et al. 2004, 2010, Mlíkovský et al. 2011, Veith et al. 2011, Herdina et al. 2014); – Wadi Al Kuf, ancient ruins in a small side valley of the wadi [5], 3 August 1981: net. 1 fs; – Wadi Al Kuf, under the Ar Ruba road bridge [6], 15 August 1981: net. 1 ma, NMW; – Wadi Al Kuf, a large cave at the SE side of the valley [7], 18 August 1981: net. 1 fa, 22 August 1981: net. 4 fa, NMW; – Wadi Al Minshiyah [8] (Fig. 99), under a bridge above the wadi, 16 May 2002: net. 1 fa, NMP (cf. Benda et al. 2004b, Hulva et al. 2004, Herdina et al. 2014); – Wadi Jarmah [9], at a rocky overhang in the wadi slope (Fig. 43), 20 May 2002: det. calls of several forarging inds. – **Published data** [all under *P. pipistrellus*]: C y r e n a i c a: 5 km SW Al Abraq [10], 8 June 1962: 1 m, USNM (Qumsiyeh & Schlitter 1982, Hanák & Elgadi 1984); – 4 km S Beida (= Al Bayda) [11], 1981: 2 m (Qumsiyeh & Schlitter 1982); – 8 km SSE Haniya [12], 3 April 1981: 1 f (Qumsiyeh & Schlitter 1982, Amr & Qumsiyeh 1993); – Wadi Al Kuf, "mistnetting site" [4], 1981 (incl. 15–16 March): 10 m, 5 f (Qumsiyeh & Schlitter 1982, Amr & Qumsiyeh 1993).

DISTRIBUTION. *Pipistrellus hanaki* s.str. is an endemic of the Mediterranean part of Cyrenaica. All its available records were made solely in the centre of the forested northern part of the Cyrenaican plateau (Jebel Al Akhdar Mts.), limited to an area of ca. 70 km by 20 km (Fig. 34). However, with twelve known localities, *P. hanaki* represents the second most common bat species of Cyrenaica (along with *Tadarida teniotis*) and belongs to one of the most fequently recorded bats of Libya as well (Table 1). The whole area of the known range of this endemic bat represents less than a thousand square kilometres.

In Africa, bats of the *Pipistrellus pipistrellus* species complex are distributed also in the Maghreb; however, their occurrence is limited to the coastal and mountain belts of the northern

Mediterranean parts of the three respective countries. In Tunisia, the records are available solely from the northernmost regions (Puechmaille et al. 2012). Hence, the North African distribution of the complex is separated into two islands of Mediterranean habitats; northern Cyrenaica and northern Maghreb. Another island distribution of the *P. pipistrellus* complex, situated close to the Cyrenaican spot of occurrence, is known from Crete. This population is closest to the Cyrenaican one not only from the geographical point of view (some 300 km of aerial distance across the Cretan Sea) but also in terms of its phylogenetic relationship (Hulva et al. 2007b, 2010).

Field notes. All individuals of *Pipistrellus hanaki* for which field data are available, were recorded at their foraging grounds. With the most probability, also the records of 18 individuals from three sites published (under *P. pipistrellus*) by Qumsiyeh & Schlitter (1982) – 4 km south of Al Bayda, 8 km south-south-east of Haniya, and Wadi Al Kuf – represent bats caught during their hunting activity.

Foraging *P. hanaki* were recorded in two basic habitat types, at water bodies and around rocky outcrops including overhangs and entrances of caves. At both these habitats, a gradient of temperature and humidity is remarkable and thus, the concentration of insect prey could be relatively high.

At three sites *P. hanaki* was netted at water surfaces. A male was netted at troughs for livestock watering near a karst spring near Massah on 31 July 1981; the troughs were situated under a single old fig tree on an almost barren slope of a valley. Three individuals of *P. hanaki* were caught in a net installed above a stream at Arqub Ash Shafshaf on 17 May 2002; this stream created seve-

Fig. 40. The forested valley of Arqub Ash Shafshaf (Cyrenaica); a foraging area of *Pipistrellus hanaki*, *Nyctalus lasiopterus* and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

Fig. 41. Upper part of Wadi Al Kuf (Cyrenaica), a shallow and wide valley ca. 5 km SW of Al Bayda; type locality of *Pipistrellus hanaki* Hulva et Benda, 2004 and a foraging habitats of *P. hanaki*, *P. kuhlii*, *Nyctalus leisleri*, *Plecotus gaisleri*, and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

ral pools of still water enclosed within bush vegetation in a narrow canyon-like valley (Fig. 40) passing through the forested northern slope of the Jabal Al Akhdar Mts. Besides *P. hanaki*, also *Nyctalus lasiopterus* and *Tadarida teniotis* were recorded at Arqub Ash Shafshaf during the same night. Several times *P. hanaki* was netted above a stream in the upper part of Wadi Al Kuf south--west of Al Bayda; the wadi in this section, at ca. 500 m a. s. l., is a rather shallow valley (Fig. 41), covered by a patchwork of fields, pastures and smaller stands of original cypress and juniper forests, although the sides of the valley consist of rocky outcrops with overhangs and shallow caves. Hanák & Elgadi (1984) caught two females there on 29 April 1980 and another female on 1 May 1980 (*Pipistrellus kuhlii* and *Nyctalus leisleri* were netted there along with *P. hanaki* on the latter occasion). On 18 May 2002, four *P. hanaki* were captured at this site in nets installed above a pool of the stream and at a rocky overhang (Fig. 42); besides the netted individuals, calls of numerous foraging individuals were detected simultaneously (during this night, also *Pipistrellus kuhlii*, *Plecotus gaisleri* and *Teniotis teniotis* were recorded at the site).

At four sites, *P. hanaki* was recorded to forage along rock walls and at outcrops of boulders and rocks. Near a quarry in the southern part of Wadi Al Kuf, this species was netted on two occasions (Fig. 85); one female was caught there on 12 August 1981 (along with one *Plecotus gaisleri*), and three individuals on 19 May 2002 (along with several *Plecotus gaisleri* and *Tadarida teniotis*). At a nearby site, in ancient ruins in a small side valley of Wadi Al Kuf, one female was netted on 3 August 1981 (together with *Plecotus gaisleri*). Five individuals of *P. hanaki* were caught when they foraged outside a large cave in a side valley of the south-eastern slope of Wadi Al Kuf on 18 August 1981 (together with *Pipistrellus kuhlii*, *Plecotus gaisleri*, *Miniopterus schreibersii*, and *Tadarida teniotis*) and on 22 August 1981 (along with *Rhinolophus horaceki*, *Pipistrellus kuhlii*, *Plecotus gaisleri*, and *Tadarida teniotis*). Numerous echolocation calls of foraging individuals of

P. hanaki were recorded along rocky overhangs on the slope of Wadi Jarmah on 20 May 2002; at this site, representing in fact the terminal part of Wadi Al Kuf, the slopes of the wadi are lined by rocky outcrops with numerous shallow cavities (Fig. 43). Besides *P. hanaki*, *Pipistrellus kuhlii*, *Plecotus gaisleri* and *Tadarida teniotis* were also recorded in Wadi Jarmah on that night.

At two sites, individuals of *P. hanaki* were netted under bridges, where the foraging bats perhaps only passed along the valley. One male was netted under the Ar Ruba road bridge in Wadi Al Kuf on 15 August 1981, one female was netted under a bridge over Wadi Al Minshiyah on 16 May 2002 together with one *Plecotus gaisleri* (Fig. 99).

Direct records of reproduction of *P. hanaki* are available from Cyrenaica, seven pregnant females were documented from three sites on three subsequent days. Two females were netted at Arqub Ash Shafshaf on 17 May, three females in the upper part of Wadi Al Kuf near Al Bayda on 18 May, and two females in the central part of Wadi Al Kuf on 19 May 2002. Each of these females contained one foetus only, with the crown-rump length of 8.3–12.2 mm (mean 9.8 mm). These findings suggest the parturitions in the Cyrenaican population of *P. hanaki* to occur in late May.

Material examined. 1 ♂, 2 ♀♀ (NMP 49890–49892 [S+A]), Arqub Ash Shafshaf, 17 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (NMW 30111 [S+B]), NW Massah, Prov. Beida, 31 July 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♂, 2 ♀♀ (NMP 49903, 49904 [S+A], 49902 [A]), Wadi Al Kuf, 19 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 2 ♀♀ (NMP 90158, 90159 [S+W]), Wadi Al Kuf, 5 km SW of Al Bayda, 29 April 1980, leg. V. Hanák & K. Hůrka; – 1 ♀ (NMP 95062 [S+W]), Wadi Al Kuf, 5 km of Al Bayda, 1 May 1980, leg. V. Hanák & K. Hůrka; – 4 ♀♀ (NMP 49894–49897 [S+A], incl. the holotype of *Pipistrellus hanaki* Hulva et Benda, 2004), Wadi Al Kuf, 5 km SW of Al Bayda, 18 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (NMP 49884 [S+A]), Wadi Al Minshiyah, 17 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (NMW 30113 [S+B]), Wadi Kuf, Prov. Beida, 12 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß;

Fig. 42. Portrait of *Pipistrellus hanaki* Hulva et Benda, 2004 from Wadi Al Minshiyah (Cyrenaica). Photo by A. Reiter.

Fig. 43. Wadi Jarmah (Cyrenaica); a foraging area of *Pipistrellus hanaki*, *P. kuhlii*, *Plecotus gaisleri*, and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

– 1 ♂ (NMW 30114 [S+B]), Wadi Kuf, Prov. Beida, 15 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (NMW 30115 [S+B]), Wadi Kuf, Prov. Beida, 18 August 1981, A. Mayer, F. Spitzenberger & E. Weiß; – 4 ♀♀ (NMW 30112, 30116–30118 [S+B]), Wadi Kuf, Prov. Beida, 22 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Pipistrellus hanaki* are shown in Table 10. For the material examined see above, for depictions of the skull, teeth, penis and baculum of *P. hanaki* see Benda et al. (2004b: 202–210, Figs. 5, 6, 8, and 9), for dimensions of the holotype of *P. hanaki* from Wadi Al Kuf see Table 5.

The Cyrenaican population of bats of the *P. pipistrellus* complex was discovered almost simultaneously by Qumsiyeh & Schlitter (1982) and Hanák & Elgadi (1984). While the former authors tentatively considered these bats as a part of the nominotypical form of *P. pipistrellus* which does not differ from other Mediterranean populations, Hanák & Elgadi (1984) stressed the larger size and more brownish-red colouration of dorsal pelage in the Cyrenaican bats in comparison with European and Asian samples.

Hulva et al. (2004) and Benda et al. (2004b) demonstrated a relatively deep divergence between the lineage comprising the Cyrenaican bats and all other lineages of *P. pipistrellus* s.l. from the whole distribution range of this complex (6.2–11.2% of uncorrected genetic distance in partial sequence of the mitochondrial gene for cytochrome *b*, cyt *b*). This pronounced divergence, along with significant morphological distinctness (body size, skull shape, size and shape of unicuspidal teeth) from other populations of the *P. pipistrellus* complex (Benda et al. 2004b) indicated a separate taxonomic position of the Cyrenaican bats. They were described as a third species of the complex, *P. hanaki*, additionally to *P. pipistrellus* (Schreber, 1774) and *P. pygmaeus* (Leach, 1825). The dimensional data on 16 specimens given by Qumsiyeh & Schlitter (1982: 380, 382) roughly correspond with those presented here (Table 10).

P. hanaki has been considered a monotypic species endemic to Cyrenaica, until its close relative was discovered in Crete (Hulva et al. 2007b). The Cretan population differed by 4.2–4.5%

of uncorrected genetic distance (cyt *b*) from the Cyrenaican populations and represented a sister lineage to the Libyan bats (Hulva et al. 2007b). Since also certain distinct morphological features were documented, which separated the Cretan bats from other populations of the complex (Benda et al. 2009), the Cretan population was described as *P. hanaki creticus* Benda, 2009.

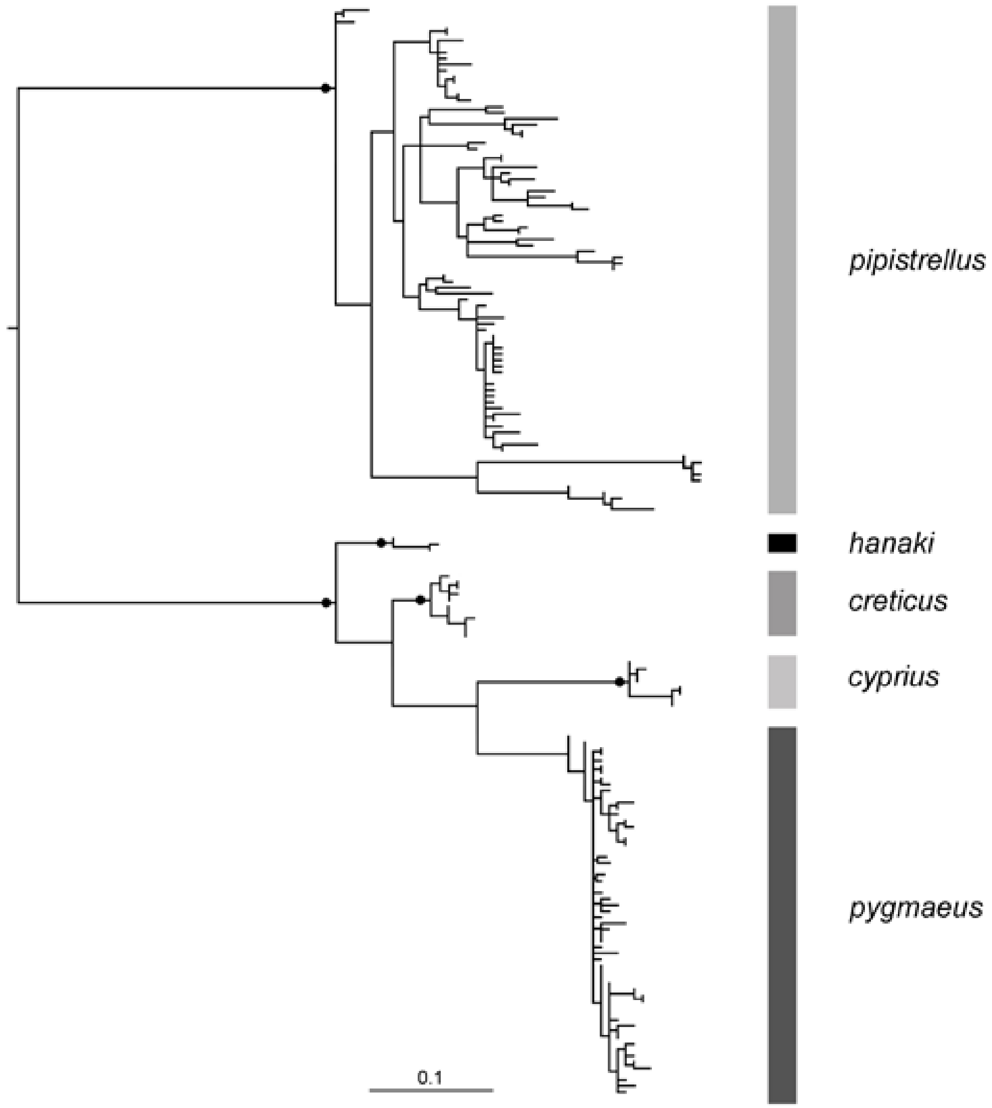


Fig. 44. Maximum likelihood phylogenetic tree of the *Pipistrellus pipistrellus* complex based on the mitochondrial D-loop sequences (Hulva et al. 2010). Branches with bootstrap values ≥75% are marked by dots. The relationships among *P. pygmaeus* s. str. and the Libyan, Cretan and Cypriot populations were not resolved due to low support.

Table 12. Percent pairwise uncorrected genetic distances among haplotypes of the *Pipistrellus pipistrellus* complex (321 bp of the D-loop sequence); above diagonal – mean, below diagonal – range

	hanaki	*creticus*	*cyprius*	*pygmaeus* s.str.	*pipistrellus* Maghreb	*pipistrellus* Eurasia
hanaki	–	6.82	10.69	8.91	12.74	13.90
creticus	4.7–7.1	–	8.35	7.54	13.24	13.92
cyprius	8.2–11.2	6.9–9.4	–	7.90	14.60	15.72
pygmaeus s,str.	6.6–10.7	5.3–9.0	6.2–9.6	–	13.97	13.33
pipistrellus Maghreb	10.0–18.0	10.3–15.8	12.8–16.3	10.9–17.3	–	9.74
pipistrellus Eurasia	10.1–17.3	10.2–17.5	10.8–17.9	9.7–17.8	5.6–14.1	–

However, although the analysis of cyt *b* gene showed the closest relationship between *P. hanaki* s.str and *P. h. creticus*, this relationship has never been supported sufficiently by the boostrap values (see Hulva et al. 2007b: 381; Benda et al. 2010a: 275; Benda et al. 2012: 423). The analyses of the mitochondrial D-loop sequences and nine microsatellites of the *P. pipistrellus* complex (Hulva et al. 2010) supported a mosaic-like division of populations of the complex in the Mediterranean, rather than grouping of all haplotypes into two main clades. The haplotypes of the *hanaki* s.str. and *creticus* lineages of the D-loop sequences were separated from each other by a similar number of substitutions (22–30) as the *creticus* lineage and the *pygmaeus* s.str. lineage (≥23) as well as the *hanaki* s.str. lineage and the *pipistrellus* s.str. lineage (≥29), see Hulva et al. (2010: 5423). In two of nine microsatellites analysed, the *hanaki* s.str. and *creticus* lineages were completely separated from each other, while only in two other microsatellites, they were more similar to each other than

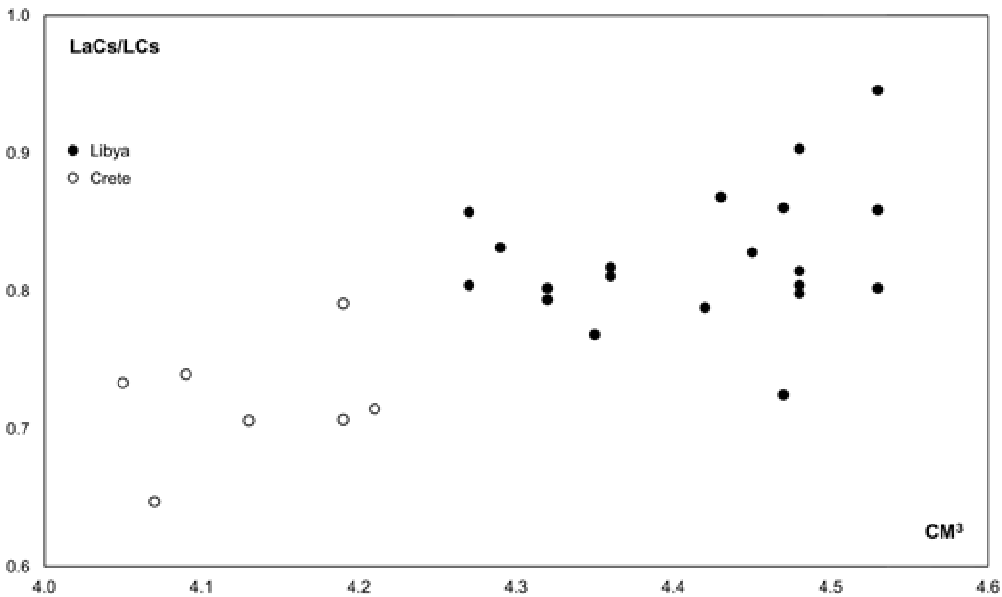


Fig. 45. Bivariate plot of the examined samples of *Pipistrellus hanaki* Hulva et Benda, 2004 from Libya and *P. creticus* Benda, 2009 from Crete: length of the upper tooth-row (CM^3) against the relative width of the upper canine (LaCs/LCs).

to any remaining lineage (Hulva et al. 2010: 5424). These differences suggest a similar level of separation among the four compared population groups.

A tree created from the D-loop sequences by Hulva et al. (2010) also demonstrated unresolved mutual positions of the particular lineages in the complex (Fig. 44), namely the Cyrenaican, Cretan and Cypriot ones (their mutual genetic divergences are also of comparable level, see Table 12). The Cretan and Cyrenaican samples also significantly differ in morphology, both in morphometric and phenetic traits (Fig. 45; see also Benda et al. 2009: 149–152, Evin et al. 2011: 2099–2101). We thus suggest the two lineages/morphotypes of *P. hanaki* s.l. to respresent two evolutionary units sufficiently separated genetically, morphologically and geographically, which should be regarded as two species, *P. hanaki* and *P. creticus*. In that case, the distribution of *P. hanaki* is confined to Cyrenaica and this bat represents an endemic of this region and Libya as well.

Feeding ecology. The feeding ecology of *Pipistrellus hanaki* has not yet been studied thoroughly, but according to the morphological and echolocation characteristics (Benda et al. 2004b) we can expect a similar foraging strategy as applied by other members of the *Pipistrellus pipistrellus* group; i.e. aerial hawking in agile and erratic flight in not very cluttered habitats, but relatively close to trees and bushes (e.g. Nicholls & Racey 2006, Dietz et al. 2007), and in urban or rocky habitats probably around buildings and rocky walls.

Žďárská (2013) analysed the diet composition of the closest *P. hanaki* relative, *P. creticus* from Crete (55 pellets from eight individuals); these samples were dominated by Brachycera, Auchenorrhyncha and Lepidoptera, with some smaller proportions of Hymenoptera (Formicoidea and Ichneumonoidea), Nematocera (Culicidae, Chironomidae) and Coleoptera.

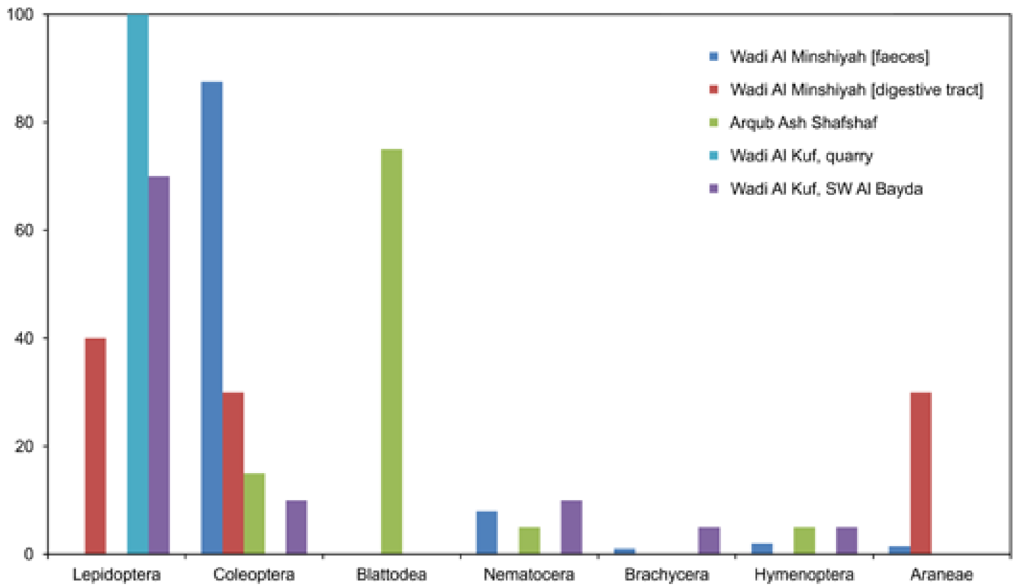


Fig. 46. Percentage volume of particular food items in the diet of *Pipistrellus hanaki* Hulva et Benda, 2004 in Libya. Material analysed: Wadi Al Minshiyah (six faecal pellets from one individual, one digestive tract), Arqub Ash Shafshaf (three digestive tracts), Wadi al Kuf, near quarry (three digestive tracts), Wadi Al Kuf, SW Al Bayda (four digestive tracts).

From Libya, we analysed four diet samples of *P. hanaki* (Fig. 46). Smaller Lepidoptera (wingspan length ca. 20–25 mm) and small Coleoptera (Scarabaeidae, Carabidae, Staphylinidae) were present in most of the samples, sometimes in important volumes. Two digestive tracts from Arqub Ash Shafshaf contained high volumes of cockroaches (Blattodea). Nematocera (Culicidae and Chironomidae) as well as Hymenoptera (Ichneumonoidea) represented only small amounts. We analysed both faecal pellets and a digestive tract of the individual collected in Wadi Al Minshiyah and due to certain dissimilarities between the results from these two sources, both result types are presented in Fig. 46. The differences were probably caused by gradual consecutive feeding on various prey taxa.

The diet of bats of the *Pipistrellus pipistrellus* group in the arid regions of the Middle East is characterised by smaller proportions of nematoceran Diptera (Benda et al. 2006, 2012), which is also the case of *P. hanaki* in Libya. Nematoceran Diptera are frequently replaced by ants (Hymenoptera, Formicoidea) or cicadas and leafhoppers (Auchenorrhyncha). In Libya, we observed that these food items were rather surprisingly replaced by Lepidoptera and Coleoptera. The presence of brachyceran Diptera may indicate that *P. hanaki* emerges very early (to be able to catch diurnal insects) and/or flies very close to vegetation and even glean the prey from foliage. This may be documented also by the presence of spiders (Araneae) in the diet (Fig. 46).

Records of ectoparasites. **Original data**: N y c t e r i b i i d a e: *Basilia daganiae*: 1 ma, 2 fa (CMŠ [A]) from 3 host inds., Arqub Ash Shafshaf, 17 May 2002. – **Published data**: N y c t e r i b i i d a e: *Basilia daganiae*: 1 ma, 3 fa from 5 host inds., Kuf National Park, 15–16 March 1981 (Amr & Qumsiyeh 1993); – 1 ma, 8 km SSE Haniya, 3 April 1981 (Amr & Qumsiyeh 1993). – *Basilia mediterranea*: 1 ma from 1 fa, El Beida env. [= Wadi Al Kuf, 5 km SW of Al Bayda], 29 April 1980 (Hůrka 1982).

Comments on ectoparasites. Two bat flies of the genus *Basilia* Miranda-Ribeiro, 1905 were collected from *Pipistrellus hanaki* in Libya, *B. daganiae* Theodor et Moscona, 1954 and *B. mediterranea* Hůrka, 1970. Both species belong to *B. bathybothyra* species group, in which the members have relatively limited ranges in comparison with other West Palaearctic species of Nycteribiidae (see the review by Kock 1984). Besides Cyrenaica, *B. daganiae* is known to occur only in the Levant (Theodor & Moscona 1954, Lewis & Harrison 1962, Hůrka & Soós 1986, Benda et al. 2010a). However, records of this parasite in other areas of the Mediterranean seem to be possible, concerning the known host spectrum representing all species of the genus *Pipistrellus* occurring in the basin.

B. mediterranea was recorded from *P. hanaki* by Hůrka (1982). This nycteribiid species has a West Mediterranean range of distribution; the known records are available from Algeria, Corsica, France, and Spain (see the reviews by Kock 1984 and Kock & Quetglas 2003). Although it was predominantly recorded from bats of the *Pipistrellus pipistrellus* complex, its findings are available also from *Hypsugo savii* (Bonaparte, 1837), *Pipistrellus nathusii* (Keyserling et Blasius, 1839), *P. kuhlii*, and *Miniopterus schreibersii*.

Pipistrellus kuhlii (Kuhl, 1817)

Records. **Original data**: C y r e n a i c a: Ad Dirsiyah (= Tolmeitha) [1], ruin of Byzantine cistern (Fig. 50), ceiling fissure, 22 May 2002: obs. a roosting colony of ca. 5 inds., coll. 3 faG, NMP (cf. Benda et al. 2004d, 2006, in press); – Ain Az Zarqa [2], at a karst spring, 11 August 1981: net. 3 m, 7 f (coll. 1 ma, 1 ms, 6 fa, 1 fs, NMW); – Ain Zeyanah [3], Al Kuwayfiyah, 15 km NE of Benghazi, abandoned house, 16 April 1979: coll. 4 faG, 2 fj, 20 April 1980: coll. 5 ma, 12 fa, 3 May 1980: coll. 3 fa, NMP (cf. Hůrka 1982, Zima 1982, Hanák & Elgadi 1984); – Al Abyar [4], ca. 5 km N, 11 October 1999: coll. 1 fs (roadkill), NMP (cf. Benda et al. 2004d, 2006, in press); – Al Aquriyah (= Tokrah) [5], ancient tomb (Fig. 52), 9 October 1999: coll. 1 fs, NMP (cf. Benda et al. 2004d, 2006, in press); – Al Bardiyah [6], wadi beneath the village (Fig. 16), 12 May 2002: det. calls of min. 10 foraging inds.; – Ar Rajmah [7], wadi ca. 2 km W of the village, above a water pit and at a rocky overhang, 22 May 2002: det. calls of numerous foraging inds., net. 5 ma, 8 faL, coll. 3 m, 3 f, NMP (cf. Benda et al. 2004d, 2006, in press); – Wadi Bu Al Gharas [8] (Fig. 58), ca. 15 km SE of At Tmimi, 14 May 2002: det. calls of min. foraging 2 inds.; – Gialo (= Jalu) [9], September 1934: 1 fa, MSNG (leg. E. Zavattari); Jalu, above a water reservoir (Fig. 56), 23 May 2002: det. calls of several foraging inds., net. 1 faG, NMP (cf. Benda et al. 2004d, 2006, in press), 24 May 2002: det. calls of several foraging inds.; – Karkurah [10], village, 8 October 1999: net. 1 ma, NMP (cf. Benda et al. 2004d, 2006, in press); – Shahhat [11], Cyrene, ancient ruins, Fountain of Apollo (Fig. 71), 19 August 1981: net. 1 fs, NMW, above ancient ruins, 10 October 1999: det. calls of 3 foraging inds.; – Wadi An Nazrat [12], 5 km W of Sidi Muhammad Al Mabkhut, at a cave entrance and above a water pit (Figs. 86, 95), 21 May 2002: net. 2 ma, 1 faL, 1 fa, NMP (cf. Benda et al. 2004d, 2006, in press); – Wadi Al Kuf [13], 5 km SW of Al Bayda, at a small river (Fig. 41), 1 May 1980: net. 1 ma, 1 fa, NMP (cf. Hanák & Gaisler 1983, Hanák & Elgadi 1984), 18 May 2002: net. 1 ma, NMP (cf. Benda et al. 2004d, 2006, in press); – Wadi Al Kuf, a large cave at the SE side of the valley [14], 18 August 1981: net. 1 ma, 22 August 1981: net. 1 fs, NMW; – Wadi Al Kuf, ancient ruins in a small side valley of Wadi Al Kuf [15], 4 August 1981: net. 1 ma, NMW; – Wadi Al Minshiyah [16] (Fig. 99), 16 May 2002: det. calls of min. 10 foraging inds.; – Wadi Darnah [17], 6 km S of Darnah, above a small river (near a gallery), 15 May 2002: det. calls of min. 3 foraging inds.; – Wadi Jarmah [18], along rocky overhangs in the wadi slope (Fig. 43), 4 August 1981: net. 1 ma, NMW, 20 May 2002: det. calls of several foraging inds., net. 3 ma, NMP (cf. Benda et al. 2004d, 2006, in press). – F e z z a n: Al Fjayj [19], tourist camping area, 6 October 1999: net. 1 ma, NMP (cf. Benda et al. 2004d, in press); – Gabrun [20], ruined village (Figs. 49, 51), 1 October 1999: net. 1 ma, mosque ruin, 2 October 1999: obs. a colony of ca. 25 inds., coll. 4 fa, 8 fs, NMP (cf. Benda et al. 2004d, in press); – Germa [21], excavated settlement, 6 October 1999: coll. 1 ma, NMP (cf. Benda et al. 2004d, in press); – Murzuch (= Murzuq) [22], March 1934: coll. 1 ma, MSNG (leg. G. Scortecci); Murzuq, fortress, 6 October 1999: coll. 1 ma, NMP (cf. Benda et al. 2004d, in press); – Taminhint [23], palm grove in a small farm, 30 September 1999: obs. & det. 1 foraging ind. – T r i p o l i t a n i a: Ain Az Zarqa [24], at a pool (Figs. 8, 9), 9 May 2002: det. calls of several foraging inds.; – Ain Sharshara [25], above a pool (Fig. 29), 26 May 2002: net. 3 ma, 7 faL, coll. 3 m, 5 f, NMP (cf. Benda et al. 2004d, 2006, in press); – Al Jawsh [26] (Fig. 37), ruined village, 6 May 2002: det. calls of 1 foraging ind., 7 May 2002: coll. 1 ma, NMP (cf. Benda et al. 2004d, 2006, in press); – Darej e dintorni (= surroundings of Darj) [27], 22–26 February 2001: coll. 1 fa (MZUF 20196; leg. M. Bachir; P. Agnelli in litt.); – Ghadamis [28], small village 3 km W of the town, 28 September 1999: obs. & det. calls of 3 foraging inds.; – Ka'am [29], at a river (Fig. 57), 25 May 2002: det. calls of min. 3 foraging inds.; – Lebdah [30], Leptis Magna, ancient ruins (Fig. 35), 1 April 1979: obs. several foraging inds. (cf. Hanák & Elgadi 1984); – Nanatalah [31], rocky fissure, 27 May 2002: obs. 1 ma, above a pool (Fig. 80), 28 May 2002: net. 6 ma, 1 mj, 5 faL, coll. 4 ma, 4 f, NMP (cf. Benda et al. 2004d, 2006, in press); – Sabratha [32], ancient ruins (Fig. 30), fissure in theatre vault, 7 May 1980: obs. a colony of ca. 35 inds., coll. 1 f, NMP (cf. Hůrka 1982, Hanák & Elgadi 1984), amphitheatre, 28 May 2002: coll. 1 ma from a ceiling hole, net. 3 ma, NMP (cf. Benda et al. 2004d, 2006, in press); – Sinawan [33], above small lakes (Figs. 54, 55), 8 May 2002: net. 5 m, 12 f, coll. 4 ma, 6 faL, 1 faG, 1 fs, 1 fj, NMP (cf. Benda et al. 2004d, 2006, in press); – Tripoli (= Tarabulus) [34], 1918: 1 ma, MHNG (leg. Taubert; cf. Benda et al. 2006, in press). – **Published data**: C y r e n a i c a: Bengasi (= Benghazi) [35], 1 m, 1 f (De Beaux 1938), Benghazi, farm on the town outskirts, winter 1981: 1 ind. [NMP] (Hanák & Elgadi 1984); – El Agheila (= Al Aqaylah) [36], August 1931: 1 m (De Beaux 1932); – Fuehat (= Benghazi, Al Fwayhat) [37], 16 May 1921: 1 m, 25 May 1921: 1 m (Festa 1921); – Gheminez (= Qaminis) [38], 13 May 1921: 1 f (Festa 1921); – Gialo (= Jalu) [9], November 1928: 1 m [MSNG] (Krüger 1928), Gialo, April 1931: 4 m, 2 f, 2 May 1931: 1 m, 1 f, [MSNG] (De Beaux 1932), Gialo, old houses (Hufnagl 1972); – Merg (= Al Marj) [39], 9–24 May 1921: 3 m, 8 f (De Beaux 1938); – Porto Bardia (= Al Bardiyah) [6], March 1927: 1 m, MSNG (De Beaux 1928); – Wadi Al Kuf, "mistnetting site" [40], 1981 (incl. 9 April): net. 2 m (Qumsiyeh & Schlitter 1982). – F e z z a n: Mursuk (= Murzuq) [22], 30 June 1901: 1 ma, BMNH (Thomas 1902, Qumsiyeh 1985, Benda et al. 2004d [under *P. deserti*], Benda et al. in press). – T r i p o l i t a n i a: Buerat (= Bwayrat) [41], old houses (Hufnagl 1972); – Mellaha (= Al Mallahah) [42], 30 September 1937: 2 f (Hanák & Elgadi 1984); – Misurata (= Misratah) [43], old houses (Hufnagl 1972); – Pisida (= Abu Kammash) [44], 230 km W of Tripoli (= Tarabulus), 28 August 1937: 1 m (Hanák & Elgadi 1984); – Sabratha [32], 1 ind. (Hufnagl 1972); – Tripoli (= Tarabulus) [34] (Temminck 1838 [under *Vespertilio marginatus*]), Tripolis (= Tarabulus) (Blasius 1857), Tripoli (= Tarabulus), 2 inds., BMNH (Dobson 1878), 2 inds. ad, RNLH (Jentink 1888, cf. Jentink 1887), Stadt Tripolis (= Tarabulus), 29 July 1906: 1 f[a, NMW] (Klaptocz 1909), Tripoli (= Tarabulus) (Hufnagl 1972); – Tripoli-Zanzur (= Janzur) [45], town outskirts, May 1978, spring 1979: 2 m, 3 f (Hanák & Elgadi 1984).*

Distribution. *Pipistrellus kuhlii* is the most common and most widespread bat of Libya; it was found very abundantly in all three regions of the country, it represents the most frequently recorded species of the two northern regions (Tripolitania, Cyrenaica) and ranks among the most frequent bat species of Fezzan (Fig. 47). Its Libyan records are over three times more numerous

* Wassif (1959: 141) reported two records of this bat in rather extreme parts of the Libyan Sahara: "Kuhl's pipistrelle bat, *Pipistrellus kuhli* has been recorded from Giarabub [= Al Jaghbub] and from Cufra by De Beaux (1928, 1932)." Although O. De Beaux reported specimens of *P. kuhlii* collected during the trips to these oases, they were recorded in Al Aqaylah, Al Bardiyah and Jalu, see the published data of Records. No bat record is available from the Kufra oasis.

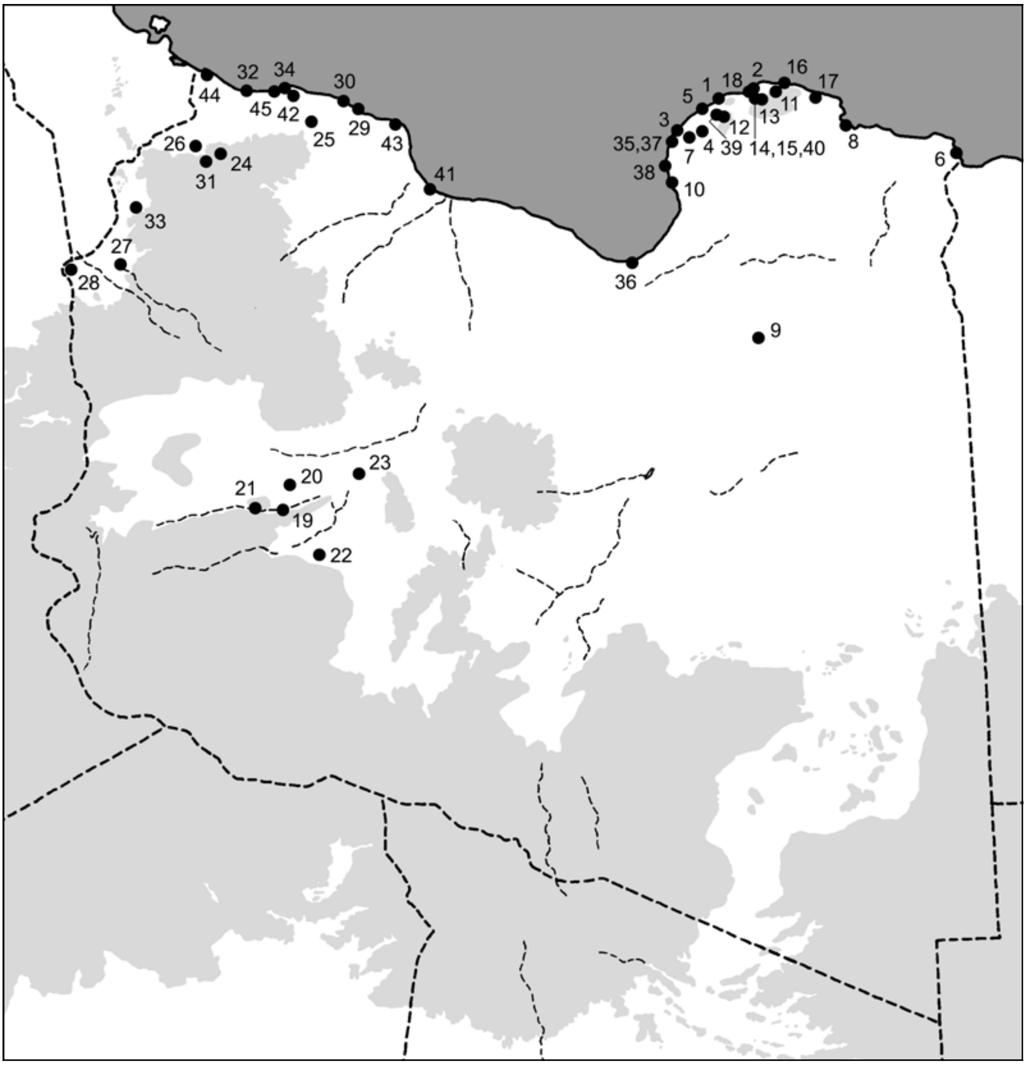
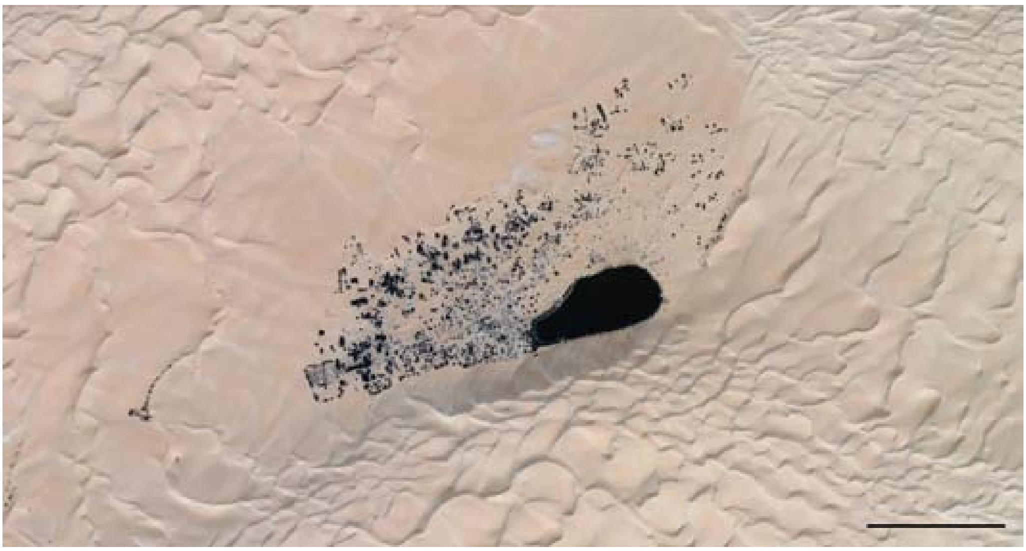


Fig. 47. Records of *Pipistrellus kuhlii* (Kuhl, 1817) in Libya.

than those of the second most common bat, *Plecotus gaisleri* (Table 1). As the only bat species, *P. kuhlii* was documented both in the Mediterranean and desert habitats, from the sea shore in the north to inner parts of the Sahara in the south.

In northern Libya, it was very frequently found in urban habitats along the coast, but also in the Mediterranean woodland of Cyreniaca (Fig. 48), in settlements in dry steppes of the Gefara plain as well as in the oasis-like habitats associated with the margins of the Nafusa plateau. *P. kuhlii* was found in several Tripolitanian semi-desert oases (Sinawan, Ghadames, Darj); it was several times recorded in the extensive oasis of Jalu (De Beaux 1932, Hufnagl 1972, new records), where it was confirmed as the only bat species. On the other hand, *P. kuhlii* has never been reported from the oasis of Al Jaghbub, although four other bat species were found there (*Rhinopoma cystops*, *Vansonia rueppellii*, *Otonycteris hemprichii*, *Plecotus christii*) and although it has been recently found in the Siwa oasis of Egypt (Benda et al. 2014), which belongs to the same geomorphological unit of the Libyan desert.



Figs. 48, 49. Satellite views of extreme foraging and roosting habitats of *Pipistrellus kuhlii* in Libya. Source: Google Earth; scale bars = 500 m. 48 (above) – the forested central part of Wadi Al Kuf, Jebel Al Akhdar Mts. (Cyrenaica). 49 (below) – the oasis of Gabrun including the Gabrun lake within the Awbari sand sea (Fezzan).

Fig. 50. Ruined Byzantine cistern of Tolmeitha, Ad Dirsiyah (Cyrenaica); a small colony of *Pipistrellus kuhlii* was discovered in a ceiling fissure of the cistern. Photo by A. Reiter (May 2002).

P. kuhlii is an inhabitant of desert oases and wadis of central Fezzan; it was documented in anthropogenic habitats of settlements and cultivated areas. Somewhat exceptional is the record from the oasis of Gabrun, situated around a desert salt lake within the Awbari sand sea (Fig. 49) and separated by 20 km of sand dunes from the continuous oasis vegetation areas of Wadi Ajal.

The Libyan range of *P. kuhlii* is a part of a broad continuous belt of distribution of this bat across North Africa, stretching from the Mediterranean coast to the central Sahara. This species is widely distributed in Egypt (Qumsiyeh 1985, Benda et al. 2014) as well as in the Maghrebian countries including their deep Saharan parts (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Benda et al. 2010b, Puechmaille et al. 2012). The records of *P. kuhlii* in Fezzan represent a part of the southern margin of the species distribution range stretching from the Western Sahara over southern Algeria and Libya to northern Sudan (Koopman 1975, Kowalski & Rzebik-Kowalska 1991, Benda et al. 2010b). The gaps between these records are undoubtedly caused by the lack of information (due to inaccessibility of the extensive desert regions) rather than a real absence of this bat in large parts of the central belt of the Sahara (see also Rebelo & Brito 2006). The experience from the Gabrun oasis in central Fezzan suggests the ability of this largely Mediterranean species to colonise well isolated and small desert spots of suitable habitats.

Field notes. As the most frequently recorded bat in Libya, *Pipistrellus kuhlii* was found both roosting and foraging at many sites. Roosts as well as foraging grounds of this bat were documented in all three main regions of Libya.

Several roost findings could be considered as evidence of maternity colonies. All documented colonies of *P. kuhlii* in Libya were found in synathropic conditions. The circumstances of the first such record were described by Hanák & Elgadi (1984: 176) as follows: "[…] a colony of 20 gravid females was found in the vicinity of Benghazi [on 16 April 1979], in a narrow crevice between the ceiling and the wall of an abandoned house in a palm grove near a bay. […], the same colony was found to occur in the same house again [on 20 April 1980]. It was not concentrated, however, into a single space and groups of females and solitary males were sheltered in chinks of walls of the outer sides of the house." The locality was the abandoned village of Ain Zeyanah, some 15 km north-east of Benghazi, composed of partially ruined houses. Another colony was discovered in the ruined Roman town of Sabratha on 7 May 1980 (cf. Hanák & Elgadi 1984; Fig. 30); an aggregation composed of some 35 individuals roosted in the fissure between stones of the ceiling vault of the entrance corridor of the theatre, some 4 m above ground. Although it is very probable that this group represented a nursery colony, this was not confirmed for sure as only one individual (adult female) was examined from it. A roosting colony of at least five *P. kuhlii* was observed in a small and narrow ceiling fissure in a ruined Byzantine cistern in the excavated ancient town of Tolmeitha on 22 May 2002 (Fig. 50). Three individuals of this group were examined and all of them were found to be pregnant females; thus, the aggregation most probably represented a forming or already established maternity colony. An aggregation of some 25 bats was discovered in the ruined village of Gabrun on 2 October 1999 (Figs. 49, 51). The group was composed of adult females and their full-grown juveniles: twelve individuals were examined and they included four adult females and eight subadult females (juveniles of the year). The colony roosted in a fissure between the wall and joist of a partially ruined mosque in the centre of an abandoned village at the Gabrun lake (but in fact, the only building of the village having still a roof).

At several sites, solitary roosting individuals of *P. kuhlii* were found, most of them adult males. With one exception, all findings were also made in man-made structures. Similarly, Hufnagl (1972: 32) reported his own observations of *P. kuhlii* in synathropic shelters in Libya as follows: "The writer has also found it roosting in the roofs of old houses in Gialo, Misurata and Buerat." The only natural roost of *P. kuhlii* in Libya was documented at Nanatalah, where a male was found hidden in a rock fissure in an overhang changed to a shelter on 27 May 2002 (Fig. 80).

An adult male was found in a small fissure above a roof beam and under a layer of palm leaves in one of the hilltop-situated buildings of the fortress of Murzuq (transformed to a museum) on

Fig. 51. The oasis of Gabrun (Fezzan); a foraging and roosting area of *Pipistrellus kuhlii*. Ruined village with a number of potential roosts in the background, bank of the Gabrun lake left (see also Fig. 49). Photo by P. Benda (October 1999).

Fig. 52. Tombs of ancient Tokrah, Al Aquriyah (Cyrenaica); an individual of *Pipistrellus kuhlii* was discovered to roost in one of the tombs. Photo by P. Benda (October 1999).

6 October 1999. One male was discovered in a horizontal hole in the mud wall of a ruined building in the archeological excavation area of Germa on 6 October 1999. A subadult female of *P. kuhlii* was localised in a fissure of the wall inside a Roman tomb at Tokrah (Al Aquriyah) on 9 October 1999 (Fig. 52). One male was found in a fissure in remains of a house situated in an abandoned and ruined part of the village of Al Jawsh (some 200 m west of the modern settlement) on 7 May 2002. Another solitary *P. kuhlii* was found in a deep circular hole in the ceiling of a cellar in the amphitheatre of Sabratha on 28 May 2002. In all these cases, the individuals were found as the only single bats when a large number of similar potential roosts were explored at the respective sites.

Foraging individuals of *P. kuhlii* were documented at numerous sites. The first such observation was reported by Klaptocz (1909: 239): "Das vorliegende Exemplar [= adult female] wurde im Suk turk gefangen, der Hauptbazargasse in der Altstadt von Tripolis [on 29 July 1906], wo es gleich vielen andern meist in der Höhe der diese Gasse stellenweise an Gerüsten Laubengangartig überspannenden Weinreben flog." [= The specimen (= adult female) was caught in Sukh Turk, the main street of the bazaar of the old town in Tripolis (on 29 July 1906), when it was flying together with many others at the height of the grapevine pergola that covered the street locally]. Although Klaptocz did not specify the method of collection of the bat specimen (still available in the NMW collection), he gave a clear description of the typical foraging behaviour of *P. kuhlii* in the conditions of a big town (Fig. 53). At another site, Klaptocz (1909: 239) also noted: "Wohl die meisten Fledermäuse, die man in der Städten (Tripolis, Bengasi, Dernah) sieht, gehören dieser Art an, namentlich aber jene, welche die Fliegenreiche Kaffee- und Gasthauslokale, erleuchtete wie dunkle, besuchen. In Bengasi beobachtete ich über ½ Stunde 2 kleine Fledermäuse, die in regelmäßigen Intervalen 20 Sekunden bis 2 Minuten einen Hellerleuchteten belebten Kaffeehausraum aufsuchten, immer durch die von Menschen vielbenutzte Türöffnung." [= Probably most bats which can be seen in the cities (Tarabulus, Benghazi, Darnah) belong to this species, especially those which visit the cafes and restaurants filled with flies, both dark and illuminated. In Benghazi I observed two small bats for more than a half an hour which in regular intervals of 20 seconds to two minutes entered a brightly lit room of a cafe always through a door that was heavily used by people]. Hufnagl (1972: 32) simply reported on foraging *P. kuhlii*: "may be seen from gardens and verandahs in the middle of Tripoli."

The largest number of foraging grounds of *P. kuhlii* was found in the Mediterranean habitats of Cyrenaica, although also in other more arid areas of Libya these bats were frequently documented.

P. kuhlii was the most commonly recorded foraging bat in desert oases of the southern parts of the country (Fig. 14). The bats were recorded to forage in gardens, above pools and reservoirs as well as in the build-up areas where they hunted around street lights (however, this is true for foraging *P. kuhlii* also in the northern parts of Libya). Echolocation calls of several foraging individuals were detected above a small (temporal?) swamp at a small village in the sand desert west of Ghadamis on 28 September 1999. At least one foraging *P. kuhlii* was observed and its calls detected in a palm grove in a small oasis-like farm at Taminhint on 30 September 1999. One adult male was netted when flying across a former street between ruined houses of the abandoned village of Gabrun on 1 October 1999. Another adult male of *P. kuhlii* was netted in a hand-net when it foraged alone around lights in a tourist campground in Al Fjayj on 6 October 1999. A large number (altogether 17 bats) was netted above several small pools (both of permanent and temporal water) in the oasis

Fig. 53. One of the streets in the Old Town of Tarabulus (Tripolitania); a foraging habitat of *Eptesicus isabellinus* and *Pipistrellus kuhlii*. Photo by A. Reiter (May 2002).

Figs. 54, 55. The oasis of Sinawan (Tripolitania); a foraging and roosting area of *Pipistrellus kuhlii*. Photos by A. Reiter (May 2002).

of Sinawan on 8 May 2002; the pools were situated in gardens close to the built-up parts of the oasis (Figs. 54, 55). Echolocation calls of several foraging individuals were recorded during two subsequent nights in the palm garden of the oasis of Jalu on 23 and 24 May 2002; during the latter night, an adult female was netted above a water reservoir in the garden (Fig. 56).

In Tripolitania, foraging *P. kuhlii* were recorded at sites situated in relatively humid areas at the sea shore and also in more arid habitats in steppes of the southern part of the Gefara plain. Several individuals were observed to hunt above the ruined Roman town of Leptis Magna on 1 April 1979 (cf. Hanák & Elgadi 1984). Calls of some foraging bats were detected at a river near Ka'am on 25 May 2002 (Fig. 57). Three adult males of *P. kuhlii* were netted in the ruined amphitheatre in the Roman town of Sabratha on 28 May 2002. Ten bats were netted above a pool at Ain Sharshara on 26 May 2002 (Fig. 29). Calls of one foraging individual were detected above a steppe valley with a ruined village at Al Jawsh (Fig. 37). Twelve *P. kuhlii* were caught in nets installed close to rocky walls and the open water of a spring of Nanatalah situated in the desert landscape of the northern escarpment of the Jebel Nafusa Mts. on 27 May 2002 (Fig. 80). Calls of several foraging individuals were detected at the closely situated and similarly positioned spring of Ain Az Zarqa on 9 May 2002 (Figs. 8, 9).

The largest number of foraging grounds of *P. kuhlii* in Cyrenaica is known from the central part of the Jebel Al Akdhar Mts. largely covered by the original Mediterranean woodland (Fig. 48), although the numbers of recorded individuals of this bat are far from prevailing over other bat species (particularly *Pipistrellus hanaki*). Several times *P. kuhlii* was recorded to forage in the upper parts of Wadi Al Kuf; this bat was first reported from this area by Qumsiyeh & Schlitter (1982), who netted two males at a "mistnetting site" of the central part of the valley near the Ar Ruba road bridge in the spring 1981. One male was netted in ancient ruins in a small side valley of Wadi Al Kuf on 4 August 1981; two individuals were netted at a large cave at the south-eastern side of a side valley of Wadi Al Kuf on 18 and 22 August 1981. In the upper shallow part of Wadi Al Kuf, at a small river south-west of Al Bayda (Fig. 41), two bats were netted on 1 May 1980 and one additional male on 18 May 2002. In the lowest part of Wadi Al Kuf, in Wadi Jarmah (Fig. 43), one male was netted at a rocky overhang on the wadi slope on 1 August 1981, and three adult males in this area on 20 May 2002. Echolocation calls of a larger foraging group of *P. kuhlii* were detected in Wadi Al Minshiyah close to the sea shore on 16 May 2002 (Fig. 99). In a similar habitat, at the karst spring of Ain Az Zarqa near the sea coast, ten foraging individuals were netted (and numerous others observed) above a swampy lake on 11 August 1981. On two occasions, *P. kuhlii* was recorded to forage around the ancient ruins of Cyrene near Shahhat; one female was netted at the water cistern known as the Fountain of Apollo on 19 August 1981 (Fig. 71) and calls of several foraging individuals were detected above the Roman necropolis on 10 October 1999. The ruins of Cyrene represent the only anthropogenic foraging area of *P. kuhlii* documented in the Jebel Al Akhdar Mts.

In the eastern part of the Mediterranean zone of Cyrenaica, echolocation calls of foraging *P. kuhlii* were recorded at three sites. Calls of about three bats were detected above a small river (near a gallery entrance) in Wadi Darnah on 15 May 2002 (Fig. 15), of two foraging bats over the dry valley of Wadi Bu Al Gharas near At Tmimi on 14 May 2002 (Fig. 58), and of some ten

Fig. 56. The oasis of Jalu (Cyrenaica); an occurrence area of *Pipistrellus kuhlii*. Photo by A. Reiter (May 2002).

Fig. 57. Ka'am (Tripolitania); an area of occurrence of *Eptesicus isabellinus* and *Pipistrellus kuhlii*. Photo by A. Reiter (May 2002).

bats in a densely vegetated wadi beneath the village of Al Bardiyah on 12 May 2002 (Fig. 16). In the less dry, western part of coastal Cyrenaica, foraging *P. kuhlii* were netted at four sites. An adult male was netted in a hand-net as it hunted around a street lamp at the edge of the village of Karkurah, close to a sand beach, on 8 October 1999. A subadult female was killed by a passing car as it foraged over the road near Al Abyar on 11 October 1999. Three bats were netted at a large rocky overhang and one bat above a pool (perhaps for livestock watering) in Wadi An Nazrat near Sidi Muhammad Al Mabkhut on 21 May 2002 (Figs. 86, 95). Eleven *P. kuhlii* were netted above a water pit in a wadi near the village of Ar Rajmah on 22 May 2002 and two other bats at a rocky overhang in this wadi the same evening; besides the netted bats, echolocation calls of numerous foraging individuals were also detected in the wadi.

While none of the above mentioned roosts of *P. kuhlii* was shared with other bat species, most of the foraging grounds were used by *P. kuhlii* along with various other bat species (with the exception of the foraging grounds in Fezzan, where *P. kuhlii* was documented as the only foraging bat at all sites). The richest community of foraging bats was documented in Wadi Al Kuf, where six species were netted at a large cave during one netting session – besides *P. kuhlii* also *Rhinolophus horaceki*, *Pipistrellus hanaki*, *Plecotus gaisleri*, *Miniopterus schreibersii*, and *Tadarida teniotis*. Five species including *P. kuhlii* were recorded at two sites, at Nanatalah additionally also *Rhinolophus ferrumequinum*, *Eptesicus isabellinus*, *Otonycteris hemprichii*, and *Plecotus gaisleri*, and in Wadi Al Minshiyah *Pipistrellus hanaki*, *Nyctalus lasiopterus*, *Plecotus gaisleri*, and *Tadarida teniotis*. Foraging communities composed of four species were recorded at five sites; in Wadi An Nazrat, Wadi Al Kuf (SW of Al Bayda in May 2002) and Wadi Jarmah (in May 2002) they included also *Pipistrellus hanaki*, *Plecotus gaisleri*, and *Tadarida teniotis*, in Wadi Darnah *Rhinolophus horaceki*, *R. mehelyi*, and *Tadarida teniotis*, and at Ain Az Zarqa (Tripolitania) *Rhinolophus ferrumequinum*, *Eptesicus isabellinus*, and *Plecotus gaisleri* foraged along with *P. kuhlii*. Groups of three hunting bat species including *P. kuhlii* were recorded at four sites: with *Myotis punicus* and *Eptesicus isabellinus* at Ain Sharshara and in Sabratha, *Pipistrellus* *hanaki* and *Nyctalus leisleri* in Wadi Al Kuf (SW of Al Bayda in May 1980), and *Nyctalus lasiopterus* and *Plecotus gaisleri* in the ruins of Cyrene (in August 1981). *P. kuhlii* was accompanied only by *Tadarida teniotis* in Cyrene (in October 1999), at Al Bardiyah and in Wadi Bu Al Gharas, by *Eptesicus isabellinus* at Al Jawsh and Ka'am, by *Rhinolophus mehelyi* at Ar Rajmah and by *Plecotus gaisleri* at the ancient ruins in Wadi Al Kuf.

In conclusion, *P. kuhlii* was most frequently – nine times – found to forage in company with *Plecotus gaisleri* and *Tadarida teniotis*; six times it was found together with *Eptesicus isabellinus* and *Pipistrellus hanaki*; and twice it foraged with *Rhinolophus ferrumequinum*, *R. horaceki*, *R. mehelyi*, *Myotis punicus*, and *Nyctalus lasiopterus*.

Direct records of reproduction of *P. kuhlii* were documented in Libya at several sites. Hanák & Elgadi (1984: 176) reported their observations from the colony discovered at Ain Zeyanah near Benghazi as follows: "All 4 females captured on April 16, were gravid, their well-developed embryos weighed 1.0 to 1.5 g. […]. Most of the females [collected on 20 April] were pregnant; from among 13 dissected females ten were with two and three with one embryos, respectively." Two pregnant females (along with four lactating ones) were netted in the oasis of Sinawan on 8 May; one examined pregnant female contained two foeti with the crown-rump length of 13.9 and 13.7 mm, respectively (the other pregnant female escaped into the expedition car, where it was discovered three days later with one associated newborn with the forearm length of 11.3 mm and weight of 0.7 g; this represents 33.8% and 14.9% of the mother's dimensions, respectively). Three pregnant females were discovered in the ruins of Tolmeitha on 22 May; one of them contained two foeti and two females one foetus each, with crown-rump lengths of 11.1–13.8 mm (mean 12.8 mm). One pregnant female was netted in the oasis of Jalu on 23 May; it contained two foeti with crown-rump lengths of 12.6 and 12.3 mm, respectively. Lactating females were found at four sites; four females were netted at Sinawan on 8 May, one female at Wadi An Nazrat on 21 May,

Fig. 58. Wadi Bu Al Gharas near At Tmimi (Cyrenaica); a foraging area of *Pipistrellus kuhlii* and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

seven females were netted at Ain Sharshara on 26 May, and five lactating females at Nanatalah on 27 May. Moreover, at the latter site, one fully volant juvenile was netted along with the lactating females on the same night.

All records of reproducing females come from northern Libya, i.e. from very similar latitudes. However, pregnant females were documented in an extensive period of more than a month, from 16 April to 23 May; lactating females were observed in the period between 8–27 May. This indicates a wide span and perhaps also certain individual plasticity in the birth timing of *P. kuhlii* in Libya, which seems to occur in a month period throughout May. This observation concurs with the data available from other Mediterranean countries (see e.g. the reviews by Benda et al. 2006, 2010a, 2012).

Hufnagl (1972: 32) mentioned the following note concerning the ecology of *P. kuhlii* in Libya: "The writer found a badly mutilated specimen which seemed to have escaped the talons of an owl among the ruins at Sabratha; it weighed only 5 grams. This little bat had six bed bugs (*Cimex lectuarius*) in its fur."

Material examined. ***kuhlii* morphotype**: 2 ♂♂, 7 ♀♀ (NMW 30120–30128 [S+B]), Ain Az Zargah, Prov. Beida, 11 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 3 ♂♂, 5 ♀♀ (NMP 49953–49955, 49958–49960 [S+A], 49956, 49957 [A]), Ain Sharshara, 26 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 3 ♀♀ (NMP 95064–95066 [S+W]), Ain Zulina, 3 May 1980, leg. V. Hanák & K. Hůrka; – 1 ♀ (NMP 48332 [S+A]), Al Abyar, 11 October 1999, leg. P. Benda; – 1 ♀ (NMP 48326 [S+A]), Al Aquriyah (Tokrah), 9 October 1999, leg. P. Benda; – 1 ♂ (NMP 49843 [S+A]), Al Jawsh, 7 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 3 ♂♂, 3 ♀♀ (NMP 49933, 49934, 49936, 49937 [S+A], 49935, 49938 [A]), Ar Rajmah, 23 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ind. (NMP 95043 [S]), Benghazi, winter 1978, leg. A. El Gadi; – 2 ♀♀ (NMP 95035 [S], 95036 [S+B]), Benghazi, 16 April 1979, leg. V. Hanák & K. Hůrka; – 4 ♂♂, 12 ♀♀ (NMP 95044–95047, 95049, 95050–95056, 95058 [S+B], 95048, 95057, 95059 [S]), Benghazi, 20 April 1980, leg. V. Hanák; – 1 ♂ (MSNG 30944 [S]), Gialo, Cirenaica, November 1928, leg. G. Krüger; – 1 ♀ (MSNG 33206 [S+B]), Gialo, September 1934, leg. E. Zavattari; – 1 ♀ (NMP 49939 [S+A]), Jalu, 24 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (NMP 48322 [S+A]), Karkurah, 8 October 1999, leg. P. Benda; – 4 ♂♂, 4 ♀♀ (NMP 49968–49970, 49972–49974 [S+A], 49971, 49975 [A]), Nanatalah, 27 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 4 ♂♂, 2 ♀♀ (MSNG 31618a–c, 31619a, b, d [S+B]), Oasi di Gialo nel Palmeto, Cirenaica, April 1931, leg. S. Patrizi; – 1 ♀ (NMW 30130 [S+B]), Ruinen v. Cyrene/Shahat, Prov. Darnah, 19 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (NMP 95068 [S+W]), Sabratha, 7 May 1980, leg. V. Hanák & K. Hůrka; – 4 ♂♂ (NMP 49981–49983 [S+A], 49984 [A]), Sabratha, 28 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 4 ♂♂, 9 ♀♀ (NMP 49845–49851, 49853, 49859 [S+A], 49844, 49852, 49854, 49860 [A]), Sinawan, 8 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 3 ♀♀ (NMP 49930, 49931 [S+A], 49932 [A]), Tolmeitha, 22 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂, 2 ♀♀ (NMP 95038, 95040 [S+B], 95037 [B]), Tripoli, 14 April 1979, leg. A. El Gadi; – 1 ♂ (MHNG 987.14 [S]), Tripoli, 1918, leg. Taubert; – 1 ♂, 1 ♀ (NMP 95060, 95061 [S+W]), Wadi Al Kuf, 5 km SW of Al Bayda, 1 May 1980, leg. V. Hanák & K. Hůrka; – 1 ♂ (NMP 49893 [S+A]), Wadi Al Kuf, 5 km SW of Al Bayda, 18 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 2 ♂♂, 2 ♀♀ (NMP 49921, 49923 [S+A], 49922, 49924 [A]), Wadi An Nazrat, Sidi Mohammad Al Mabkhut, 22 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 3 ♂♂ (NMP 49917, 49918 [S+A], 49919 [A]), Wadi Jarmah, 20 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (NMW 30119 [S+B]), Wadi Jarjaroma, Kuf Nat. Park, Prov. Beida, 4 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♂ (NMW 30129 [S+B]), Wadi Kuf, Prov. Beida, 18 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (NMW 30131 [S+B]), Wadi Kuf, Prov. Beida, 22 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (NMW 21961 [S+A]), Tripolis, Souk Türk, 29 July 1906, leg. B. Klaptocz. – ***deserti* morphotype**: 1 ♂ (NMP 48321 [S+A]), Al Fjayj, 6 October 1999, leg. P. Benda; – 1 ♂, 12 ♀♀ (NMP 48302–48305, 48309–48316, 48318 [S+A]), Gabrun, 2 October 1999, leg. P. Benda; – 1 ♂ (NMP 48320 [S+A]), Germa, 6 October 1999, leg. P. Benda; – 1 ♂ (MSNG 33207 [S+B]), Murzuch, March 1934, leg. G. Scortecci; – 1 ♂ (BMNH 2.11.4.1. [S+B], holotype of *Pipistrellus deserti* Thomas, 1902), Murzuk, Fezzan, 30 May 1901, leg. J. I. S. Whitaker; – 1 ♂ (NMP 48319 [S+A]), Murzuq, 6 October 1999, leg. P. Benda.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Pipistrellus kuhlii* are shown in Tables 10, 13. For the material examined see above, for dimensions of the holotype of *P. deserti* from Murzuq see Table 5. For depictions of the teeth characters of *P. kuhlii* morphotypes from Libya see Benda et al. (in press: Figs. 5, 6),

Table 13. Biometric data on three size morphotypes of *Pipistrellus kuhlii* (Kuhl, 1817) from Libya. For details see text, for abbreviations see p. 8

	kuhlii morphotype: large					*kuhlii* morphotype: intermediate					*deserti* morphotype				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	87	**33.85**	31.0	36.4	1.114	20	**33.71**	31.2	35.5	1.077	18	**31.48**	29.7	33.3	1.011
LCr	71	**13.25**	12.23	13.94	0.316	18	**12.78**	12.05	13.58	0.359	16	**11.94**	11.54	12.24	0.186
LCb	71	**12.87**	11.68	13.47	0.319	18	**12.44**	11.87	13.12	0.338	16	**11.47**	11.08	11.75	0.194
LaZ	62	**8.75**	8.18	9.27	0.228	17	**8.49**	8.07	8.94	0.278	16	**7.84**	7.49	8.18	0.207
LaI	71	**3.32**	3.02	3.55	0.114	18	**3.24**	3.11	3.51	0.103	17	**2.98**	2.74	3.17	0.125
LaInf	71	**4.10**	3.68	4.43	0.142	17	**3.99**	3.87	4.32	0.139	17	**3.53**	3.31	3.74	0.116
LaN	71	**6.52**	6.24	6.78	0.131	18	**6.40**	6.18	6.92	0.182	16	**6.09**	5.88	6.31	0.145
LaM	71	**7.63**	6.98	8.12	0.207	18	**7.42**	7.02	7.83	0.213	17	**7.03**	6.63	7.18	0.151
ANc	70	**4.73**	4.40	5.24	0.148	17	**4.67**	4.39	4.96	0.145	16	**4.33**	4.05	4.61	0.133
LBT	64	**3.03**	2.62	3.42	0.128	16	**2.96**	2.66	3.22	0.128	16	**2.70**	2.58	2.81	0.073
CC	71	**4.31**	3.82	4.75	0.146	17	**4.04**	3.73	4.53	0.216	17	**3.73**	3.58	3.83	0.086
M^3M^3	71	**5.83**	5.48	7.66	0.263	18	**5.53**	5.27	5.87	0.167	17	**5.09**	4.84	5.35	0.123
CM^3	71	**4.97**	4.62	6.04	0.187	18	**4.68**	4.44	4.96	0.181	18	**4.34**	4.17	4.56	0.102
LMd	71	**9.62**	8.91	10.13	0.249	18	**9.26**	8.88	9.74	0.273	17	**8.54**	8.22	8.87	0.183
ACo	71	**3.07**	2.82	3.31	0.117	18	**3.00**	2.75	3.28	0.143	18	**2.75**	2.56	3.01	0.118
CM_3	71	**5.31**	4.89	5.58	0.120	18	**5.04**	4.77	5.63	0.219	18	**4.65**	4.47	4.78	0.086

The Libyan populations of *P. kuhlii* were originally assigned to two species (Klaptocz 1909, Zavattari 1934, 1937, Toschi 1954, Setzer 1957, Hufnagl 1972, Hanák & Elgadi 1984). The populations occurring in the areas along the sea shore and in the oasis of Jalu were reported under *P. kuhlii* (most frequently, under *P. kuhlii kuhlii*; see De Beaux 1938, Toschi 1954, Setzer 1957, Qumsiyeh & Schlitter 1982) and the populations from the central Sahara (Fezzan) under *P. deserti* Thomas, 1902. This taxonomic arrangement was kept until recently, see Van Cakenberghe & Benda (2013a, b).

These two species were distinguished based on their different body and skull sizes (Fig. 59). Thomas (1902: 3) described *P. deserti* as: "a small buff-coloured desert ally of *P. kuhli*, with a particularly small skull. Size smaller than *P. kuhli*, but the forearm-length not so much less than in the form as to be in proportion with the much smaller skull. General structure, of ears, wings, and dentition, as in *P. kuhli*. […] Although with the general characters of *P. kuhli*, I do not feel justified in calling this Bat only a subspecies of that animal, for other North-African bats of this group, while tending towards *P. deserti* in colour, show no approach to its conspicuous reduction in size of skull. Examples of *P. kuhli* from Morocco […], Tunis […], and Egypt […], all have skulls of the full normal size."

The single specimen published by Thomas (1902) remained the only known representative of *P. deserti* from Libya until recently, when a series of this bat was collected from four sites of Fezzan in 1999 (Benda et al. 2004d) (additionally one unpublished MSNG specimen is available now, see Material examined). Benda et al. (2004d) compared the new series of 16 bats with the type specimen of *P. deserti* and *P. kuhlii*-like bats from North Africa from Morocco to Egypt; they confirmed the belonging of the Saharan bats to a small-sized morphotype (greatest length of skull, LCr 11.5–12.2 mm), assigned to *P. deserti* (according to Thomas' description), which sharply differed from a large North African morphotype (LCr 12.5–13.8 mm), assigned to *P. kuhlii*. Besides Libya, the *deserti* morphotype is known to occur in further Saharan countries – Algeria (Heim de Balsac 1934), Sudan (Kock 1969), Egypt (Gaisler et al. 1972), Morocco (Benda et al. 2004d), and Somalia (Van Cakenberghe & Benda 2013a), for details see Benda et al. (in press).

On the other hand, the *kuhlii* morphotype was recognised in a belt of ca. 250–300 km along the North African coast, from south-western Morocco to Egypt.

Benda et al. (in press) demonstrated that both morphotypes are conspecific and thus should be treated under the senior name, *P. kuhlii*. Although the morphometric traits can clearly distinguish between the morphotypes, the molecular genetic analyses grouped representatives of both morphotypes into one group. The comparison of partial sequences of the mitochondrial gene for cytochrome *b* clustered the North African *kuhlii* into one lineage with the "*deserti* specimens". An analysis of microsatellites yielded the same result – it clustered the North African specimens together, irrespective of their morphotype ranking (Benda et al. in press: Figs. 7, 8).

The morphometric parameters of the specimens of *P. kuhlii* s.l. from Libya are given in Table 13 and Figs. 59, 60. The samples from Fezzan are the smallest, representing the *deserti* morphotype, while the bats from northern Libya are large, representing the *kuhlii* morphotype (they conform in size to *P. kuhlii* from Europe and the Middle East, see Benda et al. 2004d, in press). The specimens from the oases of Jalu and Sinawan (situated 230 km and 250 km from the sea coast, respectively), although generally correspond in size with the *kuhlii* morphotype, represent populations intermediate in body size (Table 13, Fig. 60). The geographical distribution of the size categories in *P. kuhlii* s.l. in Libya and Egypt, on the north-south scale (Figs. 61, 62), showed

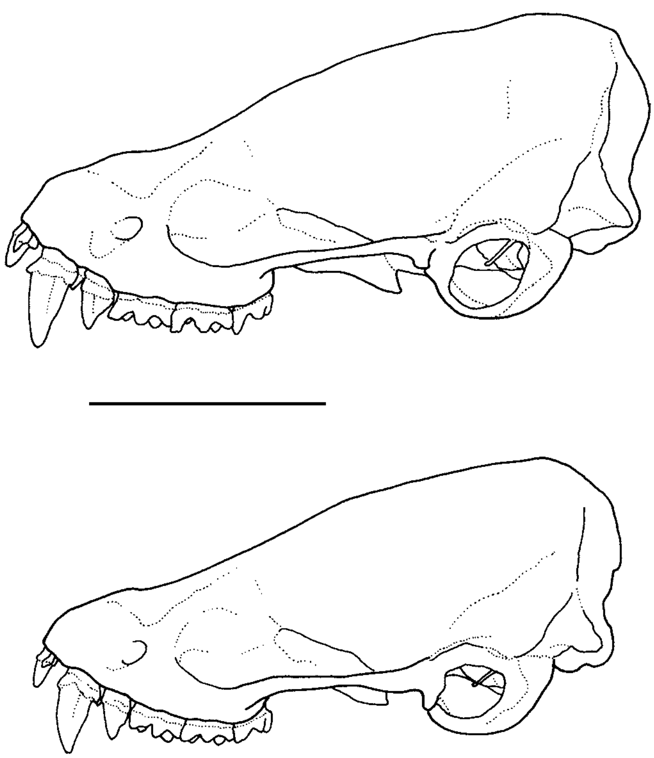


Fig. 59. Two extreme skull morphotypes of *Pipistrellus kuhlii* (Kuhl, 1817) from Libya; above – the *kuhlii* morphotype (NMP 49953, Ain Sharshara, Tripolitania; greatest length of skull [LCr] 13.02 mm), below – the *deserti* morphotype (NMP 48310, Gabrun, Fezzan; LCr 12.14 mm). Scale bar = 5 mm (after Benda et al. in press).

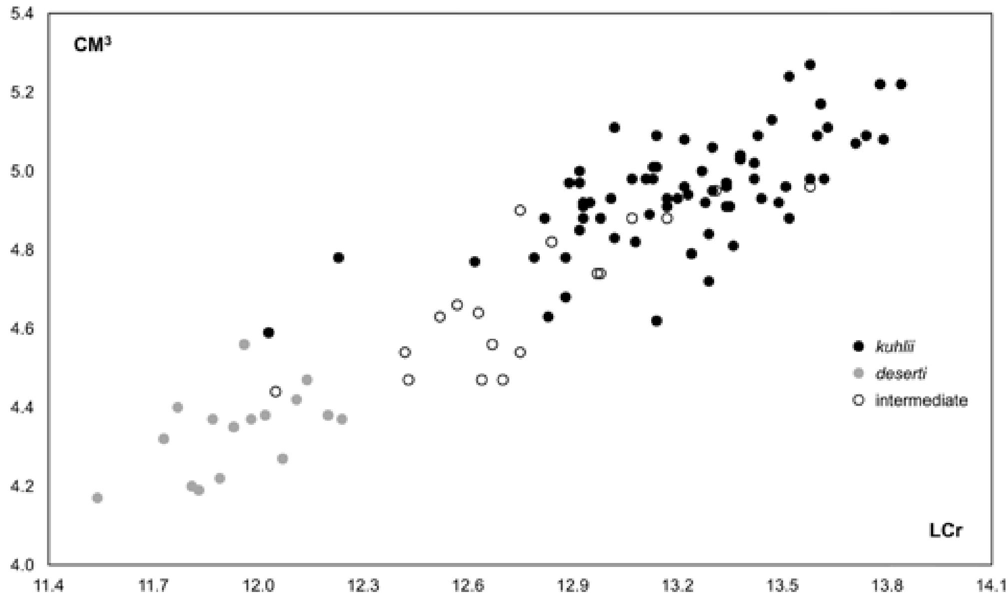


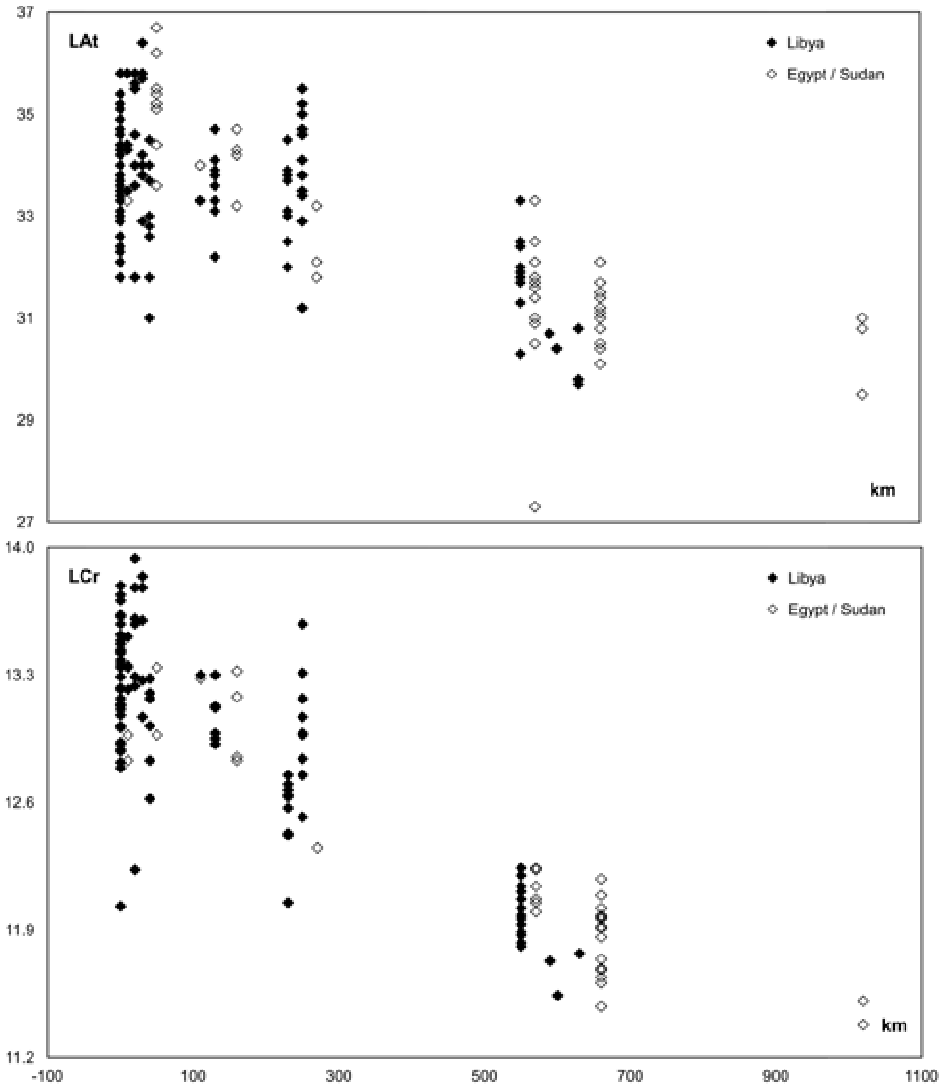
Fig. 60. Bivariate plot of the examined Libyan samples of *Pipistrellus kuhlii* (Kuhl, 1817): greatest length of skull (LCr) against the length of the upper tooth-row (CM^3). See text for details on the geographical origin of the morphotypes.

a clinal decrease of the forearm length towards the most arid regions of the central Sahara in southern Libya (Fezzan) as well as in the Egyptian/Sudanese border areas (Fig. 61); a similar comparison of distribution of the greatest skull length, however, demonstrated a rather step-like difference between the morphotypes in the areas 300–500 km south of the coast (Fig. 62). These two comparisons justified the original view by Thomas (1902).

A comparison of a more representative sampling of partial sequences of the mitochondrial gene for cytochrome *b* demonstrated a mosaic-like distribution of the *deserti* morphotype within the African/South-European lineage of *P. kuhlii* (Fig. 63). From 71 Libyan specimens of *P. kuhlii* s.l., 11 haplotypes were obtained and in most cases, the haplotypes were separated according to the morphotype (Table 14). A similar situation was found in bats of both morphotypes from Egypt and Morocco (16 and 50 specimens, respectively). However, in three cases, the *deserti* and *kuhlii* specimens shared identical haplotypes (haplotypes 1, 7, and 15, representing 60 specimens together) and in 13 other cases, the difference between the haplotypes from the *deserti* and *kuhlii* bats was one substitution only (haplotypes 2, 4, 5, 8–12, 17, 20, 22, 33, 34). The haplotypes from the *deserti* specimens from Libya and Egypt belonged to one common group with the haplotypes from the *kuhlii* specimens originating from these two countries, while the haplotypes from the *deserti* and *kuhlii* specimens from Morocco created a separate haplotype group (Fig. 63).

The presence of bats of the *deserti* morphotype within two separate lineages of *P. kuhlii*, the Libyan-Egyptian and Morrocan, suggests two directions of origin of this morphotype, the west--Saharan and east-Saharan. Thus, the arrangement of genetic relationships among the analysed specimens demonstrated (1) diphyly of the *deserti* morphotype, (2) very shallow differentiation of the two Saharan lineages of *P. kuhlii* s.l., and (3) inseparability of the two size morphotypes of *P. kuhlii* s.l. by genetic methods. These phenomena indicate the *deserti* morphotype to be a local variation (ecomorphotype) of *P. kuhlii*, which does not deserve taxonomic expression even at the subspecific level.

As it was mentioned in several other Saharan bat species, the size bimodality represents a general phenomenon, which does not affect taxonomic arrangements (see *Rhinopoma cystops*, *Rhinolophus ferrumequinum*, *R. clivosus*, and *Asellia tridens*).



Figs. 61, 62. Body size against the relative aridity of the record site (expressed as a geographical distance of the respective site from the Mediterranean Sea; in kilometres) in North African samples of *Pipistrellus kuhlii* (Kuhl, 1817) sensu lato. Fig. 61 (above) – forearm length (LAt). Fig. 62 (below) – greatest length of skull (LCr).

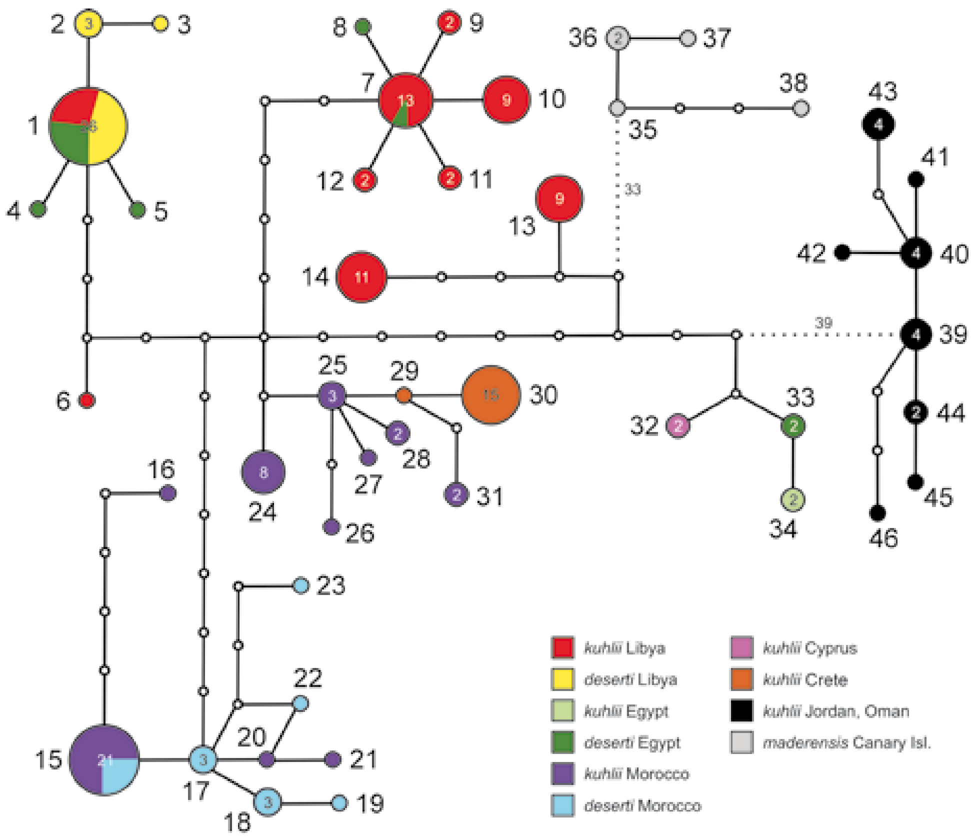


Fig. 63. Median-joining haplotype network of the *Pipistrellus kuhlii* complex based on 724 bp of the cytochrome *b* gene and 26 bp of the flanking tRNA-Thr. Circle sizes are proportional to the number of individuals with the particular haplotype; the numbers are also shown within each circle (displayed for n>1). Mutation steps are shown either as empty white circles or as numbers by the dotted lines. Numbers next to circles mark haplotypes and correspond to haplotype numbers in Table 14.

Feeding ecology. *Pipistrellus kuhlii* is a small aerial hawker (Norberg & Rayner 1987), its diet was studied in various parts of its distribution range with very variable results. Diptera, Lepidoptera, Hymenoptera (particularly Formicoidea), Auchenorrhyncha, Coleoptera, and Heteroptera were reported to be a major part of the diet of *P. kuhlii* (Rahmatulina 1983, Whitaker et al. 1994, Beck 1995, Feldman et al. 2000, Goiti et al. 2003, Benda et al. 2006, 2010a, 2012, Whitaker & Karataş 2009).

In Libya, the diet of *P. kuhlii* was analysed from 13 sites, with quite variable outcomes (Fig. 64). In general, smaller moths (Lepidoptera, wingspan length ca. 25 mm) and beetles (Coleoptera) were the most important types of prey. Regarding beetles, a high diversity was observed and four different families were identified in the samples (Scarabaeidae, Carabidae (frequently Harpalini), Staphylinidae, Tenebrionidae, Chrysomelidae: Alticinae). Besides Lepidoptera and Coleoptera, the only other major component of the diet of *P. kuhlii* were ants (Hymenoptera: Formicoidea). Medium-sized brachyceran Diptera (Muscidae, Asilidae) were also identified in the diet samples;

Table 14. GenBank Accession Numbers of the examined specimens of the *Pipistrellus kuhlii* complex (724 bp of the cytochrome *b* gene and 26 bp of the flanking tRNA-Thr); H = haplotype number as in Fig. 63, GBAN = GenBank Accession Number

H	GBAN	morphotype	voucher/s	country, site, date
1	KP455339	*deserti*	NMP 48303–48305	Libya, Gabrun, 2 October 1999
1		*deserti*	NMP 48309–48318	Libya, Gabrun, 2 October 1999
1		*kuhlii*	NMP 49953–49960	Libya, Ain Sharshara, 26 May 2002
1		*deserti*	NMP 92573–92575	Egypt, El Qasr, Dakhla oasis, 21 January 2010
1		*deserti*	NMP 92580	Egypt, El Qasr, Dakhla oasis, 23 January 2010
1		*deserti*	NMP 92581	Egypt, El Qasr, Dakhla oasis, 23 January 2010
1		*deserti*	NMP 94960	Egypt, Ismant, Dakhla oasis, 28 November 2010
1		*deserti*	NMP 94961	Egypt, Ismant, Dakhla oasis, 28 November 2010
2	KP455340	*deserti*	NMP 48319	Libya, Murzuq, 6 October 1999
2		*deserti*	NMP 48320	Libya, Germa, 6 October 1999
2		*deserti*	NMP 48321	Libya, Al Fjayj, 6 October 1999
3	KP455341	*deserti*	NMP 48302	Libya, Gabrun, 2 October 1999
4	KP455342	*deserti*	NMP 92572	Egypt, El Qasr, Dakhla oasis, 21 January 2010
5	KP455343	*deserti*	NMP 92579	Egypt, El Qasr, Dakhla oasis, 22 January 2010
6	KP455344	*kuhlii*	NMP 49939	Libya, Jalu, 24 May 2002
7	KP455345	*kuhlii*	NMP 49850	Libya, Sinawan, 8 May 2002
7		*kuhlii*	NMP 49851	Libya, Sinawan, 8 May 2002
7		*kuhlii*	NMP 49853	Libya, Sinawan, 8 May 2002
7		*kuhlii*	NMP 49957	Libya, Ain Sharshara, 26 May 2002
7		*kuhlii*	NMP 49968–49973	Libya, Nanatalah, 27 May 2002
7		*kuhlii*	NMP 49981	Libya, Sabratha, 28 May 2002
7		*kuhlii*	NMP 49983	Libya, Sabratha, 28 May 2002
7		*deserti*	NMP 94959	Egypt, Bawiti, Al Bahariya oasis, 30 December 2010
8	KP455346	*deserti*	NMP 92571	Egypt, Bawiti, Al Bahariya oasis, 19 January 2010
9	KP455347	*kuhlii*	NMP 49843	Libya, Al Jawsh, 7 May 2002
9		*kuhlii*	NMP 49844	Libya, Sinawan, 8 May 2002
10	KP455348	*kuhlii*	NMP 49845–49849	Libya, Sinawan, 8 May 2002
10		*kuhlii*	NMP 49852	Libya, Sinawan, 8 May 2002
10		*kuhlii*	NMP 49854	Libya, Sinawan, 8 May 2002
10		*kuhlii*	NMP 49859	Libya, Sinawan, 8 May 2002
10		*kuhlii*	NMP 49860	Libya, Sinawan, 8 May 2002
11	KP455349	*kuhlii*	NMP 49982	Libya, Sabratha, 28 May 2002
11		*kuhlii*	NMP 49984	Libya, Sabratha, 28 May 2002
12	KP455350	*kuhlii*	NMP 49974	Libya, Nanatalah, 27 May 2002
12		*kuhlii*	NMP 49975	Libya, Nanatalah, 27 May 2002
13	KP455351	*kuhlii*	NMP 48326	Libya, Al Aquriyah, 9 October 1999
13		*kuhlii*	NMP 49893	Libya, Wadi Al Kuf, SW of Al Bayda, 18 May 2002
13		*kuhlii*	NMP 49917–49919	Libya, Wadi Jarmah, 20 May 2002
13		*kuhlii*	NMP 49930–49932	Libya, Tolmeitha, 22 May 2002
13		*kuhlii*	NMP 49938	Libya, Ar Rajmah, 23 May 2002
14	KP455352	*kuhlii*	NMP 48322	Libya, Karkurah, 8 October 1999
14		*kuhlii*	NMP 48332	Libya, Al Abyar, 11 October 1999
14		*kuhlii*	NMP 49921–49924	Libya, Wadi An Nazrat, 22 May 2002
14		*kuhlii*	NMP 49933–49937	Libya, Ar Rajmah, 23 May 2002
15	KP455353	*deserti*	NMP 94471	Morocco, Oued Rheris, W of Rissani, 25 April 2008
15		*deserti*	NMP 94477	Morocco, Oued Rheris, W of Rissani, 25 April 2008
15		*deserti*	NMP 94478	Morocco, Oued Rheris, W of Rissani, 25 April 2008
15		*deserti*	NMP 94516–94518	Morocco, Takoumit, oasis, 26 April 2008
15		*kuhlii*	NMP 90067	Morocco, Âït-Saoun, 1 September 2003
15		*kuhlii*	NMP 94469	Morocco, Oued Rheris, W of Rissani, 25 April 2008
15		*kuhlii*	NMP 94470	Morocco, Oued Rheris, W of Rissani, 25 April 2008
15		*kuhlii*	NMP 94472–94476	Morocco, Oued Rheris, W of Rissani, 25 April 2008
15		*kuhlii*	NMP 94480–94486	Morocco, Oued Rheris, W of Rissani, 25 April 2008

H	GBAN	morphotype	voucher/s	country, site, date
16	KP455354	*kuhlii*	NMP 94479	Morocco, Oued Rheris, W of Rissani, 25 April 2008
17	KP455355	*deserti*	NMP 90058	Morocco, Oued Drâa, NW of Anagam, 31 August 2003
17		*deserti*	NMP 90071	Morocco, Gorges du Todra, 3 September 2003
17		*deserti*	NMP 90072	Morocco, Gorges du Todra, 3 September 2003
18	KP455356	*deserti*	NMP 94449	Morocco, Tassetift, oasis, 22 April 2008
18		*deserti*	NMP 94451	Morocco, Tassetift, oasis, 22 April 2008
18		*deserti*	NMP 94452	Morocco, Tassetift, oasis, 22 April 2008
19	KP455357	*deserti*	NMP 94450	Morocco, Tassetift, oasis, 22 April 2008
20	KP455358	*kuhlii*	NMP 90066	Morocco, Âït-Saoun, 1 September 2003
21	KP455359	*kuhlii*	NMP 93603	Morocco, Âït-Rahhal, Akka oasis, 10 October 2010
22	KP455360	*deserti*	NMP 90059	Morocco, Oued Drâa, NW of Anagam, 31 August 2003
23	KP455361	*deserti*	NMP 90060	Morocco, Oued Drâa, NW of Anagam, 31 August 2003
24	KP455362	*kuhlii*	NMP 90030	Morocco, Tabouda, S of Chefchaouen, 26 August 2003
24		*kuhlii*	NMP 90082–90085	Morocco, Oued Isly, Sidi Moussa, 7 September 2003
24		*kuhlii*	NMP 90097–90099	Morocco, Oued El Ammar, 9 September 2003
25	KP455363	*kuhlii*	NMP 90024	Morocco, Oued Makhazen, 25 August 2003
25		*kuhlii*	NMP 93580	Morocco, Derdara, SW Chefchaouen, 2 October 2010
25		*kuhlii*	NMP 93586	Morocco, Tafeer, 3 October 2010
26	KP455364	*kuhlii*	NMP 93581	Morocco, Derdara, SW Chefchaouen, 2 October 2010
27	KP455365	*kuhlii*	NMP 93591	Morocco, Oued Marrout, 5 October 2010
28	KP455366	*kuhlii*	NMP 93585	Morocco, Tafeer, 3 October 2010
28		*kuhlii*	NMP 93592	Morocco, Oued Marrout, 5 October 2010
29	KP455367	*kuhlii*	NMP 92324	Crete, Agia Irini, S of Knossos, 26 May 2008
30	KP455368	*kuhlii*	NMP 91185–91187	Crete, Vrisses, 2 October 2006
30		*kuhlii*	NMP 92302	Crete, Kalami, Kilianis river, 9 October 2007
30		*kuhlii*	NMP 92304–92308	Crete, Vrisses, 11 October 2007
30		*kuhlii*	NMP 92321	Crete, Lefkogia, Moni Kato Preveli, 14 October 2007
30		*kuhlii*	NMP 92336–92341	Crete, Lefkogia, Moni Kato Preveli, 30 May 2008
31	KP455369	*kuhlii*	NMP 90095	Morocco, Oued El Ammar, 9 September 2003
31		*kuhlii*	NMP 90096	Morocco, Oued El Ammar, 9 September 2003
32	KP455370	*kuhlii*	NMP 90920	Cyprus, Afendrika, basilica, 25 July 2006
32		*kuhlii*	NMP 90921	Cyprus, Afendrika, basilica, 25 July 2006
33	KP455371	*deserti*	NMP 94962	Egypt, Ismant, Dakhla oasis, 28 November 2010
33		*deserti*	NMP 94963	Egypt, Ismant, Dakhla oasis, 28 November 2010
34	KP455372	*kuhlii*	NMP 92614	Egypt, Cairo, Muqattam, 29 January 2010
34		*kuhlii*	NMP 92615	Egypt, Cairo, Muqattam, 29 January 2010
35	KP455373	*maderensis*	NMP 95112	Canary Isl., Tenerife, Güimar, 27 March 2012
36	KP455374	*maderensis*	NMP 95114	Canary Isl., Tenerife, Güimar, 27 March 2012
36		*maderensis*	NMP 95115	Canary Isl., Tenerife, Güimar, 27 March 2012
37	KP455375	*maderensis*	NMP 95111	Canary Isl., Tenerife, Güimar, 27 March 2012
38	KP455376	*maderensis*	NMP 95113	Canary Isl., Tenerife, Güimar, 27 March 2012
39	KP455377	*kuhlii*	NMP 92617	Oman, Nakhl, fortress, 17 October 2009
39		*kuhlii*	NMP 92619	Oman, Nakhl, fortress, 17 October 2009
39		*kuhlii*	NMP 92640	Oman, Ar Rustaq, fortress, 19 October 2009
39		*kuhlii*	NMP 93728	Oman, Jaalan Bani Bu Hassan, 2 April 2011
40	KP455378	*kuhlii*	NMP 92369	Jordan, Azraq Wettland, 13 October 2008
40		*kuhlii*	NMP 92370	Jordan, Azraq Wettland, 13 October 2008
40		*kuhlii*	NMP 92372	Jordan, Azraq Wettland, 13 October 2008
40		*kuhlii*	NMP 92373	Jordan, Azraq Wettland, 13 October 2008
41	KP455379	*kuhlii*	NMP 92368	Jordan, Azraq Wettland, 13 October 2008
42	KP455380	*kuhlii*	NMP 92816	Jordan, As Salihiyyah, 8 July 2010
43	KP455381	*kuhlii*	NMP 92817–92820	Jordan, As Salihiyyah, 8 July 2010
44	KP455382	*kuhlii*	NMP 92618	Oman, Nakhl, fortress, 17 October 2009
44		*kuhlii*	NMP 93816	Oman, Shinas, castle, 13 April 2011
45	KP455383	*kuhlii*	NMP 94003	Oman, Khassab, Al Khmazera Castle, 18 March 2012
46	KP455384	*kuhlii*	NMP 92822	Jordan, Azraq Wettland, 9 June 2010

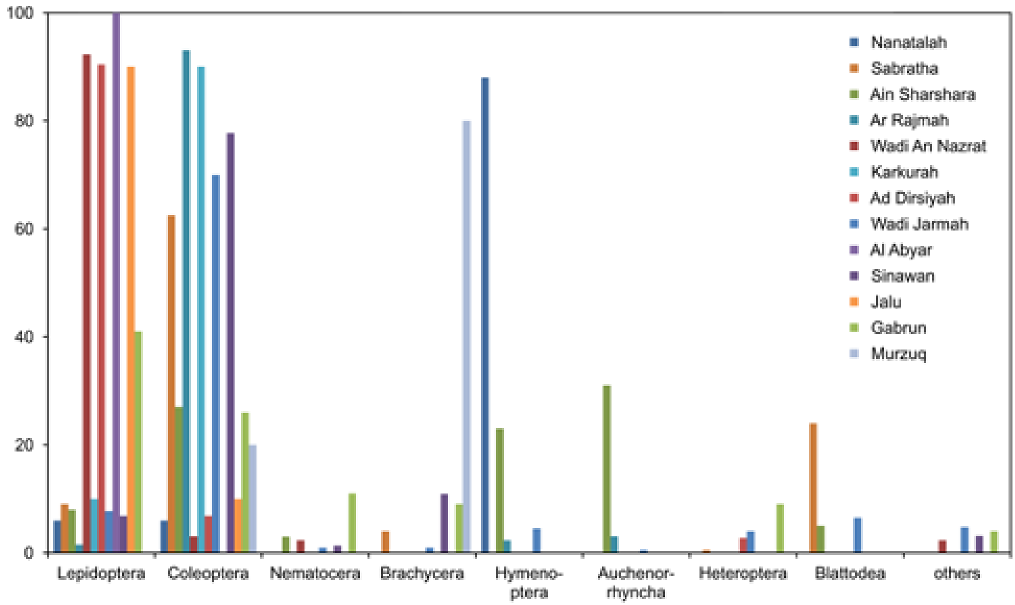


Fig. 64. Percentage volume of particular food items in the diet of *Pipistrellus kuhlii* (Kuhl, 1817) in Libya. Material analysed: Nanatalah (20 faecal pellets / from 8 individuals), Sabratha (20 / 4), Ain Sharshara (10 / 8), Ar Rajmah (13 / 6), Wadi An Nazrat (13 / 4), Karkurah (one digestive tract), Ad Dirsiyah (22 / 3), Wadi Jarmah (20 / 3), Al Abyar (one digestive tract), Sinawan (11 / 13), Jalu (one digestive tract), Gabrun (13 digestive tracts), Murzuq (one digestive tract).

however, the high proportion of Brachycera in the samples from Murzuq (Fig. 64) comes from a single bat and therefore cannot be considered as a meaningful indication of importance of this diet item. Regarding Neuroptera, both Chrysopidae and Hemerobiidae were recorded.

The general pattern of the recorded diet composition roughly corresponds with the previous studies of *P. kuhlii* diet. High geographical variability recorded in the diet of this bat in Libya indicates an opportunistic foraging strategy. Presence of mostly diurnal brachyceran Diptera cannot only be interpreted as an evidence of foliage gleaning, since this bat can be observed hunting before sunset (Dietz et al. 2007, own data).

Records of ectoparasites. **Original data**: A r g a s i d a e: *Argas vespertilionis*: 3 larvae (CMŠ [P]) from a jar containing common collection of 10 host inds. (NMP 48322, 48332, 49968–49975) collected at Karkurah, Al Abyar and Nanatalah, 8 and 11 October 1999 and 28 May 2002. – M a c r o n y s s i d a e: *Steatonyssus periblepharus*: 1 fa (CMŠ [P]; det. P. Mašán) from a jar containing common collection of 19 host inds. (NMP 49843–49849, 49851–49854, 49893, 49917–49919, 49921–49922, 49924, 49935) collected at Al Jawsh, Sinawan, Wadi Al Kuf, Wadi Jarma, Wadi An Nazrat, and Al Rajmah, 7–23 May 2002. – S p i n t u r n i c i d a e: *Spinturnix acuminata* group: 1 fa (CMŠ [P]), from a jar containing common collection of 19 host inds. (NMP 49843–49849, 49851–49854, 49893, 49917–49919, 49921–49922, 49924, 49935) collected at Al Jawsh, Sinawan, Wadi Al Kuf, Wadi Jarma, Wadi An Nazrat, and Al Rajmah, 7–23 May 2002. – **Published data**: C i m i c i d a e: *Cimex lectularius*: 6 inds. from 1 host ind., ruins at Sabratha (Hufnagl 1972). – *Cacodmus vicinus*: 1 ma from a host colony of about 50 inds., Ain Zeyanah, 16 April 1979 (Hůrka 1982). – I s c h n o p s y l l i d a e: *Ischnopsyllus consimilis*: 1 ma, 2 fa, Ain Zeyanah, 16 April 1979, 1 ma, 1 fa, Ain Zeyanah, 20 April 1980, 4 fa, Ain Zeyanah, 3 May 1980; – 1 fa, Antique ruins of Sabratha, 7 May 1980 (Hůrka 1982).

Comments on ectoparasites. Two bug species parasitic on *Pipistrellus kuhlii* were reported from Libya (Hufnagl 1972, Hůrka 1982). This bat ranks among the preferred hosts of *Cacodmus vicinus*

Horváth, 1934 (Usinger 1966); the known distribution range of this parasite comprises Spain, North Africa (including Chad) and the Levant (Aktaş & Kiyak 1990, Péricart 1996, Benda et al. 2010a, Quetglas et al. 2012). The record of *Cimex lectularius* Linnaeus, 1758 from Sabratha was doubted by Hůrka (1982), who regarded it to belong to *C. vicinus*. However, considering the recent records of bat-parasitic bugs from southern Europe and North Africa (O. Balvín & T. Bartonička, unpubl. data), also a finding of a bug from the *Cimex pipistrelli* group is possible from Libya. Thus, without a revision of the respective Hufnagl's (1972) specimens, the species identification remains open.

The bat flea *Ischnopsyllus consimilis* (Wahlgren, 1904) occurs in north-eastern Africa and the Levant (Theodor & Moscona 1954, Hopkins & Rothschild 1956, Lewis 1962, Hoogstraal & Traub 1963) and the Libyan records represent the western margin of the species range (Hůrka 1982).

P. kuhlii is a principal host of the bat soft-tick *Argas vespertilionis* (Latreille, 1802). Its evidence from this bat is not a surprise, although it was simultaneously collected from more bat species in Libya. Anyway, it is here reported from the country for the first time (for details on distribution see the comments on ectoparasites of *Rhinopoma cystops*).

An unusual record of a mite of the *Spinturnix acuminata* group is available from *P. kuhlii*. The mites of this genus are only rarely found in this host species, the records are known exclusively from the southern part of the distribution range of *P. kuhlii* – besides Libya only in Azerbaijan and Iran (Stanyukovich 1997*, Benda et al. 2012).

Steatonyssus periblepharus Kolenati, 1858 is a macronyssid mite parasitising mostly bats of the genus *Pipistrellus* (Till & Evans 1964). However, it was collected also from other bat hosts of the families Rhinolophidae, Vespertilionidae and Miniopteridae (Stanyukovich 1997). Its records are available from a large part of the Palaearctic including Mongolia and China (Teng 1980), from Libya it is here reported for the first time.

Vansonia rueppellii (Fischer, 1829)

Record. **Original data**: C y r e n a i c a: Al Jaghbub [1], above an irrigation channel (Fig. 66), 13 May 2002: net. 1 fa (NMP 49878 [S+A]; cf. Benda et al. 2004a).

Distribution. *Vansonia rueppellii* was recorded in Libya only once, in the oasis of Al Jaghbub (Giarabub) in the north-eastern part of the country (Fig. 65; Benda et al. 2004a). The oasis is a relatively small fertile site, isolated from other similar oases by enormous areas of sand and/or dust desert. It is situated approximately 240 km southwards of the coast of the Mediterranean Sea, close to the Egyptian border (Fig. 65). The Al Jaghbub oasis is found on the western margin of the Siwa basin adjacent to the Qattara depression in north-western Egypt.

V. rueppellii is a species with mainly Afro-tropical distribution, inhabiting namely savannah habitats of sub-Saharan Africa, from Senegal in the west to Ethiopia in the east and to Namibia and South Africa in the south, but also occupying arid and semi-arid regions of North Africa and the Middle East (Hayman & Hill 1971). In the Saharan and supra-Saharan parts of Africa, it was recorded along the Nile in the Sudan and Egypt, from where some dozen sites of occurrence are known (Koopman 1975, Wassif et al. 1984, Qumsiyeh 1985, own unpubl. data). Recently, *V. rueppellii* has been documented from the oases of Bahariya and Dakhla in the Libyan desert of Egypt (Benda et al. 2014). The Bahariyan site (Al Bawiti) lies ca. 450 km of aerial distance from the only known site of the species in Libya, the oasis of Al Jaghbub.

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* Stanyukovich (1997) reported a record of *Spinturnix bakeri* Rudnick, 1960 from Azerbaijan; however, it certainly is a misidentification of some other mite from the *S. acuminata* group, since the respective species belongs to the Neotropic fauna (see Rudnick 1960).

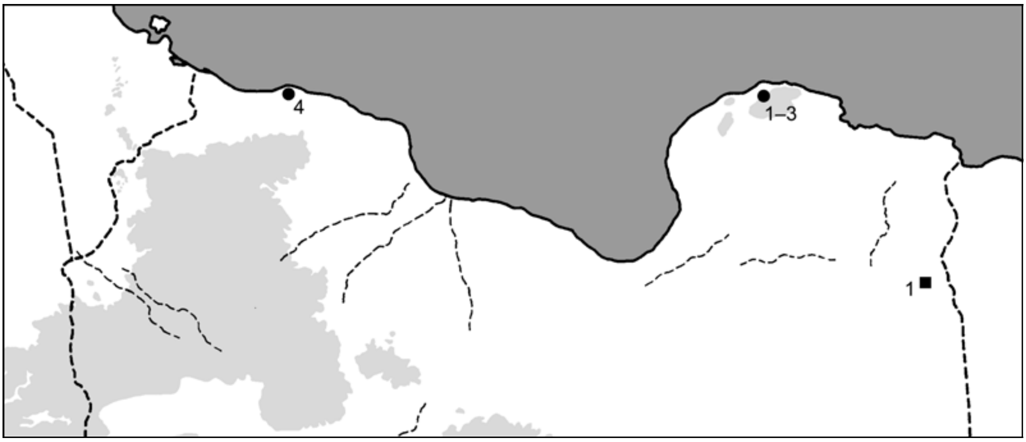

Fig. 65. Records of *Vansonia rueppellii* (Fischer, 1829) (square) and *Miniopterus schreibersii* (Kuhl, 1817) (circles) in Libya.

From other regions of North Africa (except Morocco), records of this bat are scarce compared to the above described east-Saharan part of the distribution range. One specimen is available from Tunisia, Dalhoumi et al. (2011) reported it from Matmata in the south-eastern part of the country. Two closely positioned localities, Abadla and Beni Abbès, were published from north-western Algeria (Hayman & Hill 1971, Gaisler & Kowalski 1986). Qumsiyeh & Schlitter (1981) reported one record from Garak on the margin of the savannah zone in south-western Mauritania (although more records are perhaps available from the country, see Lelant & Chenaval 2011). Two sites, far away from each other, are known from Chad – from the bank of Lac Tchad (savannah zone) and from the Ennedi plateau in the central Sahara (Dorst 1963, Vielliard 1974). In Morocco, there are at least ten known records of *V. rueppellii* in semi-deserts and steppes of the eastern and south--eastern parts of the country (Arlettaz & Aulagnier 1988, Benda et al. 2004d, 2010b, Dieuleveut et al. 2010). However, there is a question whether these rather abundant records correspond with a more common occurrence of *V. rueppellii* there or rather with a more intensive research effort in the respective region.

Anyway, *V. rueppellii* was recorded in North Africa only in marginal regions of the Sahara, while it is not known from the whole central Sahara, i.e. from the true continental deserts. The existing records of *V. rueppellii* suggest that this species penetrated to North Africa (and also to the Middle East) from sub-Saharan Africa from two directions – along the Nile valley of the Sudan and Egypt and along the west-African coast of Mauritania, Western Sahara and Morocco. Concerning the rather abundant occurrence of this bat in various parts of Egypt, the Libyan locality seems to represent a natural and not too distant offshoot of the north-east-African part of the species range. On the other hand, the findings of *V. rueppellii* from Tunisia and northern Chad, some 150 km and 300 km away, respectively, from the Libyan border, suggest a possible occurrence of this species also in Tripolitania and southern Cyrenaica.

Field notes. The only known Libyan individual of *Vansonia rueppellii*, an adult female without any traces of ongoing reproduction, was caught in a net installed above an irrigation channel in the oasis of Al Jaghbub (Fig. 66, 67) on 13 May 2002. This individual was the only bat netted during the respective netting session.

Fig. 66. The oasis of Al Jaghbub, Libyan desert (Cyrenaica); a site of occurrence of *Rhinopoma cystops*, *Vansonia rueppellii*, *Otonycteris hemprichii*, and *Plecotus christii*. Photo by A. Reiter (May 2002).

Material examined. 1 ♀ (NMP 49878 [S+A]), Al Jaghbub, 13 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimen of *Vansonia rueppellii* are shown in Table 15. For the material examined see above. The only known Libyan specimen of *V. rueppellii* is extremely small, it is the smallest representative of all compared

Fig. 67. Portrait of *Vansonia rueppellii* (Fischer, 1829) from Al Jaghbub (Cyrenaica). Photo by A. Reiter.

Table 15. Basic biometric data on the examined Libyan samples of *Vansonia rueppellii* (Fischer, 1829), *Nyctalus leisleri* (Kuhl, 1817), *Otonycteris hemprichii* Peters, 1859, *Miniopterus schreibersii* (Kuhl, 1817), and *Tadarida teniotis* (Rafinesque, 1814). For abbreviations see p. 8

	Vansonia rueppellii	*Nyctalus leisleri*	*Otonycteris hemprichii*	*Miniopterus schreibersii*					*Tadarida teniotis*				
				n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	30.4	41.2	63.5	8	**42.65**	42.0	43.8	0.535	19	**57.83**	53.4	60.7	1.524
LCr	12.02	15.32	23.30	9	**14.64**	14.44	14.89	0.139	19	**23.58**	22.63	24.25	0.404
LCb	11.27	15.31	21.84	9	**14.13**	13.86	14.48	0.177	19	**22.99**	21.92	23.73	0.485
LaZ	7.58	9.93	14.29	9	**8.25**	8.04	8.56	0.170	19	**14.10**	13.63	14.44	0.207
LaI	3.18	4.33	4.23	9	**3.49**	3.38	3.56	0.061	19	**4.58**	4.33	4.83	0.131
LaInf	3.51	4.92	6.03	9	**3.86**	3.68	3.94	0.093	19	**4.86**	4.68	5.14	0.111
LaN	6.32	7.86	10.17	9	**7.73**	7.62	7.93	0.112	19	**11.59**	11.27	12.07	0.238
LaM	6.55	9.29	11.29	9	**8.43**	8.28	8.62	0.121	19	**12.77**	12.41	13.31	0.232
ANc	4.37	5.42	7.23	9	**6.17**	5.94	6.41	0.129	19	**7.29**	7.11	7.56	0.121
LBT	2.85	3.68	6.06	7	**2.94**	2.82	3.16	0.124	16	**5.27**	4.93	5.68	0.201
CC	3.42	5.65	6.31	9	**4.42**	4.36	4.53	0.058	19	**5.61**	5.12	5.95	0.197
M^3M^3	4.67	6.91	9.66	9	**6.21**	6.17	6.24	0.026	19	**9.39**	9.08	9.93	0.206
CM^3	4.08	5.79	8.36	9	**5.74**	5.67	5.91	0.075	19	**8.80**	8.34	9.11	0.228
LMd	8.18	11.34	15.97	9	**10.34**	9.94	10.75	0.220	19	**16.67**	16.01	17.19	0.305
ACo	2.18	2.96	7.37	9	**2.51**	2.42	2.73	0.103	19	**4.15**	3.71	4.43	0.174
CM_3	4.18	6.17	9.18	9	**6.09**	6.02	6.18	0.058	19	**9.28**	6.67	9.84	0.687

samples from the species distribution range (Fig. 68, Table 16; see also Benda et al. 2004a: 115). From the comparison of dimensions of several sample sets of *V. rueppellii* from Africa (Fig. 68), a certain size variation is evident. However, most of the available specimens from the northern part of Africa cluster into one common group with the exception of the Libyan specimen, which is extremely small, and one Egyptian specimen, which is unusually large (a separate position is also found in a specimen from southern Africa, which is even larger). Since the number of compared population sets is rather limited, the results of their comparison cannot be explained easily. Two possibilities are suggested: (1) a clinal increase of size in Africa from north to south,

Table 16. Biometric data on comparative sample sets of *Vansonia rueppellii* (Fischer, 1829). For abbreviations see p. 8

	Egypt & Sudan					Maghreb					sub-Saharan Africa				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	17	**31.99**	28.5	35.0	1.628	18	**33.17**	30.5	35.2	1.291	5	**35.06**	33.3	38.3	2.053
LCr	18	**13.05**	12.57	13.82	0.320	12	**12.62**	12.31	13.18	0.270	7	**13.35**	12.68	14.19	0.506
LCb	18	**12.61**	12.04	13.37	0.301	12	**12.17**	11.64	12.67	0.329	8	**12.64**	11.47	13.47	0.615
LaZ	15	**8.57**	8.27	8.98	0.217	11	**8.19**	7.85	8.53	0.207	5	**8.94**	8.59	9.36	0.323
LaI	21	**3.52**	3.33	3.77	0.132	12	**3.42**	3.21	3.65	0.143	8	**3.88**	3.48	4.23	0.244
LaN	19	**6.89**	6.58	7.18	0.187	12	**6.52**	6.28	6.71	0.123	8	**7.06**	6.12	8.08	0.435
ANc	17	**4.72**	4.44	5.15	0.200	12	**4.67**	4.43	4.92	0.135	8	**5.04**	4.62	5.43	0.267
CC	21	**4.04**	3.82	4.33	0.143	12	**3.86**	3.36	4.17	0.221	8	**4.10**	3.64	4.36	0.279
M^3M^3	21	**5.48**	5.21	5.69	0.150	11	**5.31**	4.95	5.65	0.212	7	**5.48**	5.27	5.71	0.194
CM^3	21	**4.66**	4.42	5.02	0.137	11	**4.55**	4.42	4.75	0.109	7	**4.67**	4.32	5.11	0.270
LMd	19	**9.23**	8.91	9.82	0.251	12	**8.98**	8.67	9.34	0.203	7	**9.38**	8.93	9.98	0.366
ACo	19	**2.53**	2.23	2.75	0.139	12	**2.40**	2.27	2.61	0.102	7	**2.62**	2.51	2.74	0.078
CM_3	20	**4.93**	4.75	5.19	0.148	12	**4.78**	4.63	5.10	0.135	8	**4.98**	4.57	5.42	0.270

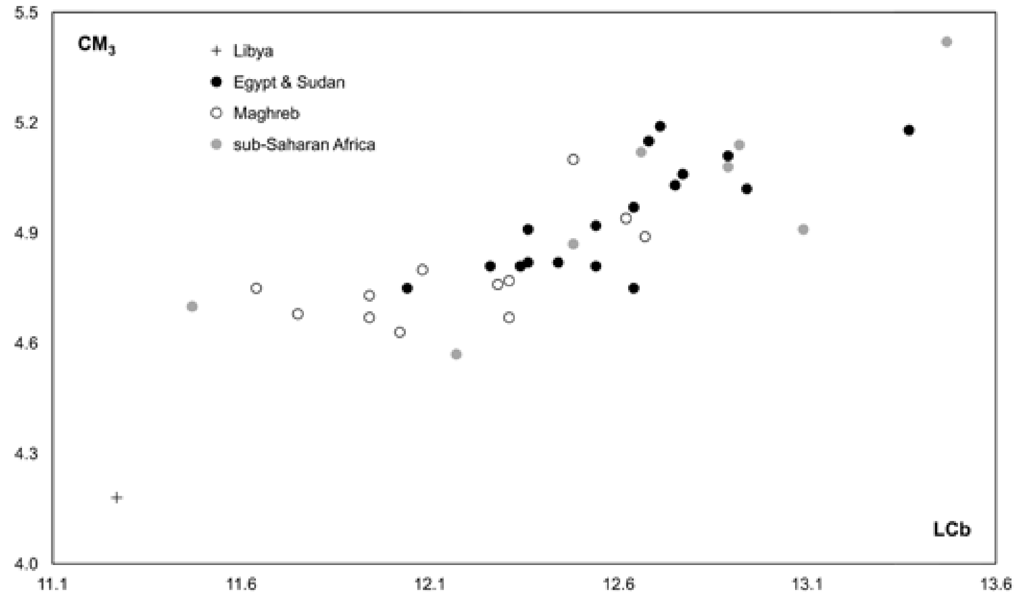

Fig. 68. Bivariate plot of the examined Libyan and comparative samples of *Vansonia rueppellii* (Fischer, 1829): greatest length of skull (LCr) against the length of the lower tooth-row (CM_3).

or alternatively, (2) an extreme variation of local populations without any obvious geographical trend. Three to five subspecies of *V. rueppellii* are reported to occur in Africa (Hayman & Hill 1971, Koopman 1994, Horáček et al. 2000, Happold 2013). Two names were assigned to the North African populations by Koopman (1994), *V. r. rueppellii* (Fischer, 1829) to the bats from the eastern parts of the Sahara and the Sahel zone (Egypt, Sudan, South Sudan, Chad) and *V. r. senegalensis* (Dorst, 1960) to the bats from the western parts of the Sahara and the Sahel zone (Algeria, Morocco, Mauritania, Senegal). However, as Hayman & Hill (1971) stated, the validity of the latter subspecies remains to be shown. Besides its (former) geographical isolation, the main difference from the nominotypical form of *V. rueppellii* mentioned by Dorst (1960) in the description of *V. r. senegalensis* is its large size in comparison with Sudanese (nominotypical) individuals. Indeed, the comparison presented here (Fig. 68) shows the sub-Saharan (incl. Senegalese) samples to be on average slightly larger in body size than the Saharan bats; however, among the Saharan bats, the specimens from the Maghreb were on average the smallest and at the same time, very similar in size to the Egyptian and Sudanese samples.

The morphometric comparison of available samples alone does not seem to be sufficient for description of the geographical variation in the North African populations of *V. rueppellii*. The only reliable method to assess the relationships among particular populations of this bat species is a molecular genetic analysis.

Feeding ecology. *Vansonia rueppellii* is a small bat capturing its prey in flight by slow-hawking; it was observed to forage mostly in riparian habitats or in swamps (Happold 2013). From various parts of its range, the species is reported to feed mostly on Lepidoptera, Diptera, Coleoptera, Trichoptera, and Hymenoptera (Fenton & Thomas 1980, Whitaker et al. 1994, Feldman et al. 2000).

From Libya, we analysed the content of a digestive tract from the individual collected in the Al Jaghbub oasis; it contained 50% of the volume of brachyceran Diptera, 30% of Lepidoptera and 20% of nematoceran Diptera. The relatively high proportion of diurnal Brachycera in the diet may be caused by proximity of dwellings of local people and their livestock; it can also indicate that the species emerges very early from the roost to catch diurnal insects.

Nyctalus lasiopterus (Schreber, 1780)

Records. **Original data**: C y r e n a i c a: Arqub Ash Shafshaf [1], above a stream (Fig. 40), 17 May 2002: net. 4 ma, NMP; – Shahhat [2], Cyrene, ancient ruins, Fountain of Apollo (Fig. 71), 19 August 1981: net. 2 ma, NMW (cf. Spitzenberger 1982); – Wadi Al Kuf [3], confluence of Wadi Al Kuf and a valley on the SE side, fissure in ceiling of a rocky overhang (Fig. 70), 9 August 1981: coll. 1 ma, NMW (cf. Spitzenberger 1982); – Wadi Al Minshiyah [4] (Fig. 99), above a water pit, 16 May 2002: net. 1 fs, NMP. – **Published data**: C y r e n a i c a: Wadi Al Kuf, "mistnetting site" [5], 15 March 1981: net. 1 m, 3 f, 28 March 1981: net. 1 f, 29 March 1981: net. 1 m (Qumsiyeh & Schlitter 1982).

Distribution. The known occurrence of *Nyctalus lasiopterus* in Libya is restricted to the Mediterranean part of Cyrenaica (Fig. 69). The available records were made in the centre of the forested northern part of the Cyrenaican plateau (Jebel Al Akhdar Mts.), limited to an area of ca. 60 km by 25 km. With five record sites, *N. lasiopterus* belongs to the least frequent bats of Cyrenaica. As it was already mentioned (Spitzenberger 1982, Hanák & Elgadi 1984), this bat was documented from the best preserved parts of the Jebel Al Akhdar Mts., where remnants of original woodland dominated by juniper and cypress trees still exist. The records were made in various altitudes from the sea level up to 650 m a. s. l.

N. lasiopterus was found in Africa in two areas situated some 2500 km from each other; in northern and north-western Morocco and in Libyan Cyrenaica (Ibáñez 2013). However, while from Cyrenaica at least 14 specimens are known from five sites (see Records), from Morocco only two specimens from two sites were collected (Palmeirim 1982, Ibañez 1988). The Moroccan part of the *N. lasiopterus* range continues into a relatively abundant species occurrence in Iberia (Juste 2002), the occasionally recorded individuals from Morocco can thus be regarded rather as irregular strays from the north across the Strait of Gibraltar (contra Ibáñez 2013). Such a conclu-

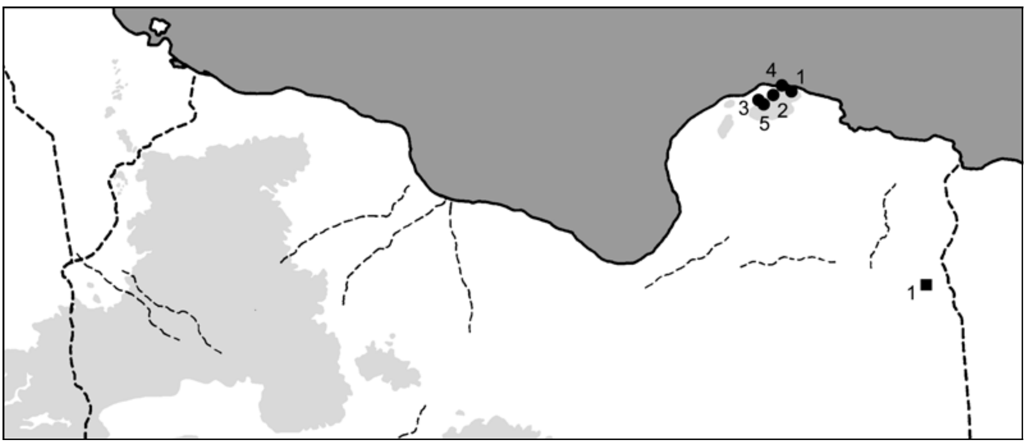

Fig. 69. Records of *Nyctalus lasiopterus* (Schreber, 1780) (circles) and *Plecotus christii* Gray, 1838 (square) in Libya.

sion is supported also by the results of the molecular genetic comparison (García-Mudarra et al. 2009). On the other hand, the records from the small Libyan area of occurrence rather suggest an existence of a resident reproducing population of *N. lasiopterus* (Hanák & Elgadi 1984). The bats were netted there throughout a large part of the year (March, May, August), and the May catch contained also a subadult female, indicating the presence of a nursery colony and thus, reproduction in the region. The supposition of a resident population is also supported by a relative isolation of the Cyrenaican range of *N. lasiopterus*. In the central and eastern Mediterranean, there is no continuation of distribution from Cyrenaica in any direction; the species remains unknown from the Peloponnese and Crete as well as from other Greek islands (Hanák et al. 2001, Benda et al. 2009), from Maltese archipelago (Borg et al. 1997), and from Pelagic islands (Lanza 2012); a very limited number of records is available from Sicily (Agnelli et al. 2008), a single record is known from southern Turkey (Yiğit et al. 2008) as well as from Cyprus (Benda et al. 2007). Only the latter record supposedly represents evidence of a resident population (a nursery colony was found); however, the Cypriot and Cyrenaican localities lie some 1000 km away from each other. Other reproducing populations of *N. lasiopterus* live only in the European continent; the nearest findings to Cyrenaica are available from the Balkans – 21 occurrence sites (including one nursery colony) were documented in central and northern Greece and in southern Bulgaria (Hanák et al. 2001, Benda et al. 2003) – at least 650 km north of Cyrenaica.

In summary, the numerous records of *N. lasiopterus* in the isolation of the Mediterranean Cyrenaica seem to represent a sedentary reproducing population, with most probability the only one in Africa.

FIELD NOTES. *Nyctalus lasiopterus* was found in Libya only once in a roost (Spitzenberger 1982), while foraging individuals were netted several times. An adult male was found to roost in a fist-sized hole in the ceiling of a huge overhang some 6 m above ground (Fig. 70); the overhang was situated on the slope on the confluence of Wadi Al Kuf and a side valley on the south-eastern side of the wadi. This record is remarkable for the type of the roost; *N. lasiopterus* is traditionally considered a tree-dwelling species, which uses mainly tree cavities for roosting, while the finding from Wadi Al Kuf represents the only evidence of this species from a rock shelter in its whole range (see Ibáñez et al. 2004, Ibáñez 2013).

All netted individuals of *N. lasiopterus* were caught in nets installed above or at water bodies; this is perhaps true also for six specimens collected by Qumsiyeh & Schlitter (1982) at a “mistnetting site” in Wadi Al Kuf (they were netted at one site on three occasions in the period 15–29 March 1981). Spitzenberger (1982) reported on netting of two males at the Fountain of Apollo within the area of the ruined Roman town of Cyrene at Shahhat. These bats were caught in nets installed at the side openings to a water cistern (“Fountain of Apollo”, Fig. 71) on 19 August 1981; the bodies of both bats were completely covered with subcutaneous packs of yellow fat. Besides *N. lasiopterus*, *Pipistrellus kuhlii* and *Plecotus gaisleri* were also caught during the same netting session. One subadult female of *N. lasiopterus* was netted above a pool in the terminal part of Wadi Al Minshiyah, some 150 m from the sea shore (Fig. 72, 99) on 16 May 2002. This pool in the riverbed was probably dug as a watering site for livestock, since no fresh water was available in the surrounding areas. *N. lasiopterus* was the only bat caught at this pool, although *Pipistrellus hanaki*, *P. kuhlii*, *Plecotus gaisleri*, and *Tadarida teniotis* were also recorded in other parts of the locality on that night. Four males of *N. lasiopterus* were caught in a net installed above a stream at Arqub Ash Shafshaf on 17 May 2002; the stream created several pools of still water enclosed within bush vegetation in a narrow canyon-like valley (Fig. 40) passing through the forested northern slope of the Jabal Al Akhdar Mts. *Pipistrellus hanaki* and *Tadarida teniotis* were recorded at the site during the same night along with *N. lasiopterus*.

Fig. 70. Entrance to an overhang / shallow cave situated in the slope at the confluence of Wadi Al Kuf and a side valley (Cyrenaica). A male *Nyctalus lasiopterus* was found roosting in a fist-sized hole in the overhang ceiling some 6 m above ground. Photo by E. Weiß (August 1981).

Table 17. Basic biometric data on the examined Libyan samples of *Nyctalus lasiopterus* (Schreber, 1780), *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004 and *P. christii* Gray, 1838. For abbreviations see p. 8

	Nyctalus lasiopterus					*Plecotus gaisleri*					*Plecotus christii*				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	7	**59.79**	57.2	60.9	1.259	41	**38.89**	35.8	41.8	1.224	7	**37.51**	36.2	40.2	1.417
LPol	–	–	–	–	–	41	**5.99**	5.3	6.5	0.291	7	**5.50**	5.3	5.7	0.141
LCr	7	**21.28**	20.88	21.69	0.303	36	**16.94**	16.35	17.63	0.288	5	**16.34**	15.92	16.75	0.363
LCb	7	**21.76**	21.15	22.35	0.399	36	**15.90**	15.32	16.42	0.260	4	**15.22**	14.97	15.57	0.302
LaZ	6	**15.52**	14.89	15.92	0.403	35	**8.93**	8.58	9.22	0.152	5	**8.50**	8.22	8.74	0.198
LaI	7	**5.57**	5.34	5.73	0.140	36	**3.48**	3.37	3.62	0.058	6	**3.18**	3.04	3.27	0.081
LaInf	7	**8.70**	8.27	9.13	0.276	36	**4.18**	3.98	4.41	0.110	6	**4.00**	3.72	4.13	0.145
LaN	7	**11.10**	10.75	11.28	0.201	36	**8.27**	7.98	8.76	0.172	5	**8.11**	8.02	8.31	0.117
LaM	7	**14.07**	13.68	14.43	0.290	36	**9.34**	8.91	9.68	0.135	2	**8.96**	8.83	9.09	0.184
ANc	7	**7.73**	7.32	8.13	0.266	36	**5.49**	5.28	5.69	0.099	4	**5.47**	5.42	5.52	0.041
LBT	7	**5.51**	5.06	5.79	0.232	34	**4.50**	4.28	4.70	0.090	5	**4.43**	4.31	4.55	0.098
CC	7	**8.87**	8.52	9.17	0.240	36	**3.97**	3.56	4.15	0.105	6	**3.44**	3.33	3.48	0.058
M^{3}M^3	7	**10.30**	10.13	10.48	0.104	36	**6.20**	5.93	6.54	0.121	6	**5.92**	5.79	6.07	0.092
CM^3	7	**8.92**	8.74	9.14	0.146	36	**5.73**	5.54	5.94	0.104	7	**5.30**	5.08	5.47	0.118
LMd	7	**16.87**	16.57	17.33	0.274	35	**10.87**	10.34	11.48	0.238	7	**10.18**	9.78	10.52	0.260
ACo	7	**4.96**	4.76	5.12	0.129	35	**3.19**	2.83	3.56	0.134	6	**2.94**	2.87	3.10	0.086
CM$_3$	7	**9.50**	9.42	9.62	0.074	36	**6.15**	5.83	6.42	0.135	7	**5.41**	3.51	5.86	0.844
CM^3/LCb	7	**0.410**	0.406	0.414	0.003	–	–	–	–	–	–	–	–	–	–
M^{3}M^3/CM^3	7	**1.155**	1.129	1.178	0.017	–	–	–	–	–	–	–	–	–	–

No signs of reproduction were detected in *N. lasiopterus* from Cyrenaica, although an assumption of local reproduction in these populations exists (see Distribution). Testes of three males were of the following size: 12.8×6.8 mm (caught on 9 August; Fig. 73), 11.0×6.8 mm and 12.1×5.9 mm (19 August).

Material examined. 4 ♂♂ (NMP 49886–49888 [S+A], 49889 [A]), Arqub Ash Shafshaf, 17 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 2 ♂♂ (NMW 30109 [S], 30110 [S+B]), Cyrene (Shahat), Prov. Darnah, 19 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (NMP 49885 [S+A]), Wadi Al Minshiyah, 17 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (NMW S81/59 [S]), Wadi Kuf, Prov. Beida, 9 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Nyctalus lasiopterus* are shown in Table 17. For the material examined see above.

The Cyrenaican populations of *N. lasiopterus* were discovered simultaneously by Qumsiyeh & Schlitter (1982) and Spitzenberger (1982) during two trips in 1981. Concerning the morphology of the specimens caught, the former authors provided the following information (p. 386): "The cranial measurements of the Libyan specimens are slightly smaller than those of European specimens of *N. lasiopterus*. The external measurements of the Libyan specimens are smaller than are those of European specimens and correspond more closely with those of *N. aviator* […] of the Far East."

Ibáñez et al. (2004), using also the data by Qumsiyeh & Schlitter (1982), reported a clinal increase of body size in *N. lasiopterus* (expressed in forearm length, LAt) from North Africa via Iberia to Europe; the North African populations (Morroco, Libya) as the smallest (LAt 59.0–64.0 mm, mean 61.6 mm; n=8), the Iberian populations as intermediate (LAt 61.3–67.8 mm, mean 64.5 mm;

Fig. 71. Central part of the ruins of Cyrene, Shahhat (Cyrenaica); in the centre of the picture, there are large openings to the water cistern known as the Fountain of Apollo. A foraging and/or roosting area of *Pipistrellus kuhlii*, *Nyctalus lasiopterus*, *Plecotus gaisleri*, and *Tadarida teniotis*. Photo by E. Weiß (August 1981).

Figs. 72, 73. *Nyctalus lasiopterus* (Schreber, 1780) from Cyrenaica. 72 (left) – portrait of a female from Wadi Al Minshiyah. Photo by A. Reiter. 73 (right) – genitalia of a male caught on 9 August 1981 in Wadi Al Kuf. Photo by E. Weiß.

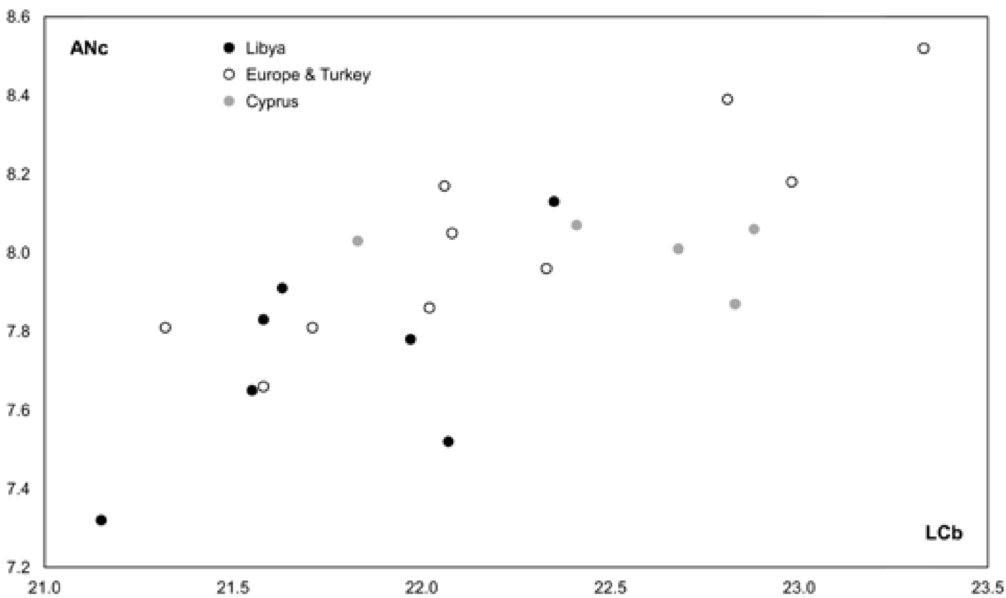

Fig. 74. Bivariate plot of the examined Libyan and comparative samples of *Nyctalus lasiopterus* (Schreber, 1780): condylobasal length of skull (LCb) against the neurocranium height (ANc).

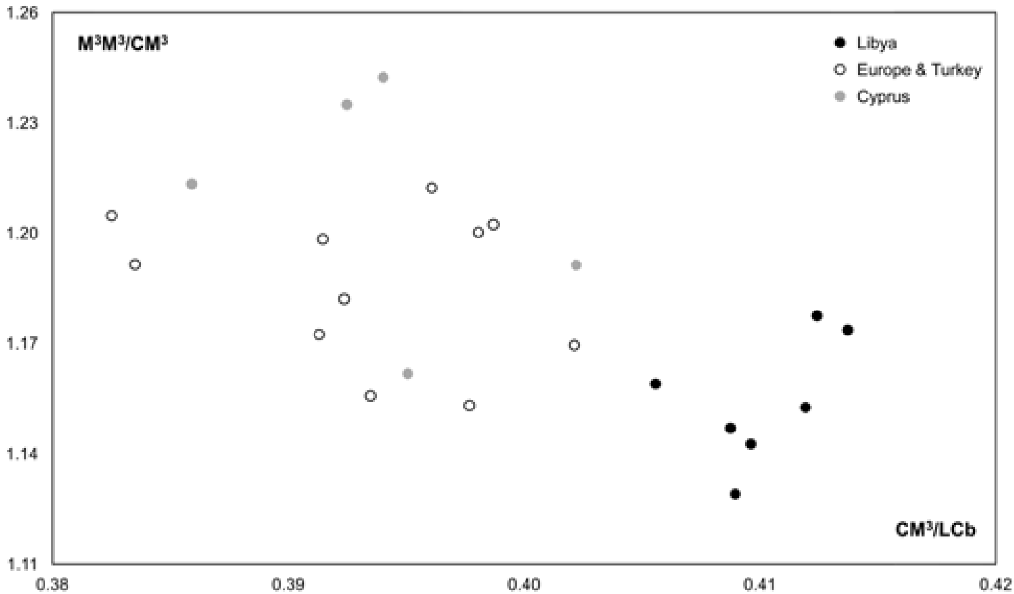

Fig. 75. Bivariate plot of the examined Libyan and comparative samples of *Nyctalus lasiopterus* (Schreber, 1780): relative length of rostrum (CM^3/LCb) against the relative width of rostrum (M^{3}M^3/CM^3).

n=70), and the bats from the rest of Europe (France, Italy, Switzerland, Ukraine, Russia) as the largest ones (LAt 63.5–70.0 mm, mean 66.3 mm; n=39). Although no other comparison than that of forearm length was carried out, Ibáñez et al. (2004) considered *N. lasiopterus* as a monotypic species.

Morphometric comparison of the Libyan specimens with limited samples from the rest of the species range (Europe, Turkey, Cyprus) showed a rather peculiar position of the Libyan bats (Table 18, Figs. 74, 75). While the European and Cypriot samples create a cluster of similarly sized bats, the Libyan samples are on average smaller in the forearm and skull sizes than the rest of the compared sample sets (Table 18, Fig. 74). This is in accordance with the opinions by Qumsiyeh & Schlitter (1982) and Ibáñez et al. (2004). Moreover, the Libyan bats show a different shape of rostrum than the other samples (Fig. 75). Their rostra are relatively long and narrow, whereas the rostra of the European, Turkish and Cypriot bats are relatively short and wide.

The results of this simple comparison indicate that the Cyrenaican populations of *N. lasiopterus* possess a fixed unique morphotype. It suggests that these populations evolved separately from those in the rest of the species range (see also Distribution). However, only a molecular genetic comparison can quantify the level of differentiation of the Cyrenaican populations of *N. lasiopterus*. Such a comparison remains a task for next sudies.

Feeding ecology. *Nyctalus lasiopterus* is a rather large bat flying fast and directly mainly in open spaces; it is regularly observed at great heights (Ibáñez et al. 2004, Dietz et al. 2007). The diet of *N. lasiopterus* consists mainly of larger insects and according to a convincing evidence, this bat is partially carnivorous, perhaps as the only bat species in the western Palaearctic. Remains of birds were discovered in the faecal pellets in several parts of the Mediterranean region (Dondi-

Table 18. Biometric data on comparative sample sets of *Nyctalus lasiopterus* (Schreber, 1780). For abbreviations see p. 8

	Europe & Turkey					Cyprus				
	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	8	**63.93**	60.4	65.9	1.893	6	**66.38**	63.8	68.1	1.466
LCr	10	**21.48**	20.60	22.35	0.662	5	**21.92**	21.17	22.87	0.639
LCb	10	**22.22**	21.32	23.33	0.644	5	**22.53**	21.83	22.88	0.430
LaZ	6	**15.63**	14.92	16.23	0.546	5	**15.61**	15.22	15.89	0.280
LaI	11	**5.62**	5.44	5.75	0.105	5	**5.72**	5.48	5.97	0.185
LaN	12	**11.57**	11.13	12.19	0.381	5	**11.72**	11.36	12.01	0.262
ANc	10	**8.04**	7.66	8.52	0.275	5	**8.01**	7.87	8.07	0.081
CC	11	**8.99**	8.69	9.27	0.186	5	**8.78**	8.24	9.19	0.393
M^3M^3	11	**10.39**	10.08	11.02	0.279	5	**10.72**	10.41	11.09	0.302
CM^3	12	**8.74**	8.46	9.18	0.241	5	**8.87**	8.78	8.98	0.091
LMd	12	**17.31**	16.44	17.95	0.470	5	**17.42**	16.74	17.68	0.386
ACo	12	**5.25**	4.93	5.50	0.212	5	**5.35**	5.19	5.56	0.177
CM_3	12	**9.47**	9.21	9.78	0.174	5	**9.56**	9.40	9.82	0.170
CM^3/LCb	11	**0.393**	0.383	0.402	0.006	5	**0.394**	0.386	0.402	0.006
M^3M^3/CM^3	11	**1.186**	1.153	1.212	0.020	5	**1.209**	1.162	1.242	0.033

ni & Vergari 2000, Ibáñez et al. 2001, Dietz et al. 2007) as well as in southern Russia (Smirnov & Vekhnik 2013). On the contrary, results from Slovakia and Cyprus showed no evidence of vertebrate prey in the analysed samples (Uhrin et al. 2006, Andreas 2010). Regarding the insect prey,

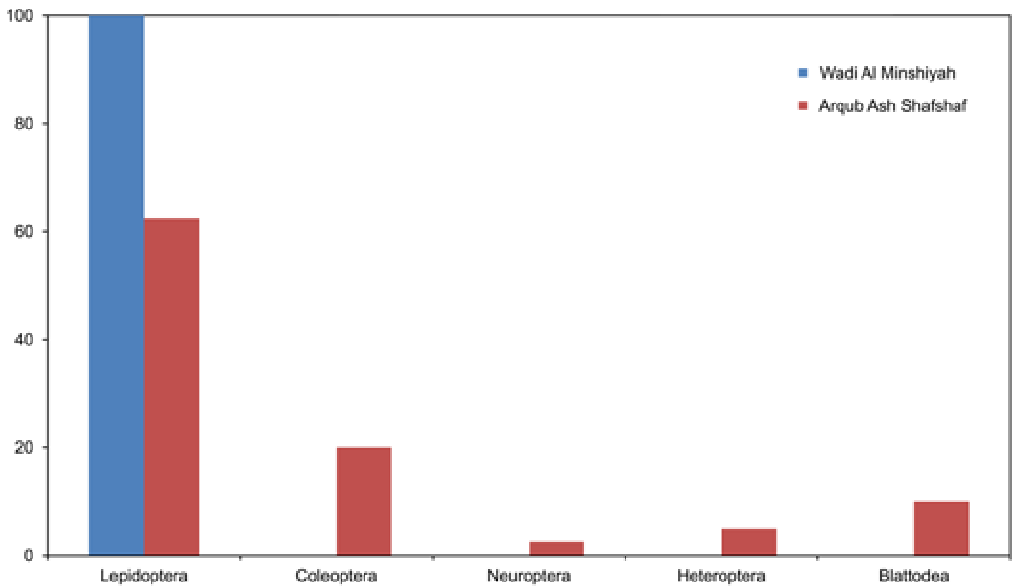

Fig. 76. Percentage volume of particular food items in the diet of *Nyctalus lasiopterus* (Schreber, 1780) in Libya. Material analysed: Wadi Al Minshiyah (one digestive tract), Arqub Ash Shafshaf (four digestive tracts).

N. lasiopterus feeds especially on moths (Lepidoptera), dipterans (Diptera) and lacewings (Neuroptera) in Slovakia (Uhrin et al. 2006), while Hymenoptera, Auchenorrhyncha and scarabaeid beetles were found to prevail in faecal pellets collected in Cyprus (Andreas 2010). Lepidoptera dominated in the results of the analysis from Russia, being complemented by Homoptera, Neuroptera and bird feathers; Orthoptera and Diptera were extremely rare (Smirnov & Vekhnik 2013). Besides bird feathers and bone fragments, Dondini & Vergari (2000) recorded dragonflies (Odonata), moths (Lepidoptera) and rather surprisingly, spiders (Araneae) and harvestmen (Opilionida).

From Libya, we analysed contents of five digestive tracts collected at two sites (Fig. 76). The diet was dominated by medium-sized moths (Lepidoptera) with the wingspan length of ca. 30 mm, other recorded items were ground beetles (Carabidae), cockroaches (Blattodea), true bugs (Heteroptera) and ant-lions (Neuroptera: Myrmeleontidae). No evidence of carnivory (flesh, bones, feathers) was recorded in the analysed contents of the digestive tracts.

The majority of Lepidoptera in the studied samples from Libya corresponds well with the data from Slovakia and Russia (Uhrin et al. 2006, Smirnov & Vekhnik 2013). The results from Libya as well as the data from Slovakia and Cyprus suggest that *N. lasiopterus* is not an obligatory bird-hunting predator and the predation on birds is a type of foraging behaviour probably temporarily and/or geographically limited. The studies regarding carnivory in this species discovered significant seasonal variation also in the volume of vertebrate prey in its diet (Ibáñez et al. 2001, Popa-Lisseanu et al. 2007). All these findings indicate that birds are not always a food source of *N. lasiopterus* and the carnivory is probably a local and/or seasonal phenomenon, perhaps during the bird migration periods (cf. Popa-Lisseanu et al. 2007).

Nyctalus leisleri (Kuhl, 1817)

Record. **Original data**: C y r e n a i c a: Wadi Al Kuf [1], 5 km SW of Al Bayda (Fig. 41), 1 May 1980: net. 1 ma, NMP (cf. Hanák & Gaisler 1983, Hanák & Elgadi 1984).

Distribution. *Nyctalus leisleri* was documented in Libya only once; an adult male was netted in Wadi Kuf near Al Bayda, a site situated in the forested Jebel Al Akhdar Mts., in the northern part of the Cyrenaican plateau (Fig. 28; Hanák & Gaisler 1983). Although *N. leisleri* is currently known also from some other parts of North Africa, the Libyan record represented the first evidence of the species in the African continent. Later, *N. leisleri* was found also in Algeria (Hanák & Gaisler 1983), Morocco (Ibañez 1988), Canary islands (Trujillo et al. 1988), and its occurrence has been tentatively suggested also in Tunisia based on uncertain call recordings (Puechmaille et al. 2012). The nearest locality of this species in Africa, Yakouren near Tizi Ouzou in the central Tell Atlas Mts. of Algeria (Hanák & Gaisler 1983), is situated ca. 1600 km west of Wadi Al Kuf. However, the area of *N. leisleri* occurrence lying closest to Wadi Al Kuf is the island of Crete (Greece), some 300 km north of Cyrenaica across the Cretan Sea (Benda et al. 2009).

Considering the well known migratory behaviour of *N. leisleri* (see Strelkov 1969, Hutterer et al. 2005), a question arises whether the only bat collected in Cyrenaica represents a regular or accidental migrant from the species main range in Europe or whether there is a population of *N. leisleri* resident in Cyrenaica. Although it is difficult to evaluate a single record, the pattern of *N. leisleri* occurrence in Libya rather differs from that in Morocco, and rather resembles the circumstances of recent records of this bat made in Crete. *N. leisleri* was reported in Morocco from six sites scattered across the northern part of the country, from the Rif Mts. in the north to the Middle Atlas Mts. in the south (Ibañez 1988, Benda et al. 2004d, 2010b). Ibañez (1988) found a part of a nursery colony (two adult females with six juveniles) near Fès, in the centre of the Moroccan range. This record as well as the temporal distribution of the remaining records

– including repeated records in the western Rif Mts. in 1986, 2003 and 2010, and in the Middle Atlas Mts. in 2003 and 2008 (Ibañez 1988, Benda et al. 2004d, 2010b) – clearly indicate a presence of a resident reproducing population in the woodlands of northern Morocco; this is perhaps true also for the Algerian occurrence (cf. Hanák & Gaisler 1983). Similarly, a resident population of *N. leisleri* is supposed to exist in Cyprus (Benda et al. 2007).

On the other hand, three adult males of *N. leisleri* were netted at two sites of Crete during one month in 2008, suggesting they were stray individuals arriving during one migration wave to the island; see the discussion by Benda et al. (2009). In Cyrenaica and Crete, *N. leisleri* is an extremely rare bat, documented during one season only; this suggests similar chorology of the populations in these geographically close parts of the species range. Considering also the length of the migration routes known in *N. leisleri*, reaching up to 1550 km (see the review by Hutterer et al. 2005), the distance between Cyrenaica and Greece (less than 400 km) is well acceptable as a part of such a migratory route. However, until more data are gathered concerning the Cyrenaican spot of the *N. leisleri* occurrence, all such conclusions are mere speculations only.

Field notes. The only known Libyan individual of *Nyctalus leisleri*, an adult male, was caught in a net installed above a small river in the upper part of Wadi Al Kuf some 5 km south-west of Al Bayda on 1 May 1980. The wadi in this section, at ca. 500 m a. s. l., is a rather shallow valley (Fig. 41), covered by a patchwork of fields, pastures and smaller stands of original cypress and juniper forests, although the sides of the valley consist of rocky outcrops with overhangs. Along with the *N. leisleri* individual, *Pipistrellus hanaki* and *P. kuhlii* were also netted during this netting session.

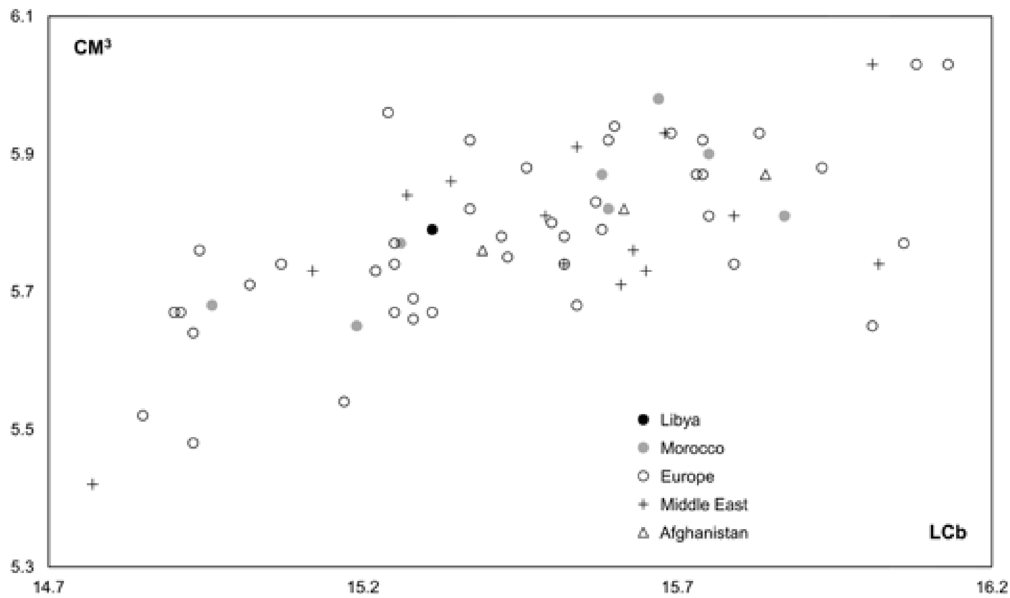

Fig. 77. Bivariate plot of the examined Libyan and comparative samples of *Nyctalus leisleri* (Kuhl, 1817): condylobasal length of skull (LCb) against the length of the upper tooth-row (CM^3).

Table 19. Biometric data on comparative sample sets of *Nyctalus leisleri* (Kuhl, 1817). For abbreviations see p. 8

	Morocco					Europe					Middle East & Afghanistan				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	8	**43.09**	41.5	44.7	1.274	44	**43.32**	41.0	45.1	0.999	19	**44.13**	40.8	46.8	1.817
LCr	8	**15.37**	14.80	15.76	0.330	44	**15.35**	14.72	16.15	0.325	17	**15.40**	14.58	15.98	0.378
LCb	8	**15.48**	14.96	15.87	0.313	44	**15.45**	14.85	16.13	0.351	17	**15.50**	14.77	16.02	0.364
LaZ	8	**10.47**	10.07	10.88	0.271	35	**10.38**	9.85	10.77	0.215	15	**10.49**	10.02	11.02	0.280
LaI	8	**4.65**	4.47	4.98	0.160	44	**4.66**	4.40	5.62	0.189	18	**4.71**	4.49	4.99	0.147
LaN	8	**8.22**	7.97	8.44	0.166	44	**8.20**	7.82	8.51	0.150	18	**8.24**	7.96	8.62	0.215
ANc	8	**5.46**	5.33	5.64	0.109	42	**5.52**	5.26	5.74	0.110	18	**5.48**	5.01	5.70	0.185
CC	8	**5.79**	5.51	6.09	0.186	41	**5.67**	5.34	6.00	0.150	17	**5.62**	5.27	5.87	0.161
M^3M^3	8	**7.19**	6.94	7.51	0.208	42	**7.06**	6.69	7.42	0.176	17	**7.06**	6.73	7.37	0.186
CM^3	8	**5.81**	5.65	5.98	0.110	43	**5.77**	5.48	6.03	0.130	17	**5.79**	5.42	6.03	0.129
LMd	8	**11.47**	11.05	11.76	0.239	43	**11.45**	11.07	11.82	0.197	18	**11.49**	10.91	11.97	0.272
ACo	8	**3.33**	3.06	3.52	0.173	43	**3.20**	2.98	3.38	0.097	18	**3.28**	3.06	3.52	0.135
CM_3	8	**6.21**	5.97	6.38	0.131	41	**6.16**	5.89	6.37	0.126	17	**6.16**	5.93	6.36	0.128

MATERIAL EXAMINED. 1 ♂ (NMP 95063 [S+W]), Wadi Al Kuf, 5 km SW of Al Bayda, 1 May 1980, leg. V. Hanák & K. Hůrka.

MORPHOLOGY AND VARIATION. Forearm and cranial dimensions of the Libyan specimen of *Nyctalus leisleri* are shown in Table 15. For the material examined see above, for depiction of the baculum from Libyan *N. leisleri* see Hanák & Elgadi (1984: 177, Fig. 5).

The only known Libyan specimen of *N. leisleri* falls into the variation ranges of dimensions of populations from other parts of the species distribution range including the Maghreb, Europe and the Middle East (Table 19; cf. Hanák & Gaisler 1983, Hanák & Elgadi 1984). There is no obvious geographical variation in skull size throughout this part of the species range (Fig. 77). All compared populations of *N. leisleri* seem to represent one homogeneous morphotype, which is in accordance with the migratory habits of this bat (see also Distribution).

N. leisleri is considered monotypic in the continental part of its distribution range (Europe, North Africa, SW Asia, Mediterranean and British islands), only the nominotypical subspecies is currently recognised in this area (Ellerman & Morrison-Scott 1951, Corbet 1978, Palmeirim 1991, Koopman 1994, Horáček et al. 2000, Bogdanowicz & Ruprecht 2004, Simmons 2005). Two other subspecies of *N. leisleri* are known from the Atlantic islands, *N. l. verrucosus* Bowdich, 1825 occurring in Madeira and *N. l. azoreum* (Thomas, 1901) in the Azores. The results of molecular genetic analyses of the whole complex (Salguiero et al. 2004, 2007) suggest an extremely low geographical variability in this species and thus, its monotypy in the range from Morocco to India (with the exception of the Atlantic insular populations, which significantly differ in morphology, see Palmeirim 1991). Thus, if there exists a population of *N. leisleri* regularly occurring in Libya, it belongs with most probability to the nominotypical form.

Otonycteris hemprichii Peters, 1859

RECORDS. **Original data**: T r i p o l i t a n i a: Nanatalah [1], above a pool (Fig. 80), 27 May 2002: net. 1 ma, NMP (cf. Benda et al. 2006, Benda & Gvoždík 2010). – **Published data**: C y r e n a i c a: Bahr el Tubat, 21 km ESE of Giarabub (= Al Jaghbub) [2], 29 May 1962: 1 m, 1 f, USNM (Nader & Kock 1983, Hanák & Elgadi 1984, Qumsiyeh 1985). – F e z z a n: Brak [3], Fezzan, 19 June 1977: 1 fj (Hanák & Elgadi 1984, Benda & Gvoždík 2010); – Fezzan [undefined] (Toschi 1954).

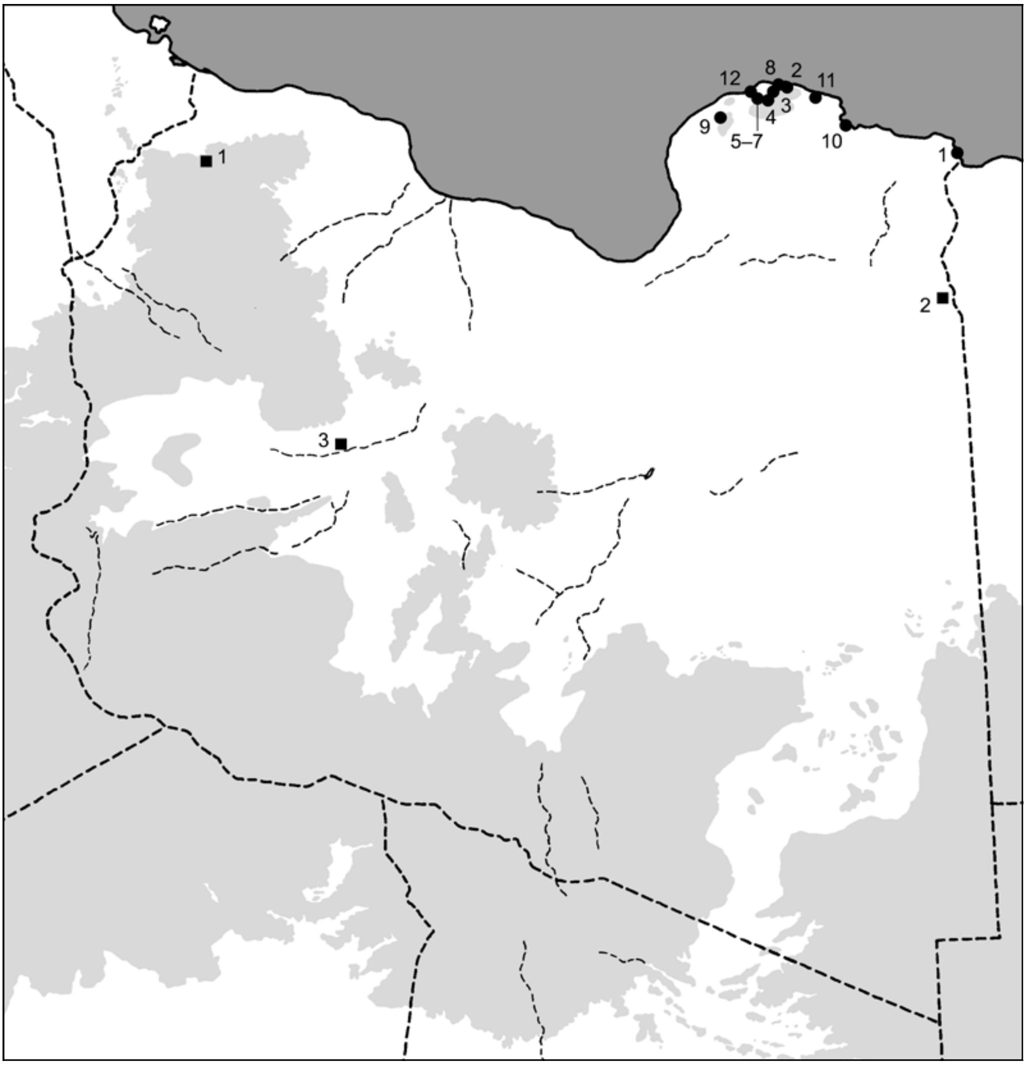

Fig. 78. Records of *Otonycteris hemprichii* Peters, 1859 (squares) and *Tadarida teniotis* (Rafinesque, 1814) (circles) in Libya.

Distribution. *Otonycteris hemprichii* ranks among rare bats of Libya, it is known only from three sites (Fig. 78). However, these sites are distributed in all three main regions of the country; therefore, *O. hemprichii* is the second most widespread bat of Libya (after *Pipistrellus kuhlii*). The records of *O. hemprichii* were made at very distant locations, lying between 530–1260 km away from each other, besides the unspecified Fezzan record mentioned by Toschi (1954), which could originate from an even more remote site. However, all findings were made in similarly dry habitats, ranging from arid steppe (Jebel Nafusa Mts.) to the harsh continental desert (Brak).

O. hemprichii is an inhabitant of hostile deserts in a broad belt comprising the Sahara, Arabian desert, Mesopotamia and southern Iran (Benda & Gvoždík 2010). Its limited evidence in Libya continues right into the known distribution in the neighbouring African countries (cf. Nader & Kock 1983). The record from the Jebel Nafusa Mts. in western Tripolitania (Nanatalah) extends the occurrence known from south-eastern Tunisia. Two findings are available there from the Jebel Dahar Mts.; from Ksar Haddada, north-east of Tataouine (Beaucournu et al. 1983) and from near Ghomrassen (Puechmaille et al. 2012), both lying about 180 km from Nanatalah and only slightly over 100 km away from the border of Libya, respectively. Other Tunisian records of *O. hemprichii* were made in the central arid belt of the country (Deleuil 1957, Fain 1959a, Nader & Kock 1983), where they more probably continue the species evidence from the northern part of the Algerian Sahara (Kowalski & Rzebik-Kowalska 1991) and south-eastern Morocco (Aulagnier & Thevenot 1986, Benda et al. 2004d, Dielevuet et al. 2010), i.e. the western margin of the species distribution.

More abundant records of *O. hemprichii* are known from Egypt, they are scattered over the whole country (Qumsiyeh 1985, Benda et al. 2008). The species was documented from two oases of the Western desert; Anderson (1902) reported specimens from the oasis of Siwa (some 100 km SE of the collection site near the oasis of Al Jaghbub in eastern Cyrenaica) and Gaisler et al. (1972) from the oasis of Kharga. *O. hemprichii* was also collected from desert localities adjacent

Fig. 79. Portrait of *Otonycteris hemprichii* Peters, 1859 from Nanatalah (Tripolitania). Photo by A. Reiter.

to the Nile valley from the west, i.e. Libyan desert west of Alexandria (Anderson 1902), Wadi El Natrun and El Faiyum (Sanborn & Hoogstraal 1955). Hence, *O. hemprichii* belongs, along with *Asellia tridens*, *Pipistellus kuhlii* and *Plecotus christii*, to the most widespread bat species of the Libyan/Western desert (cf. Benda et al. 2014). The record of *O. hemprichii* from near Al Jaghbub in eastern Libya represents the western margin of this particular segment of the species range.

Two findings of *O. hemprichii* are available from mountains of the interior Sahara, from sites lying south-west of Fezzan. Heim de Balsac (1965) reported a bone finding from owl pellets collected at Djanet, Tassili n'Ajjer Mts., in south-eastern Algeria, a site situated 73 km away from the Libyan border. Another record was made in the Aïr Mts., north-eastern Niger, where Fairon (1980) captured several individuals between Timia and Iferouan, north-east of Tin Telloust, about 600 km away from the south-westernmost point of Libya. These localities in the central Sahara along with those from Lower Nubia (Peters 1859, Fitzinger 1866) delineate the southern margin of the species distribution range in Africa (Nader & Kock 1983). All these records indicate possible occurrence of *O. hemprichii* also in the southernmost areas of Libya.

Field notes. No field data are available on the specimens of *Otonycteris hemprichii* collected at Brak and Bahr el Tubat (Nader & Kock 1983, Hanák & Elgadi 1984); anyway, both sites lie in arid areas of the inner Sahara.

An adult male of *O. hemprichii* was caught in a net installed between rocks close to a small lake at Nanatalah on 27 May 2002 (Fig. 79); the lake was filled from a spring surrounded by a few trees and situated in an arid landscape of the northern escarpment of the Jebel Nafusa Mts. (Fig. 80). Since the site lies just on the border between desert and Mediterranean habitats, *O. hemprichii* was documented there as a part of a larger bat community representing both faunal types: *Rhinolophus ferrumequinum*, *Eptesicus isabellinus*, *Pipistrellus kuhlii*, and *Plecotus gaisleri* were netted along with *O. hemprichii* at this site.

Hanák & Elgadi (1984) reported the only available reproduction data on *O. hemprichii* from Libya; they mentioned a juvenile female collected at Brak on 19 June. The respective specimens represents an almost volant or just volant individual with cartilaginous parts of wing bones and an incompletely ossified skull, i.e. a bat ca. two months old. The forearm length (LAt) is 57.5 mm, representing 90.6% of the LAt of the adult male individual collected at Nanatalah (LAt 63.5 mm). This finding suggests the timing of parturitions in the Libyan populations of *O. hemprichii* to occur in April. It corresponds with the available evidence on reproduction of *O. hemprichii* from Iran (Benda et al. 2012).

Material examined. 1 ♀ (NMP 95041 [S+B]), Brak, Fezzan, 19 June 1977, leg. Z. Roček; – 1 ♂ (NMP 49964 [S+A]), Nanatalah, 27 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin.

Morphology and variation. Forearm and cranial dimensions of the (only available adult) Libyan specimen of *Otonycteris hemprichii* are shown in Table 15. For the material examined see above.

The geographical variation of *O. hemprichii*, including the limited available samples from Libya, was evaluated by Benda & Gvoždík (2010). The Libyan populations were shown to be a part of the nominotypical subspecies, in accordance with the traditional view (see e.g. Setzer 1957, Kock 1969, Hayman & Hill 1971). In comparison with other populations of the genus they are characterised by smaller body size, very pale (or even white) pelage colouration, relatively wide and short rostrum, a relatively wide braincase, relatively large tympanic bullae, relatively high coronoid processes of the mandible, and a rather small and robust baculum. This form was described from the Egyptian-Sudanese Nubia (Kock 1969) and occurs throughout North Africa and Levant to Mesopotamia (Benda & Gvoždík 2010); so, it has the largest distribution range among all taxa of *Otonycteris*. Other forms of this genus occur in the eastern parts of the range; *O. h. cinerea* Satunin, 1910 and *O. h. jin* Cheesman et Hinton, 1924 in eastern Arabia and Iran and *O. leucophaea* (Severcov, 1873) in West Turkestan, Afghanistan and Kashmir.

FEEDING ECOLOGY. *Otonycteris hemprichii* is a relatively large bat gleaning its food frequently from the ground and locating arthropods also using prey-generated sounds and walking noises (Fenton et al. 1999, Holderied et al. 2011), as well as hawking the prey on the wing (Hackett et al. 2014). The diet composition of *O. hemprichii* was studied in many regions of the Middle East (Whitaker et al. 1994, Fenton et al. 1999, Benda et al. 2006, 2008, 2010a, 2012, Hackett et

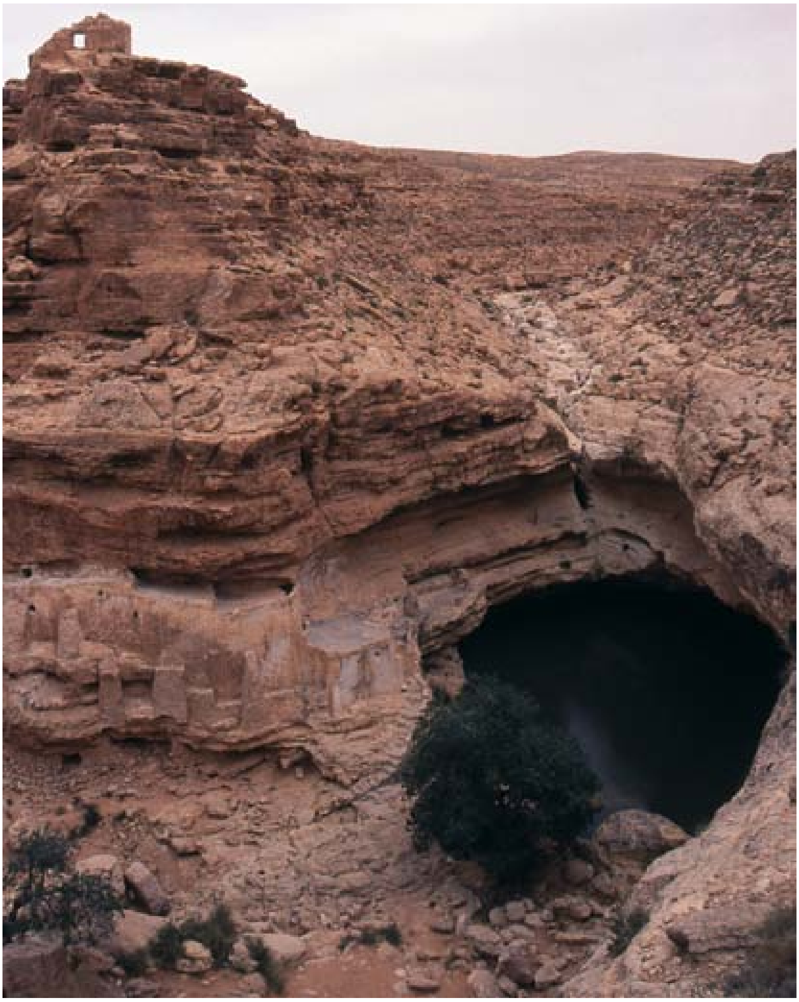

Fig. 80. The oasis of Nanatalah situated in the escarpment of the Jebel Nafusa Mts. (Tripolitania). *Rhinolophus ferrum-equinum*, *Eptesicus isabellinus*, *Pipistrellus kuhlii*, *Otonycteris hemprichii*, and *Plecotus gaisleri* were recorded to forage and/or to roost at the site. Photo by A. Reiter (May 2002).

al. 2014). The diet of the species is dominated by medium-sized and larger individuals of many insect taxa (Coleoptera, Blattodea, Orthoptera, Heteroptera, and Hymenoptera) and some other arthropods (Scorpionida, Solpugida). Fairly different diet composition and main prey items recorded in various parts of the Middle East indicate relative flexibility of the species' foraging habits (cf. Hackett et al. 2014). Nevertheless, the importance of the ground gleaning strategy is quite apparent in most cases.

We analysed one sample set of the diet of *O. hemprichii* from Libya (14 pellets from one individual); it was dominated by robust crickets (Ensifera; 97.1% of volume), complemented by a small proportion of moth remnants (Lepidoptera; 2.9%). We cannot conclude whether the prey was taken from the ground or captured in the flight in that case, as both options are plausible. Since diet samples of *O. hemprichii* dominated by orthopterans have also been recorded previously (e.g. Benda et al. 2012), we find our results to correspond with previous studies.

Plecotus gaisleri Benda, Kiefer, Hanák et Veith, 2004

Records. **Original data**: C y r e n a i c a: Qaryat Al Faioyah [1], 6 km S, cellar, 30 April 1980: coll. 1 ma, NMP (cf. Hanák & Elgadi 1984 [under *P. austriacus*], Benda et al. 2004c [under *P. teneriffae*]); – Qasr Ash Shahdayn [2], ruins (Figs. 82, 83), 5 August 1981: net. 4 ma, 1 fa (coll. 4 m, NMW; cf. Spitzenberger et al. 2006 [under *P. kolombatovici*]), underground spaces of the ruins, 21 May 2002: coll. 1 ma, NMP (cf. Benda et al. 2004c [under *P. teneriffae*]); – Shahhat [3], Cyrene, ancient ruins, vaulted room at the Temple of Zeus, 14 April 1979: coll. 1 ma, NMP (cf. Hanák & Elgadi 1984 [under *P. austriacus*], Benda et al. 2004c [under *P. teneriffae*]), Fountain of Apollo (Fig. 71), 19 August 1981: net. 1 ma, underground aquaduct, 11 October 1999: coll. 2 ma, NMP (cf. Juste et al. 2004, Benda et al. 2004c [under *P. teneriffae*]); – Wadi An Nazrat [4], 5 km W of Sidi Muhammad Al Mabkhut, at a cave entrance (Fig. 95), 21 May 2002: net. 3 ma, NMP (cf. Benda et al. 2004c [under *P. teneriffae*]); – Wadi Al Kuf [5], 5 km SW of Al Bayda, at a rocky overhang (Fig. 41), 18 May 2002: net. 4 ma, NMP (cf. Benda et al. 2004c [under *P. teneriffae*]); – Wadi Al Kuf [6], near a quarry, 12 August 1981: net. 1 fs, NMW (cf. Spitzenberger et al. 2006 [under *P. kolombatovici*]), small cave, 19 May 2002: net. 4 ma, 2 faG, 1 faL, 2 inds., NMP (cf. Benda et al. 2004c [under *P. teneriffae*], Mlíkovský et al. 2011, Lanza 2012); – Wadi Al Kuf, ancient ruins in a small side valley of Wadi Al Kuf [7], 3 August 1981: net. 3 fa, 4 August 1981: net. 3 ma, 1 fa, NMW (cf. Spitzenberger et al. 2006 [under *P. kolombatovici*]); – Wadi Al Kuf, a large cave at the SE side of the valley [8], 18 August 1981: net. 1 ma, 22 August 1981: net. 1 ma, 2 ms, 1 fa, NMW (cf. Spitzenberger et al. 2006 [under *P. kolombatovici*]); – Wadi Al Minshiyah [9] (Fig. 99), under a bridge above the wadi, 16 May 2002: net. 1 faL, NMP (cf. Benda et al. 2004c [under *P. teneriffae*]); – Wadi Jarmah [10], at a rocky overhang in the wadi slope (Fig. 43),

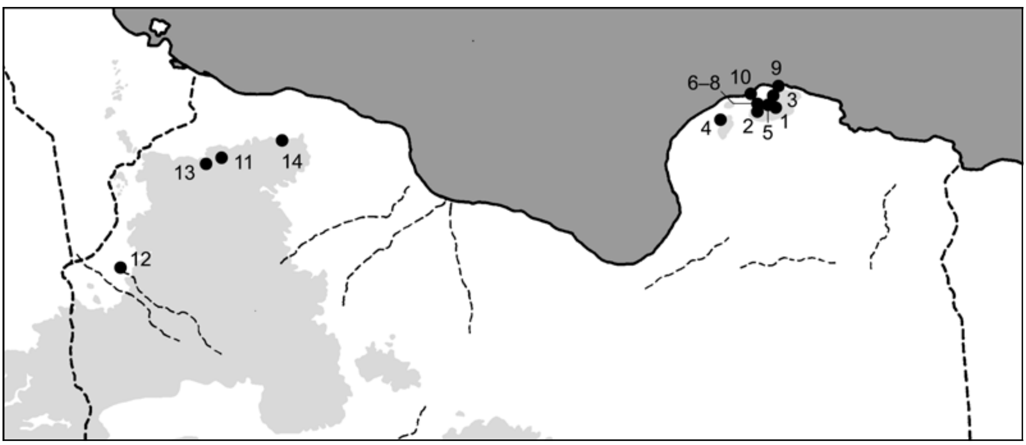

Fig. 81. Records of *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004 in Libya.

Figs. 82, 83. Qasr Ash Shahdayn in the centre of the forested Jebel Al Akhdar Mts. (Cyrenaica); a roosting site of *Rhinolophus horaceki* and *Plecotus gaisleri*. Photos by E. Weiß & A. Reiter (August 1981 & May 2002).

20 May 2002: net. 1 ms, NMP (cf. Benda et al. 2004c [under *P. teneriffae*], Lanza 2012). – T r i p o l i t a n i a: Ain Az Zarqa [11], above a pool (Figs. 8, 9), 9 May 2002: net. 2 faL, NMP (cf. Benda et al. 2004c [under *P. teneriffae*], Lanza 2012); – Darej e dintorni (= surroundings of Darj) [12], 22–26 February 2001: coll. 1 ma (MZUF 20195; leg. M. Bachir; P. Agnelli in litt.); – Nanatalah [13], at a rock wall near a pool (Fig. 80), 27 May 2002: net. 1 ma, 1 fa, NMP (cf. Benda et al. 2004c [under *P. teneriffae*], Lanza 2012). – **Published data** [under *P. austriacus*]: C y r e n a i c a: 6 km SE Qasr Maqdam, ruins (= Qasr Ash Shahdayn) [2], 1981: 1 m (Qumsiyeh & Schlitter 1982, Qumsiyeh 1985); – Wadi Al Kuf, "mistnetting site" [6], 1981: net. 1 f (Qumsiyeh & Schlitter 1982, Qumsiyeh 1985). – T r i p o l i t a n i a: Tagherna (= Tigrinnah) [14], 1 ind. (Qumsiyeh 1985).

Distribution. *Plecotus gaisleri* is a rather frequent species in Libya, fourteen record sites are known from the northernmost part of the country (Fig. 81). This bat is widespread over the Mediterranean woodland habitats associated with the northern part of the Cyrenaican plateau (Jebel

Fig. 84. *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004 from the ruins of Cyrene, Shahhat (Cyrenaica). Photo by P. Benda.

Al Akhdar Mts.) and the sub-Mediterranean dry steppes along the northern margin of the Jebel Nafusa Mts. in Tripolitania. Qumsiyeh & Schlitter (1982) and Hanák & Elgadi (1984) presented Libyan records assignable to *P. gaisleri* solely from northern Cyrenaica (Table 1) and also most of the available records (71%) summarised here originate from this region (they come from a limited territory of ca. 120 km by 35 km).

The Tripolitanian occurrence of *P. gaisleri* represents a newly documented part of the species range; three records are available from sites situated at the northern escarpment of the Jebel Nafusa Mts. and one from the surroundings of Darj, relatively deep inside the desert region, ca. 280 km from the sea shore. However, such a finding is not completely exceptional in *P. gaisleri*, similar records from Morocco and Algeria have been published already. Hill (1964) reported specimens collected at Figuig, south-eastern Morocco (ca. 330 km from the sea shore) and Gaisler & Kowalski (1986) and Kowalski et al. (1986) at Brezina, north-western Algeria (ca. 300 km); both these sites lie in the Saharan Atlas Mts. Anyway, such records in desert areas – making up the southern margin of the *P. gaisleri* range – could be regarded very rare as these regions certainly represent the environmental limits for this Mediterranean species. The Libyan locality from near Darj, at 30° 10’ N, belongs to the extremely southward localised sites within the species range, only the record site of Bou Izakarne in south-western Morocco (Panouse 1953) lies slightly more to the south.

P. gaisleri is an endemic of the Mediterranean part of Africa and some adjacent islands (Benda & Aulagnier 2013b); from the true Mediterranean zone of the Maghreb and Libya it slightly penetrates to northern margins of the Sahara (see above) and it also occurs in the islands of Malta and Pantelleria (Felten & Storch 1970, Borg et al. 1997, Benda et al. 2004c, Spitzenberger et al. 2006). The Cyrenaican records of *P. gaisleri* comprise the eastern part of the African distribution area, Wadi Al Minshiyah (22° 03’ E) representing the easternmost known point of the species occurrence. The Cyrenaican section is completely isolated from the western part of the African range of *P. gaisleri* by more than 900 km of arid steppe and desert habitats along the coast of the Gulf of Syrte.

The western section of the African range stretches from south-western Morocco via northern Algeria and Tunisia to western Tripolitania; in this whole range *P. gaisleri* belongs to the rather common species (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Dieuleveut et al. 2010, Puechmaille et al. 2012). The Tripolitanian records of *P. gaisleri* from the Jebel Nafusa Mts. connect the species occurrence in the Jebel Dahar Mts. of south-eastern Tunisia. Dalhoumi et al. (2011) summarised four localities from this mountain chain, with records from Duirat, Tatahouine and 2 km. S Foum Tatahouine being the nearest to the Libyan territory (some 90–100 km away; Anderson 1892, Laurent 1939, Baker et al. 1974).

Field notes. *Plecotus gaisleri* was frequently recorded in Libya both from its roosts and at its foraging grounds. While in Tripolitania it is known only from foraging sites, in Cyrenaica roosts of this bat were also found.

A roost containing most probably a remaining group of a maternity colony was discovered in ancient ruins covered by carob trees in a small side valley of Wadi Al Kuf on 3 and 4 August 1981. The group of *P. gaisleri* roosted in a cistern built inside a natural cave, whose ceiling contained many deep holes and crevices. Four females were netted there on the former night, and one female and three males on the latter night. Some of the females were still lactating, but among males one fully independent juvenile was documented. One *Pipistrellus hanaki* was netted at the ruins on the first and one *P. kuhlii* on the second netting occasion.

At several places of Cyrenaica, solitary roosting individuals of *P. gaisleri* were found. Qumsiyeh & Schlitter (1982) reported a male of this species collected from the ruined Byzantine fortress

Fig. 85. Left slope of Wadi Al Kuf (Cyrenaica); a foraging habitat of *Pipistrellus hanaki* and *Plecotus gaisleri*. Photo by E. Weiß (August 1981).

Fig. 86. Wadi An Nazrat, the westernmost part of the Jebel Al Akhdar Mts. at the border of the steppe plateau of Al Marj (Cyrenaica); foraging and roosting areas of *Pipistrellus kuhlii*, *Plecotus gaisleri* and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

of Qasr Ash Shahdayn (Figs. 82, 83), the record most probably represents evidence of a roost. In the underground spaces of this ruin, another roosting male was found on 21 May 2002 (along with one *Rhinolophus horaceki*). The underground of the fortress is three-storeyed and composed of corridors and rooms dug in the rock. Five adult individuals of *P. gaisleri* were netted at this fortress on 5 August 1981. This species was twice found to roost in the area of the ancient ruins of Cyrene near Shahhat. One adult male was found in the fissure of a vaulted ceiling some 5 m above ground in a large cistern near the Temple of Zeus on 14 April 1979 (cf. Hanák & Elgadi 1984; under *Plecotus austriacus*), two solitary adult males were collected from an (almost ruined) underground aqueduct on 11 October 1999 (Fig. 84). Additionally, one male was netted at the Fountain of Apollo on 19 August 1981 (together with *Pipistrellus kuhlii* and *Nyctalus lasiopterus*; Fig. 71). Hanák & Elgadi (1984) reported a finding of one male (as *P. austriacus*) in a cellar near Qaryat Al Faioyah on 30 April 1980.

All these records indicate *P. gaisleri* to be a petrophilous species which seems to select its roosts solely in underground spaces rather open to daylight and in rock fissures – or in artificial habitats with similar characteristics, respectively.

The affinity of *P. gaisleri* to rocky habitats is apparent also from the evidence of foraging bats. All netted individuals were recorded flying along rock walls, at overhangs, cave entrances or other similar sites. In the central part of Wadi Al Kuf, *P. gaisleri* was netted in all these habitat types (Fig. 85); one female was caught in a loose stand of cypress trees near a quarry on 12 August 1981 (along with one *Pipistrellus hanaki*), one male at a large cave at the south-eastern side of the valley on 18 August 1981 (together with *Pipistrellus hanaki*, *P. kuhlii*, *Miniopterus schreibersii*, and *Tadarida teniotis*), four bats at the same site on 22 August 1981 (along with *Rhinolophus horaceki*, *Pipistrellus hanaki*, *P. kuhlii*, and *Tadarida teniotis*), and nine individuals at a small cave near the quarry on 19 May 2002 (together with *Pipistrellus hanaki* and *Tadarida teniotis*).

In the upper part of Wadi Al Kuf near Al Bayda, four males of *P. gaisleri* were netted at a rocky overhang on 18 May 2002 (Fig. 41; along with netted individuals of *Pipistrellus hanaki* and *P. kuhlii*, and detected calls of *Tadarida teniotis*). In Wadi Jarmah, i.e. in the terminal part of Wadi Al Kuf (Fig. 43), one male of *P. gaisleri* was netted at a rocky overhang high on the wadi slope on 20 May 2002 (*Pipistrellus hanaki*, *P. kuhlii* and *Tadarida teniotis* were recorded there on the same night). All these mentioned sites are situated in the central, most elevated and most humid section of the Jebel Al Akhdar Mts., which is still largely covered by original cypress and juniper forests. From this area of Wadi Al Kuf, Qumsiyeh & Schlitter (1982; under *P. austriacus*) reported also a record of *P. gaisleri* female from spring 1981.

Three adult males of *P. gaisleri* were netted at the entrance to a large and shallow cave in Wadi An Nazrat near Sidi Muhammad Al Mabkhut on 21 May 2002; the cave was situated on a slope above a dry steppe landscape intensively used as a pasture with only few trees (Figs. 86, 95) and *Pipistrellus kuhlii* and *Tadarida teniotis* were also netted there. One female of *P. gaisleri* was netted under an old stone bridge over the terminal part of Wadi Al Minshiyah close to the sea shore on 16 May 2002 (Fig. 99; along with one *Pipistrellus hanaki*).

Two and two individuals of *P. gaisleri*, respectively, were netted at rocky walls near lakes situated in the dry landscape of the northern escarpment of the Jebel Nafusa Mts. in Tripolitania, viz. Ain Az Zarqa on 9 May 2002 (Figs. 8, 9, 87) and Nanatalah on 27 May 2002 (Fig. 80). The lakes are surrounded by dense riparian vegetation and a limited rim of trees. At both sites the individuals of *P. gaisleri* were documented as parts of larger bat communities representing both the Mediterranean and desert faunas. Calls of *Pipistrellus kuhlii* were detected, and *Rhinolophus ferrumequinum* and *Eptesicus isabellinus* were netted together with *P. gaisleri* at Ain Az Zarqa, while *Rhinolophus ferrumequinum*, *Eptesicus isabellinus*, *Pipistrellus kuhlii*, and *Otonycteris hemprichii* were netted along with this bat species at Nanatalah.

Reproduction of *P. gaisleri* was documented in Libya several times. Two pregnant females were collected in the central part of Wadi Al Kuf on 19 May; each of them contained one foetus with a crown-rump length of 23.8 and 22.6 mm, respectively. Lactating females were found in several sites in the period between 9 May and 4 August. Two lactating females were collected at Ain Az Zarqa on 9 May, one female in Wadi Al Minshiyah on 16 May 2002, one female in the central part of Wadi Al Kuf on 19 May 2002, and three and one females in the latter area also on 3 and 4 August, respectively. These records suggest the parturitions in Libya to be spread over a longer period covering a larger part of May.

Material examined. 2 ♀♀ (NMP 49857, 49858 [S+A]), Ain Az Zarqa, 9 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂, 1 ♀ (NMP 49965, 49966 [S+A]), Nanatalah, 27 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 3 ♀♀ (NMW 30132–30134 [S+B]), Prov. Beida, 3 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 3 ♂♂, 1 ♀ (NMW 30135–30138 [S+B]), Prov. Beida, 4 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 4 ♂♂ (NMW 30139–30142 [S+B]), Prov. Beida, 5 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (NMW 30143 [S+Sk]), Prov. Beida, 12 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♂ (NMW 30144 [S+B]), Prov. Beida, 18 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 3 ♂♂, 1 ♀ (NMW 30145–30148 [S+B]), Prov. Beida, 22 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♂ (NMP 49916 [S+A]), Qasr Ash Shahdayn, 20 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (NMP 90121 [S+W]), Qaryat Al Faioyah, 30 April 1980, leg. V. Hanák & K. Hůrka; – 1 ♂ (NMP 90120 [S+W]), Shahhat (Cyrene), 14 April 1979, leg. V. Hanák & K. Hůrka; – 2 ♂♂ (NMP 48330, 48331 [S+A]), Shahhat, Cyrene ruins, 11 October 1999, leg. P. Benda & P. Nová; – 4 ♂♂ (NMP 49899, 49900 [S+A], 49898, 49901 [A]), Wadi Al Kuf, 5 km SW of Al Bayda, 18 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 4 ♂♂, 3 ♀♀ (NMP 49905–49907, 49911 [S+A], 49908–49910 [A]; type series of *Plecotus teneriffae gaisleri* Benda, Kiefer, Hanák et Veith, 2004), Wadi Al Kuf, 19 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♀ (NMP 49883 [S+A]), Wadi Al Minshiyah, 17 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 3 ♂♂ (NMP 49926, 49927 [S+A], 49925 [A]), Wadi An Nazrat, Sidi Mohammad Al Mabkhut, 22 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (NMP 49920 [S+A]), Wadi Jarmah, 20 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Plecotus gaisleri* are shown in Table 17. For the material examined see above, for depiction of bacula from Libyan *P. gaisleri* see Hanák & Elgadi (1984: 177, Fig. 5) and Benda et al. (2004c: 16, Fig. 5), for dimensions of the holotype of *P. teneriffae gaisleri* from Wadi Al Kuf see Table 5 and for depiction of the holotype skull see Benda et al. (2004c: 24, Fig. 8), for depictions of the third upper molars of Libyan *P. gaisleri* see Benda et al. (2004c: 25, Fig. 9).

The dimensions of the Libyan samples (both Cyrenaican and Tripolitanian) of *P. gaisleri* fall into the variation ranges of the Maghrebian populations (Table 20, Fig. 89). There is no obvious trend in the geographical variation through the North African species range; the Maghrebian and Libyan populations of *P. gaisleri* create one homogeneous morphotype. This conforms with the conclusions by Benda et al. (2004c) and Benda & Aulagnier (2013b). This was contradicted by Spitzenberger et al. (2006), as a discriminant analysis of skull measurements placed the Cyrenaican and Maghrebian samples in clearly separated morphospaces. This result was supported by genetic analyses of (together) three different genes (Juste et al. 2004, Spitzenberger et al. 2006). The only variation of North African populations of *P. gaisleri* was observed in their colouration; the pelage and naked skin of face and ears of bats from dry environments of Tripolitania were markedly paler than those of bats from more mesic areas of Cyrenaica (Figs. 84, 87, 88). Similar variation can be observed in Morocco, where darker bats live in the forested Middle Atlas Mts., while paler bats in the arid southern parts of the country.

Populations of *Plecotus* bats inhabiting the Mediterranean habitats of Cyrenaica were simultaneously discovered by Qumsiyeh & Schlitter (1982) and Hanák & Elgadi (1984) and identified

Figs. 87, 88. Portraits of *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004 from Libya. Photos by A. Reiter. 87 (left) – Ain Az Zarqa (Tripolitania). 88 (right) – Wadi Al Minshiyah (Cyrenaica).

Table 20. Biometric data on Libyan and comparative sample sets of *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004. For abbreviations see p. 8

	Cyrenaica					Tripolitania				
	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	37	**38.69**	35.8	40.8	1.073	4	**40.78**	39.5	41.8	0.950
LCr	32	**16.92**	16.35	17.43	0.271	4	**17.13**	16.76	17.63	0.392
LCb	32	**15.87**	15.32	16.38	0.250	4	**16.11**	15.81	16.42	0.276
LaZ	31	**8.91**	8.58	9.14	0.148	4	**9.06**	8.94	9.22	0.127
LaI	32	**3.49**	3.37	3.62	0.054	4	**3.42**	3.37	3.48	0.052
LaN	32	**8.27**	7.98	8.76	0.175	4	**8.28**	8.08	8.47	0.160
ANc	32	**5.50**	5.36	5.69	0.092	4	**5.37**	5.28	5.44	0.072
CC	32	**3.98**	3.75	4.15	0.081	4	**3.89**	3.56	4.05	0.223
M^3M^3	32	**6.19**	5.93	6.41	0.112	4	**6.29**	6.14	6.54	0.177
CM^3	32	**5.73**	5.54	5.94	0.100	4	**5.83**	5.75	5.94	0.097
LMd	31	**10.83**	10.34	11.21	0.205	4	**11.16**	10.85	11.48	0.309
ACo	31	**3.19**	2.83	3.56	0.134	4	**3.19**	3.02	3.34	0.150
CM_3	32	**6.13**	5.83	6.32	0.123	4	**6.34**	6.27	6.42	0.079

	Tunisia					Algeria					Morocco				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	2	**41.15**	40.7	41.6	0.636	14	**39.46**	36.9	41.1	1.265	11	**40.21**	38.6	41.8	0.997
LCr	4	**17.07**	16.37	17.37	0.471	14	**16.84**	16.17	17.11	0.277	11	**16.99**	16.38	17.41	0.286
LCb	4	**15.89**	15.46	16.18	0.346	14	**15.74**	15.43	16.03	0.200	10	**15.93**	15.50	16.31	0.253
LaZ	3	**8.99**	8.90	9.05	0.079	14	**8.99**	8.58	9.23	0.199	9	**9.03**	8.80	9.29	0.150
LaI	4	**3.47**	3.33	3.59	0.107	14	**3.30**	2.88	3.54	0.167	11	**3.36**	3.06	3.53	0.125
LaN	4	**8.26**	7.87	8.48	0.269	14	**8.33**	7.75	8.68	0.277	10	**8.45**	8.14	8.82	0.236
ANc	4	**5.28**	5.08	5.47	0.159	14	**5.35**	5.07	5.58	0.153	10	**5.30**	5.09	5.43	0.111
CC	4	**3.89**	3.75	3.97	0.098	13	**3.96**	3.78	4.07	0.086	11	**3.96**	3.71	4.19	0.155
M^3M^3	4	**6.18**	5.88	6.39	0.219	14	**6.15**	5.93	6.42	0.136	11	**6.27**	6.14	6.49	0.110
CM^3	4	**5.75**	5.57	5.85	0.128	13	**5.73**	5.63	5.91	0.079	11	**5.78**	5.64	5.95	0.097
LMd	4	**11.00**	10.58	11.23	0.295	14	**10.83**	10.32	11.08	0.199	11	**10.98**	10.62	11.33	0.244
ACo	4	**3.12**	2.94	3.32	0.157	14	**3.17**	2.82	3.37	0.136	10	**3.16**	2.92	3.43	0.154
CM_3	4	**6.23**	6.06	6.38	0.133	14	**6.16**	5.65	6.38	0.165	11	**5.96**	3.32	6.39	0.878

as *P. austriacus* (Fischer, 1829). The latter authors suggested to affiliate this population to the nominotypical subspecies of this bat, which was considered polytypic at that time (Hanák 1966). Juste et al. (2004), Benda et al. (2004c) and Spitzenberger et al. (2006) demonstrated a different phylogenetic position of these bats, which belonged to a common lineage with *Plecotus teneriffae* Barrett-Hamilton, 1907 from the Canary Islands and *P. kolombatovici* Đulić, 1980 from the Balkans and Asia Minor, and this lineage was in a sister position to *P. austriacus* s.str. from Europe.

As analysis of two genes separated the Canarian samples with a high bootstrap support from the samples from Turkey and Libya, Juste et al. (2004) maintained the species rank for *P. teneriffae*. However, Benda et al. (2004c) considered this whole lineage as one species, *P. teneriffae*, with three subspecies. The latter authors defined the differences among these three taxa which included mainly the body size and the size and shape of teeth and baculum, while the differences in genetic traits were less pronounced. The Canarian form (*teneriffae*) was the largest in size (forearm length [LAt] 41.1–44.4 mm, mean 42.43 mm; greatest length of skull [LCr] 17.3–18.0 mm, mean 17.58 mm); the Balkanian-Anatolian form (*kolombatovici*) the smallest (LAt 36.1–39.0 mm, mean 37.64 mm; LCr 15.9–17.0 mm, mean 16.32 mm); and the North African form medium-sized (LAt

36.9–41.6 mm, mean 39.53 mm; LCr 16.2–17.6 mm, mean 16.97 mm). The North African and Canarian forms differed from the Balkanian-Anatolian form significantly in the shape and size of teeth; on the other hand, the Canarian form differed very markedly from the two other forms in the shape of baculum (although the latter two also significantly differed from each other); for more details see Benda et al. (2004c: 10–18). The genetic distance of the mitochondrial 16S rRNA gene among these sublineages was on average 1.8–2.2%; the smallest distance (on average 1.8%) was found between the Canarian and North African sublineages. Benda et al. (2004c) described the Libyan populations as a new taxon, *P. teneriffae gaisleri*, and assigned also the *Plecotus* populations from the Maghreb to this subspecies.

On the other hand, Spitzenberger et al. (2006) followed Juste et al. (2004) in keeping species rank for *P. teneriffae* s.str. and considered the rest of the lineage as one species, *P. kolombatovici*, comprising three subspecies, Balkanian-Anatolian (*kolombatovici*), Cyrenaican (*gaisleri*) and Maghrebian (undescribed). However, based on the anaysis of a different mitochondrial gene, Mayer et al. (2007) suggested a separate species status for the populations of *Plecotus* from the Mediterranean North Africa as *P. gaisleri*. This opinion was rather accepted by subsequent authors and currently remains in prevailing use (see e.g. Dietz et al. 2007, Dalhoumi et al. 2011, Lanza 2012, Puechmaille et al. 2012, Benda & Aulagnier 2013b).

Feeding ecology. *Plecotus gaisleri* is a small bat that hunts flying close to vegetation, along rock walls and outcrops or low above the ground (cf. Dietz et al. 2007, own observations). The diet of this species has not yet been studied, but remnants of large noctuids were found in the roosts of *P. gaisleri* in Morocco (Dietz et al. 2007). From Libya, we analysed eight sample sets of the diet of *P. gaisleri* (Fig. 90); we recorded an overwhelming majority of moths (Lepidoptera) in all

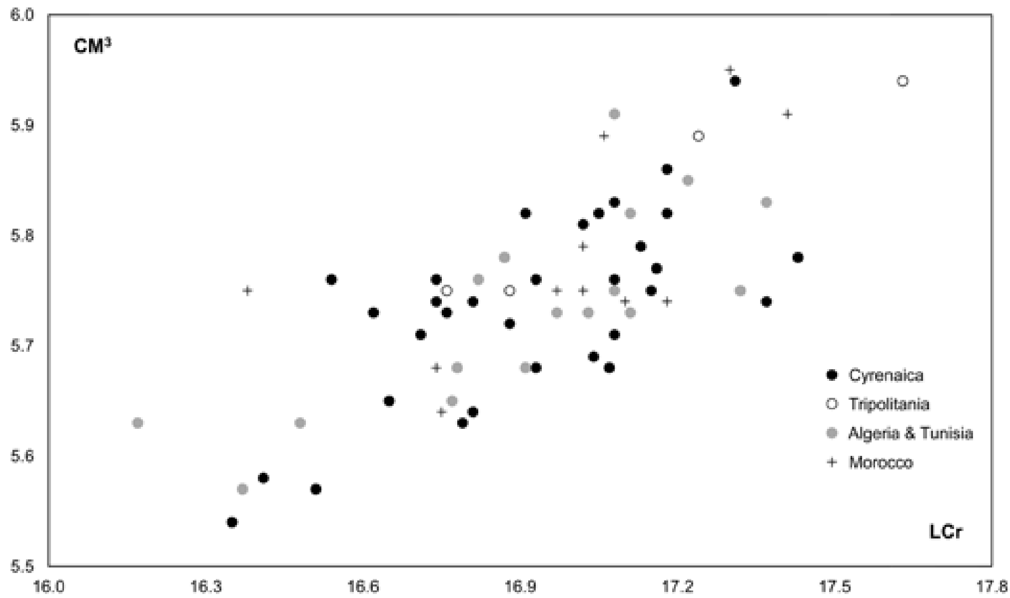

Fig. 89. Bivariate plot of the examined Libyan and comparative samples of *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004: greatest length of skull (LCr) against the length of the upper tooth-row (CM^3).

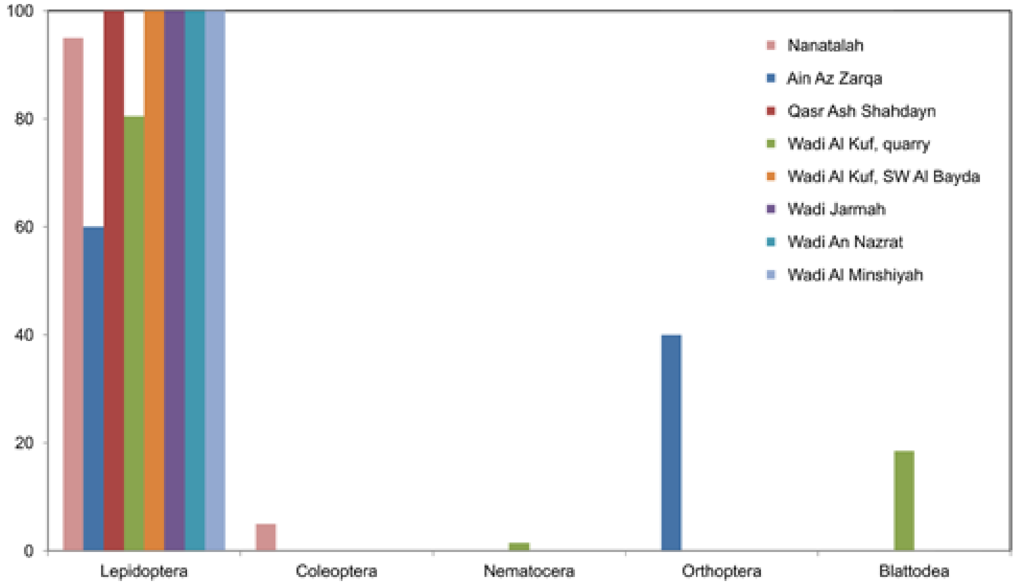

Fig. 90. Percentage volume of particular food items in the diet of *Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004 in Libya. Material analysed: Nanatalah (two digestive tracts), Ain Az Zarqa (Tripolitania) (5 faecal pellets / from 2 individuals), Qasr Ash Shahdayn (8 / 1), Wadi Al Kuf, near quarry (22 / 7), Wadi Al Kuf, SW Al Bayda (18 / 4), Wadi Jarmah (8 / 1), Wadi An Nazrat (14 / 3), Wadi Al Minshiyah (5 / 1).

of them. Among the moths, medium-sized forms with wingspan length of ca. 30–35 mm highly dominated. The sample set from one individual collected at Ain Az Zarqa (Tripolitania) contained also orthopterans (namely Ensifera). Some bats collected near the quarry in Wadi al Kuf consumed cockroaches (Blattodea) in high volumes. At one site, a small proportion of nematoceran Diptera was recorded and at another site a low proportion of small beetles (Coleoptera).

Generally, the trophic niche of *P. gaisleri* resembles well that of the other *Plecotus* species, which are reported as moth eating specialists (see e.g. Robinson 1990, Beck 1995, Whitaker & Karataş 2009, Ashrafi et al. 2011, Alberdi et al. 2012, Benda et al. 2012, etc.). However, certain foraging flexibility and diet variation were recorded similarly as in *P. auritus* from Europe (Rydell 1989, Shiel et al. 1991).

Records of ectoparasites. **Original data**: A c a r i f o r m e s: Acariformes gen. sp.: 1 egg with praelarva (CMŠ [A]) from a jar containing comon collection of 8 host inds. (NMP 49883, 49898–49901, 49906, 49925, 49926) collected at Wadi Al Minshiyah, Wadi Al Kuf, and Wadi An Nazrat, on 17, 19, 20, and 22 May 2002.

Comments on ectoparasites. One egg with praelarva of a mite from the superorder Acariformes was collected from *Plecotus gaisleri*. However, the taxonomic identification of this specimen is not possible.

Plecotus christii Gray, 1838

Records. **Original data**: C y r e n a i c a: Al Jaghbub [1], ruins of Italian fort (Figs. 3, 4), 13 May 2002: coll. 1 ma, abandoned Arabic fort, 13 May 2002: coll. 1 faL, NMP (cf. Benda et al. 2004c, 2006, 2008, 2010a); Oasi di Giarabub, Cirenaica

(= Al Jaghbub), June 1926: 1 ma, MSNG (leg. G. Krüger; cf. Benda et al. 2010a). – **Published data**: C y r e n a i c a: Giarabub (= Al Jaghbub) [1], 1927–1928 [7 and 10 December 1926, 17 March 1927]: 3 m, 1 f, MSNG (De Beaux 1928 [under *P. auritus*], Lanza 1960 [under *P. wardi*], Qumsiyeh 1985 [under *P. austriacus*], Benda et al. 2010a).

Distribution. *Plecotus christii* was recorded only at one site in Libya, the oasis of Al Jaghbub (Giarabub) in the north-eastern part of the country (Fig. 69); however, it was documented there several times. More specimens were collected from this oasis by Italian collectors in the 1920s (at least five MSNG specimens are available, some of them published by De Beaux 1928), another two individuals were found there in 2002 (Benda et al. 2004c). These data suggest permanent and rather abundant presence of this bat in the oasis – Al Jaghbub is found on the western margin of the Siwa basin adjacent to the Qattara depression in north-western Egypt. In the Egyptian oasis of Siwa (some 115 km SE of Al Jaghbub), *P. christii* was collected in 1935 (Hayman 1949) and 1953 (Wassif et al. 1984). Benda et al. (2014) reported evidence of this species from two additional oases of the Libyan/Western desert in Egypt.

P. christii is an inhabitant of desert oases in north-eastern Africa with a small projection to the Middle East (Benda & Aulagnier 2013a). Its distribution range covers whole Egypt and the Egyptian distribution roughly delineates the whole range of this bat in Africa. In Egypt, it occurs in the Nile Valley from Aswan to the Cairo region (Qumsiyeh 1985, Wassif 1995), in the Red Sea Mts. (Osborn 1988), in Sinai (Benda et al. 2008) as well as in the Western oases, including Siwa, Bahariya and Dakhla (Hayman 1949, Benda et al. 2014). From the Egyptian centre of the distribution range, the occurrence of *P. christii* projects to the desert parts of southern Israel and south-western Jordan (Mendelssohn & Yom-Tov 1999, Benda et al. 2010a), where the species reaches the northern and eastern limits of its distribution. The southernmost margin of the range was documented at the Fifth Cataract of the Nile, northern Sudan (Flower 1932), while another record from northern Sudan (Ferka) was mentioned by Benda et al. (2010a). The westernmost distribution point is represented by the Libyan oasis of Al Jaghbub (see above).

Figs. 91, 92. Portraits of *Plecotus christii* Gray, 1838 from Al Jaghbub (Cyrenaica). Photos by P. Benda & A. Reiter.

P. christii is an endemic of the limited arid area of the African-Asian transition. The pattern of its distribution hardly enables to predict any other potential area of occurrence in Libya than the only known spot. If anywhere, occurrence could be also expected in the Kufra oasis in southern Cyrenaica, situated also in the Libyan desert in relative proximity to the Western oases of Egypt, which are inhabited by this bat (about 500 km west of the Dakhla oasis). However, so far no bat records are available from the whole area of southern Cyrenaica (south of 29° N).

Field notes. All records of *Plecotus christii* from Libya come from Al Jaghbub, a small oasis surrounded by sand and rocky deserts (Fig. 66). No data are available on the circumstances of the collection of bats coming from this oasis and deposited in the MSNG collection (cf. De Beaux 1928, Benda et al. 2010a). Two additional bats were found there on 13 May 2002 (Figs. 91, 92); an adult male was found torpid in an abovegroud room in a ruined Italian fortress in the centre of the oasis (a colony of *Rhinopoma cystops* was also documented in the ruins; Figs. 3, 4) and a lactating female was found roosting alone in the modern concrete but abandoned Arabic military fort at the northern edge of the oasis. In both cases, the bats roosted freely on the wall in a spacious room with a considerable amount of daylight.

Material examined. 1 ♂, 1 ♀ (NMP 49862, 49863 [S+A]), Al Jaghbub, 13 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (MSNG 26219a [S+B]), Giarabub (Cirenaica), 7 December 1926, leg. C. Confalonieri; – 1 ♂ (MSNG 26219b [S+B]), Giarabub (Cirenaica), 10 December 1926, leg. C. Confalonieri; – 1 ♂ (MSNG 26220a [S+B]), Giarabub (Cirenaica), 1926–1927, leg. C. Confalonieri; – 1 ♀ (MSNG 26220b [S+B]), Giarabub (Cirenaica), 17 March 1927, leg. C. Confalonieri; – 1 ♂ (MSNG 47016 [S+A]), Oasi di Giarabub, Cirenaica, June 1926, leg. G. Krüger.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Plecotus christii* are shown in Table 17. For the material examined see above, for depiction of bacula from Libyan *P. christii* see Lanza (1960: 11, Fig. 1), Hanák & Elgadi (1984: 177, Fig. 5) and Benda et al. (2004c: 16, Fig. 5), for depiction of the skull of Libyan *P. christii* see Benda et al. (2004c: 24, Fig. 8), and for depictions of their third upper molars see Benda et al. (2004c: 25, Fig. 9).

The geographical variation in *P. christii*, including the above mentioned Libyan samples, was evaluated by Benda et al. (2010a: 303–306). The species is composed of two size morphotypes; smaller bats inhabiting the desert habitats of continental Egypt, northern Sudan and eastern Libya (Al Jaghbub oasis) (forearm length [LAt] 36.2–40.5 mm, mean 38.26 mm; greatest length of skull [LCr] 15.9–16.8 mm, mean 16.38 mm) are assigned to the nominotypical form, while larger bats occurring in the Holy Land (LAt 38.1–42.4 mm, mean 40.21 mm; LCr 16.3–17.5 mm, mean 16.86 mm) represent *P. c. petraeus* Benda, 2008.

The Libyan population of *Plecotus* bats from the Al Jaghbub oasis was first mentioned by De Beaux (1928) under *P. auritus* (Linnaeus, 1758), the only species of the genus recognised at that time from the Palaearctic (Aellen 1939, Ellerman & Morrison-Scott 1951). Setzer (1957: 49) specified the taxonomic affiliation of this population to *P. auritus* cf. *christii*, Lanza (1960) to *P. wardi* cf. *christiei*, and Hanák (1966) and Hanák & Elgadi (1984) referred it to *P. austriacus christiei*. Based on a molecular genetic analysis of the Libyan bats, Benda et al. (2004c) demonstrated the species status of the form *christii*, separated by 4.1–5.4% of genetic distance (16S rRNA gene) from its sister lineage *teneriffae*/*kolombatovici*, which included also *P. gaisleri* from Cyrenaica.

In their revision of taxonomy of the genus *Plecotus*, Spitzenberger et al. (2006: 218) supported the use of a different spelling of the name, *P. christiei*, introduced by Thomas (1911). Since Gray (1838) named this species after the holotype collector, T. Christie, Thomas (1911) suggested to change the spelling accordingly, i.e. to correct the "incorrect original spelling" *christii* by a "corrected subsequent spelling" *christiei*. It could be considered being in accordance with the Articles 32.4 and 32.5 of the International Code of Zoological Nomenclature (ICZN 1999) and this correction being a justified emendation (ICZN 1999: Article 32.5). However, here we use the original spelling *christii* that reflects Gray's opinion to use for a latinised form of the personal name (Christius, *christii*). The use of original spellings originating from latinised personal names currently absolutely prevails over the emended spellings (comp. e.g. Ellerman & Morrison-Scott 1951 and Simmons 2005).

Feeding ecology. *Plecotus christii* is a small bat applying the gleaning foraging strategy (Whitaker et al. 1994, Benda et al. 2008). The feeding ecology of the species was studied in some parts of its distribution range, including Israel, Jordan and the Sinai (Whitaker et al. 1994, Feldman et al. 2000, Benda et al. 2008, 2010a). The most important prey items recorded were Lepidoptera, complemented with Trichoptera, Coleoptera and Diptera (Feldman et al. 2000) or Blattodea (Benda et al. 2008). Some small proportions of Chilopoda, Brachycera, Neuroptera, Coleoptera, Orthoptera, Solpugida, Araneae, Heteroptera, Auchenorrhyncha, Hymenoptera, and Mantodea were found in Jordan (Benda et al. 2010a). Very interesting results come from some Jordanian desert sites, where the diet of *P. christii* was dominated by Coleoptera and Orthoptera instead of Lepidoptera which were recorded in the more mesic localities. This indicates certain foraging flexibility in this bat.

From Libya, we analysed the contents of digestive tracts from two individuals collected in the Al Jaghbub oasis; they were composed solely of moths (Lepidoptera). The predominance of moths corresponds with most of the available diet analyses of *P. christii* and known dietary preferences of other members of the genus *Plecotus* as well (see also Feeding ecology in *P. gaisleri* above).

Records of ectoparasites. **Original data**: A r g a s i d a e: *Argas vespertilionis*: 1 larva (CMŠ [P]) from 2 host inds. (NMP 49862, 49863), Al Jaghbub, 13 May 2002.

Comments on ectoparasites. One larva of *Argas vespertilionis* (Latreille, 1802) was collected from *Plecotus christii*; this parasite is here reported from Libya for the first time, although it was found to parasitise four species of bats in this country. From *P. christii* this soft-tick species was already recorded in Egypt (Hoogstraal 1956). For distributional notes on this parasite see also the comments on ectoparasites of *Rhinopoma cystops*.

Miniopterus schreibersii (Kuhl, 1817)

Records. **Original data**: C y r e n a i c a: Wadi Al Kuf, a cave at the SE side of the valley [1], 9 August 1981: obs. 2 inds. (exam. 1 ma), 10 August 1981: obs. 5 inds., 15 August 1981: obs. a cluster of 21 inds. in topor (coll. 4 ma, 3 fa, NMW); – Wadi Al Kuf, a large cave at the SE side of the valley [2], 18 August 1981: net. 1 fs, NMW. – **Published data**: C y r e n a i c a: Wadi Al Kuf [3], unnamed cave, 1981: 3 f (Qumsiyeh & Schlitter 1982). – T r i p o l i t a n i a: Tripoli (= Tarabulus), Sidi Mesri [4], town outskirts, November 1979: 1 ind. [NMP] (Hanák & Elgadi 1984).

Distribution. *Miniopterus schreibersii* is known in Libya from four records in the Mediterranean parts of the country (Qumsiyeh & Schlitter 1982, Hanák & Elgadi 1984, present data) and these distant localities lie in two regions of the country, Cyrenaica and Tripolitania, some thousand kilometres away from each other (Fig. 65). While from Tripolitania only one record is available, three findings are known from Cyrenaica; however, the Cyrenaican sites are situated very close to each other, on an area of one or two square kilometres. Concerning the cave dwelling bat fauna of Libya and considering the width of the Libyan range, *M. schreibersii* represents one of the rarest cave bat species.

The Libyan records represent the easternmost part of the distribution range of *M. schreibersii* in Africa. These bats occur continually in the belt of Mediterranean habitats from south-western Morocco to Tunisia as well as in the islands of Malta and Lampedusa (Zava & Catalano 1983, Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Borg et al. 1997, Puechmaille et al. 2012). However, the Libyan records of *M. schreibersii* are quite isolated from the rest of the distribution range. The locality situated nearest to the Tripolitanian site of Sidi Mesri is the island of Lampedusa, situated ca. 300 km away. Concerning the African mainland, the closest site is the Bou Hedma National Park (ca. 450 km NW; Moldrzyk 2003, Hizem & Allegrini 2009). However, the area inhabited by *M. schreibersii* s.str. lying nearest to Cyrenaica and the Libyan range as well, is the island of Crete (Greece), which is situated less than 300 km north across the Cretan Sea (Benda et al. 2009).

Field notes. With the exception of the record from Tripolitania (cf. Hanák & Elgadi 1984) where collecting circumstances are not available, *Miniopterus schreibersii* was documented only in or at its roosts in Libya.

All records with field data attached come from the forested central part of Wadi Al Kuf. An aggregation of this bat was observed in a cave situated in the slope of the south-eastern side valley of Wadi Al Kuf, 0.8 km south-east of the Ar Ruba road bridge several times in August 1981. Two individuals were observed there on 9 August, five bats on 10 August and 21 individuals in torpor were counted there on 15 August. The aggregation perhaps did not represent remains of a maternity colony, since of eight bats examined, five were adult males and three adult females; i.e. no juvenile was documented and adult females did not dominate the record. The cave was ca. 40 m long, with three chambers (up to 8 m in height) and contained a heap of guano in the last chamber. *Rhinolophus mehelyi* was recorded there along with *M. schreibersi* during the first and third visits. One subadult female of *M. schreibersii* was netted at the entrance of a large cave in a side valley of the south-eastern slope of Wadi Al Kuf on 18 August 1981 (together with *Pipistrellus hanaki*,

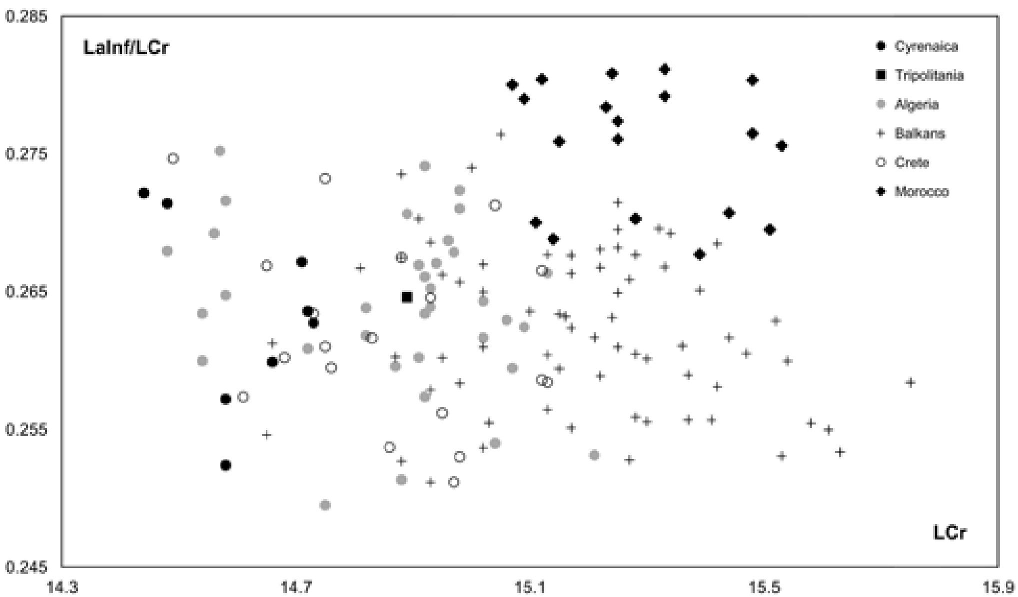

Fig. 93. Bivariate plot of the examined Libyan and comparative samples of *Miniopterus schreibersii* (Kuhl, 1817) and the samples of *M. maghrebensis* Puechmaille, Allegrini, Benda, Bilgin, Ibáñez et Juste, 2014 from Morocco: greatest length of skull (LCr) against the length of the upper tooth-row (CM^3).

Table 21. Biometric data on comparative sample sets of the genus *Miniopterus* Bonaparte, 1837: *M. maghrebensis* Puechmaille, Allegrini, Benda, Bilgin, Ibáñez et Juste, 2014 from Morocco and *M. schreibersii* (Kuhl, 1817) from other parts of the Mediterranean. For abbreviations see p. 8

	Cyrenaica					Tripolitania	Algeria				
	n	**M**	min	max	SD		n	**M**	min	max	SD
LAt	8	**42.65**	42.0	43.8	0.535	–	38	**45.34**	43.2	47.0	0.857
LCr	8	**14.61**	14.44	14.73	0.111	14.89	36	**14.87**	14.48	15.21	0.187
LCb	8	**14.09**	13.86	14.28	0.129	14.48	36	**14.41**	13.94	14.74	0.185
LaZ	8	**8.22**	8.04	8.37	0.133	8.56	34	**8.45**	8.11	8.74	0.145
LaI	8	**3.48**	3.38	3.54	0.058	3.56	36	**3.57**	3.43	3.74	0.082
LaInf	8	**3.85**	3.68	3.93	0.093	3.94	36	**3.93**	3.68	4.09	0.093
LaN	8	**7.71**	7.62	7.93	0.101	7.89	36	**7.97**	7.76	8.22	0.114
ANc	8	**6.17**	5.94	6.41	0.138	6.18	36	**6.22**	5.98	6.39	0.110
CC	8	**4.42**	4.36	4.53	0.060	4.38	30	**4.47**	4.28	4.66	0.096
M^3M^3	8	**6.20**	6.17	6.24	0.025	6.24	36	**6.20**	5.97	6.44	0.109
CM^3	8	**5.72**	5.67	5.78	0.044	5.91	36	**5.82**	5.65	5.94	0.079
LMd	8	**10.29**	9.94	10.49	0.170	10.75	36	**10.65**	10.28	10.92	0.134
ACo	8	**2.48**	2.42	2.57	0.065	2.73	36	**2.56**	2.32	2.71	0.091
CM_3	8	**6.08**	6.02	6.17	0.051	6.18	36	**6.18**	5.78	6.34	0.105
LaInf/LCr	8	**0.263**	0.252	0.272	0.007	0.265	36	**0.264**	0.250	0.275	0.006

	Morocco					Balkans					Crete				
	n	**M**	min	max	SD	n	**M**	min	max	SD	n	**M**	min	max	SD
LAt	25	**46.38**	45.3	47.7	0.710	86	**45.81**	41.2	48.0	1.047	25	**44.90**	44.0	46.0	0.528
LCr	20	**15.28**	15.07	15.53	0.148	83	**15.16**	14.52	15.75	0.238	19	**14.85**	14.49	15.13	0.184
LCb	20	**14.94**	14.74	15.23	0.145	84	**14.71**	14.00	15.17	0.222	19	**14.44**	14.11	14.67	0.132
LaZ	20	**8.70**	8.44	9.04	0.147	75	**8.57**	8.18	8.85	0.135	19	**8.52**	8.22	8.77	0.130
LaI	20	**3.68**	3.48	3.92	0.106	91	**3.60**	3.33	3.84	0.085	19	**3.55**	3.38	3.73	0.100
LaInf	20	**4.22**	4.07	4.34	0.074	78	**3.98**	3.64	4.16	0.102	19	**3.89**	3.76	4.08	0.097
LaN	20	**8.07**	7.88	8.28	0.121	87	**8.04**	7.67	8.38	0.135	19	**7.83**	7.68	7.96	0.080
ANc	20	**6.38**	6.18	6.57	0.107	86	**6.30**	5.92	6.54	0.119	19	**6.24**	6.02	6.44	0.099
CC	20	**4.69**	4.48	4.86	0.099	82	**4.53**	4.11	4.74	0.111	19	**4.53**	4.39	4.74	0.085
M^3M^3	20	**6.42**	6.21	6.64	0.101	84	**6.34**	5.36	6.58	0.166	19	**6.28**	6.09	6.42	0.087
CM^3	20	**5.97**	5.75	6.16	0.097	88	**5.93**	5.75	6.17	0.084	19	**5.86**	5.62	5.98	0.086
LMd	20	**10.89**	10.74	11.22	0.150	81	**10.79**	10.41	11.22	0.154	19	**10.55**	10.27	10.77	0.116
ACo	20	**2.62**	2.47	2.75	0.065	83	**2.50**	2.16	2.84	0.107	19	**2.57**	2.42	2.66	0.060
CM_3	20	**6.33**	6.08	6.56	0.108	81	**6.31**	6.13	6.57	0.081	19	**6.24**	6.02	6.34	0.068
LaInf/LCr	20	**0.276**	0.268	0.281	0.005	73	**0.262**	0.242	0.276	0.006	19	**0.262**	0.251	0.275	0.007

P. kuhlii, *Plecotus gaisleri*, and *Tadarida teniotis*). This cave was ca. 40 m long, built along a cleft in the rock; however, no bat was found to roost inside the cave. From an "unnamed cave" in the south-western part of Wadi Al Kuf, Qumsiyeh & Schlitter (1982) reported a collection of three specimens of *M. schreibersii* (together with ten *Rhinolophus mehelyi*).

No evidence of reproduction of *M. schreibersii* was documented in Libya.

Material examined. 4 ♂♂, 3 ♀♀ (NMW 30149–30155 [S+B]), Al Kuf, 15 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (NMW 30156 [S+B]), Al Kuf, 18 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ind. (NMP 95042 [S]), Tripoli, Sidi Mesri, November 1979, leg. A. El Gadi.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Miniopterus schreibersii* are shown in Table 15. For the material examined see above.

Bats of the genus *Miniopterus* were discovered in Libya almost simultaneously by Qumsiyeh & Schlitter (1982) and Hanák & Elgadi (1984). While the latter authors collected one skull from Tripolitania in 1979, the former authors collected three bats in Cyrenaica in 1981. Qumsiyeh & Schlitter (1982: 387) added the following observation: "External and cranial measurements and color of pelage of three specimens agree with those of specimens of Europe and northeast [= northwest] Africa (the nominate subspecies) rather than with those of the Eastern Mediterranean region referable to *M. s. pallidus*." The dimensional data on three bats from Cyrenaica given by Qumsiyeh & Schlitter (1982: 381, 383) correspond with those presented here (Table 21). The pelage colouration of the NMW bats from Cyrenaica is dark greyish-brown, conforming to the colouration of the Maghrebian, European and Levantine bats.

The comparison of cranial dimensions showed somewhat different positions of the samples from Cyrenaica and from Tripolitania (Table 21, Fig. 93). The Tripolitanian bat is larger in skull size than the group of Cyrenaican bats. In comparison with other population sets from the Mediterranean (with the exception of *M. pallidus* Thomas, 1907 from the Middle East), the Cyrenaican specimens are on average the smallest bats among the compared sets, even smaller than those from Crete, which were shown to be the smallest *Miniopterus* bats in the western Palaearctic by Šrámek et al. (2013). The bat from Tripolitania conforms in size well to the average size of the samples from Algeria and Crete. All the Libyan specimens clearly differ – both in size and in skull

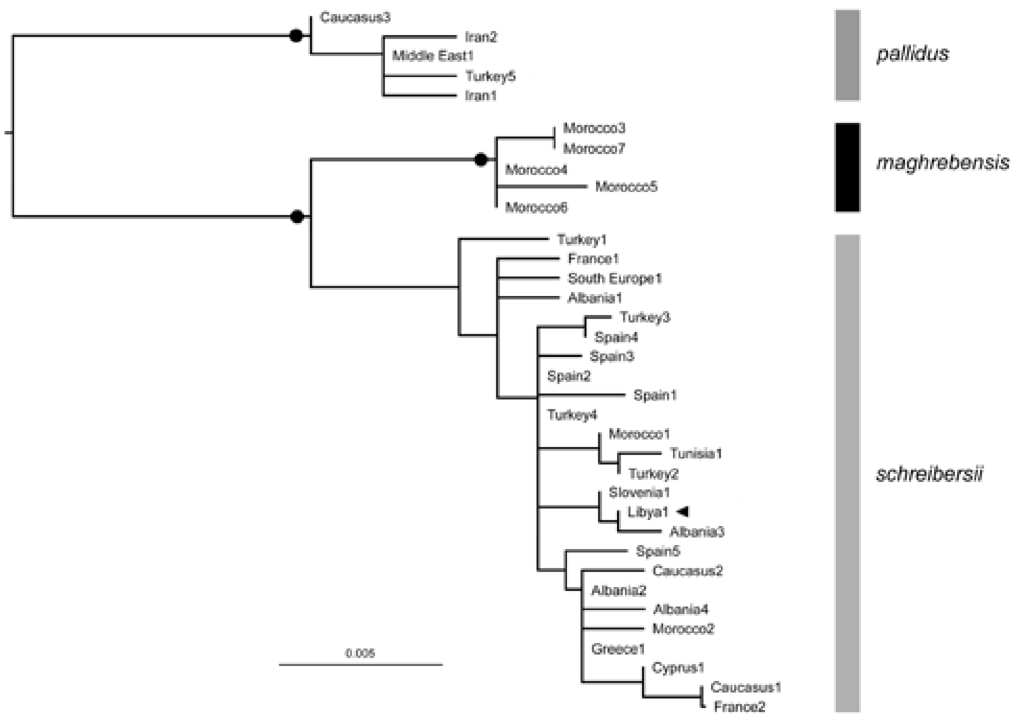

Fig. 94. Maximum likelihood phylogenetic tree of *Miniopterus schreibersii*, *M. maghrebensis* and *M. pallidus* based on partial sequences of the gene for cytochrome *b*. Branches with bootstrap values ≥75% are marked by dots, the Cyrenaican haplotype is marked with an arrow.

Table 22. Percent pairwise uncorrected genetic distances among haplotypes of the *Miniopterus schreibersii* complex (456 bp of the gene for cytochrome *b*); above diagonal – mean, below diagonal – range

	Cyrenaica	*M. schreibersii*	*M. maghrebensis*	*M. pallidus*
Cyrenaica	–	0.13	0.99	2.89
M. schreibersii	0.0–0.9	–	1.11	2.27
M. maghrebensis	0.5–1.8	0.7–1.8	–	2.45
M. pallidus	2.6–3.1	2.0–5.6	2.0–3.6	–

Table 23. GenBank Accession Numbers of haplotypes of the *Miniopterus schreibersii* complex used in molecular genetic comparison (mitochondrial gene for cytochrome *b*; Fig. 94); * = haplotype of the holotype specimen of *M. maghrebensis* Puechmaille, Allegrini, Benda, Bilgin, Ibáñez et Juste, 2014; GBAN = GenBank Accession Number

haplotype	GBAN	country; site (voucher/source)
Miniopterus schreibersii		
Libya1	KP455385	Libya; Wadi Al Kuf (NMW 30149)
Spain1	AF376830	Spain; Barcelona (Ruedi & Mayer 2001)
Spain2	DQ120911	Spain; North Iberia (Ibáñez et al. 2006)
Spain3	DQ120912	Spain; South Iberia (Ibáñez et al. 2006)
Spain4	DQ120913	Spain; South Iberia (Ibáñez et al. 2006)
Greece1	DQ120914	Greece (Ibáñez et al. 2006)
Turkey1	DQ120915	Turkey (Ibáñez et al. 2006)
Turkey2	GU290286	Turkey; Obruk (Furman et al. 2010)
Caucasus1	GU290287	Georgia; Ghliana (Furman et al. 2010)
Turkey3	GU290288	Turkey; Karanlık (Furman et al. 2010)
Turkey4	GU290289	Turkey; Zindan, Hızar, Horataşı (Furman et al. 2010)
Morocco1	KJ535789	Morocco (Puechmaille et al. 2014)
Tunisia1	KJ535790	Tunisia (Puechmaille et al. 2014)
Morocco2	KJ535791	Morocco (Puechmaille et al. 2014)
Albania1	KJ535792	Albania (Puechmaille et al. 2014)
Albania2	KJ535793	Albania (Puechmaille et al. 2014)
Albania3	KJ535794	Albania (Puechmaille et al. 2014)
France1	KJ535795	France (Puechmaille et al. 2014)
South Europe1	KJ535796	Croatia, Romania, Russia, Slovakia, Slovenia, Spain (Puechmaille et al. 2014)
Caucasus2	KJ535800	Russia (Puechmaille et al. 2014)
Slovenia1	KJ535802	Slovenia (Puechmaille et al. 2014)
Albania4	KJ535808	Albania (Puechmaille et al. 2014)
Cyprus1	KJ535810	Cyprus (Puechmaille et al. 2014)
France2	KJ535813	France (Puechmaille et al. 2014)
Spain5	KJ535822	Spain (Puechmaille et al. 2014)
Miniopterus maghrebensis		
Morocco3	KP455387	Morocco; Oued Tessaouat, Talkout (NMP 90047)
Morocco4	KP455388	Morocco; Azigza Cave, S of Tazouguerte (NMP 94505)
Morocco5	KP455386	Morocco; Azigza Cave, S of Tazouguerte (NMP 94509)
Morocco6*	KJ535784	Morocco; Azigza Cave, S of Tazouguerte (Puechmaille et al. 2014)
Morocco7	KJ535785	Morocco (Puechmaille et al. 2014)
Miniopterus pallidus		
Iran1	GU290281	Iran; Karaftu Cave (Furman et al. 2010)
Iran2	GU290282	Iran; Sarin Ab-Garma Cave (Furman et al. 2010)
Turkey5	GU290283	Turkey; Epçik (Furman et al. 2010)
Caucasus3	GU290284	Azerbiajan; Azoh Cave (Furman et al. 2010)
Middle East1	GU290285	Azerbaijan, Turkey, Iran; Azoh Cave, Delikli, Karaftu Cave (Furman et al. 2010)

shape – from the Moroccan samples of *M. maghrebensis* Puechmaille, Allegrini, Benda, Bilgin, Ibáñez et Juste, 2014 (Fig. 93), a species distinguished by a larger skull size and a relatively broad rostrum (Puechmaille et al. 2014). The comparisons of absolute and relative dimensions of the skull indicate that the Libyan samples have to be identified as *M. schreibersii*.

The affiliation of the Libyan *Miniopterus* populations to *M. schreibersii* s.str. was confirmed also by a comparison of molecular genetic data. A partial sequence of the gene for cytochrome *b* was extracted from a skin specimen (NMW 30149) and the obtained fragment clustered with the sequences of bats from the nominotypical populations from Europe, Caucasus, Levant, and the Maghreb (Fig. 94, Table 23). Moreover, the small mean genetic distance of 0.13% between the Cyrenaican and comparative samples (Table 22) indicates a relatively recent differentiation of the Mediterranean populations of *M. schreibersii* and colonisation of Cyrenaica.

The morphometric difference between the Cyrenaican and other Mediterranean population thus seems to be a result of a rather fast evolution of a separate morphotype under the environmental conditions of Cyrenaica. It should be noted that the Cyrenaican population of *M. schreibersii* is known only from a limited area, the central part of the Wadi Al Kuf, and the population is probably small concerning the number of individuals. Such a limited population is perhaps more sensitive to external influences, which can than produce morphological adaptations relatively rapidly.

Tadarida teniotis (Rafinesque, 1814)

Records. **Original data**: C y r e n a i c a: Al Bardiyah [1], wadi beneath the village (Fig. 16), 12 May 2002: det. calls of several foraging inds.; – Arqub Ash Shafshaf [2], at a stream (Fig. 40), 17 May 2002: det. calls of min. 1 foraging ind.; – Shahhat [3], Cyrene, ancient ruins (Fig. 71), 10 October 1999: det. calls of 1 ind.; – Wadi Al Kuf [4], 5 km SW of Al Bayda, at a small river (Fig. 41), 18 May 2002: det. calls of min. 5 foraging inds.; – Wadi Al Kuf, a large cave at the SE side of the valley [5], 18 August 1981: net. 1 ma, 22 August 1981: net. 1 m, 2 f (coll. 1 ma, 1 fa, NMW; cf. Benda et al. 2012); – Wadi Al Kuf [6], cave entrance in the western slope of the wadi (Fig. 96), 20 May 2002: obs. 3 inds. in a rocky fissure; – Wadi Al Kuf [7], rocky fissure in a quarry, 9 August 1981: coll. 2 ma, 6 fa, NMW (cf. Benda et al. 2012), small cave, 19 May 2002: det. calls of several foraging inds., net. 1 ma, 1 ms, 1 fa, NMP (cf. Benda et al. 2012); – Wadi Al Minshiyah [8] (Fig. 99), 16 May 2002: det. calls of min. 1 foraging ind.; – Wadi An Nazrat [9], 5 km W of Sidi Muhammad Al Mabkhut, a cave entrance (Figs. 86, 95), 21 May 2002: obs. a roosting colony of ca. 15 inds, net. 1 ma, 1 fa, NMP (cf. Benda et al. 2012); – Wadi Bu Al Gharas [10] (Fig. 58), ca. 15 km SE of At Tmimi, 14 May 2002: det. calls of min. 1 foraging ind.; – Wadi Darnah [11], above a small river 6 km S of Darnah (near a gallery), 15 May 2002: det. calls of min. 5 foraging inds., net. 1 ma, NMP (cf. Ammerman et al. 2012, Benda et al. 2012); – Wadi Jarmah [12], rocky overhang (Fig. 43), 6 August 1981: net. 3 ma (coll. 2 m, NMW; cf. Benda et al. 2012), 20 May 2002: det. calls of min. 1 foraging ind. – **Published data**: C y r e n a i c a: Wadi Al Kuf [7], "mistnetting site", 1981: 8 m, 4 f (Qumsiyeh & Schlitter 1982).

Distribution. The distribution of *Tadarida teniotis* records in Libya is restricted to the Mediterranean part of Cyrenaica (Fig. 78). However, with twelve localities, *T. teniotis* is the second most common bat species in this region (along with *Pipistrellus hanaki* and after *P. kuhlii*) and third most common bat species in Libya as a whole (after *Pipistrellus kuhlii* and *Plecotus gaisleri*). Among the species limited by their Libyan distribution to the Mediterranean zone of Cyrenaica, *T. teniotis* has the broadest range, stretching over more than 400 km from Wadi Al Nazrat in the west to Al Bardiyah in the east (Fig. 78). However, most of the localities (67%) are concentrated to the forested northern slopes of the Cyrenaican plateau (Jebel Al Akhdar Mts.), in the surroundings of Al Bayda, in a limited area of some 75 km by 25 km (comparable with the known Libyan ranges of *Pipistrellus hanaki* or *Nyctalus lasiopterus*; see Figs. 34, 69).

T. teniotis shows the Mediterranean type of distribution, it occurs in an interrupted belt from the Canary Islands, Maghreb and Iberia through southern Europe and the Middle East to West Turkestan and Afghanistan (Corbet 1978, Kock & Nader 1984, Koopman 1994). The only discontinuation of the species occurrence in the circum-Mediterranean area is found in north-eastern Africa, between

Fig. 95. A cave in Wadi An Nazrat (Cyrenaica; see also Fig. 86); foraging and roosting site of *Pipistrellus kuhlii*, *Plecotus gaisleri* and *Tadarida teniotis*. Photo by A. Reiter (May 2002).

the Cyrenaican part of range and the neighbouring parts in Egypt and the Maghreb, respectively. In Egypt, *T. teniotis* was documented in the Cairo region (Wassif et al. 1984, Qumsiyeh 1985) and in the Sinai (Benda et al. 2008). The Egyptian records situated nearest to the Cyrenican range are available from Wadi El Natrun (Wassif et al. 1984, Benda et al. 2014), 500–530 km east of Al Bardiyah, which is situated close to the Libyan-Egyptian border (Fig. 78).

In the Maghreb, *T. teniotis* occurs in the whole belt of the Mediterranean arboreal zone from southern Morocco to Tunisia, including also relatively arid areas close to the northern margins of the Sahara (Aulagnier & Thevenot 1986, Kowalski & Rzebik-Kowalska 1991, Benda et al. 2004d, 2010b, Dieuleveut et al. 2010, Puechmaille et al. 2012). All localities known from Tunisia (eight) lie in the northern part of the country, with an exception of Ksar Haddada, north-east of Tataouine (Beaucournu et al. 1983), situated in the Jebel Dahar Mts., ca. 115 km from the border of Libya. The record from the latter site suggests a possible – at least temporal – occurrence of *T. teniotis* in the adjacent areas of the Jebel Nafusa Mts. in Tripolitania. However, netting and call detecting carried out in this region did not bring any sign of such a possibility. On the other hand, this nearest Tunisian locality of *T. teniotis* is situated more than one thousand kilometres from the western margin of its Cyrenaican range.

Anyway, the area inhabited by *T. teniotis* lying nearest to Cyrenaica is the island of Crete (Greece), which is situated less than 300 km north of Cyrenaica across the Cretan Sea. From this large island, similar in area and landscape structure to Cyrenaica, more than a hundred records of this bat are available (Benda et al. 2009). Considering the relatively short distance between these places and the ability of strong and fast flight in *T. teniotis*, it cannot be excluded that the Cyrenaican populations of this bat have a connection (at least irregular) with its European range rather than with the ranges in other parts of Africa.

On the other hand, regarding the nature of habitats along the coast of the Mediterranean Sea in Libya and Egypt, which are very similar to those in southern and eastern Morocco and/or in the Sinai, it can be well possible that *T. teniotis* really occurs in the coastal belt along the whole

North African shore without any extensive interruption. However, if so, its abundance there is perhaps too low to be detected by the limited effort made in these areas.

FIELD NOTES. *Tadarida teniotis* was recorded in Libya most frequently at its foraging grounds, although findings in roosts are also available.

A roosting colony of *T. teniotis* composed of some 15 bats was discovered in a ceiling fissure in the portal of a large but shallow cave in Wadi An Nazrat near Sidi Muhammad Al Mabkhut on 21 May 2002; the cave was situated on a slope above a dry steppe landscape intensively used as a pasture with only a small tree coverage (Figs. 86, 95). One adult male and one adult female which most probably emerged from or approached the roost were netted during the precendent night in the portal of the cave. As no signs of reproduction were documented in the female, the colony perhaps represented an agglomeration of non-reproducing individuals (*Pipistrellus kuhlii* and *Plecotus gaisleri* were also netted at this cave). Another roosting group of *T. teniotis*, com-

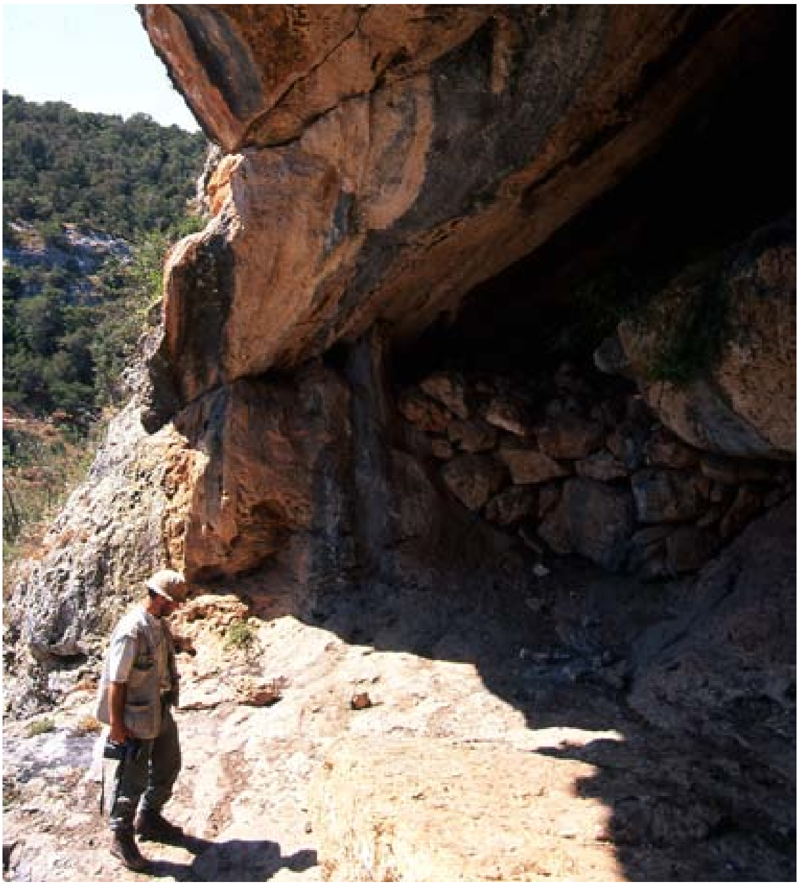

Fig. 96. A cave situated in the northern slope of the side valley of the western part of Wadi Al Kuf (Cyrenaica). A roosting group of *Tadarida teniotis* was hidden in a fissure of the entrance ceiling. Photo by A. Reiter (May 2002).

posed of at least three observable bats, was discovered in conditions very similar to the previous record. The group was hidden in a fissure of the entrance ceiling of a cave situated in the forested northern slope of the side valley of the western part of Wadi Al Kuf on 20 May 2002 (Fig. 96). The cave was some 40 m long and several individuals of *Rhinolophus horaceki* were found to roost inside the cave. In this part of Wadi Al Kuf, another roosting group of *T. teniotis* was discovered in a quarry south-west of Massah on 9 August 1981; at least eight bats (two males, six females) were aggregated under an unstable stone at the rock face along the road to the quarry.

Foraging individuals of *T. teniotis* were documented at a series of sites, in most cases such findings were represented by recordings of echolocation calls. Foraging bats were netted at several sites in the forested central part of Wadi Al Kuf, south-west of Massah; the nets were installed at cave entrances as well as at water bodies. One *T. teniotis* was caught at a large cave at the SE side of the valley on 18 August 1981 (along with *Pipistrellus hanaki*, *P. kuhlii*, *Plecotus gaisleri*, and *Miniopterus schreibersii*) and three other individuals at the same site on 22 August 1981 (along with *Rhinolophus horaceki*, *Pipistrellus hanaki*, *P. kuhlii*, and *Plecotus gaisleri*); three bats were netted at a small cave on 19 May 2002 (Fig. 97; along with *Pipistrellus hanaki* and *Plecotus gaisleri*); and twelve individuals of *T. teniotis* were netted by Qumsiyeh & Schlitter (1982) at the "mistnetting site" in central Wadi Al Kuf in spring 1981. Three bats were caught at a rocky overhang on the left side of Wadi Jarmah (Fig. 43) on 6 August 1981. One adult male of *T. teniotis* was netted – and echolocation calls of some five other foraging bats recorded – above a small river in Wadi Darnah some 6 km south of Darnah (Figs. 15, 98) on 15 May 2002 (calls of *Pipistrellus kuhlii* were also recorded there).

Figs. 97, 98. Portraits of *Tadarida teniotis* (Rafinesque, 1814) from Cyrenaica. 97 (left) – a bat netted in Wadi Al Kuf. 98 (right) – male from Wadi Darnah. Photos by A. Reiter.

Fig. 99. Wadi Al Minshiyah (Cyrenaica); a foraging habitat of *Pipistrellus hanaki*, *P. kuhlii*, *Nyctalus lasiopterus*, *Plecotus gaisleri*, and *Tadarida teniotis*. Photo by A. Reiter. (May 2002)

Echolocation calls of foraging *T. teniotis* were recorded at least at seven sites. Several foraging individuals were recorded in a wadi beneath Al Bardiyah (Fig. 16) on 12 May 2002 (together with calls of *Pipistrellus kuhlii*). Calls of one foraging *T. teniotis* were detected in the valley at Arqub Ash Shafshaf on 17 May 2002 (Fig. 40; *Pipistrellus hanaki* and *Nyctalus lasiopterus* were also netted there). Calls of one individual were also detected in the shallow valley of Wadi Bu Al Gharas (Fig. 58) south-east of At Tmimi on 14 May 2002 (together with calls of *Pipistrellus kuhlii*). One *T. teniotis* was registered passing over the ancient necropolis of Cyrene at Shahhat on 10 October 1999 (Fig. 71; together with calls of *Pipistrellus kuhlii*). Calls of a larger number of foraging individuals were detected in the upper part of Wadi Al Kuf near Al Bayda on 18 May 2002 (Fig. 41); at the site, *Pipistrellus hanaki*, *P. kuhlii* and *Plecotus gaisleri* were also recorded on that night). One foraging *T. teniotis* was registered in the terminal part of Wadi Al Minshiyah on 16 May 2002 (Fig. 99; in the area, *Pipistrellus hanaki*, *P. kuhlii*, *Nyctalus lasiopterus*, and *Plecotus gaisleri* were recorded on the same night). Calls of one *T. teniotis* were detected at rocks of valley sides in Wadi Jarmah on 20 May 2002 (along with netted *Pipistrellus kuhlii* and *Plecotus gaisleri,* and detected calls of *Pipistrellus hanaki*).

No direct observation of reproduction (pregnancy, lactation) of *T. teniotis* was documented in Libya. In four out of six female bats collected on 9 August the right uterus horn was considerably enlarged indicating previous pregnancy.

Material examined. 2 ♂♂, 1 ♀ (NMP 49912–49914 [S+A]), Wadi Al Kuf, 19 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂, 1 ♀ (NMP 49928, 49929 [S+A]), Wadi An Nazrat, Sidi Mohammad Al Mabkhut, 22 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 1 ♂ (NMP 49881 [S+A]), Wadi Darnah, 6 km

S of Darnah, 15 May 2002, leg. M. Andreas, P. Benda, V. Hanák, A. Reiter & M. Uhrin; – 2 ♂♂ (NMW 30157, 30158 [S+B]), Wadi Jarjaroma, Kouf Nat. Park, Prov. Beida, 6 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 2 ♂♂, 6 ♀♀ (NMW 30159–30166 [S+B]), Wadi Kuf, Prov. Beida, 9 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♂ (NMW 30167 [S+B]), Wadi Kuf, Prov. Beida, 18 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♂, 1 ♀ (NMW 30168, 30169 [S+B]), Wadi Kuf, Prov. Beida, 22 August 1981, leg. A. Mayer, F. Spitzenberger & E. Weiß.

Morphology and variation. Forearm and cranial dimensions of the Libyan specimens of *Tadarida teniotis* are shown in Table 15. For the material examined see above.

The population of *T. teniotis* occurring in Cyrenaica was discovered by Qumsiyeh & Schlitter (1982), who collected twelve specimens in Wadi Al Kuf. The authors did not examine the geographical variation, they only mentioned the following information concerning the respective bats (p. 387): "They are referred, on geographic reasons, to *T. teniotis rueppellii* Temminck, the subspecies found in Morocco, Algeria, Egypt, and elsewhere in the Middle East." Later on, Qumsiyeh (1985: 73) reported that in pelage colouration: "[the] specimens from Libya are closer to the nominate subspecies than those from Egypt." Perhaps because of the latter observation, Ibáñez & Arlettaz (2013) referred the populations living in North Africa from Morocco to Libya to the nominotypical form, while those in Egypt and Arabia to *T. t. rueppellii* (Temminck, 1826).

The two subspecies of *T. teniotis* traditionally recognised in the western Palaearctic, *T. t. teniotis* and *T. t. rueppellii* (see e.g. Ellerman & Morrison-Scott 1951, Kock 1969, Kock & Nader 1984, Harrison & Bates 1991, Simmons 2005, etc.), were described based solely on the pelage colouration tinge, in the nominotypical form the dorsal pelage is reported as brownish-grey, while in *rueppellii* as pale ashy-grey. However, the colouration traits were shown to be very variable throughout the range of *T. teniotis* and not useful for separation of geographical forms (see the review by Benda et al. 2008). Thus, the subdivision of the species into two colour forms regarded

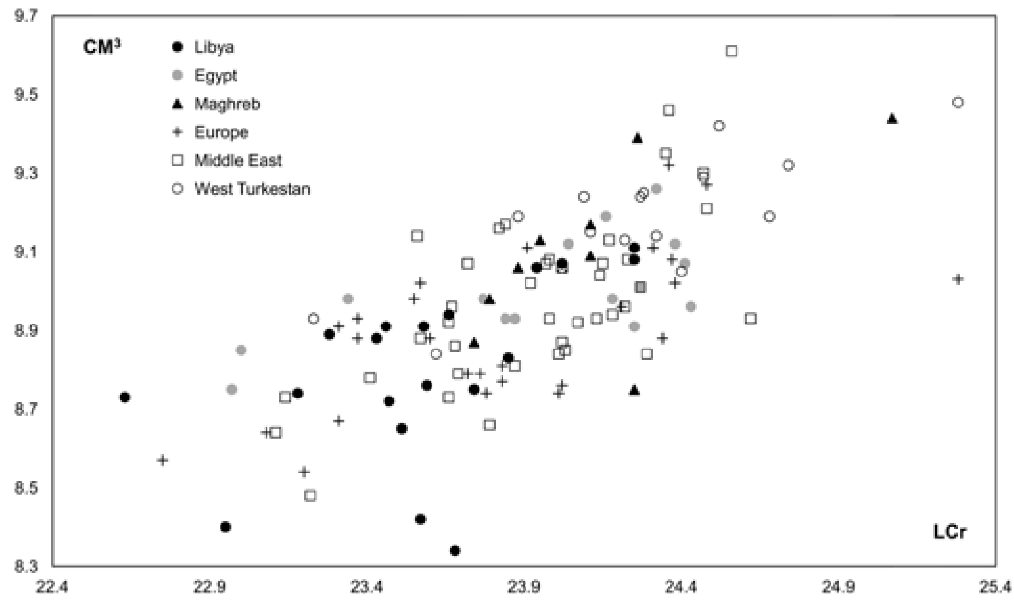

Fig. 100. Bivariate plot of the examined Libyan and comparative samples of *Tadarida teniotis* (Rafinesque, 1814): greatest length of skull (LCr) against the length of the upper tooth-row (CM^3).

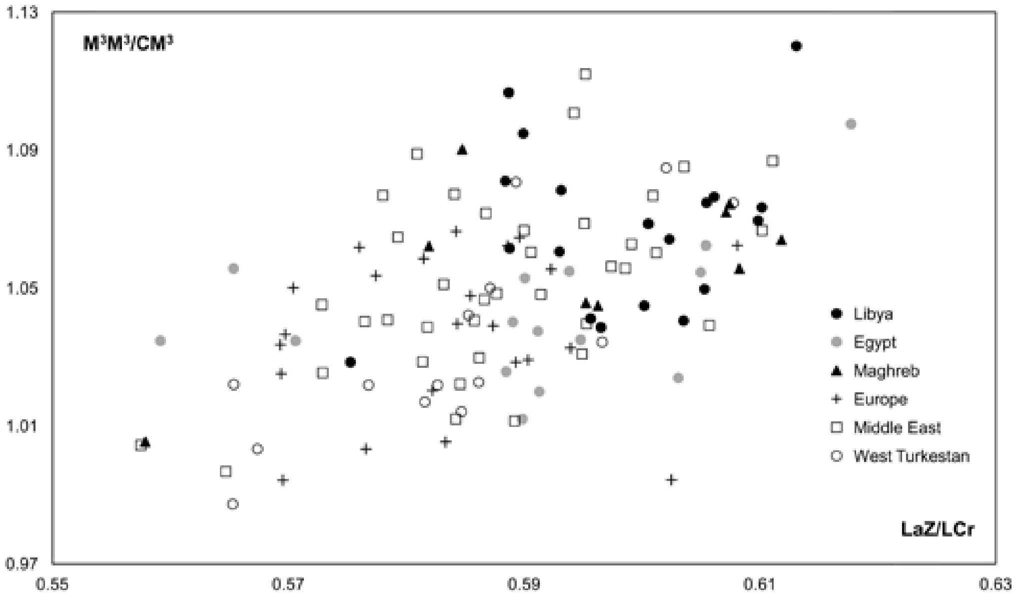

Fig. 101. Bivariate plot of the examined Libyan and comparative samples of *Tadarida teniotis* (Rafinesque, 1814): relative width of skull (LaZ/LCr) against the relative width of rostrum (M^3M^3/CM^3).

as subspecies was suggested to be rejected (cf. Corbet 1978, Qumsiyeh 1985, Koopman 1994, Benda et al. 2008). Anyhow, only the dark brownish-grey coloured individuals of *T. teniotis* were recorded in Cyrenaica (Figs. 97, 98), perhaps due to their occurrence in relatively humid habitats of the Mediterranean arboreal zone (see Distribution).

The morphometric variation in *T. teniotis*, including the above mentioned Libyan samples, was evaluated by Benda et al. (2012). This comparison revealed slight differences in mean body size among the compared sample sets from all main parts of the species range (Fig. 100; see also Benda et al. 2012: 502, 514, Tables 36, 37). The geographical sets clustered into groups of rather smaller bats from Cyrenaica and Europe and of rather larger bats from the Maghreb, Iran and West Turkestan, while the samples from the Levant and Egypt were medium-sized in this comparison. The Cyrenaican *T. teniotis* were on average the smallest bats among the compared sets (Fig. 100). On the other hand, their skulls were the most robust (relative widths of their skulls were on average the largest) and the Libyan samples were in this character more similar to the large bats from the Maghreb (Fig. 101). The dimensional data on twelve Cyrenaican bats given by Qumsiyeh & Schlitter (1982: 381, 383) roughly correspond with those presented here (Table 15).

Benda et al. (2012: 513) mentioned that: “This geographically discontinual plasticity in metric traits suggests a morphological response to climatic conditions in the particular range parts; larger bats seem to occur in higher mountains or continental steppes (Atlas Mts., Iranian plateau, Tien--Shan Mts.), while smaller bats in coastal areas of the Mediterranean basin.” However, since all the examined Cyrenaican *T. teniotis* individuals uniformly belonged to the dark morph, the metric plasticity does not seem to be linked with colour variation that was recorded in all other parts of the species range, including the Maghreb and Egypt (Hill 1964, Kock & Nader 1984, Qumsiyeh 1985, Kock 1987, Benda et al. 2008).

The results of colouration and morphometric comparisons of *T. teniotis* suggest that the variability in body size and pelage colouration represents rather local and individual variation than any clear phylogenetic and geographical trends. The real description of geographical variation in *T. teniotis* has to be based on a molecular genetic analysis of samples representing the whole circum-Mediterranean range of this bat.

FEEDING ECOLOGY. *Tadarida teniotis* is a rather large bat searching for its prey in direct flight in open spaces (Norberg & Rayner 1987, Feldman et al. 2000); its diet was widely studied in many parts of its distribution range, including Europe, Middle East and West Turkestan (Rydell & Arlettaz 1994, Whitaker et al. 1994, Benda et al. 2006, 2008, 2010a, 2012, Whitaker & Karataş 2009). Lepidoptera were the most important food item recorded in the overwhelming majority of the analyses. Besides that, only Orthoptera were several times also found to contribute to the diet substantially (Whitaker & Karataş 2009, Benda et al. 2010a). Other taxa recorded in the diet of *T. teniotis* were Neuroptera, Hemiptera, Coleoptera, Trichoptera, Blattodea, and Diptera. A sample set of 20 pellets from three bats collected in Rhodes, Greece, was dominated by Coleoptera, mostly Curculionidae (Žďárská 2013).

From Libya, we analysed four sample sets of faecal pellets. Ten pellets from two individuals collected at Wadi An Nazrat contained only large moths (Lepidoptera, wingspan length ca. 40–45 mm) and one pellet collected at the quarry in Wadi Al Kuf also contained only remnants of large moths. Twenty pellets collected at a roost in a cave in the side walley of the western approach to Wadi Al Kuf contained 97% of volume of medium-sized moths (Lepidoptera, wingspan length ca. 30–35 mm) and 3% of beetles (Coleoptera). Eight pellets collected from one individual from Wadi Darnah contained 56% of volume of medium-sized moths and 44% of lacewings (Neuroptera: Chrysopidae).

The high proportion of moths found in the Libyan samples corresponds well with most of the previous results and supports the allotonic frequency hypothesis (i.e. the use of echolocation calls with frequencies above or below the best hearing of tympanate insects is an adaptation to increase the availability of these insects; see e.g. Rydell & Arlettaz 1994).

RECORDS OF ECTOPARASITES. **Original data**: all parasite specimens were collected from a jar containing common collection of 6 host inds. (NMP 49881, 49912–49914, 49928, 49929) collected at Wadi Darnah, Wadi Al Kuf and Wadi An Nazrat, 15, 20 and 22 May 2002. – I s c h n o p s y l l i d a e: *Araeopsylla gestroi*: 1 ma (CMŠ [P]). – M a c r o n y s s i d a e: *Parasteatonyssus hoogstraali*: 1 protonymph (CMŠ [P]). – S p i n t u r n i c i d a e: *Spinturnix myoti*: 1 protonymph (CMŠ [P]). – T r o m b i c u l i d a e: Trombiculidae gen. sp.: 2 larvae (CMŠ [P]).

COMMENTS ON ECTOPARASITES. From *Tadarida teniotis*, one species of bat flea was collected, *Araeopsylla gestroi* (Rothschild, 1906), and this record represents the first evidence of this rare parasite in Libya. *A. gestroi* parasitises primarily bats of the genus *Tadarida* and its presumed distribution range corresponds with the range of its main host, *T. teniotis*. Within this range, only few records are known; in Africa, Hoogstraal & Traub (1963) collected this bat flea from Egypt.

The mite *Spinturnix myoti* (Kolenati, 1856) is a permanent parasite of some species of the genus *Myotis* (*M. myotis* group, *M. nattereri* group, *M. capaccinii*; see Deunff et al. 2004), its occurrence thus depends on availability of these hosts. However, it was frequently found also in other host species (Rudnick 1960), perhaps due to a horizontal transfer between the species within a common habitat. *T. teniotis* certainly represents an unusual host of *S. myoti*. From Libya, this parasite is here reported for the first time (it was also collected from *Myotis punicus*).

The mite *Parasteatonyssus hoogstraali* (Keegan, 1956) is here reported from Libya for the first time; however, this parasite has a broad distribution comprising also Egypt, Canary Islands, Jordan and Kirghizstan (Keegan 1956, Lange 1959, Radovsky 1967, Estrada-Peña & Sanchez 1988, Benda et al. 2010a). Species of the genus *Parasteatonyssus* are parasites of the genera *Ta-*

darida and *Taphozous*, occurring in Africa, southern Europe and southern Asia (Radovsky 1967, Estrada-Peña et al. 1990).

Two larvae of trombiculid mites were collected from *T. teniotis* and this record represents the first evidence of this family from bats in Libya. However, for the time being the generic and specific affiliations of these specimens remain open and will be a subject of next studies.

DISCUSSION AND CONCLUSIONS

Fauna

The present review summarises 138 records of 18 bat species from the territory of Libya (Table 1). Concerning the number of bat species, the faunal list of Libya is the shortest of all countries of North Africa (Qumsiyeh 1985, Kowalski & Rzebik-Kowalska 1991, Benda et al. 2004d, Dalhoumi et al. 2011), although the faunas of neighbouring Tunisia and Egypt are rather comparatively rich (20 species in each country, under the current taxonomy). The review of the Libyan bat fauna by Hanák & Elgadi (1984) plus the report of new records from Cyrenaica published by Qumsiyeh & Schlitter (1982) brought altogether 56 records of 14 species (Table 1). In comparison with these numbers, the list of records summarised here presents a number more than twice higher (246%) and the list of species has increased by five species, while one species has been deleted from the list (increase by 20%).

Three species were newly documented to occur in Libya; *Rhinopoma cystops* and *Vansonia rueppellii* were already reported by Benda et al. (2004a), the first records of *Rhinolophus ferrumequinum* are presented here. Two more species were discovered as new due to taxonomic splitting; *Rhinolophus horaceki* was separated from *R. clivosus* (Benda & Vallo 2012) and the pair of *Plecotus* species, *P. christii* and *P. gaisleri*, is recognised instead of one species, *P. austriacus* (Benda et al. 2004c). On the other hand, the specific status of *Pipistrellus deserti* was reasonably doubted by Benda et al. (in press) and as a consequence, this species was deleted from the faunal list. The respective populations are now regarded as a part of the species content of *Pipistrellus kuhlii* (see under this species). Taxonomic revisions also brought new namings of some Libyan bats that were assigned to different species by previous authors (*Rhinopoma cystops*, *Myotis punicus*, *Eptesicus isabellinus*, and *Pipistrellus hanaki*); however, these changes did not affect the number of bat species in the Libyan fauna.

Considering the number of records, only *Pipistrellus kuhlii* could be regarded as abundant in Libya; its records represent one third of all bat records from the country (Table 1). Of the remaining bats, only four species were found at more than ten sites in Libya. Also the relatively low diversity of the Libyan bat fauna is most probably a consequence of the limited level of surveys made in the country, particularly in the desert regions. It clearly indicates that, concerning the faunal knowledge, Libya is not yet a well documented country. This conclusion was made already by Hanák & Elgadi (1984) and since that the situation has changed only slightly. In the south-eastern part of Libya, there is a continuous territory of more than a million square kilometres (majority of the country's area), from where no single bat record is available. In comparison with countries of a similar size, climatic zone and culture as Libya, the number of bat records is very low; for example, from Libya this number is currently more than six times smaller than from Iran (see Benda et al. 2012).

However, in the countries neighbouring Libya, records of several bat species were made in regions relatively close to the Libyan border. These species have not yet been found in Libya, but they could enrich the bat fauna of the country when appropriate field studies were carried out.

The Mediterranean faunal elements of the Maghreb that have not been recorded in Libya represent eight species of three families, viz. *Rhinolophus hipposideros* (Borkhausen, 1797), *R.*

euryale Blasius, 1853, *R. blasii* Peters, 1867, *Myotis emarginatus* (Geoffroy, 1806), *M. capaccinii* (Bonaparte, 1837), *Hypsugo savii* (Bonaparte, 1837), *Pipistrellus pipistrellus* (Schreber, 1774), and *Miniopterus maghrebensis* Puechmaille, Allegrini, Benda, Bilgin, Ibáñez et Juste, 2014. The nearest occurrences to Tripolitania of almost all these bats were recorded in the Mediterranean arboreal zone of the northern part of Tunisia (Puechmaille et al. 2012, 2014), i.e. in the aerial distance of 700–900 km from the Libyan border (*Rhinolophus hipposideros* is known additionally also from the Pantelleria island; Felten & Storch 1970). Hence, their findings in Tripolitania seem to be less probable.

The only exception among the Mediterranean bats from the Maghreb is represented by *Myotis emarginatus*, which was reported by Dalhoumi et al. (2011) from the Sidi Toui NP, ca. 50 km west of the Libyan border. Although Puechmaille et al. (2012) questioned the evidence of the finding, occurrence of this bat in the respective area is well possible; *M. emarginatus* ranks among the Mediterranean species that penetrate deep into arid areas of the southern Palaearctic – this was documented namely from Arabia and Iran (Harrison 1977, Al Jumaily 2003, Benda et al. 2012). In this respect, occurrence of this bat also in Tripolitania would not be too surprising.

Other potential members of the Libyan bat fauna could be found among the species occurring in arid areas of the neighbouring countries, i.e. in the Saharan parts of Egypt, Sudan, Chad, Niger, Algeria, and Morocco. Among these faunal elements, three species could be regarded as the biggest candidates for enrichment of the Libyan fauna, viz. *Taphozous nudiventris* Cretzschmar, 1830, *Nycteris thebaica* Geoffroy, 1818 and *Nyctinomus aegyptiacus* Geoffroy, 1818.

Taphozous nudiventris is known to occur in all Saharan countries around Libya (Vielliard 1974, Koopman 1975, Dorst 1982, Qumsiyeh 1985, Kowalski & Rzebik-Kowalska 1991, Aulagnier & Denys 2000); its nearest records were reported from the Dakhla oasis, Libyan desert, western Egypt (Benda et al. 2014), and from Oued Tit, Hoggar Mts., south-eastern Algeria (Anciaux de Faveaux 1984, Kowalski & Rzebik-Kowalska 1991)*. The Libyan territory represents a gap in the continuous range of *T. nudiventris* through the central Sahara, and particularly in the southern parts of Libya the occurrence of this bat is very likely.

The Saharan distribution of *Nycteris thebaica* comprises the Nile valley and delta of Egypt (westernmost sites being Alexandria and Wadi El Natrun) and of the Sudan (Koopman 1975, Qumsiyeh 1985); however, the nearest record to the Libyan border was reported from the western Tibesti Mts., Chad, some 250 km south of Libya (Toschi 1954)†. Thus, the southern parts of the country are the most probable areas of a possible Libyan occurrence of *N. thebaica*.

In the countries surrounding Libya, *Nyctinomus aegyptiacus* is known from various sites of the eastern part of Egypt (Qumsiyeh 1985, Osborn 1988, Benda et al. 2014), from western Sudan (Thomas & Hinton 1923), from northern Niger (Bernard & Happold 2013b), from various parts of Algeria, including two sites in the Hoggar Mts. (Dorst & Petter 1959, Schlitter & Robbins 1973, Qumsiyeh 1985), and from southern Morocco (Denys et al. 1995, Benda et al. 2004d). This distribution pattern suggests, similarly as in the two latter species, possible occurrence of *N. aegyptiacus* in desert regions of Libya (see also the data by Rebelo & Brito 2006).

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* Kowalski & Rzebik-Kowalska (1991: 64) reported on the occurrence of *Taphozous nudiventris* in Algeria as follows: "According to information obtained from M. Anciaux de Faveaux, one specimen was collected in a small cave in Oued Tit". This record was, however, published already by Anciaux de Faveaux (1984: 19) as from "Hoggar (after Bauer in litt.)". The respective specimen is deposited in the NMW collection with the following information associated: ♂ (NMW 25732 [S+B]), Oued Tit, 42 km NW Tamanrasset, summer 1977, leg. F. Trost.

† In his review of Libyan mammals, Toschi (1954) reported a record of *Nycteris thebaica* from Zouar, Tibesti Mts., currently situated deep in the territory of Chad. Setzer (1957), Hufnagl (1972) and Masseti (2010) listed this species among the mammals of Libya. Kock (1969) and Hanák & Elgadi (1984) pointed out the actual site of the collection and deleted *N. thebaica* from the list of the Libyan mammals.

Several other bat species could be also regarded as possible candidates for the Libyan fauna; however, considering their distribution pattern in the Sahara as well as the known occurrence nearest to Libya, this possibility seems to be rather limited. *Rousettus aegyptiacus* (Geoffroy, 1810), *Rhinopoma microphyllum* (Brünnich, 1782) and *Taphozous perforatus* Geoffroy, 1818 are distributed in the Sahel zone and/or other parts of sub-Saharan Africa (Kock 1969, Koch-Weser 1984) and along the Nile valley they penetrate through the Sudan and Egypt to the Levant (Koopman 1975, Qumsiyeh 1985, Harrison & Bates 1991). *Nycticeinops schlieffenii* (Peters, 1859) has a somewhat similar type of distribution (Koopman 1975, Qumsiyeh 1985). Moreover, *R. aegyptiacus* was documented in several oases of the Libyan desert – Dakhla, Kharga and Bahariya (Churcher 1991, Benda et al. 2011a). All these species are savannah dwellers adapted to survive in desert habitats and their existence in remote oases of southern Libya cannot be fully excluded.

A series of other sub-Saharan bat species occur – at least temporarily – also in the southern parts of the Sahara and on the Saharan-Sahelian transition, e.g. *Eidolon helvum* (Kerr, 1792), *Hipposideros tephrus* Cabrera, 1906, *Nycteris hispida* (Schreber, 1775), *Neoromicia nana* (Peters, 1852), and possibly some others (see Happold & Happold 2013). Although these species are mainly savannah dwellers, some of them were recorded also in central regions of the Sahara (Adrar Mts., Aïr Mts., Kaouar Mts., Ennedi Mts., etc.), relatively close and in habitats similar to the southern parts of Libya.

In conclusion, the number of 18 species documented in the bat fauna of Libya is probably not yet final and the real list of bat species of this country can contain some 20–22 items as a minimum.

Zoogeography

Considering the bat fauna composition, the territory of Libya comprises three clearly delimited bioregions; (1) the region of the Mediterranean arboreal zone in northern Cyrenaica, (2) the region of dry Mediterranean steppes in the Gefara plain and adjacent slopes of the Jebel Nafusa Mts. in north-western Tripolitania, and (3) desert and semi-desert regions of the Libyan Sahara. This division corresponds well with the zoogeographical division of Libya based on the terrestrial mammal fauna (Ranck 1968) as well as with the main natural geographical division of the Libyan landscape. Ranck (1968) recognised two additional bioregions, Coastal Plains (a very narrow belt of areas along the whole Mediterranean coast of Libya) and Saharan Steppes (broad belt of deserts between the above regions 1+2 and deserts of the central Sahara, some 200–300 km wide); however, the existence of such bioregions is not supported by the known bat distribution.

Although being the smallest one (some 20,000 km^2), the Cyrenaican bioregion (1) exhibits the most diverse bat fauna, which is composed of nine species and characterised by the exclusive Libyan occurrence of six species (one third of the fauna), viz. *Rhinolophus horaceki*, *R. mehelyi*, *Pipistrellus hanaki*, *Nyctalus lasiopterus*, *N. leisleri*, and *Tadarida teniotis*. The Tripolitanian bioregion (2) is only slightly larger (over 30,000 km^2), its bat fauna is composed of seven species and characterised by the exclusive occurrence of only three species, viz. *Rhinolophus ferrumequinum*, *Myotis punicus* and *Eptesicus isabellinus*. The Saharan bioregion (3) comprises more than 1,700,000 km^2 (~97% of the country's area) and its bat fauna is also composed of seven species, but is characterised by the exclusive occurrence of five species, viz. *Rhinopoma cystops*, *Rhinolophus clivosus*, *Asellia tridens*, *Vansonia rueppellii*, and *Plecotus christii*.

Five bat species (slightly over a quarter of the fauna, 27.8%) were documented in more than one bioregion; *Miniopterus schreibersii* was found in both Mediterranean bioregions (1+2), *Otonycteris hemprichii* was found mostly in the Saharan bioregion but one record was made at the margin of the Tripolitanian part of the Mediterranean steppes. *Plecotus gaisleri* and *Pipistrellus kuhlii* are known from all three bioregions (1+2+3); however, while *P. gaisleri* is mostly a Mediterranean species and only one record was made in the desert zone close to a margin of the Mediterranean steppe region, *P. kuhlii* was equally recorded in all bioregions and is thus the most widespread and ecologically universal bat of Libya.

The bioregions (2) and (3) are subunits of larger faunal regions. The Tripolitanian bioregion (2) is the easternmost extension of the Maghreb, characterised by several mammal endemics in Libya, viz. *Myotis punicus* and *Eptesicus isabellinus* among bats, and *Elephantulus rozeti* Duvernoy, 1833, *Atelerix algirus* (Lereboullet, 1842), *Gerbillus latastei* Thomas et Trouessart, 1903, and *Ctenodactylus gundi* (Rothman, 1776) among other mammals (Ranck 1968, Qumsiyeh 1983, Hanák & Elgadi 1984). Qumsiyeh (1983) regarded *M. punicus* as the only species belonging to the Maghrebian fauna among the Tripolitanian bats; however, today it is clear that also two additional species from Tripolitania, *Rhinolophus ferrumequinum* and *Eptesicus isabellinus*, belong to this fauna.

The Saharan bioregion (3) is a part of the extensive desert area known as the Saharo-Sindic zone, stretching from southern Morocco and Mauritania across the Sahara and Arabian desert to southern Iran and the Thar desert of Pakistan and India. Among the Libyan bats, representatives of the Saharo-Sindic elements include *Rhinopoma cystops*, *Rhinolophus clivosus*, *Asellia tridens*, *Otonycteris hemprichii*, and *Plecotus christii* (although not all these species occur throughout the whole zone), and among other Libyan mammals *Paraechinus aethiopicus* (Ehrenberg, 1833), *Gerbillus gerbillus* (Olivier, 1801), *G. pyramidum* Geoffroy, 1803, *G. amoenus* de Winton, 1902, *Meriones crassus* Sundevall, 1842, and *Acomys cahirinus* (Geoffroy, 1803), together with other desert species of carnivores and ungulates (see Ranck 1968: 55).

The Saharan faunal elements among bats (and also one of the Mediterranean bats), viz. *Rhinopoma cystops*, *Rhinolophus ferrumequinum*, *R. clivosus*, *Asellia tridens*, *Pipistrellus kuhlii*, and *Plecotus christii*, exhibit two size morphotypes. In the relatively mesic habitats of the northern parts of the Sahara or even in the Mediterranean zone, these species create the large-sized morphotype, while in the relatively arid habitats of the Sahara, they are represented by the small-sized morphotype. However, only in *Pipistrellus kuhlii*, both basic morphotypes were documented in Libya, the small-sized morphotype was found in Fezzan (and originally described as a separate species, *P. deserti*), while bats of all other areas were large in size (see Figs. 60–62). In all other species, only one size morphotype was documented in Libya, in *Rhinopoma cystops* the large-sized morphotype, while in *Rhinolophus ferrumequinum*, *Asellia tridens* and *Plecotus christii* the small-sized one. However, the size bimodality of these five species is well documented from other parts of the Sahara.

While the two previously discussed bioregions (2+3) represent small parts of much larger regions, the Cyrenaican bioregion (1) is a unique region of its own. This small area of arboreal zone in Libya is a biogeographical hotspot, its bat fauna shows a considerable level of endemism. Two of nine Cyrenaican species, *Rhinolophus horaceki* and *Pipistrellus hanaki*, are endemics of this bioregion and of Libya as well (similarly as *Crocidura aleksandrisi* Vesmanis, 1977 and *Microtus mustersi* Hinton, 1926 from other mammalian groups, although some authors consider both latter forms as subspecies of more widespread species). *R. horaceki* is the most exotic bat of Cyrenaica, it has phylogenetic affinities to the African (mostly sub-Saharan) group of the genus *Rhinolophus* (see Benda & Vallo 2012). Due to the presence of endemics in Cyrenaica, Libya is a unique area among the north-African countries; Cyrenaica represents a stable, most probably a long existing and isolated island of the Mediterranean environment (see Hulva et al. 2004). No similarly spatially limited hotspot is present in any other continental country around the Mediterranean Sea. All other zones of Mediterranean endemism, such as the Maghreb, southern Iberia or the Levant, are more extensive concerning their area. All other Cyrenaican bats represent true Mediterranean elements, however, these species have different affinities to several neigbouring faunal regions of the Mediterranean basin (Maghreb, Crete, Balkans, Egypt, Levant), see the particular species accounts for details. *Tadarida teniotis* is a widespread Mediterranean species, distributed in all adjacent Mediterranean areas (Maghreb, Balkans, Crete, Egypt, Levant). *Rhinolophus mehelyi* shows a similar distribution as the latter species, with the exception of Crete. *Nyctalus leisleri* and *Miniopterus schreibersii* represent typical species of the Mediterranean arboreal zone, occurring in all spots of this environment in the basin, including the Maghreb, Balkans, Crete, and the Levant. *Nyctalus lasiopterus* occurs in the Balkans and in other parts of southern Europe and was also documented in Asia Minor. The Cyrenaican populations of *Plecotus gaisleri* have the most pronounced phylogenetic affinity to the Maghrebian-Tripolitanian populations of the genus *Plecotus*.

In conclusion, the bat fauna of Libya is composed of a mixture of various faunal types (see also Hanák & Elgadi 1984). The majority of the fauna (eleven species, almost two thirds of the fauna) is represented by true Mediterranean elements; most of these species exhibit a more or less circum-Mediterranean distribution (*Rhinolophus ferrumequinum*, *R. mehelyi*, *Nyctalus leisleri*, *N. lasiopterus*, *Miniopterus schreibersii*, *Tadarida teniotis*), three species are endemics of the south-western Mediterranean (*Myotis punicus*, *Eptesicus isabellinus*, *Plecotus gaisleri*), and two are Cyrenaican endemics (*Rhinolophus horaceki*, *Pipistrellus hanaki*). Five species are true Saharo-Sindic elements; two of them are distributed across the whole zone (*Asellia tridens*, *Otonycteris hemprichii*), two species are Saharo-Arabian faunal forms (*Rhinopoma cystops*, *Rhinolophus clivosus*), and one species is an endemic of the deserts at the Afro-Arabian transition (*Plecotus christii*). One species belongs to the Afro-Arabian savannah elements (*Vansonia rueppellii*) and one species combines the Saharo-Sindic and Mediterranean types of distribution (*Pipistrellus kuhlii*).

Ectoparasites

Altogether, at least 18 parasite species (seven of them new for the country) belonging to eight families were recorded in Libya; viz. Cimicidae, Ischnopsyllidae, Nycteribiidae, Streblidae, Argasidae, Macronyssidae, Spinturnicidae, and Trombiculidae. The occurrence of three ectoparasite families, Spinturnicidae, Macronyssidae and Trombiculidae, is here reported from Libya for the first time from bats, records of the species from other ectoparasite families were published previously (Hufnagl 1972, Hůrka 1982, Amr & Qumsiyeh 1993).

Two genera and species of bugs of the family Cimicidae (Heteroptera) were mentioned from Libya, *Cimex lectularius* Linnaeus, 1758 and *Cacodmus vicinus* Horváth, 1934 (Hufnagl 1972, Hůrka 1982). *Cimex lectularius* was reported by Hufnagl (1972) from *Pipistrellus kuhlii*. Hůrka (1982) doubted this species identification and assigned the record to *Cadodmus vicinus*, which he collected from *P. kuhlii* near Benghazi. However, considering the recent records of bat parasitic bugs from southern Europe and North Africa (O. Balvín & T. Bartonička, unpubl. data), a finding of a bug from the *Cimex pipistrelli* group is possible also from Libya; records of *C. emarginatus* Simov, Ivanova et Schunger, 2006 parasitising the genus *Pipistrellus* are already available from Morocco and Bulgaria. Thus, without a revision of Hufnagl's (1972) specimens, the species identification remains open, although their identification as *C. lectularius* seems to be rather improbable. On the other hand, the distribution of *Cacodmus vicinus* is known from a large part of North Africa (Algeria, Libya, Egypt, Chad), from the Levant (Turkey, Cyprus, Syria, Lebanon, Israel, Jordan) as well as from Spain (Aktaş & Kiyak 1990, Péricart 1996, Quetglas et al. 2012).

Records of four species of three genera of fleas of the family Ischnopsyllidae (Siphonaptera) are available from Libya, viz. *Araeopsylla gestroi* (Rothschild, 1906), *Ischnopsyllus consimilis* (Wahlgren, 1904), *I. intermedius* (Rothschild, 1898), and *Rhinolophopsylla unipectinata* (Taschenberg, 1880). The rare flea *Araeopsylla gestroi* was collected from *Tadarida teniotis* and is here reported from Libya for the first time. This species is a West Palaearctic element, it was recorded from Iberia, Balearic Islands, Italy, Egypt, Lebanon, Azerbaijan, and Kirghizstan (Hopkins & Rothschild 1956, Taskaeva 1960, Hoogstraal & Traub 1963, Lewis 1964, Medvedev 1992, Mei 1996, Quetglas et al. 2014). This flea is, along with the Egyptian flea *A. wassifi* Traub, 1954, a primary parasite of the genus *Tadarida*. *Ischnopsyllus consimilis* was collected by Hůrka (1982) from *Pipistrellus kuhlii*. This bat flea is a specific parasite of this bat and is known from a relatively small area of the eastern Mediterranean, between Cyrenaica and southern Levant (Theodor & Moscona 1954, Hopkins & Rothschild 1956, Hoogstraal & Traub 1963, Hůrka 1982). *Ischnopsyllus intermedius* is distributed in a South Palaearctic belt from the Azores, over southern Europe and North Africa, to the Ural Mts. (Beaucornu & Launay 1990). In Libya, it was collected from *Eptesicus isabellinus*; serotine bats of the *serotinus* group are regarded as principal hosts over the whole distribution range of this parasite. *Rhinolophopsylla unipectinata* s.l. is distributed in the southern part of the Palaearctic and in the north-western Himalayas. The North African subspecies, *R. u. arabs* Jordan et Rothschild, 1921, was described from Algeria and reported also from Morocco and Tunisia (Jordan & Rothschild 1921, Vermeil 1961, Beaucornu et al. 1975, Hastriter & Tipton 1975, Beaucornu & Hellal 1977). In Libya, it was collected from two host species and two regions (Hůrka 1982), *Rhinolophus mehelyi* from Cyrenaica and *Myotis punicus* from Tripolitania; these records markedly extended the known species range.

One species of bat fly of the family Streblidae (Diptera) was recorded in Libya (Hůrka 1982, Amr & Qumsiyeh 1993), *Brachytarsina flavipennis* Macquart, 1851. This species is common throughout the Mediterranean and parasitises various species of the genus *Rhinolophus*, in Libya it was collected only from *Rhinolophus mehelyi*. Occurrence of other species of the family Streblidae is not probable in Libya, since their primary hosts do not occur there (cf. Theodor 1975).

Five species of three genera of bat flies of the family Nycteribiidae (Diptera) are known from Libya, *Nycteribia latreillii* (Leach, 1817) and *N. vexata* Westwood, 1835 (both from *Myotis punicus*), *Basilia daganiae* Theodor et Moscona, 1954 and *B. mediterranea* Hůrka, 1970 (both from *Pipistrellus hanaki*) and *Phthiridium biarticulatum* (Hermann, 1864) (from *Rhinolophus mehelyi*). The species of the genera *Nycteribia* and *Phthiridium* belong to broadly distributed West Palaearctic bat flies with occurrence depending on the distribution of their principal hosts – bats of the *Myotis myotis* group in *Nycteribia* and the genus *Rhinolophus* in *Phthiridium* (Hůrka 1964, 1982). The species of the genus *Basilia* are distributed in smaller ranges in parts of the Mediterraenean, see Kock (1984: Map 1).

The family Spinturnicidae (Mesostigmata) is represented in Libya by one known species, *Spinturnix myoti* (Kolenati, 1856), and an unidentified taxon of this genus; anyway, the members of this family are here reported from the country for the first time. *S. myoti* was collected from *Myotis punicus* and *Tadarida teniotis*, and also from a mixed collection of hosts*. This mite is

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*Records of ectoparasites from mixed collections of hosts. **Original data**: Argasidae: *Argas vespertilionis*: 1 larva (CMŠ [P]) from a jar containing 3 *Eptesicus isabellinus* and 1 *Otonycteris hemprichii*, Nanatalah, 28 May 2002. – *Argas* sp. (*A. vespertilionis* group): 1 larva (CMŠ [P]) from a jar containing 4 *Eptesicus isabellinus*, 1 *Myotis punicus* and 4 *Pipistrellus kuhlii*, Sabratha, 28 May 2002. – Spinturnicidae: *Spinturnix myoti*: 1 ma, 1 fa (CMŠ [P]) from a jar containing 3 *Eptesicus isabellinus* and 8 *Pipistrellus kuhlii*, Ain Sharshara, 27 May 2002. – *Spinturnix* sp. (*acuminata* group): 1 ma (CMŠ [P]) from a jar containing 1 *Eptesicus isabellinus* and 13 *Pipistrellus kuhlii*, Ain Az Zarqa, Ad Dirsiyah, Jalu, Sinawan, and Wadi An Nazrat, 2, 8, 10, 22 & 24 May 2002; – 1 fa (CMŠ [P]) from a jar containing 4 *Eptesicus isabellinus*, 1 *Myotis punicus* and 4 *Pipistrellus kuhlii*, Sabratha, 28 May 2002; – 1 ma, 1 fa (CMŠ [P]) from a jar containing 3 *Eptesicus isabellinus* and 8 *Pipistrellus kuhlii*, Ain Sharshara, 27 May 2002. – *Spinturnix* sp.: 1 nymphal stage (CMŠ [P]) from a jar containing 3 *Eptesicus isabellinus* and 8 *Pipistrellus kuhlii*, Ain Sharshara, 27 May 2002. – Macronyssidae: *Steatonyssus occidentalis*: 1 fa (CMŠ [P]; det. P. Mašán) from a jar containing 3 *Eptesicus isabellinus* and 8 *Pipistrellus kuhlii*, Ain Sharshara, 27 May 2002; – 1 fa (CMŠ [P]) from a jar containing 3 *Eptesicus isabellinus* and 1 *Otonycteris hemprichii*, Nanatalah, 28 May 2002.

parasitic mostly on bats of the genus *Myotis* of several species groups (Deunff et al. 2004) and it was already mentioned also from *Myotis punicus* (Bruyndonckx et al. 2010); this bat perhaps belongs to the main hosts in North Africa. Other recorded mites of the family Spinturnicidae (collected from *Pipistrellus kuhlii* and from mixed collections*) belong to the *Spinturnix acuminata* group. However, according to their particular characters, it is impossible to assign these mites to any known species of the group described from or occurring in the western Palaearctic and the collected material is in need of taxonomic revision. Thus, the species composition of the family Spinturnicidae in Libya could be finally even richer.

Three species belonging to two genera of mites of the family Macronyssidae (Mesostigmata) are known from Libya; all three species are here reported from the country for the first time, viz. *Steatonyssus occidentalis* (Ewing, 1933) (from *Myotis punicus* and from a mixed collection*), *S. periblepharus* Kolenati, 1858 (from *Pipistrellus kuhlii*) and *Parasteatonyssus hoogstraali* (Keegan, 1956) (from *Tadarida teniotis*). The species of the genus *Steatonyssus* are considered as dendrophilous oligoxenic parasites and their hosts are particularly tree dwelling bat species. These mites are cosmopolitan species and their host range comprises also other species of the families Vespertilionidae and Miniopteridae (Lanza 1999). *P. hoogstraali* is a troglobiotic species parasitising mostly *Tadarida teniotis* (Keegan 1956, Lange 1959, Radovsky 1967, Estrada-Peña & Sanchez 1988, Rybin et al. 1989, Benda et al. 2010a). All these species are originally endophilic obligatory haematophagous parasites showing a transition from the periodic to permanent types of parasitism on bats (Dusbábek 1972).

One tick species of the family Argasidae (Ixodida) was recorded from Libya, *Argas vespertilionis* (Latreille, 1802). It is here reported from the country for the first time; it was collected from four bat hosts, *Rhinopoma cystops*, *Eptesicus isabellinus*, *Pipistrellus kuhlii*, and *Plecotus christii.* This soft tick occurs in a wide area stretching from Europe and North Africa to Australia (Filippova 1966, Dusbábek & Rosický 1976). From the territry of Libya, presence of two other species of soft--ticks from the *vespertilionis* group could be expected: *A. boueti* Roubaud et Colas-Belcour 1933 and *A. confusus* Hoogstraal, 1955. Both species are known from scattered localities across Africa and the Middle East from a variety of hosts (Hoogstraal 1955, 1956, Benda et al. 2010a).

Two unidentified specimens of chigger mites of the family Trombiculidae (Trombidiformes) were collected from *Tadarida teniotis*; they represent the first records of this family from Libya. Only once a chigger mite was mentioned from this host, Kudrâšova (1992) described *Willmannium parvulus* Kudryashova, 1992 from Kirghizstan. Since the generic and specific affiliations of the respective Libyan specimens are unknown, they will be subjects of next studies.

One unidentified specimen of the mite of the superorder Acariformes was collected from *Plecotus gaisleri* and this finding represents the first record of a skin mite from a bat in Libya. Although the identification of this mite is not possible due to more reasons, members of two families could be expected to parasitise this bat in the country, viz. Psorergatidae and Sarcoptidae. From the bat genus *Plecotus*, three species of these families have been reported so far, *Psorergatoides kerivoulae* Fain, 1959 from Belgium, *Notoedres plecoti* Fain, 1959 from Belgium and Bulgaria and *Nycteridocoptes poppei* Oudemans, 1898 from Germany and Switzerland (Lukoschus 1952, Fain 1959b, c, 1960, Beron 1970).

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APPENDIX I

Gazetteer

Coordinates and altitudes of particular sites were determined mostly by the GPS receiver in the field or localised with help of Google Earth web application; in some cases the data were taken from literature; alt. = altitude [m a. s. l.]

site	province (district)	coordinates	alt.
Abu Kammash	Tripolitania (Nuqat Al Khams)	36° 04’ N, 11° 44’ E	5
Ad Dirsiyah (= Tolmeitha)	Cyrenaica (Marj)	32° 43’ N, 20° 58’ E	15
Ain Az Zarqa, 4 km SW of Jadu	Tripolitania (Jabal Al Gharbi)	31° 55’ N, 12° 00’ E	620
Ain Az Zarqa, 6 km SW of Haniya, karst spring	Cyrenaica (Jabal Al Akhdar)	32° 48’ N, 21° 28’ E	6
Ain Sharshara, 3 km N of Tarhunah	Tripolitania (Murqub)	32° 28’ N, 13° 37’ E	335
Ain Zeyanah, Al Kuwayfiyah, 15 km NE of Benghazi	Cyrenaica (Benghazi)	32° 12’ N, 20° 10’ E	10
Al Abraq, 5 km SW of the village	Cyrenaica (Jabal Al Akhdar)	32° 45’ N, 21° 58’ E	685
Al Abyar, ca. 5 km N of the town	Cyrenaica (Marj)	32° 12’ N, 20° 37’ E	305
Al Aqaylah	Cyrenaica (Al Wahat)	30° 16’ N, 19° 12’ E	25
Al Aquriyah (= Tokrah)	Cyrenaica (Benghazi)	32° 32’ N, 20° 34’ E	5
Al Awaynat	Fezzan (Ghat)	25° 47’ N, 10° 34’ E	650
Al Awaynat, small oasis ca. 17 km WNW of the town	Fezzan (Ghat)	25° 48’ N, 10° 25’ E	685
Al Bardiyah	Cyrenaica (Butnan)	31° 45’ N, 25° 05’ E	10
Al Bayda	Cyrenaica (Jabal Al Akhdar)	35° 46’ N, 21° 45’ E	620
Al Bayda, 4 km S of the town	Cyrenaica (Jabal Al Akhdar)	32° 44’ N, 21° 43’ E	600
Al Bayda, a cave W of post-office	Cyrenaica (Jabal Al Akhdar)	32° 47’ N, 21° 44’ E	620
Al Fjayj	Fezzan (Wadi Al Hayaa)	26° 32’ N, 13° 19’ E	480
Al Fwayhat	Cyrenaica (Benghazi)	32° 05’ N, 20° 06’ E	15
Al Jaghbub	Cyrenaica (Butnan)	29° 45’ N, 24° 31’ E	0
Al Jawsh	Tripolitania (Nalut)	32° 00’ N, 11° 39’ E	245
Al Kuwayfiyah … see Ain Zeyanah			
Al Mallahah	Tripolitania (Tarabulus)	32° 53’ N, 13° 17’ E	5
Al Marj	Cyrenaica (Marj)	32° 30’ N, 20° 54’ E	285
Ar Rajmah, wadi ca. 2 km W of the village	Cyrenaica (Benghazi)	32° 03’ N, 20° 19’ E	195
Arqub Ash Shafshaf, ca. 3 km S of Al Hilal	Cyrenaica (Darnah)	32° 52’ N, 22° 11’ E	350
Awbari	Fezzan (Wadi Al Hayaa)	26° 35’ N, 12° 47’ E	470
Bahr el Tubat, 21 km ESE of Giarabub (= Al Jaghbub)	Cyrenaica (Butnan)	29° 40’ N, 24° 44’ E	–5
Baida, Beida … see Al Bayda			
Bengasi … see Benghazi			
Benghazi	Cyrenaica (Benghazi)	32° 07’ N, 20° 04’ E	10
Brak	Fezzan (Wadi Ash Shati)	27° 33’ N, 14° 16’ E	350
Buerat … see Bwayrat			
Bwayrat	Tripolitania (Surt)	31° 24’ N, 15° 44’ E	5
Cyrene … see Shahhat			
Darej e dintorni (= surroundings of Darj) … see Darj			
Darj	Tripolitania (Nalut)	30° 10’ N, 10° 27’ E	420
El Agheila … see Al Aqaylah			
Fuehat … see Al Fwayhat			
Gabrun	Fezzan (Wadi Al Hayaa)	26° 48’ N, 13° 32’ E	440
Germa	Fezzan (Wadi Al Hayaa)	26° 32’ N, 13° 04’ E	470
Ghadamis, small village 3 km W of the town	Cyrenaica (Nalut)	30° 08’ N, 09° 29’ E	315
Ghat	Fezzan (Ghat)	24° 56’ N, 10° 10’ E	680
Gheminez … see Qaminis			
Gialo … see Jalu			
Giarabub … see Al Jaghbub			
Haniya, 8 km SSE of the town	Cyrenaica (Jabal Al Akhdar)	32° 46’ N, 21° 37’ E	260
Jalu	Cyrenaica (Al Wahat)	29° 04’ N, 21° 28’ E	40
Janzur	Tripolitania (Tarabulus)	32° 49’ N, 13° 01’ E	20
Ka’am	Tripolitania (Murqub)	32° 31’ N, 14° 27’ E	10
Kaf Ash Shaluh	Cyrenaica (Jabal Al Akhdar)	32° 46’ N, 21° 34’ E	295

site	province (district)	coordinates	alt.
Karkurah	Cyrenaica (Benghazi)	31° 25' N, 20° 01' E	15
Kufanta, Roman aquaduct … see Kaf Ash Shaluh			
Lebdah, ruins of ancient Leptis Magna	Tripolitania (Murqub)	32° 38' N, 14° 17' E	15
Leptis Magna … see Lebdah			
Massah, 7 km NW of the town	Cyrenaica (Jabal Al Akhdar)	32° 47' N, 21° 34' E	265
Mellaha … see Al Mallahah			
Merg … see Al Marj			
Misratah	Tripolitania (Misratah)	32° 21' N, 15° 06' E	5
Misurata … see Misratah			
Mursuk, Murzuch, Murzuk … see Murzuq			
Murzuq	Fezzan (Murzuq)	25° 55' N, 13° 54' E	450
Nanatalah, 10 km W of Ar Rhaybah	Tripolitania (Nalut)	31° 47' N, 11° 47' E	565
Oasi di Gialo … see Jalu			
Oasi di Giarabub … see Al Jaghbub			
Pisida … see Abu Kammash			
Porto Bardia … see Al Bardiyah			
Qaminis	Cyrenaica (Benghazi)	31° 39' N, 20° 01' E	20
Qaryat Al Faioyah, 6 km S of the village	Cyrenaica (Jabal Al Akhdar)	32° 38' N, 21° 55' E	805
Qasr Ash Shahdayn	Cyrenaica (Jabal Al Akhdar)	32° 37' N, 21° 35' E	610
Qasr Maqdam, 6 km SE of, ruins … see Qasr Ash Shahdayn			
Sabratha	Tripolitania (Jafarah)	32° 48' N, 12° 29' E	10
Serdeles … see Al Awaynat			
Serir … see Al Awaynat			
Shahhat, ruins of Cyrene	Cyrenaica (Jabal Al Akhdar)	32° 49' N, 21° 51' E	560
Sidi Al Mesri	Tripolitania (Tarabulus)	32° 52' N, 13° 12' E	20
Sinawan	Tripolitania (Nalut)	31° 02' N, 10° 36' E	455
Tagherna … see Tigrinnah			
Taminhint, small farm	Fezzan (Sabha)	27° 10' N, 14° 33' E	400
Tarabulus	Tripolitania (Tarabulus)	32° 54' N, 13° 11' E	10
Tarabulus, Sidi Al Mesri … see Sidi Al Mesri			
Tigrinnah	Tripolitania (Jabal Al Gharbi)	32° 08' N, 13° 00' E	745
Tokrah … see Al Aquriyah			
Tolmeitha … see Ad Dirsiyah			
Traghen	Fezzan (Murzuq)	25° 56' N, 14° 26' E	420
Tripoli, Tripolis … see Tarabulus			
Tripoli-Zanzur … see Janzur			
Umm el-Araneb	Fezzan (Murzuq)	26° 08' N, 14° 44' E	420
Ubari … see Awbari			
Wadi Ajal … see Awbari			
Wadi Al Kuf, 5 km SW of Al Bayda	Cyrenaica (Jabal Al Akhdar)	32° 44' N, 21° 41' E	495
Wadi Al Kuf, ancient ruins	Cyrenaica (Jabal Al Akhdar)	32° 42' N, 21° 35' E	360
Wadi Al Kuf, Ar Ruba bridge	Cyrenaica (Jabal Al Akhdar)	32° 41' N, 21° 33' E	300
Wadi Al Kuf, confluence	Cyrenaica (Jabal Al Akhdar)	32° 42' N, 21° 34' E	330
Wadi Al Kuf, large cave	Cyrenaica (Jabal Al Akhdar)	32° 41' N, 21° 33' E	370
Wadi Al Kuf, mistnetting site	Cyrenaica (Jabal Al Akhdar)	32° 42' N, 21° 35' E	350
Wadi Al Kuf, near a quarry	Cyrenaica (Jabal Al Akhdar)	32° 42' N, 21° 35' E	320
Wadi Al Kuf, small cave	Cyrenaica (Jabal Al Akhdar)	32° 41' N, 21° 34' E	330
Wadi Al Kuf, unnamed cave	Cyrenaica (Jabal Al Akhdar)	32° 41' N, 21° 33' E	330
Wadi Al Minshiyah, ca. 8 km E of Susah, terminal part of the wadi	Cyrenaica (Darnah)	32° 54' N, 22° 03' E	15
Wadi An Nazrat, 5 km W of Sidi Muhammad Al Mabkhut	Cyrenaica (Marj)	32° 29' N, 20° 56' E	335
Wadi Bu Al Gharas, ca. 15 km SE of At Tmimi	Cyreniaca (Darnah)	32° 12' N, 23° 15' E	35
Wadi Darnah, gallery ca. 6 km S of Darnah	Cyrenaica (Darnah)	32° 42' N, 22° 37' E	110
Wadi Darnah, cave ca. 10 km S of Darnah	Cyrenaica (Darnah)	32° 41' N, 22° 36' E	220
Wadi Jarmah, ca. 3 km S of the estuary	Cyrenaica (Jabal Al Akhdar)	32° 46' N, 21° 25' E	35
Zuila … see Zuwaylah			
Zuwaylah	Fezzan (Murzuq)	26° 10' N, 15° 08' E	420

APPENDIX II

List of the comparative material examined

Rhinopoma cystops Thomas, 1903

Algeria: 4 ♂♂, 5 ♀♀ (NMW 25738–25746 [S+A]), Oued Tit, NW Tamanrasset, Hoggar Mts., Summer 1977, leg. F. Trost. – **Egypt**: 3 ♂♂, 3 ♀♀ (NMP 93840–93844 [S+A], 93839 [A]), Aswan, west bank of the Nile, Tombs of Nobles, 9 January 2011, leg. R. Lučan; – 1 ♂, 7 ♀♀ (IVB E23, E24, E26, E27, E34–36, E38 [S+B]), Cairo, Bar Kouky mosque, 21 April 1969, leg. J. Gaisler; – 2 ♂♂, 10 ♀♀ (IVB E135–144, E146, E147 [S+B]), Dandara, Temple of Hathor, 27 April 1969, leg. J. Gaisler; – 1 ♂, 3 ♀♀ (ZFMK 77.156–77.1059 [S+B]), Tempel von Dendera, 6 April 1897, leg. A. Koenig; – 1 ♂, 2 ♀♀ (IVB E81, E82, E84 [S+B]), Karnak, Temple, 26 April 1969, leg. J. Gaisler; – 6 ♂♂, 2 ♀♀ (NMP 92605 [S+A], 92599–92604, 92606 [A]), Luxor, Thebes, tombs, 27 January 2010, leg. P. Benda, R. Lučan & I. Horáček; – 1 ♀ (BMNH 2.1.17.2. [S+B], holotype of *Rhinopoma cystops* Thomas, 1903), Luxor, date unlisted, leg. N. C. Rotschild; – 1 ♂ (IVB E199 [S+B]), Luxor, Valley of Kings, a tomb, 30 April 1969, leg. J. Gaisler; – 4 ♂♂, 4 ♀♀ (IVB E40–42, E49, E50, E55–57 [S+B]), Sakkara, Prison of Joseph, 23 April 1969, leg. J. Gaisler. – **Morocco**: 8 ♂♂ (NMP 94487–94492, 94532 [S+A], 94494 [A]), Azigza Cave, 27 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo; – 2 ♀♀ (MNHN 1954-360a, 1954-360e [S]), Tata, 25 April 1954, leg. J. Dorst. – **Somalia**: 3 ♂♂, 9 ♀♀ (MZUF 9919–9922, 9925, 9927, 9929, 9930, 9932, 9933, 9935, 9937 [S+A]), Taleh, 18–19 April 1980, leg. B. Lanza. – **Sudan**: 1 ♂ (ZFMK 96.455 [S+B]), 6. Katarakt, ca. 100 km N Khartoum, 7 March 1986, leg. J. Niethammer; – 1 ♂ (ZFMK 96.456 [S+B]), Djebel, ca. 30 km NW Khartoum, 18 March 1986, leg. J. Niethammer; – 3 ♂♂, 2 ♀♀ (NMP 93660–93663 [S+A], 93659 [A]), Dongola Alajuz, 7 December 2010, leg. P. Benda & J. Šmíd; – 1 ♂, 2 ♀♀ (NMP 93648–93650 [S+A]), Karima, Jebel Barkal, cave, 6 December 2010, leg. P. Benda & J. Šmíd.

Rhinolophus ferrumequinum (Schreber, 1774)

Algeria: 9 ♂♂, 4 ♀♀ (MUB A13, A40, A328, A329, A355, A356, A372, A402, A415, A426, A439, A455, A456 [S+B]), Aokas near Bejaïa, cave, 30 April & 7 May 1981, 7 & 28 October, 26 November 1982, 25 February, 24 March, 15 April, 16 May, & 10 June 1983, leg. J. Gaisler; – 2 ♂♂ (MUB A389, A390 [S+B]), Bordj-Mira, mine, 14 January 1983, leg. J. Gaisler; – 1 ♂ (MUB A511 [S+B]), Brezina, 23 July 1983, leg. J. Gaisler; – 1 ♂ (MUB A205 [S+B]), Gages de Kherrata, tunnel, 15 January 1982, leg. J. Gaisler; – 1 ♀ (MUB A091 [S+B]), Grotte Aftis, 17 September 1981, leg. J. Gaisler; – 1 ♂ (MUB A219 [S+B]), Grotte Les Falaises, 23 April 1982, leg. J. Gaisler; – 1 ind. (MUB A406 [S+B]), Souk-el Tenine, Grotte, 25 February 1983, leg. J. Gaisler. – **Bulgaria**: 1 ♂ (NMP 49808 [S+A]), Dabromir, 30 July 1979, leg. D. Holečková, P. Donát, I. Horáček, J. Jirouš & V. Vohralík; – 4 ♂♂, 2 ♀♀ (NMP 38549, 38550, 38552, 38558, 47/72/C30, 47/72/C36 [S+B]), Jagodina, 2–3 August 1971, leg. J. Červený, I. Horáček, A. Taušl & D. Vítek; – 5 ♂♂, 9 ♀♀ (IVB 1095, 1096, 1098, NMP 49360, 49363, 50206, 50208, 50209, 50211, 50213, 50216, 50217, 50289, 50424 [S+B]), Karlukovo, 7 February 1965, 3, 5 & 6 July 1976, 6 & 8 August 1978, leg. M. Braniš, P. Donát, J. Figala, J. Flegr, J. Gaisler, V. Hanák, I. Horáček, K. Hůrka, J. Janda, J. Jirouš, V. Švihla & V. Vohralík; – 2 ♂♂, 1 ♀ (IVB 8–10 [S+B]), Karlukovo, Tamnata dupka Cave, 3 October 1962, leg. J. Gaisler; – 3 ♂♂ (NMP 49750, 50293, 50294 [S+A]), Karlukovo, Temnata dupka Cave, 7 August 1978, leg. P. Donát, J. Flegr, J. Janda & V. Vohralík; – 3 ♀♀ (NMP 50321–50323 [S+A]), Komunari, 12 July 1979, leg. D. Holečková, P. Donát, I. Horáček, J. Jirouš & V. Vohralík; – 1 ♂ (NMP 40923 [S+B]), Kotel, 20 June 1982, leg. D. Frynta, D. Holečková, I. Horáček, H. Prágerová & V. Vohralík; – 1 ♀ (IVB 28 [S+B]), Lakatnik, 10 February 1965, leg. J. Figala, J. Gaisler, V. Hanák & K. Hůrka; – 3 ♂♂, 1 ♀ (IVB 4–7 [S+B]), Lakatnik, Ražiška dupka Cave, 30 September 1962, leg. J. Gaisler; – 1 ♂, 3 ♀♀ (NMP 49144, 49145, 49812 [S+B], 50423 [B]), Lakatnik, Suhata peštera Cave, 18 March 1956, 19 May 1957, 3 January 1962, leg. V. Hanák & J. Sklenář; – 1 ind. (NMP 49811 [S+B]), Lakatnik, Temnata dupka Cave, 3 January 1962, leg. J. Sklenář; – 2 ♂♂, 1 ♀ (NMP 50138–50140 [S+B]), Lakatnik, Vraži dupka Cave, 19 March 1956, leg. V. Hanák; – 4 ♂♂, 2 ♀♀ (IVB 21–26 [S+B]), Malka Brestnica, 8 February 1965, leg. J. Figala, J. Gaisler, V. Hanák & K. Hůrka; – 3 ♂♂ (NMP 50334, 50369, 50370 [S+A]), Orehovo, 25 August 1980, 28 June 1984, leg. D. Holečková, J. Jirouš, D. Král, H. Prágerová, T. Scholz & V. Vohralík; – 2 ♀♀ (IVB 3, 17 [S+B]), Peštera, Nova peštera Cave, 18 September 1962, 4 February 1965, leg. J. Figala, J. Gaisler, V. Hanák & K. Hůrka; – 4 ♂♂, 17 ♀♀ (NMP 49841, 49842, 50331–50333, 50374–50377, 50345–50352, 50354, 50356–50358 [S+A]), Ploski, cave, 8 July 1980, 19 July 1981, 17 July 1982, 14 August 1987, J. Flousek, D. Frynta, R. Fuchs, D. Holečková, I. Horáček, J. Jirouš, P. Musil, H. Prágerová & V. Vohralík; – 2 ♂♂, 9 ♀♀ (NMP 38551, 38553, 38554, 38557, 47/72/C53, 47/72/C67, 47/72/C75, 47/72/C87, 47/72/C88, 47/72/C95, 47/72/C107 [S+B]), Primorsko, 17 August 1971, leg. J. Červený, I. Horáček, A. Taušl & D. Vítek; – 1 ♀ (NMP 49346 [S+B]), Ropotamo, 6 June 1957, leg. V. Hanák; – 1 ♀ (NMP 49346 [S+B]), Ropotamo, 6 June 1957, leg. V. Hanák; – 1 ♀ (IVB 27 [S+B]), Zlatna Panega, Panežka izvira Cave, 8 February 1965, leg. J. Figala, J. Gaisler, V. Hanák & K. Hůrka; – 4 inds. (NMP 47/72/A, C–E [S+B]), Bulgaria (undef.), August 1971, leg. J. Červený, I. Horáček, A. Taušl & D. Vítek. – **Crete**, **Greece**: 1 ♀ (NMP 91188 [S+A]), Agios Antonias Cave, 1.5 km N of Patsos, 3 October 2006, leg. P. Benda, V. Hanák & P. Hulva; – 1 ♂ (NMP 91189 [S+A]), Eileithyia Spilia Cave, 1 km S of Amnisos, 4 October 2006, leg. P. Benda, V. Hanák & P. Hulva; – 2 ♂♂, 1 ♀ (NMP 92319, 92342, 92343 [S+A]), Gaidourotrypa Cave, 5 km W of Kritsa, 14 October 2007, 31 May 2008, leg. P. Benda & V. Hanák; – 1 ♂, 1 ♀ (NMP 91119 [S+A], 91120 [A]), Kolymvari, mine, 9 October 2006, leg. P. Benda, V. Hanák & P. Hulva; – 1 ♂ (NMP 93566 [S+A]), Mikri Lavyrinthos Cave, 7 October 2007, leg. P. Benda; – 1 ♀ (NMP 92332 [S+A]), Moni Kato Preveli, 3 km E of Lefkogia, Venetian bridge under, 30 May 2008, leg. P. Benda & V. Hanák; – 1 ♂, 2 ♀♀ (NMP 92294, 92296 [S+A], 92295 [A]), Sarakinas Cave, 8 October 2007, leg. P. Benda & V. Hanák; – 1 ♂, 1 ♀ (NMP 91195, 92293 [S+A]), Spilaio Geraniou Cave, Gerani, 6 October 2006, 8 October 2007, leg. P. Benda, V. Hanák & P. Hulva; – 2 ♂♂ (NMP 91177, 91178 [S+A]), Spilion Tsanis Cave, Omalos, 1 October 2006, leg. P. Benda, V. Hanák & P. Hulva; – 1 ♂ (NMP 91048 [S+A]), Spilia Arkoudiotissa Cave, 4 km NE of Koumares, 28 September 2006, leg. P. Benda, V. Hanák & P. Hulva; – 6 ♂♂, 3 ♀♀ (NMP 91101–91103, 91105, 91199, 91200 [S+A], 91104, 91106, 91107 [A]), Spilia Milatou Cave, 1 km E of Milatos, 7 October 2006, leg. P. Benda, V. Hanák & P. Hulva. – **Cyprus**: 1 ♂ (NMP 91235 [S+A]), Afendrika, 17 October 2005, leg. I. Horáček, P. Hulva & R. Lučan; – 1 ♂, 5 ♀♀ (NMP 91249, 91250, 91205, 91206 [S+A], 91248, 91204 [A]), Akamas Peninsula, Smigies Trail, mines, 27 March & 12 October 2005, leg. I. Horáček, P. Hulva & R. Lučan; – 2 ♂♂ (NMP 90425, 91234 [S+A]), Inçirli Cave, 4 km SE of Cinarli, 17 April & 15 October 2005, leg. P. Benda, V. Hanák, I. Horáček, P. Hulva & R. Lučan; – 1 ♀ (NMP 90432 [S+A]), 3 km NW of Kalavasos, mine, 19 April 2005, leg. P. Benda, V. Hanák & I. Horáček; – 1 ♂ (NMP 91225 [S+A]), Troodos Forest, 4.5 km SW of Kakopetria, mine, 14 October 2005, I. Horáček, P. Hulva & R. Lučan. – **Greece**: 1 ♂ (NMP 48568 [S+B]), Delphi, 23 September 1988, leg. V. Hanák, Z. Roček & V. Vohralík; – 1 ♀ (NMP 48709 [S+B]), Despotiko Cave, 3 July 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 1 ♂ (NMP 48729 [S+A]), Kombotades, bunker, 11 September 1996, leg. M. Andreas, P. Benda & M. Uhrin; – 2 ♀♀ (NMP 48644, 48645 [S+B]), 2 km S of Maronia, above creek, 19 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 3 ♂♂, 1 ♀ (NMP 48638, 48640, 48641 [S+B], 48639 [S]), 3 km SW of Maronia, Cave of the Cyclops Polyphemos, 19 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 1 ♀ (NMP 48608 [S]), Petralona, cave, 28 September 1988, leg. V. Hanák, Z. Roček & V. Vohralík; – 1 ♂ (NMP 49049 [S+A]), Prespa, Zahariani Cave, 3 September 2001, leg. P. Benda; – 1 ♂ (NMP 48688 [S+B]), Thassos, Panagia, Drakotrypa Cave, 24 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 3 ♀♀ (NMP 48697–48699 [S+B]), Thassos, 1 km W of Arhangelou Monastery, 26 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík. – **Jordan**: 1 ♂ (NMP 92408 [S+A]), Dibbine Forest, mine, 27 October 2008, leg. P. Benda & J. Obuch; – 1 ♂ (NMP 92562 [S+A]), Milka, cave, 28 May 2009, leg. Z. Amr, P. Benda & A. Reiter; – 1 ♀ (NMP 92504 [S+A]), Tabaqat Fahl, cave, 24 May 2009, leg. P. Benda & A. Reiter; – 3 ♂♂, 2 ♀♀ (NMP 92403, 92404, 92506, 92507 [S+A], 92405 [A]), Zubiya Cave, 25 October 2008, 24 May 2009, leg. P. Benda, J. Obuch & A. Reiter. – **Morocco**: 1 ♀ (NMP 90035 [S+A]), Oued Tessaouat, Talkout, mine, 30 August 2003, leg. P. Benda. – **Syria**: 2 ♂♂ (NMP 48030, 48804 [S+A]), As Salihiyyah, Dura Europos, ruins, 18 June 1998, 16 May 2001, leg. M. Andreas, P. Benda, A. Reiter, M. Uhrin & D. Weinfurtová; – 2 ♂♂, 3 ♀♀ (NMP 48975–48978 [S+A], 48974 [S+B]), 1 km NW of As Salihiyyah, cave, 20 April 2001, leg. P. Munclinger & P. Nová; – 5 ♀♀ (NMP 48854–48858 [S+A]), Bosra, citadelle, 25 May 2001, leg. M. Andreas, P. Benda & D. Weinfurtová; – 1 ♂ (MNHN 1983-1958 [S+A]), Lattakié, 1900, leg. H. Gadeau de Kerville; – 1 ♂, 5 ♀♀ (NMP 48759–48764 [S+A]), Qala'at Najm, cellar, 10 May 2001, leg. M. Andreas, P. Benda, A. Reiter & D. Weinfurtová; – 1 ♂ (NMP 48270 [S+A]), Qala'at Nimrud, cellar, 18 July 1999, leg. P. Benda; – 1 ♂, 1 ♀, 1 ind. (NMP 48073, 48074 [S+A], 90342 [S]), Qala'at Salah ad Din, cellar, 30 June 1998, 13 October 2004, leg. M. Andreas, P. Benda, R. Lučan & M. Uhrin; – 3 ♀♀ (NMP 48935, 48936 [S+A], 48937 [S+B]), Qala'at Samaan, cellar, 3 June 2001, leg. M. Andreas, A. Reiter & D. Weinfurtová; – 7 ♀♀ (NMP 48077–48081, 48892 [S+A], 48083 [A]), Qala'at Sheisar, cellar, 1 July 1998, 31 May 2001, leg. M. Andreas, P. Benda, A. Reiter, M. Uhrin & D. Weinfurtová; – 2 ♀♀ (NMP 48927, 48928 [S+A]), Qatura, 2 June 2001, leg. M. Andreas, P. Benda, A. Reiter & D. Weinfurtová. – **Turkey**: 1 ♀ (SMF 83701 [S+A]), Alarahan, W of Alanya, gallery, 19 February 1996, leg. G. Storch & K. Storch; – 1 ♂ (NMW 24577 [S+B]), Apollohöhle, 2 km W of Ahmetbeyli, 16 February 1969, leg. F. Spitzenberger; – 1 ind. (NMW 68029 [S]), Belikesir Prov., 17 May 1975, leg. M. Çağlar; – 2 ♀♀ (NMW 20509 [S+B], 24584 [S+A]), Bergama, Akropolis, 17 September 1960, 1 April 1969, leg. M. Çağlar & F. Spitzenberger; – 1 ♂, 1 ♀ (SMF 36748, 36749 [S]), 10 km N of Bolu, 16 September 1965, leg. Exkursion des Säugetier-Sektion; – 1 ♂ (NMW 24576 [B]), Höhlen NE Bornova, 20 February 1969, leg. F. Spitzenberger; – 1 ♂, 9 ♀♀ (NMP 47928, 47929, 47930–47933, 48089–48093 [S+A]), Çevlik, 20 May 1995, leg. P. Benda, J. Flegr & J. Sádlová; – 1 ♂, 1 ♀ (MHNG 1713.070 [S+A], 1713.072 [A]), Grand grotte Chikefté, 1956, leg. K. Lindberg; – 1 ♂ (NMW 24579 [S+B]), 2 km NW of Cobanisa, 15 March 1969, leg. F. Spitzenberger; – 1 ♂ (CUP T93/61 [S+A]), Derebük, 27 October 1993, leg. P. Benda & I. Horáček; – 1 ♀ (CUP T93/39 [S+A]), Dupnisa Mağara Cave, Sarpdere, 16 October 1993, leg. P. Benda & I. Horáček; – 5 ♂♂, 2 ♀♀ (NMW 34322–34326 [S+B], 34327, 34328 [A]), Egil, 26 July 1984, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♂ (SMF 36750 [S+A]), Eskipazar, ca. 88 km ENE of Bolu, 24 September 1965, leg. Exkursion des Säugetier-Sektion; – 1 ♀ (NMW 11836 [S]), SW Ende des Gala Gölü, 8 km ENE Enez, 4 June 1967, leg. F. Spitzenberger; – 1 ♂ (NMW 24580 [S+A]), Höhle bei Havran, 17 March 1969, leg. F. Spitzenberger; – 1 ♂, 1 ♀ (NMW 24581 [S+A], 24582 [S+B]), Kusini Mağarasi in Inkaya Köyü, 18 March 1969, leg. F. Spitzenberger; – 1 ♂ (NMP 90490 [S+A]), Muradiye, 23 June 2003, leg. J. Hájek & J. Hotový; – 1 ♂ (NMW 24583 [S+B), Kaya Köyü, S of Fethiye, 26 March 1969, leg. F. Spitzenberger; – 1 ♂ (NMW 34321 [S+B]), S Kiziltas, 19 July 1984, leg. A. Mayer, F. Spitzenberger & E. Weiß; – 1 ♀ (CUP T93/60 [S+A]), Kürtler, 23 October 1993, leg. P. Benda & I. Horáček; – 3 ♂♂, 1 ♀ (NMW 37201–37204 [S+B]), Perge (= Aksu), ruins, 14 August 1986, leg. F. Spitzenberger;

– 1 ♂ (MHNG 967.84 [S+A]), Tunnel entre Pozant et Yenice, 2 June 1954, leg. H. Coiffait; – 1 ♂, 1 ♀ (MHNG 967.65 [S+A], 967.64 [A]), Satzmal Mağarasi, ouest de Sile, 29 April 1955, leg. H. Coiffat & P. Strinati; – 1 ♂, 3 ♀♀ (MHNG 1719.13–15 [S+A], 1719.012 [A]), Grotte de Soultan, 1956, leg. K. Lindberg; – 1 ♂, 1 ♀ (MHNG 1719.27 [S+A], 1719.028 [A]), Grotte de Tchihatcheff, 1956, leg. K. Lindberg; – 1 ind. (NMW 14622 [S]), Verburan, April 1971, leg. Huss; – 4 ♂♂ (CUP T93/69–72 [S+A]), Yalan Dünya Mağara Cave, 30 October 1993, leg. P. Benda & I. Horáček; – 6 ♂♂, 3 ♀♀ (MHNG 967.66–967.72 [S+A], 967.73, 967.74 [A]), Yassikaya, W de Aqua, 30 April 1955, leg. H. Coiffat & P. Strinati; – 1 ♂ (NMW 24578 [S+B]), Zindan Mağara Cave, 1.5 km E of Anamas, 28 February 1969, leg. F. Spitzenberger.

Rhinolophus mehelyi Matschie, 1901

Algeria: 2 ♂♂, 1 ♀ (ISEA 9314, 9317, 9332 [S+B]), Ain Ouarha, 8 January & 2 November 1982, leg. K. Kowalski & B. Rzebik-Kowalska; – 2 ♀♀ (ISEA 9311 [S+B], 9305 [S]), Brezina, cave, 12 February & 30 October 1981, leg. K. Kowalski & B. Rzebik-Kowalska; – 1 ♂ (ISEA 9306 [S+B]), Houaine, 8 May 1981, leg. K. Kowalski & B. Rzebik-Kowalska; – 9 ♂♂, 8 ♀♀ (ISEA 9277, 9278, 9290–9297, 9299, MUB A118, A119 [S+B], ISEA 9289, 9328–9330 [S]), Misserghin near Oran, 7 December 1979, 14 March 1980, 20 October 1981, 1 March & 11 May 1982, leg. J. Gaisler, K. Kowalski & B. Rzebik-Kowalska; – 10 ♂♂, 6 ♀♀ (MUB A138, A140, A142–145, A147, A149–152, A154–156, A158 [S+B]), Tiddis near Constantine, hot cave, 20 November 1981, leg. J. Gaisler; – 2 ♂♂, 1 ♀ (ISEA 9307, 9308, 9335 [S+B]), Sig, 9 May 1981, 25 January 1983, leg. K. Kowalski & B. Rzebik-Kowalska. – **Bulgaria**: 1 ind. (NMNHS unnumbered [S]), Bežanovo, Parnicite Cave, 17 February 1963, leg. P. Beron; – 1 ind. (NMNHS unnumbered [S]), Červen, Zorievica Cave, 31 January 1998, leg. T. Ivanova & B. Petrov; – 1 ♂ (NMNHS, unnumbered [S]), Lesovo, April 1990, leg. P. Stoev; – 1 ♂ (NMNHS N106 [S]), Muselievo, Nanin Kamăk Cave, 10 May 1997, leg. T. Ivanova & B. Petrov; – 3 ♂♂, 1 ♀, 3 inds. (NMNHS N2, unnumbered, RMR 741, 743, 744 [S]), Pepelina, Orlova Čuka Cave, 4 April 1966, 2 & 16 October 1993, 31 January 1998, leg. T. Ivanova, B. Petrov, A. Stoânov & E. Undžiân; – 1 ♀ (NMNHS N68 [S]), Ribino, Aina-Ini Cave, 21 September 1996, leg. A. Georgieva & T. Ivanova; – 6 ♂♂, 1 ♀ (NMP 49176, 49674, 49682, 49683 [S+B], 50279, 50280, 50288 [S+A]), Sliven, Zmejovi dupki Cave, 27 May 1957, 15 July 1975, leg. V. Hanák & J. Červený. – **Greece**: 1 ♀ (NMP 48637 [S+B]), Cave of the Cyclops Polyphemos, 3 km SW of Maronia, 18 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 3 ♀♀ (NMP 48668–48670 [S+B]), Didimotiho, cave, 22 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 1 ♀ (NMP 48672 [S+B]), Kimmeria, mine, 23 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 4 ♂♂, 1 ♀ (NMP 48591, 48592, 48600, 48602, 48605 [S+B]), Petralona, 28 September 1988, leg. V. Hanák, Z. Roček & V. Vohralík. – **Israel**: 1 ♀ (ZMB 12984 [A]), Jerusalem, 1879, leg. Kersten; – 2 ♀♀ (ZMB 12978, 12979 [A], including the holotype of *Rhinolophus* (*Euryalus*) *judaicus* Andersen et Matschie, 1904), Jerusalem, Adullam Cave, leg. Petermann. – **Romania**: 8 ♂♂, 15 ♀♀ (NMP 90256–90278 [S+B]), Limanu, Pestera de la Limanu, 21 July 1974, leg. J. Červený; – 3 inds. (ZMB A3.08 [S]), Romania, leg. Dombrowski. – **Syria**: 8 ♂♂, 9 ♀♀ (NMW 21977–21992 [S+A], 21976 [S]), Aleppo [= Halab], 13–23 March 1910, 4 July 1914, leg. V. Pietschmann; – 4 ♂♂, 1 ♀ (MNHN 1911-580A–E [A]), Djéroud, 1908, leg. H. Gadeau de Kerville. – **Turkey**: 1 ♀ (MHNG 1713.71 [S+A]), Grand grotte Chikefté, 1956, leg. K. Lindberg; – 2 ♂♂ (NMW 24606 [S+B], 24607 [S+A]), Dereköy, 2 km S of Kaklik, cave, 23 February 1969, leg. F. Spitzenberger; – 1 ♀ (NMP 47961 [S+A]), Sergen, Safe Suyu Spring Cave, 1 September 1996, leg. M. Andreas, P. Benda & M. Uhrin; – 1 ♂, 1 ♀ (NMW 24608 [S+B], CUP T93/82 [S+A]), Taşkapi, Insuyu Mağara Cave, 24 February 1969, 1 November 1993, leg. P. Benda, I. Horáček & F. Spitzenberger; – 5 ♂♂, 3 ♀♀ (NMW 11788–11790 [S+B], 11791, 11792 [S+A], 13348–13350 [B]), 4 km SE of Yalova, castle ruins, 29 May 1967, 8 May 1968, leg. K. Bauer, H. Böhm, F. Spitzenberger, M. Ganso & L. Wald.

Asellia tridens (Geoffroy, 1813)

Algeria: 10 ♂♂, 1 ♀ (ISEA 9523, 9524, 9527, 9528, 9530, 9532, 9533 [S+B], ISEA 9534, MUB A477 [S], ISEA 9526, 9531 [B]), Ain Ouarka, 20 May 1982, leg. J. Gaisler, K. Kowalski & B. Rzebik-Kowalska; – 2 ♂♂, 1 ♀ (ISEA 9522, 9534, 9535 [S+B]), Benni Abbes, 15 May 1981, 19 July 1983, leg. K. Kowalski & B. Rzebik-Kowalska; – 1 ind. (BMNH 94.7.12.1. [S]), Biskra, date & collector unlisted; – 1 ♂ (ISEA 9536 [S+B]), Brezina, 23 July 1983, leg. K. Kowalski & B. Rzebik-Kowalska; – 3 ♂♂, 1 ♀ (BMNH 12.11.14.1., 12.11.14.2., MSNG 33629a, b [S+B], incl. the holotype of *A. tridens diluta* Andersen, 1918), El Golea, 16 May 1912, April 1938, leg. W. Rotschild, E. Hartert & P. Laurent. – **Chad**: 1 ♂, 1 ♀ (BMNH 64.240, 64.241 [S+B]), Zouar, Tibesti, Sahara, 1735 m, 9 & 16 October 1955, leg. I. G. Gibson. – **Egypt**: 2 ♀♀ (MSNG 33202a, b [S+B]), Abu Simbel, 27 January 1904, leg. E. A. D'Albertis; – 8 ♂♂, 2 ♀♀ (NMP 92585–92592 [S+A], 92593, 92594 [A]), Aswan, 24 January 2010, leg. P. Benda, I. Horáček & R. Lučan; – 1 ♀, 1 ind. (NMP 94978, 94979 [S+A]), Dakhla oasis, Al Rashda, 10 October 2011, leg. R. Lučan; – 2 ♂♂ (IVB 22, 27 [S+B]), Dandara, temple, 27 April 1969, leg. J. Gaisler; – 1 ♂ (MNHN 1986-1068 [S+B], lectotype of *Rhinolophus tridens* Geoffroy, 1813), Egypte [= Thebes], leg. E. Geoffroy Saint-Hilaire; – 4 ♂♂, 2 ♀♀ (MSNG 33201a–d, 6994, 6995 [S+B]), Garbu Suan, in faccia ad Assuan, February 1907, leg. E. A. D'Albertis; – 4 ♂♂ (MSNG 33200a–d [S+B]), Sakkarah (Cairo), May 1906, leg. F. W. Innes Bey; – 3 inds. (NMP 90351, 90352, 90354 [S+A]), Shali, Siwa oasis, 12 April 2002, leg. P. Munclinger & P. Nová; – 17 ♂♂, 2 inds. (IVB 30, 31, 33–36, 38–43, 45–51 [S+B]), Thebes, tombs, 30 April 1969, leg. J. Gaisler. – **Gambia**:

1 ♂ (SMF 82480 [S]), Georgetown [= Janjangbureh], MacCarthy Island, 20 April 1995, leg. D. Kock; – 1 ♂ (SMF 92154 [S]), Janjangbureh, 22 January 2001, leg. L. Barnett & C. Emms; – 1 ♀ (BMNH 49.476. [S+B]), 10 mi SE of Kontaur, 24 August 1948, leg. A. P. Buxton. – **Mauritania**: 1 ♀ (MZUF 20732 [A]), Ouadane, 23 November 2002, leg. P. Agnelli; – 1 ♂ (NMP 93647 [S+A]), Tarjit, 21 October 2010, leg. P. Benda, A. Reiter & M. Uhrin; – 7 ♀♀ (NMP 93639–93641, 93643–93645 [S+A], 93642 [A]), Tin Labbé, 19 October 2010, leg. P. Benda, A. Reiter & M. Uhrin. – **Morocco**: 3 ♀♀ (NMP 94441–94443 [S+A]), Tassetift, 22 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo. – **Senegal**: 3 ♂♂, 1 ♀ (ZFMK 76.29–76.31 [S+B], 76.28 [B]), Tatki, 20 km E Fété-Olé, 21 November 1975, leg. W. Boehme et al. – **Sudan**: 2 ♂♂, 2 ♀♀ (ZFMK 97.001–97.003, 97.005 [S+Sk+B]), Djebel, ca. 30 km NW of Khartoum, 18 March 1986, leg. J. Niethammer; – 4 ♂♂ (NMP 93664–93666 [S+A], 93667 [A]), Dongola Alajuz, 7 December 2010, leg. P. Benda & J. Šmíd; – 2 ♂♂, 7 ♀♀, 6 inds. (IVB 1–9 [S+B], NMP 90344–90349 [S+A]), Jebel el Azraq, 18 February 1966, leg. P. Štys; – 3 ♂♂, 4 ♀♀ (NMP 93651–93653, 93655–93657 [S+A], 93654 [A]), Karima, Jebel Barkal, cave, 6 December 2010, leg. P. Benda & J. Šmíd; – 1 ♂ (NMP 93680 [S+A]), 8 km W of Masoud, Bayudah Desert, 13 December 2010, leg. P. Benda & J. Šmíd; – 1 ♂, 2 ♀♀ (NMP 93670, 93671 [S+A], 93672 [A]), Quikkah, 9 December 2010, leg. P. Benda & J. Šmíd. – **Tunisia**: 24 ♂♂ (MUB 1.2.75–1.2.98 [S+B]), El Hammá, nr. Tozeur, autumn 1973, leg. Pavlík.

Myotis punicus Felten, 1977

Algeria: 28 ♂♂, 14 ♀♀ (MUB A14–18, A32, A39, A45–49, A70–73, A76, A77, A266, A267, A269–280, A282–289, A325, A374, A382, A416, A443 [S+B]), Aokas near Bejaïa, cave, 30 April, 5 & 21 May, 2 September 1981, 20 June, 7 October, 26 November & 16 December 1982, 24 March & 16 May 1983, leg. J. Gaisler; – 1 ♀ (MUB A240 [S+B]), Honaine, cave, 30 April 1982, leg. J. Gaisler; – 1 ♀ (MUB A238 [S+B]), Sebdou, Tlemcen Mts., canyon, 30 April 1982, leg. K. Kowalski; – 2 ♀♀ (MUB A116, A117 [S+B]), Sig, 6 October 1981, leg. K. Kowalski; – 1 ♀ (MUB A95 [S+B]), Souk El Tenine, les Falaises, cave, 18 September 1981, leg. J. Gaisler; – 4 ♂♂ (MUB A162, A164–166 [S+B]), Tiddis near Constantine, hot cave, 20 November 1981, leg. J. Gaisler; – 2 ♂♂ (MUB A458, A474 [S+B]), Tikjda, Djurdjura, 2 & 3 July 1983, leg. J. Gaisler; – 1 ♂ (MUB A418 [S+B]), Yakouren, forest, 14 April 1983, leg. J. Gaisler. – **Morocco**: 1 ♂ (MHNG 1805.085 [S+A]), 23 km SW Taza, date unlisted, leg. M. Ruedi; – 5 ♂♂ (NMP 94503, 94534, 94535 [S+A], 94502, 94504 [A]), Azigza Cave, 26–27 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo; – 1 ♂ (MHNG 1805.087 [S+A]), Berkam, 13 August 1993, leg. R. Arlettaz; – 1 ♂ (NMP 93587 [S+A]), Dar-el-Aroussi, Oued Marrout, 5 October 2010, leg. P. Benda, A. Reiter, M. Ševčík & M. Uhrin; – 1 ♂ (MHNG 1805.091 [S+A]), Oued Berd, 15 August 1993, leg. R. Arlettaz; – 1 ♂ (NMP 90092 [S+A]), Sebt-des-Aït-Serhrouchen, Oued El-Ammar, 9 September 2003, leg. P. Benda; – 9 ♂♂, 1 ♀ (NMP 90036–90045 [S+A]), Oued Tessaout, Talkout, mine, 30 August 2003, leg. P. Benda; – 1 ♂ (MHNG 1805.096 [S+A]), Tazouguerte, 16 August 1993, leg. R. Arlettaz. – **Tunisia**: 3 ♂♂, 14 ♀♀ (SMF 18946–18952, 18955–18964 [S], paratype series of *Myotis blythii punicus* Felten, 1977), Cap Bon, 15 May 1960, leg. H. P. Müller; – 1 ♂, 4 ♀♀ (SMF 22214, 22217–22220 [S], paratype series of *Myotis blythii punicus* Felten, 1977), Cap Bon, El Haouaria Cave, 12 March 1963, leg. J. Kiepenhauer & K. Linsenmair; – 2 ♂♂, 14 ♀♀ (SMF 43386–43392, 44097–44104, 44618 [S]), type series of *Myotis blythii punicus* Felten, 1977, including the holotype), Cap Bon, El Haouaria Cave, 25 March 1971, leg. P. Nagel, K. Schubert & J. Vesmanis; – 1 ♂, 7 ♀♀ (SMF 43961–43968 [S], paratype series of *Myotis blythii punicus* Felten, 1977), Cap Bon, El Haouaria Cave, 29 August 1972, leg. J. Vesmanis; – 10 ♂♂, 2 ♀♀ (CUP tu6, tu8, tu9–13, tu16, tu18, tu19, tu21, tu28 [S+B]), El Djem, amphitheatre, 2–4 September 1973, leg. H. Burda; – 2 ♀♀ (MHNG 1807.66, 1807.67 [S+A]), Ghar Tabouda, El Haouaria Cave, 11 July 2000, leg. V. Castella; – 2 ♂♂, 2 ♀♀ (MHNG 1144.76, 1144.77, 1144.79 [S+A], 1144.78 [S]), Jendouba, Grotte du Kef-el-Agab, 7 October 1967, leg. V. Aellen & P. Strinati.

Eptesicus isabellinus (Temminck, 1840)

Algeria: 1 ♂, 2 ♀♀ (MUB A523, A525, RMO 5135 [S+B]), Ain El Hadjad near Ain Sefra, 21 July 1983, leg. J. Gaisler; – 4 ♂♂ (VMO 5141–5144 [S+B]), Amentane, Aurès, S of Menaa, 8 August 1983, leg. J. Gaisler; – 1 ♂ (MNHN 1985-659 [S+B]), Haljam, Oran, April 1961, leg. Dulcrot; – 3 ♂♂, 3 ♀♀ (MUB A480–483, RMO 5131, 5132 [S+B]), Misserghin, Oran, 14 July 1983, leg. J. Gaisler; – 1 ♂ (MUB A457 [S+B]), Tikjda, Djurdjura, 2 July 1983, leg. J. Gaisler. – **Morocco**: 1 ind. (MNHN 1985-1983 [S]), Beni Snassen, 1955, leg. A. Brosset; – 1 ♀ (NMP 90079 [S+A]), Cascades Bou Mazouz, Oued Za, 6 September 2003, leg. P. Benda; – 1 ♂ (MNHN 1985-1051 [S]), Forer de Nefifiq, 1956, leg. I. P.; – 2 ♂♂, 4 ♀♀ (NMP 90086–90091 [S+A]), Gorges du Zegzel, 5 km S of Berkane, 8 September 2003, leg. P. Benda; – 1 ♂ (NMP 90068 [S+A]), Oued Dades, 5 km NW of Aït-Ali, 2 September 2003, leg. P. Benda; – 1 ♂, 1 ♀ (NMP 90093, 90094 [S+A]), Oued El-Ammar, Sebt-des-Aït-Serhrouchen, 9 September 2003, leg. P. Benda; – 1 ♂, 2 ♀♀ (NMP 93588, 93589 [S+A], 93590 [A]), Oued Marrout, Dar-el-Aroussi, 5 October 2010, leg. P. Benda, A. Reiter, M. Ševčík & M. Uhrin; – 1 ♀ (NMP 94457 [S+A]), Oued Rheris, 5 km W of Rissani, 25 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo; – 1 ♀ (NMP 90056 [S+A]), Oued Tessaout, Talkout, mine, 30 August 2003, leg. P. Benda; – 1 ♂ (NMP 90032 [S+A]), Oum er Rbia, 5 km SW of Bekrite, 28 August 2003, leg. P. Benda; – 2 ♂♂, 1 ♀ (NMP 90027–90029 [S+A]), 10 km W of Tabouda, 26 August 2003, leg. P. Benda; – 5 ♀♀ (NMP 94444–94447 [S+A], 94448 [A]), Tassetift, ca. 37 km N of Foum Zguid, 22 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo; – 1 ♂ (NMP 94523 [S+A]), Takoumit, 2 km NE of Tazouguerte, 26 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo.

***Pipistrellus creticus* Benda, 2009**

Crete, Greece: 1 ♂ (NMP 92323 [S+A]), 1 km N of Zaros, 25 May 2008, leg. P. Benda & V. Hanák; – 1 ♂ (NMP 92344 [S+A]), Monastiraki, Genianos river, 2 June 2008, leg. P. Benda, P. Georgiakakis & V. Hanák; – 5 ♂♂ (NMP 92349–92351, 92353 [S+A], 92352 [A]), Rouva forest at Agiou Ioanni chapel, 4 June 2008, leg. P. Benda, P. Georgiakakis & V. Hanák; – 1 ♂ (NMP 91180 [S+A]), Tzani Cave, Omalos plateau, 1 October 2006, leg. P. Benda, V. Hanák & P. Hulva.

***Pipistrellus kuhlii* (Kuhl, 1817)**

Egypt: 2 ♂♂ (IVB E1, E2 [S+B]), Abu Rawash, 19 April 1969, leg. J. Gaisler; – 1 ♂ (SMF 26114 [S+A]), Bahig, Western Desert, 16 August 1965, leg. leg. J. Kiepenhauer & K. Linsenmair; – 1 ♂ (NMP 92571 [S+A]), Bawiti, Bahariya Oasis, 19 January 2010, leg. P. Benda, R. Lučan & I. Horáček; – 1 ind. (SMF 22014 [S+A]), between Cairo and Ismaila, 5 September 1962, leg. R. Rau; – 1 ♂ (IVB E275 [S+B]), Burgh el Arab, 14 May 1969, leg. J. Gaisler; – 2 ♂♂ (NMP 92614, 92615 [S+A]), Cairo, 29 January 2010, leg. P. Benda, R. Lučan & I. Horáček; – 6 ♂♂, 1 ♀ (NMP 92572–92575, 92580, 92581 [S+A], 92579 [A]), El Qasr, Dakhla Oasis, 22 & 23 January 2010, leg. P. Benda, R. Lučan & I. Horáček; – 1 ♂, 15 ♀♀ (IVB E91, E92, E148—153, E157–159, E245–248, E250 [S+B]), Luxor, hotel garden, 26–29 April 1969, 1 May 1969, leg. J. Gaisler; – 1 ind. (SMF 4307 [S+B], lectotype of *Vespertilio marginatus* Cretzschmar, 1830), Nubia and Petraean Arabia [= Lower Egypt sensu Anderson 1902], 1822, leg. E. Rüppell; – 6 ♂♂, 3 ♀♀(NMP 90535, 90536 [S+A], 90534, 90537–90542 [A]), San El Hagar El Gibiliya, Nile Delta, 20 September 2005, leg. M. Andreas, P. Benda, J. Hotový & R. Lučan. – **Sudan**: 1 ♂, 2 ♀♀ (MHNG 1626.4, 1626.5 [S+A], 1626.6 [A]), Wadi Halfa, date unlisted, leg. F. Bona.

***Vansonia rueppellii* (Fischer, 1829)**

Algeria: 1 ♂, 1 ♀ (ISEA 9601, MUB A496 [S+B]), Abadla, Oued Guir, 20 July 1983, leg. J. Gaisler, K. Kowalski & B. Rzebik-Kowalska; – 1 ♂ (ISEA 9600 [S+B]), Benni Abbes, 31 October 1982, leg. K. Kowalski & B. Rzebik-Kowalska. – **Central Africa**: 1 ♀ (MNHN 1985-1035 [S]), Bangui, date unlisted, leg. A. Chippeaux. – **Egypt**: 3 ♂♂, 3 ♀♀ (NMP 94965–94970 [S+A]), Bawiti, El Baharyia Oasis, 18 October 2011, leg. R. Lučan; – 1 ♂ (NMP 92578 [S+A]), El Qasr, Dakhla Oasis, 22 January 2010, leg. P. Benda, R. Lučan & I. Horáček; – 1 ♂ (BMNH 92.9.9.20. [S]), Luxor, date unlisted, leg. J. Anderson; – 1 ♀ (ZFMK 81.254 [S+A]), Ras Abu Daragh, Golf von Suez, 12 October 1980, leg. H.-E. Back; – 1 ind. (MNHN 1985-1032 [S]), Egypte (undef.), 1829, leg. A. Lefébre. – **Ethiopia**: 1 ♀ (SMF 45023 [S]), unterhalb von Gidole am Lake Chamo, Gamu Gofa Prov., 4 August 1973, leg. H. Rupp. – **Morocco**: 1 ♀ (MHNG 1706.28 [S+A]), Aoufouss, 19–20 April 1985, leg. R. Arlettaz; – 2 ♀♀ (NMP 90080, 90081 [S+A]), Cascades Bou Mazouz, 10 km NW of Taourirt, 6 September 2003, leg. P. Benda; – 1 ♀ (NMP 90057 [S+A]), Oued Drâa, 5 km NE of Anagam, 31 August 2003, leg. P. Benda; – 7 ♂♂, 4 ♀♀ (NMP 94460–94463, 94465, 94467 [S+A], 94458, 94459, 94464, 94466, 94468 [A]), Rissani, 25 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo. – **Namibia**: 1 ♀ (NMP pb5262 [S+A]), Nsheshe Camp, 6 km W of Sangwali, 30 January 2012, leg. P. Benda, S. Eiseb & P. Vallo. – **Nigeria**: 1 ♂ (MHNG 1717.61 [S+B]), Baga-Kawwa, 31 May 1970, leg. J. Vielliard. – **Senegal**: 1 ♂ (MNHN 1995-2677 [S]), Parc Le Djoudj, April 1972, collector unlisted; – 2 ♂♂ (IVB S1981, S1982 [S+A]), Mbilor Dieri, 10 November 2008, leg. P. Benda, J. Červený, A. Konečný & P. Koubek. – **Sudan**: 2 ♂♂ (NMP 93681, 93682 [S+A]), 8 km W of Masoud, Bayudah Desert, 13 December 2010, leg. P. Benda & J. Šmíd; – 2 inds. (ZFMK unnumbered [156] [S+B], [157] [S]), Djebel Ariel, Bahr El Abiad, 15 February 1910, leg. A. Koenig; – 1 ♂ (BMNH 1.8.8.15. [S]), Fashoda, date unlisted, leg. R. M. D. Hawker; – 1 ♀ (BMNH 1.8.8.16. [S+B]), Goz Abu Gumer, 17 May 1901, leg. R. M. D. Hawker; – 1 ♀ (MHNG 1626.22 [S+A]), Kerma, 40 km amont de la 3e chute, bord du Nil, January 1983, leg. L. Chaix; – 2 ♂♂ (BMNH 1.8.8.13., 1.8.8.14. [S+B]), Khartoum, 24 January & 21 March 1901, leg. R. M. D. Hawker; – 1 ♂ (SMF 78115 [S]), Khartoum, Univ. Campus, 1. Hälfte 1991, leg. E. Abdellatif; – 1 ind. (SMF 12385 [S]), Schendi, date unlisted, leg. E. Rüppell; – 1 ♀ (BMNH 15.3.6.63. [S]), Tonga, White Nile, date unlisted, leg. W. P. Lowe. – **Uganda**: 1 ♂ (SMF 16898 [S]), Insel Bugala, O.-Afrika, 1908, leg. E. Banyon.

***Nyctalus lasiopterus* (Schreber, 1780)**

Bulgaria: 1 ♂ (ZFMK 39.22 [S+B]), Rila-Gebirge, beim Rila-Kloster, 1100 m, 29 May 1938, leg. A. von Jordans. – **Cyprus**: 1 ♂, 5 ♀♀ (NMP 90913–90916, 90918 [S+A], 90917 [A]), Gefyra Bridge, 23 July 2006, leg. P. Benda. – **Greece**: 1 ♂ (NMP 49031 [S+A]), Anthiro, 31 August 2001, leg. P. Benda; – 2 ♂♂ (ZFMK 64.693, 64.694 [S+B]), Pertuli, Pindos Mts., 9 June 1964, leg. H. Wolf. – **Italy**: 1 ♂ (SMF 44597 [S]), Ravenna, Pineta di Ravenne, May 1877, collector unlisted. – **Portugal**: 1 ind. (SMF 18071 [S]), Coimbra, 25 February 1932, leg. M. M. da Gama. – **Slovakia**: 1 ♀ (ZMM ZM-150/73 [S+B]), Iňačovce, 7 September 1973, leg. Š. Danko; – 2 ♂♂ (NMP 90628, 90629 [S+A]), Zlatno, Za Havraník valley, 2 August 2005, leg. E. Hapl. – **Spain**: 1 ♂, 1 ♀ (ZFMK 46.297, 46.298 [S+B]), Linares de Riofrio, Salamanca, 8–9 July 1942, leg. H. Grünn. – **Turkey**: 1 ind. (SMF 21077 [S]), Deveci Konasü, Müstafa Kemal Paşa, 21 June 1960, leg. H. Kahmann.

Nyctalus leisleri (Kuhl, 1817)

Afghanistan: 1 ♂ (SMF 38750 [S+A]), Matoon, Ismael Khel, 1340 m, 21 May 1963, leg. D. Meyer-Oehme; – 1 ♂ (ZFMK 97.145 [S+B]), Nimla, 1000 m, 21 March 1972, leg. J. Niethammer; – 1 ♀ (ZFMK 83.011 [S+A]), Petsch-Tal, Nuristan, June 1965, leg. E. Kullman. – **Bulgaria**: 1 ♂ (NMP 50034 [S+B]), Gorna Breznica, 19 July 1982, leg. I. Horáček & V. Vohralík. – **Crimea, Ukraine**: 2 ♂♂ (NMP pb4367, pb4368 [S+A]), General'skoe, 18 September 2009, leg. P. Benda, S. Gazaryan & M. Uhrin; – 1 ♂ (NMP pb4318 [S+A]), Laspi, 14 September 2009, leg. P. Benda, S. Gazaryan & M. Uhrin; – 3 ♂♂, 1 ♀ (NMP pb4278, pb4282, pb4285 [S+A], pb4277 [A]), Naučnoe, 11 September 2009, leg. P. Benda, S. Gazaryan & M. Uhrin; – 1 ♂ (NMP pb4400 [S+A]), Ŝebetovka, 21 September 2009, leg. P. Benda, S. Gazaryan & M. Uhrin; – 1 ♀ (NMP pb4273 [S+A]), Trudolûbovka, 10 September 2009, leg. P. Benda, S. Gazaryan & M. Uhrin; – 3 ♂♂ (NMP pb4300, pb4301 [S+A], pb4299 [A]), Uzundža, 13 September 2009, leg. P. Benda, S. Gazaryan & M. Uhrin. – **Cyprus**: 3 ♂♂, 1 ♀ (NMP 90411, 90412, 90901, 90902 [S+A]), Troodos Forest, 2 km S of Troodos, 12 April 2005, 22 July 2006, leg. P. Benda, V. Hanák & I. Horáček. – **Czech Republic**: 1 ind. (NMP 95110 [S+B]), Brno, 1 January 1973, leg. J. Gaisler; – 1 ♀ (NMP 95102 [B]), Hatě u Svinař, 30 April 1971, leg. V. Hanák; – 1 ♂ (NMP 95105 [S+B]), Klec Fishpond, 24 August 1976, leg. V. Hanák; – 1 ♀ (NMP 10350 [S]), Lanžhot, July 1943, leg. J. V. Staněk; – 1 ind. (NMP 10348 [S]), Šumava Mts., date unlisted, coll. Lokay; – 1 ♀ (NMP 95101 [S+B]), Šumperk, 1 June 1967, leg. V. Hanák; – 2 ♀♀ (NMP 95103, 95104 [S+B]), Vracov u Hodonína, 10 August 1972, leg. V. Hanák; – 2 ♀♀ (NMP 95106, 95107 [B]), Žihobce, 23 August 1979, leg. V. Hanák; – 1 ♂ (NMP 95108 [B]), Žofín, 16 July 1974, leg. V. Hanák. – **Germany**: 1 ♂ (SMF 16181 [S]), Frankfurt am Main, zoo, 4 July 1956, collector unlisted; – 1 ♀ (SMF 66779 [S]), Holler, Unterwesterwald, 24 June 1985, leg. Forstdirekt. Volkening; – 1 ♂, 1 ♀ (SMF 23509, 23636 [S]), Kaiserslautern, Autumn 1963, leg. G. Preuß. – **Greece**: 3 ♂♂, 2 ♀♀ (NMP 49033–49037 [S+A]), Anthiro, 31 August 2001, leg. P. Benda; – 1 ♂, 1 ♀ (NMP 49038, 49039 [S+A]), Dimitra, 1 September 2001, leg. P. Benda; – 1 ind. (NMP 48739 [S+B]), Drakolimni Lake, Tymphi Mts., 2250 m, 25 September 1988, leg. V. Hanák, Z. Roček & V. Vohralík; – 1 ♂ (NMP 48724 [S+A]), Kombotades, 9 September 1996, leg. M. Andreas, P. Benda & M. Uhrin; – 2 ♂♂ (NMP 49042, 49043 [S+A]), Papagianni, 2 September 2001, leg. P. Benda; – 1 ♂ (NMP 48631 [S+B]), Xanthi, 17 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík. – **Iran**: 2 ♂♂, 2 ♀♀ (NMP 94099–94102 [S+A]), Kalaleh, 28 September 2011, leg. M. Andreas, P. Benda, A. Reiter & M. Uhrin; – 2 ♂♂, 4 ♀♀ (NMP 90867–90871 [S+A], 90872 [A]), Korud Abad, 2 km SE of Ali Abad, 28 May 2006, leg. P. Benda & A. Reiter. – **Morocco**: 1 ♂ (NMP 90034, 94537, 94538 [S+A]), Bekrite, 28 August 2003, 27 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo; – 1 ♀ (NMP 93582 [S+A]), Derdara, 6 km SW of Chefchaouen, 2 October 2010, leg. P. Benda, A. Reiter, M. Ševčík & M. Uhrin; – 1 ♂, 2 ♀♀ (NMP 90100–90102 [S+A]), Oued El-Ammar, Sebt-des-Aït-Serhrouchen, 9 September 2003, leg. P. Benda; – 1 ♀ (NMP 90026 [S+A]), Souk-Khemis-des-Beni-Arouss, Makhazen River, 25 August 2003, leg. P. Benda. – **Romania**: 1 ♀ (MSNG 27596 [S+B]), Zorleni, Valle del Barlad, Moldavia, December 1909, leg. A. L. Montandon. – **Slovakia**: 1 ♂ (ZMM ZM-448/75 [S+B]), Michalovce, 10 June 1974, leg. Š. Danko. – **Spain**: 1 ♂, 1 ind. (SMF 16188, 16189 [S]), Linares de Riofrio, Salamanca, 29 May & 25 June 1956, leg. H. Grün. – **Switzerland**: 1 ♀ (NMP 95109 [S+B]), Col de Bretolet, 6 September 1969, leg. V. Aellen. – **Turkey**: 2 ♀♀, 1 ind. (NMW 11733, 11734, 11741 [S+B]), 5 km W of Igneada, 15 & 17 May 1967, leg. F. Spitzenberger; – 1 ♂ (NMP 47979 [S+A]), Abant Gölü, 14 June 1998, leg. M. Andreas, P. Benda & M. Uhrin; – 1 ind. (NMW H 1998-14-4 [S]), Altinbeşik, Düdensuyu-Höhle, Ürünlü, 5–10 October 1998, leg. U. Passauer & H. Mixanig; – 2 ♂♂ (NMP 47948, 47949 [S+A]), Velika Köprüsü, 31 August 1996, leg. M. Andreas, P. Benda & M. Uhrin.

Plecotus gaisleri Benda, Kiefer, Hanák et Veith, 2004

Algeria: 1 ♂ (MUB A57 [S+B]), Aokas near Bejaïa, cave, 30 May 1981, leg. J. Gaisler; – 2 ♀♀ (MUB A509, VMO 5138 [S+B]), Brezina, 22 July 1983, leg. J. Gaisler; – 1 ♀ (BMNH 12.11.14.3. [S+B]), Oumash, near Biskra, 5 March 1911, leg. E. Hartert; – 4 ♂♂ (MUB A122, A334, VMO 4670, 4671 [S+B]), Setif, 1 & 17 November 1981, 8 October 1982, leg. J. Gaisler; – 1 ♂, 4 ♀♀ (MUB A459, A460, VMO 5123–5125 [S+B]), Tikjda, Djurdjura, 2 July 1983, leg. J. Gaisler; – 1 ♂ (MUB A120 [S+B]), Timgad, 14 November 1981, leg. J. Gaisler. – **Morocco**: 2 ♂♂ (MHNG 1806.51, NMP 94536 [S+A]), Azigza Cave, 6 km S of Tazouguerte, 16 August 1993, 27 April 2008, leg. R. Arlettaz, P. Benda, J. Červený, A. Konečný & P. Vallo; – 1 ♀ (BMNH 63.1591. [S]), Figuig, date unlisted, E. D. W. Johnson; – 1 ♀ (MNHN 1983-511 [S+B]), Bou Izakarne, 4 February 1953, collector unlisted; – 3 ♂♂, 4 ♀♀ (NMP 93594–93599 [S+A], 93593 [A]), Mibladene, mine, 6 October 2010, leg. P. Benda, A. Reiter, M. Ševčík & M. Uhrin; -- 1 ♂ (NMP 94522 [S+A]), Takoumit, 2 km NE of Tazouguerte, 26 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo. – **Tunisia**: 1 ♂, 1 ♀ (BMNH 91.10.15.5. [S+B], unnumbered [S]), Duirat, date unlisted, leg. J. Anderson; – 1 ♀ (SMF 22352 [S+B]), El Haouaria, Cap Bon, 12 March 1963, leg. J. Kiepenhauer & K. Linsenmair; – 1 ♀ (MNHN 1962-2631 [S+A]), Tatahouine, May 1938, leg. M. Blanc.

Miniopterus schreibersii (Kuhl, 1817)

Algeria: 20 ♂♂, 14 ♀♀ (MUB A2–12, A33–35, A51–53, A98, A175–177, A179, A249, A268, A273, A290–294, A296, A332, A349, A386 [S+B]), Aokas near Bejaïa, cave, 30 April, 21 May, 1 October & 10 December 1981, 14 May, 20 June, 7 & 28 October & 26 November 1982, 7 January 1983, leg. J. Gaisler; – 1 ♀ (MUB A486 [S+B]), Misserghin near Oran, 14 July 1983, leg. J. Gaisler; – 2 ♀♀ (MUB A114, A115 [S+B]), Sig, 6 October 1981, leg. K. Kowalski & B. Rzebik-Kowalska; – 1 ♂ (MUB A160 [S+B]), Tiddis near Constantine, cave, 20 November 1981, leg. J. Gaisler. – **Bulgaria**: 1 ♂ (NMP 49806 [S+A]), Bačkovo, Marciganica hut, 23 July 1979, leg. D. Holečková, P. Donát, I. Horáček, J. Jirouš & V. Vohralík; – 1 ♀ (NMP 40690 [S+B]), Beloslav, Temnata dupka Cave, 4 September 1966, leg. B. Pražan; – 2 ♀♀ (NMP 49647, 49648 [S+A]), Devenci, Hajduška dupka Cave, 14 June 1977, leg. V. Bejček, J. Červený, J. Škopek, P. Vašák & V. Vohralík; – 2 ♀♀ (NMP 50049, 50050 [S+A]), Kamen Brâg, cave, 12 July 1986, leg. V. Hanzal, K. Hůrka, P. Musil, M. Průcha, M. Šálek, V. Vohralík & K. Weidinger; – 1 ♂, 5 ♀♀ (NMP 49351 [S], 49356, 49357, 49361, 49362, 49367 [S+A]), Karlukovo, 3, 5 & 6 July 1976, leg. M. Braniš, V. Hanák, I. Horáček, K. Hůrka, J. Jirouš, V. Švihla & V. Vohralík; – 1 ♂, 1 ♀ (NMP 49798, 49799 [S+A]), Kotel, Nirica peŝera Cave, 15 July 1979, leg. D. Holečková, P. Donát, I. Horáček, J. Jirouš & V. Vohralík; – 1 ind. (NMP 50143 [S+B]), Lakatnik, Suhata peŝera Cave, 21 December 1956, leg. V. Beškov & V. Hanák; – 2 ♂♂, 4 ♀♀ (NMP 50040, 50058–50062 [S+A]), Mostovo, Gargina dupka Cave, 22 June 1984, 22 August 1987, leg. D. Král, P. Musil, P. Scholz & V. Vohralík; – 10 ♂♂, 21 ♀♀, 2 inds. (NMP 49186, 49191, 49192, 49198, 49205–49207, 49214, 49220, 49222, 49226–49229, 49231, 49232, 49341 [S+A], 49686, 49688, 49690–49700, 49702, 49703 [S+B], 49197 [S]), Primorsko, Maslen Nos, cave, 5 June 1957, 27 August 1961, leg. V. Hanák; – 2 ♀♀ (NMP 40925 [S+B], 40926 [S]), Sliven, 10 & 19 June 1982, leg. D. Frynta, D. Holečková, I. Horáček, H. Prágerová & V. Vohralík; – 4 ♂♂, 8 ♀♀ (NMP 49148, 49165, 49166, 49177–49181 [S+A], 49150–49152, 49162 [S+B], 50191 [A]), Sliven, Zmejovi dupki Cave, 25 & 27 May 1957, leg. V. Hanák. – **Crete, Greece**: 1 ♂ (NMP 92311 [S+A]), Lefkogeia, Venetian bridge, 11 October 2007, leg. P. Benda; – 3 ♂♂, 4 ♀♀ (NMP 91112–91115, 91118 [S+A], 91116, 91117 [A]), Milatos, Milatou Cave, 7 October 2006, leg. P. Benda, V. Hanák & P. Hulva; – 14 ♂♂, 2 ♀♀ (NMP 91161–91171, 91176 [S+A], 91172–91175 [A]), Tzani Cave, Omalos Plateau, 1 October 2006, leg. P. Benda, V. Hanák & P. Hulva; – 1 ♀ (NMP 92316 [S+A]), Vreiko Cave, Pefkoi, 12 October 2007, leg. P. Benda. – **Greece**: 1 ♂ (NMP 48657 [S+B]), 2 km S of Avas, 20 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 1 ♂, 2 ♀♀ (NMP 48632, 48633, 48642 [S+B]), Cave of the Cyclops Polyphemos, 3 km SW of Maronia, 18 & 19 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 1 ♂, 2 ♀♀ (NMP 48665–48667 [S+B]), Didimotiho, cave, 22 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 2 ♂♂, 2 ♀♀ (NMP 48622–48625 [S+B]), Kimmeria, mine, 16 June 1989, leg. R. Chaloupka, V. Hanák & V. Vohralík; – 2 ♀♀ (NMP 48578, 48579 [S]), Pappigo, 26 September 1988, leg. V. Hanák, Z. Roček & V. Vohralík; – 1 ♂, 1 ♀ (NMP 48610, 48611 [S+B]), Petralona, 28 September 1988, leg. V. Hanák, Z. Roček & V. Vohralík. – **Turkey**: 5 ♂♂, 3 ♀♀ (PMS 11446, 11447, 11455–11460 [S]), Dupnisa Mağara Cave, Sarpdere, 4 July 1995, leg. B. Kryštufek.

Miniopterus maghrebensis Puechmaille, Allegrini, Benda, Bilgin, Ibáñez et Juste, 2014

Morocco: 7 ♂♂, 7 ♀♀ (NMP 94426, 94506–94512, 94514, 94515, 93600, 93601 [S+A], 94505, 94513 [A], type series of *Miniopterus maghrebensis* Puechmaille, Allegrini, Benda, Bilgin, Ibáñez et Juste, 2014), Azigza Cave, 6 km S of Tazouguerte, 26 April 2008, 7 October 2010, leg. P. Benda, J. Červený, A. Konečný, M. Ševčík, A. Reiter, M. Uhrin & P. Vallo; – 1 ♀ (NMP 90103 [S+A]), Oued El-Ammar, Sebt-des-Aït-Serhrouchen, 9 Septmber 2003, leg. P. Benda; – 6 ♂♂, 4 ♀♀ (NMP 90046, 90049–90055 [S+A], 90047, 90048 [A]), Talkout, Oued Tessaout, mine, 30 August 2003, leg. P. Benda.

Tadarida teniotis (Rafinesque, 1814)

Algeria: 5 ♀♀ (ISEA 9596, 9597, 9599, MUB A514, A515 [S+B], ISEA 9598 [S]), Amentane, Aurès, 8 August 1983, leg. J. Gaisler, K. Kowalski & B. Rzebik-Kowalska. – **Azerbaijan**: 1 ♂ (MUB 1.2.38 [S+B]), Nagornyj Karabah Republic, Šušinskoe Canyon, 17 August 1939, leg. A. Kuzâkin. – **Cyprus**: 1 ♂ (NMP 91831 [S+A]), Paramytha, 31 March 2005, leg. I. Horáček, P. Hulva & R. Lučan. – **Egypt**: 1 ♂, 1 ♀, 2 inds. (BMNH 3.4.1.1., 3.4.1.2., 3.6.3.1., 3.6.3.2. [S+B]), Abu Roash, 27 February & 31 March 1903, leg. S. S. Flower; – 1 ♂ (BMNH 15.10.2.1. [S+B]), Aburoash, Giza, March 1914, leg. Bonhote; – 2 inds. (SMF 12379, 12380 [S]; type series of *Dysopes rupelii* Temminck, 1826), Ägypten, before 1822, ded. E. Rüppell; – 1 ♂ (NMW 27416 [S]), Ägypten, date unlisted, leg. Th. von Heuglin; – 1 ♂ (MSNG 44418 [S+A]), Dintorni di Cairo, 15 March 1906, leg. F. W. Innes Bey; – 1 ♂, 1 ♀ (BMNH 23.1.14.3., 23.1.14.4. [S+B]), Giza, 26 & 28 March 1922, leg. S. S. Flower; – 1 ♀ (BMNH 9.7.1.12. [S+B]), near Giza, 17 November 1908, leg. M. J. Nicoll; – 8 ♂♂ (NMP 90525, 90526, 90529–90532 [S+A], 90524 [A]), Sinai, Ein El Furtaga, leg. 16 & 17 September 2005, leg. M. Andreas, P. Benda, J. Hotový & R. Lučan. – **France**: 3 inds. (MHNG 1325.87–1325.89 [S]), Gorges de la Bourne, Grotte du Bournillon, 28 September 1975, leg. J. F. Desmet; – 1 ind. (MHNG 1625.81 [S]), Isere, Grotte du Bournillon, January 1976, leg. J. F. Noblet; – 1 ind. (SMF 33562 [S]), Süd Frankreich, 30 Remoulin, Pont du Gard, 30 August 1963, collector unlisted. – **Greece**: 1 ind. (NMW 45848 [S+B]), Spilia Franthi am Ormos/Golf Agios Spiridon, Argolis, 28 May 1982, collector unlisted; – 1 ♂ (SMF 28221 [S]), Crete, Sitia, 22 March 1958, leg. H. Kahmann. – **Iran**: 1 ♂ (NMP

90833 [S+A]), Dorbadam, 23 May 2006, leg. P. Benda & A. Reiter; – 3 ♂♂, 3 ♀♀ (NMP 48449–48454 [S+A]), Gishan, 19 April 2000, leg. P. Benda & A. Reiter; – 1 ♂ (NMP 48458 [S+A]), Serizjan, 21 April 2000, leg. P. Benda & A. Reiter; – 2 ♀♀ (NMP 90797, 90798 [S+A]), Shurlaq, 18 May 2006, leg. P. Benda & A. Reiter; – 1 ♀ (NMP 90811 [S+A]), Tahir Abad (Khorasan-e Razawi Prov.), 21 May 2006, leg. P. Benda & A. Reiter. – **Israel**: 2 ♂♂ (MSNG 18233[a, b] [S+B]), Gerusalemme, 1923, leg. Padre Contini. – **Italy**: 1 ♀ (MHNG 975.90 [S+A]), Cagliari, Sardaigne, date unlisted, leg. F. Bona; – 1 ♀ (MZUF 9881 [S]), Castello, Firenze, 29 September 1877, collector unlisted; – 1 ♂, 2 ♀♀ (MZUF 7383, 45084 [A], 7384 [S]), Corigliano Calabro, Torre de Castello Compagna, 30 June 1904, leg. A. Andreini; – 1 ♂, 3 ♀♀ (MZUF 5352A, 6743, 6744, 14663 [S]), Firenze, 2 August 1873, 9 July 1908, collector unlisted; – 1 ♂ (MZUF 20294 [A]), Firenze, 25 September 2001, leg. S. Bambi; – 1 ♂, 1 ♀ (MSNG 44985, 54224 [A]), Genova, date and collector unlisted; – 1 ♀ (MSNG 45097 [A]), Genova, in citta, 4 April 1902, leg. C. Fiori; – 1 ♂ (MSNG 6516 [S]), Genova, Begato, 12 May 1907, leg. B. Borgioli; – 1 ♀ (MSNG 54223 [A]), Genova, via Bellucci, Liceo Colombo, 8 October 2007, leg. LIPU; – 1 ♂ (MSNG 48502 [A]), Genova, Piazza Sarzana, 14 January 1992, leg. E. Tagliarini; – 1 ♀ (MSNG 6518 [S+B]), Isola Giglio, Torre del Campese, 30 November 1909, leg. L. Doria; – 1 ♂ (MSNG 54574 [A]), Leca d'Albenga, May 2008, leg. L. Lamagni; – 1 ♀ (MSNG 51316 [A]), San Remo, 15 February 2000, collector unlisted; – 1 ♂ (MSNG 47121 [A]), Siliqua, Cagliari, June 1906, leg. R. Meloni; – 2 ♂♂, 1 ind. (MZUF 9879 [S], NMW 23414, 26649 [S+B]), Pisa, May & 1 June 1830, 20 February 1905, leg. K. Michelhelts & P. Savi; – 1 ♀ (MZUF 7382 [A]), Rossano, Cosenza, July 1904, leg. A. Andreini; – 1 ♂ (MZUF 9381 [S]), Sicilia, Catania, 31 May 1974, collector unlisted; – 1 ind. (SMF 11959 [S]), Toscana, before 1846, collector unlisted; – 1 ♀ (MHNG 975.91 [S+A]), Toscane, date unlisted, leg. F. Bona. – **Jordan**: 1 ♂ (RSCN unnumbered [S+A]), Rashah, Mujib Reserve, 20 April 1999, leg. K. A. Al Omari, F. L. Amerian & R. Heil; – 1 ♀ (NMP 92826 [S+A]), Wadi Al Wala, 11 July 2010, leg. P. Benda & A. Reiter; – 1 ♀ (RSCN unnumbered [S+A]), Wadi Zarqa Ma'in, 5 April 1999, leg. K. A. Al Omari & M. A. Abu Baker. – **Kirghizstan**: 1 ♂ (CUP CT84/256 [S+A]), Aravan, Čarvak, 20 August 1984, leg. J. Červený & I. Horáček; – 4 ♂♂, 8 ♀♀, 2 inds. (CUP CT84/293, CT84/297, CT84/301, CT84/304–306, CT84/308, CT84/309, CT84/312, CT89/34, NMP 58321, 58322 [S+A], CUP CT84/302, CT84/311 [A]), Aravan, Sasyk Ungur Cave, 24 August 1984, 11 July 1988, 8 June 1989, leg. J. Červený, A. Červená, I. Horáček, J. Hošek, J. Mlíkovský & J. Obuch; – 3 ♀♀ (CUP CT84/171–173 [S+A]), Oš, Toâ-Moûn, Aždar-Ungur, 8 August 1984, leg. J. Červený & I. Horáček. – **Lebanon**: 3 ♂♂, 5 ♀♀ (AUB M75, M78, M79, BMNH 61.407 [S+B], AUB M665–667/1–2 [S+A]), Faraya, Natural Bridge, 29 July & 25 September 1960, 31 May 1961, 25 May 1962, leg. R. E. Lewis. – **Macedonia**: 1 ♀ (HMNH 2000.46.1. [S+B]), Demir Kapija, 28 September 1975, leg. G. Topál. – **Morocco**: 3 ♂♂, 1 ♀ (BMNH 63.1581.–63.1584. [S]), Figuig, date unlisted, leg. E. D. W. Johnson; – 2 ♂♂, 1 ♀ (NMP 94454–94456 [S+A]), Gorges du Dades, 24 April 2008, leg. P. Benda, J. Červený, A. Konečný & P. Vallo; – 1 ♂ (NMP 90078 [S+A]), Tamtattouchte, 3 November 2003, leg. P. Benda. – **Portugal**: 1 ♂ (MSNG 45091 [A]), Cintra, 1906, collector unlisted. – **Spain**: 1 ♀ (MHNG 1013.37 [S+A]), Cordoba, October–November 1962, leg. P. Lora; – 1 ♂ (MHNG 975.89 [S+B]), Espagne, date unlisted, leg. V. Aellen. – **Switzerland**: 1 ♂ (MHNG 949.7 [S+B]), Col de Bretolet, Val d'Illiez, 27 August 1958, leg. F. Vuilleumier; – 2 ♂♂ (MHNG 1044.12 [S], 1044.13 [S+B]), Col de Bretolet, Val d'Illiez, 19 & 22 September 1963, leg. A. Meylan. – **Syria**: 1 ind. (ISEA M/11781, M/11782 [S]), Kisret Mhamadali, 28 June 1998, leg. A. Shehab. – **Turkey**: 1 ♀ (NMW 37260 [S+B]), Bergama, 5 August 1986, leg. F. Spitzenberger; – 5 ♀♀ (ZFMK 64.699–64.702, 72.141 [S+B]), Birecik, 26 May 1964, 11 May 1972, leg. H. Kumerloeve & U. Hirsch; – 4 ♀♀ (NMW 20626, 20628, 20629 [S+B], 20627 [S+A]), Göreme, 20 July 1975, leg F. Spitzenberger; – 1 ♀ (NMW 20620 [S+B]), Sarihan bei Nevsehir, 17 July 1975, leg. F. Spitzenberger; – 7 ♀♀ (NMW 20618, 20619, 20622, 20623, 20625 [S+B], 20621, 20624 [S+A]), Zelve, 16 & 19 July 1975, leg. F. Spitzenberger.

APPENDIX III
Biometric data on the bats from Libya

Basic external and cranial measurements of the examined bat specimens originating from Libya (pp. 155–162). Only the specimens with the skulls extracted are included. For collection acronyms and measurement abbreviations see p. 8. Arranged in numerical and alphabetical orders, according to collection number.

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCc	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Rhinopoma cystops																					
NMP 49864	Al Jaghbub	f	s	10.6	62	67	58.4	21.2	6.6	17.60	15.65	10.53	2.61	7.19	5.72	4.52	8.02	6.06	12.22	4.68	6.38
NMP 49865	Al Jaghbub	f	a	10.8	64	70	58.8	22.6	7.2	18.05	16.13	10.61	2.41	7.51	5.74	4.41	8.11	6.22	12.41	4.93	6.74
NMP 49866	Al Jaghbub	f	a	13.7	64	77	61.5	22.4	7.6	18.31	16.08	10.94	2.46	7.58	5.64	4.65	8.18	6.19	12.63	4.92	6.62
NMP 49867	Al Jaghbub	f	a	11.8	66	77	62.6	22.4	7.9	18.92	16.84	11.27	2.57	7.76	6.07	5.08	8.23	6.48	12.62	5.26	6.88
NMP 49868	Al Jaghbub	m	s	12.0	65	74	61.1	23.7	7.4	18.61	16.66	11.26	2.49	7.69	6.27	4.74	8.31	6.51	12.75	5.14	6.91
NMP 49869	Al Jaghbub	m	a	12.4	67	–	60.5	22.9	8.0	18.75	16.68	10.98	2.61	7.64	5.98	4.76	8.28	6.39	13.02	5.08	6.88
NMP 49872	Al Jaghbub	m	a	11.8	65	69	60.8	21.6	7.7	18.51	16.61	11.13	2.60	7.56	5.89	4.65	8.23	6.35	12.55	5.16	6.80
NMP 49873	Al Jaghbub	m	s	12.2	65	69	61.7	22.0	7.4	18.72	16.65	11.03	2.51	7.57	5.77	4.46	8.29	6.74	12.92	5.08	7.18
NMP 49874	Al Jaghbub	m	a	11.5	65	71	60.3	23.4	8.1	18.62	16.48	11.15	2.42	7.89	5.83	4.70	8.55	6.61	12.73	5.02	7.07
NMP 49875	Al Jaghbub	m	a	12.8	66	75	60.0	23.4	7.7	18.85	16.94	11.13	2.38	7.69	6.31	4.92	8.42	6.65	13.03	5.03	7.12
NMP 49876	Al Jaghbub	m	a	12.2	65	79	62.6	21.6	7.2	18.94	16.78	10.94	2.48	7.72	5.85	4.62	8.28	6.59	13.19	5.18	7.01
NMP 49877	Al Jaghbub	f	a	12.8	63	72	61.8	22.9	7.1	18.38	16.11	11.12	2.40	7.58	5.76	4.75	8.58	6.35	12.33	4.90	6.75
Rhinolophus ferrumequinum																					
NMP 49856	Ain Az Zarqa	m	a	11.7	59	31	53.3	23.6	–	21.61	18.43	10.90	2.48	8.89	6.37	5.88	7.98	7.88	14.36	3.75	8.48
NMP 49967	Nanatalah	f	a	16.7	65	35	52.6	24.5	–	21.82	18.67	11.21	2.48	8.59	6.67	6.18	8.12	7.90	14.53	3.80	8.61
Rhinolophus horaceki																					
NMP 49861	Al Bardiyah	m	a	11.4	59	32	48.2	21.4	–	20.64	17.69	10.98	2.24	8.58	6.25	6.09	8.09	7.40	13.61	3.41	8.27
NMP 49879	Wadi Darnah	m	a	10.8	62	36	49.6	22.4	–	20.88	18.11	10.86	2.23	8.65	6.41	6.07	7.79	7.60	13.84	3.54	8.30
NMP 49880	Wadi Darnah	m	a	11.0	60	34	48.4	21.3	–	20.17	17.48	10.71	2.44	8.45	6.22	5.87	7.70	7.49	13.24	3.28	8.14
NMP 49882	Wadi Darnah	f	a	14.8	60	38	49.2	22.7	–	20.46	17.57	10.80	2.36	8.62	6.22	5.98	7.71	7.31	13.42	3.63	8.07
NMP 49915	Wadi Al Kuf	f	a	14.8	63	31	50.2	20.8	–	20.57	17.72	10.77	2.46	8.69	6.34	5.85	7.91	7.39	13.43	3.44	8.09
NMW 30106	Wadi Al Kuf	f	s	11.2	60	26	47.7	20.6	–	–	17.53	10.68	2.22	8.26	6.19	5.81	7.88	7.32	13.28	3.37	7.91
NMW 30107	Wadi Al Kuf	f	a	11.0	59	28	48.0	21.0	–	–	17.63	10.67	2.38	8.56	6.38	5.92	7.89	7.31	13.23	3.28	8.01
NMW 30108	Wadi Al Kuf	m	s	10.5	56	29	48.6	21.6	–	–	18.07	10.93	2.48	8.66	6.02	5.91	7.82	7.43	13.93	3.41	8.13
Rhinolophus mehelyi																					
NMP 90236	Wadi Al Kuf	f	a	12.0	55	24	47.6	22.0	–	20.27	17.33	10.44	2.52	8.57	6.27	5.20	7.41	6.93	12.75	3.06	7.33
NMP 90237	Wadi Al Kuf	m	a	10.0	55	25	47.8	21.0	–	19.94	17.23	10.68	2.52	8.58	6.17	5.27	7.46	6.82	12.67	2.89	7.31
NMP 90238	Wadi Al Kuf	m	a	9.0	53	27	46.0	21.0	–	19.68	16.75	10.27	2.68	8.68	6.14	5.07	7.29	6.78	12.53	2.97	7.24
NMP 90239	Wadi Al Kuf	m	a	9.0	53	26	46.0	21.0	–	19.37	16.53	10.12	2.61	8.58	6.02	5.14	7.24	6.67	12.36	2.74	6.98
NMP 90240	Wadi Al Kuf	m	a	9.5	55	25	47.3	21.0	–	19.67	16.98	10.29	2.56	8.82	6.14	5.12	7.22	6.87	12.34	2.89	7.23
NMP 90241	Wadi Al Kuf	m	a	9.5	53	25	46.8	21.0	–	19.58	16.95	10.35	2.54	8.53	6.31	5.21	7.36	6.86	12.73	2.97	7.17
NMP 90242	Wadi Al Kuf	f	a	9.0	54	25	47.0	20.0	–	19.67	16.86	10.08	2.58	8.42	5.77	5.02	7.14	6.62	12.09	2.89	7.08
NMP 90243	Wadi Al Kuf	m	a	10.0	53	27	47.8	21.0	–	19.80	17.01	10.45	2.62	8.59	6.27	5.32	7.31	6.77	12.74	3.04	7.32
NMP 90244	Wadi Al Kuf	m	a	11.0	53	28	48.2	21.0	–	20.12	17.12	10.42	2.53	8.57	6.28	5.14	7.42	6.81	12.48	2.97	7.31
NMP 90245	Wadi Al Kuf	f	a	14.0	57	27	47.0	22.0	–	19.88	16.93	10.37	2.63	8.47	6.22	5.19	7.51	6.83	12.58	2.89	7.21
NMP 90246	Wadi Al Kuf	m	a	8.0	54	23	46.8	22.0	–	19.39	16.66	10.39	2.52	8.63	6.22	5.16	7.24	6.74	12.27	3.07	7.14
NMP 90247	Wadi Al Kuf	m	a	10.0	57	28	46.9	22.0	–	20.23	17.25	10.54	2.54	8.58	6.35	5.32	7.62	6.96	12.73	3.07	7.58
NMP 90248	Wadi Al Kuf	m	a	10.0	54	27	47.6	22.0	–	20.02	16.94	10.26	2.57	8.59	6.17	5.11	7.34	6.76	12.47	2.85	7.30
NMP 90249	Wadi Al Kuf	m	a	10.0	55	25	47.8	21.0	–	20.11	17.31	10.45	2.55	8.85	6.14	5.39	7.45	7.03	12.81	3.04	7.31
NMP 90250	Wadi Al Kuf	m	a	9.0	55	23	46.0	22.5	–	19.69	16.73	10.42	2.57	8.74	6.34	5.29	7.29	6.73	12.18	2.80	6.93

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCc/b	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Rhinolophus mehelyi																					
NMP 90251	Wadi Al Kuf	f	s	8.0	52	23	46.0	21.0	–	19.36	16.68	10.29	2.87	8.42	5.98	4.84	7.17	6.68	12.31	2.85	7.14
NMP 90252	Wadi Al Kuf	m	a	11.0	56	–	47.6	22.0	–	19.95	17.19	10.28	2.61	8.59	6.04	5.14	7.14	6.77	12.61	3.17	7.20
NMP 90253	Wadi Al Kuf	m	s	7.5	54	24	46.7	21.0	–	19.60	16.62	10.07	2.56	8.44	5.71	4.92	7.07	6.71	12.40	2.92	7.24
NMP 90254	Wadi Al Kuf	m	a	10.0	56	23	47.3	23.0	–	19.82	16.74	10.33	2.47	8.67	6.34	4.99	7.22	6.77	12.33	3.08	7.05
NMP 90255	Wadi Al Kuf	m	a	10.0	57	26	47.3	23.0	–	19.90	17.17	10.25	2.47	8.62	5.96	5.18	7.22	6.76	12.81	2.93	7.27
NMW 27350	Al Bayda	f	a	–	83	29	–	21.0	–	–	17.04	10.25	2.45	8.67	6.09	5.02	7.26	6.69	12.67	3.06	7.42
NMW 27351	Wadi Al Kuf	m	a	7.0	49	27	45.7	20.0	–	–	16.18	10.28	2.68	8.62	6.34	5.14	7.13	6.47	12.02	2.82	6.93
NMW 27352	Wadi Al Kuf	m	a	10.0	56	26	48.7	21.0	–	19.02	17.20	9.97	2.41	8.57	6.38	5.08	7.18	6.78	12.55	2.92	7.12
NMW 30105	Wadi Al Kuf	m	a	–	–	–	49.0	–	–	–	17.38	10.34	2.62	8.64	–	5.17	7.21	6.85	12.61	3.01	7.23
Asellia tridens																					
MSNG 32180	Awbari	f	s/a	–	–	–	45.6	–	–	18.02	15.88	9.65	2.36	7.14	5.47	4.93	7.02	6.72	11.89	3.48	7.22
MSNG 33222	Zuwaylah	f	s/a	–	–	–	45.5	–	–	17.18	15.41	9.29	2.46	7.16	5.14	4.76	7.02	6.61	11.64	3.55	7.03
NMP 48317	Ghat	f	s	6.2	57	22	49.5	18.3	–	17.58	15.58	10.22	2.19	7.26	5.07	4.83	7.24	6.62	11.78	3.84	7.33
SMF 11787	Murzuq	m	a	–	–	–	–	–	–	18.69	16.56	10.13	2.34	7.28	5.51	5.21	7.28	6.81	12.66	3.74	7.51
Myotis punicus																					
NMP 49944	Ain Sharshara	m	a	16.5	67	60	57.6	28.4	12.5	21.54	20.35	13.88	5.29	9.73	7.57	5.53	8.98	9.33	16.52	5.60	10.08
NMP 49945	Ain Sharshara	f	a	21.4	71	61	61.7	28.2	12.3	22.58	21.24	14.11	5.21	10.04	7.75	5.68	9.27	9.31	16.68	5.58	10.05
NMP 49946	Ain Sharshara	m	a	19.4	70	55	58.5	28.8	10.8	22.38	21.08	14.02	5.27	9.92	7.72	5.63	9.15	9.33	16.75	5.85	10.08
NMP 49947	Ain Sharshara	f	s	15.7	66	54	61.2	28.3	11.6	21.41	20.48	–	5.04	9.64	7.11	5.48	8.82	9.04	16.14	5.32	9.84
NMP 49980	Sabratha	m	a	19.2	67	55	59.3	29.1	11.5	22.31	21.20	14.48	5.07	9.78	7.57	5.68	9.19	9.25	16.97	5.66	9.92
SMF 90872	Sabratha	m	a	20.0	69	55	58.7	25.6	13.0	22.14	21.16	14.21	5.27	9.91	7.85	5.94	9.08	9.25	16.82	5.83	9.87
Eptesicus isabellinus																					
MSNG 46923	Abu Kammash	f	a	–	–	–	52.7	–	–	20.34	19.77	14.06	4.48	9.58	6.64	6.75	8.91	7.76	15.36	5.75	8.57
NMP 49855	Ain Az Zarqa	m	a	18.2	74	51	49.8	20.6	7.3	19.16	19.08	14.02	4.41	9.17	6.63	6.83	8.68	7.69	14.71	5.19	8.47
NMP 49941	Lebdah	m	a	14.8	69	47	45.1	19.7	6.4	18.51	18.30	12.77	4.18	8.73	6.17	6.14	7.93	7.13	13.93	5.11	7.92
NMP 49942	Lebdah	m	a	16.7	69	51	47.7	20.4	7.0	18.96	18.73	13.96	4.27	9.03	6.46	6.48	8.77	7.25	14.45	5.38	8.04
NMP 49943	Lebdah	m	a	18.3	71	51	47.2	20.1	6.8	19.34	18.88	13.67	4.27	9.04	6.84	6.38	8.25	7.14	14.39	5.17	7.90
NMP 49950	Ain Sharshara	m	a	19.4	72	55	49.1	20.3	7.5	19.83	19.63	13.98	4.38	9.46	6.45	6.62	8.52	7.49	14.75	5.54	8.22
NMP 49951	Ain Sharshara	f	a	24.2	74	54	51.6	20.9	7.7	20.37	19.86	14.31	4.41	9.45	6.88	6.66	8.62	7.57	15.02	5.67	8.42
NMP 49961	Nanatalah	m	a	16.0	69	53	47.3	20.6	7.4	19.25	18.67	13.27	4.37	9.11	6.87	6.38	8.29	7.07	14.19	5.20	7.76
NMP 49962	Nanatalah	m	a	22.2	76	56	49.7	21.4	7.9	19.82	19.65	14.15	4.39	9.67	6.65	6.75	8.71	7.74	14.98	5.62	8.41
NMP 49977	Sabratha	f	a	20.1	77	51	50.4	20.6	7.5	20.22	19.59	14.08	4.34	9.54	6.58	6.74	8.94	7.73	15.12	5.54	8.49
NMP 49978	Sabratha	f	a	19.6	75	55	50.3	20.1	6.2	19.11	18.88	14.22	4.15	8.88	6.92	6.59	8.67	7.41	14.87	5.68	8.28
NMP 49979	Sabratha	m	a	20.0	69	51	46.0	19.9	6.6	19.15	18.97	13.92	4.58	9.12	6.54	6.41	8.55	7.25	14.25	4.98	7.87
NMP 95039	Tarabulus	f	j	–	58	38	41.7	17.0	7.0	17.37	–	11.07	–	–	–	–	–	6.28	–	–	7.43
NMP 95067	Tarabulus	f	s	22.0	77	58	50.4	16.5	8.8	20.51	20.02	14.42	4.13	9.32	7.08	6.62	8.74	7.38	14.92	5.52	8.34
Pipistrellus hanaki																					
NMP 49884	Wadi Minshiyah	f	a	5.2	47	39	33.4	12.5	5.1	12.69	12.18	7.96	3.12	6.27	4.47	3.87	5.11	4.47	8.82	2.47	4.63
NMP 49890	Arqub Shafshaf	f	a	5.9	45	36	33.3	12.3	5.1	12.49	11.92	7.91	3.24	6.29	4.42	3.88	5.31	4.45	8.66	2.58	4.75
NMP 49891	Arqub Shafshaf	m	a	5.5	49	38	31.2	11.2	4.8	12.37	11.78	7.75	2.98	6.24	4.36	3.91	5.05	4.48	8.62	2.63	4.73

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCb	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Pipistrellus hanaki																					
NMP 49892	Arqub Shafshaf	f	a	6.5	41	38	32.9	11.6	5.3	12.14	11.95	7.85	3.03	6.12	4.37	3.82	5.19	4.53	8.72	2.58	4.83
NMP 49894	Wadi Al Kuf	f	a	5.3	43	36	32.7	12.3	5.1	12.54	11.97	7.82	3.08	6.34	4.46	3.88	5.02	4.43	–	–	–
NMP 49895	Wadi Al Kuf	f	a	5.3	46	37	33.2	11.8	5.9	12.58	12.01	8.12	3.35	6.45	4.63	3.93	5.21	4.47	8.78	2.54	4.66
NMP 49896	Wadi Al Kuf	f	a	4.6	44	37	32.4	10.8	5.7	12.42	11.87	7.82	3.24	6.35	4.42	3.92	5.16	4.48	8.69	2.60	4.75
NMP 49897	Wadi Al Kuf	f	s	4.7	43	39	32.5	12.3	5.4	12.47	12.17	8.09	3.14	6.51	4.52	4.08	5.19	4.53	8.77	2.76	4.76
NMP 49903	Wadi Al Kuf	f	a	5.1	45	35	31.3	12.5	5.1	12.33	11.90	7.85	3.18	6.35	4.48	3.84	4.98	4.35	8.71	2.48	4.62
NMP 49904	Wadi Al Kuf	f	a	5.6	44	37	31.9	13.0	5.1	12.16	11.64	7.74	3.12	6.35	4.46	3.88	5.11	4.48	8.62	2.57	4.69
NMP 90158	Wadi Al Kuf	f	a	5.0	42	32	32.5	9.5	5.0	12.36	11.88	7.62	3.12	6.04	4.43	3.73	4.98	4.48	8.61	2.48	4.76
NMP 90159	Wadi Al Kuf	f	a	5.0	45	36	32.8	10.0	5.5	12.42	11.92	7.68	3.01	6.28	4.43	3.93	5.16	4.44	8.92	2.48	4.78
NMP 95062	Wadi Al Kuf	f	a	5.3	43	34	32.9	9.5	5.0	12.54	12.03	7.84	3.32	6.24	4.48	3.95	5.12	4.37	8.74	2.57	4.78
NMW 30111	Massah	m	a	3.8	40	31	30.9	10.7	–	11.69	11.12	7.43	3.08	6.01	4.14	3.63	4.98	4.29	8.23	2.57	4.49
NMW 30112	Wadi Al Kuf	f	a	4.8	45	35	30.9	11.4	–	12.13	11.58	7.71	3.06	6.03	4.53	3.87	5.08	4.27	8.49	2.61	4.61
NMW 30113	Wadi Al Kuf	f	a	4.9	41	31	31.2	10.0	–	11.89	11.41	7.54	3.11	5.87	4.27	3.75	5.11	4.36	8.23	2.55	4.59
NMW 30114	Wadi Al Kuf	m	a	4.8	45	31	30.8	11.4	–	12.24	11.61	7.68	3.03	6.13	4.53	3.83	5.04	4.27	8.38	2.49	4.51
NMW 30115	Wadi Al Kuf	f	a	5.0	46	30	32.6	12.0	–	12.35	12.01	7.81	3.08	6.13	4.42	3.91	5.14	4.48	8.66	2.61	4.77
NMW 30116	Wadi Al Kuf	f	a	4.2	47	37	32.8	11.9	–	11.98	11.48	7.59	3.01	6.01	4.41	3.62	4.89	4.32	8.33	2.53	4.60
NMW 30117	Wadi Al Kuf	f	a	4.9	46	35	32.2	10.4	–	12.39	11.82	7.63	3.08	6.26	4.58	3.78	5.02	4.32	8.48	2.47	4.58
NMW 30118	Wadi Al Kuf	f	a	4.2	46	35	32.1	12.4	–	12.01	11.55	7.74	3.11	6.11	4.39	3.89	5.16	4.42	8.44	2.61	4.69
Pipistrellus kuhlii																					
BMNH 2.11.4.1	Murzuq	m	a	–	–	–	29.7	–	–	11.77	11.43	–	3.08	6.06	4.37	3.68	5.07	4.40	8.22	2.83	4.62
MHNG 987.14	Tarabulus	m	a	–	–	–	34.4	–	–	13.74	13.38	8.63	3.34	6.61	4.75	4.35	5.76	5.09	9.30	2.95	5.42
MSNG 30944	Jalu	m	a	–	–	–	–	–	–	12.05	11.87	–	3.39	6.22	4.39	3.73	5.27	4.44	9.02	2.87	4.77
MSNG 33206	Jalu	f	a	–	–	–	33.9	–	–	12.63	12.27	–	3.20	6.24	4.69	4.03	5.59	4.64	8.95	2.89	5.02
MSNG 33207	Murzuq	m	a	–	–	–	29.7	–	–	–	–	–	–	–	–	–	–	4.28	8.44	2.68	4.52
MSNG 31618a	Jalu	m	a	–	–	–	33.1	–	–	12.64	12.28	8.24	3.25	6.28	4.69	3.73	5.48	4.47	9.19	3.06	4.88
MSNG 31618b	Jalu	m	a	–	–	–	32.5	–	–	12.70	12.43	8.07	3.17	6.25	4.51	3.82	5.37	4.47	9.04	2.95	4.84
MSNG 31618c	Jalu	m	a	–	–	–	32.0	–	–	12.43	11.97	–	3.11	6.31	–	3.82	5.28	4.47	9.08	2.92	4.83
MSNG 31618d	Jalu	m	a	–	–	–	33.0	–	–	12.75	12.17	–	3.33	6.35	4.67	3.88	5.42	4.54	9.08	2.75	5.03
MSNG 31619a	Jalu	f	a	–	–	–	33.7	–	–	12.67	12.31	–	3.51	6.43	4.70	3.95	5.43	4.56	9.18	2.79	4.83
MSNG 31619b	Jalu	f	a	–	–	–	34.5	–	–	12.42	12.11	–	3.32	6.54	4.76	3.89	5.58	4.54	8.93	2.93	4.83
NMP 48302	Gabrun	f	a	4.0	44	37	31.9	11.5	5.3	11.96	11.53	7.61	2.84	5.89	4.40	3.59	5.08	4.56	8.54	2.69	4.71
NMP 48303	Gabrun	f	a	4.2	41	37	32.5	11.2	4.7	12.24	11.49	8.18	3.17	6.31	4.61	3.79	5.35	4.37	8.76	2.85	4.75
NMP 48304	Gabrun	f	a	4.6	45	37	32.0	11.1	5.0	11.93	11.42	7.82	2.87	5.92	4.42	3.73	5.13	4.35	8.46	2.75	4.47
NMP 48305	Gabrun	f	a	4.5	51	39	31.3	10.7	5.3	12.11	11.72	8.00	2.98	6.08	4.43	3.81	5.11	4.42	8.71	2.72	4.71
NMP 48309	Gabrun	m	a	3.8	46	35	30.3	12.1	5.3	11.98	11.58	7.77	2.88	6.07	4.28	3.80	5.17	4.37	8.73	2.75	4.61
NMP 48310	Gabrun	f	a	–	46	38	31.8	11.4	5.3	12.14	11.68	7.92	2.91	6.18	4.28	3.81	5.15	4.47	8.61	2.92	4.78
NMP 48311	Gabrun	f	s	3.3	44	40	31.8	11.1	5.2	11.87	11.54	7.88	3.06	6.06	4.32	3.82	5.13	4.37	8.47	2.68	4.74
NMP 48312	Gabrun	f	a	3.5	44	40	32.4	10.8	4.9	11.83	11.08	7.52	2.94	5.93	4.25	3.62	5.06	4.19	8.33	2.63	4.54
NMP 48313	Gabrun	f	s	3.0	44	38	31.9	12.2	5.7	11.89	11.42	7.86	2.98	6.06	4.17	3.68	4.93	4.22	–	2.67	4.68
NMP 48314	Gabrun	f	a	3.3	46	35	32.0	12.0	5.1	12.07	11.56	8.02	3.13	6.25	4.18	3.67	4.98	4.27	8.87	3.01	4.62
NMP 48315	Gabrun	f	a	3.6	45	40	32.5	12.0	5.1	12.20	11.75	7.92	3.17	6.31	4.33	3.83	5.27	4.38	8.73	2.88	4.64
NMP 48316	Gabrun	f	a	4.1	42	38	33.3	10.3	4.8	11.81	11.38	8.08	2.96	6.23	4.47	3.75	5.03	4.20	8.61	2.78	4.59

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCb	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Pipistrellus kuhlii																					
NMP 48318	Gabrun	f	s	3.4	47	38	31.7	11.7	5.3	12.02	11.61	7.98	3.10	6.18	4.37	3.82	5.19	4.38	8.58	2.88	4.72
NMP 48319	Murzuq	m	a	3.9	43	37	30.8	12.2	5.0	–	–	7.49	2.74	–	–	3.75	4.84	4.37	8.42	2.56	4.67
NMP 48320	Germa	m	a	3.7	45	39	30.4	11.4	5.6	11.54	11.11	7.53	2.85	5.88	4.05	3.58	4.97	4.17	8.26	2.66	4.61
NMP 48321	Al Fjayj	m	a	3.6	44	40	30.7	13.0	5.7	11.73	11.28	7.84	2.93	5.96	4.28	3.64	5.08	4.32	8.45	2.64	4.74
NMP 48322	Karkurah	m	a	6.1	49	41	32.3	11.5	5.9	12.89	12.58	8.49	3.07	6.42	4.62	4.14	5.75	4.97	9.50	3.00	5.27
NMP 48326	Al Aquriyah	f	s	5.6	53	41	33.0	12.2	6.1	13.02	12.72	8.64	3.32	6.39	4.54	4.21	5.65	4.83	9.62	2.98	5.22
NMP 48332	Al Abyar	f	s	7.5	51	45	36.4	15.3	5.9	13.60	13.02	9.27	3.23	6.53	4.73	4.51	5.88	5.09	9.92	3.24	5.35
NMP 49843	Al Jawsh	m	a	6.0	48	35	33.3	13.5	6.3	13.30	12.86	8.71	3.25	6.64	4.75	4.35	5.69	5.06	9.67	3.09	5.38
NMP 49845	Sinawan	m	a	5.1	48	41	32.9	15.6	6.2	12.75	12.32	8.40	3.14	6.36	4.76	4.23	5.57	4.90	9.23	3.10	5.23
NMP 49846	Sinawan	m	a	4.8	47	39	31.2	14.4	6.4	12.52	12.49	8.30	3.17	6.38	4.55	–	5.37	4.63	8.88	2.97	4.95
NMP 49847	Sinawan	m	a	5.9	49	46	33.8	14.6	5.3	13.58	13.12	8.94	3.28	6.92	4.96	4.53	5.87	4.96	9.74	3.28	5.30
NMP 49848	Sinawan	f	a	7.1	50	43	34.7	13.7	5.5	13.17	12.74	8.68	3.20	6.46	4.67	4.21	5.56	4.88	9.72	2.98	5.14
NMP 49849	Sinawan	f	a	6.3	50	42	35.2	14.6	6.4	13.07	13.04	8.71	3.30	6.70	4.89	4.23	5.82	4.88	9.69	3.15	5.25
NMP 49850	Sinawan	f	a	4.9	45	38	33.8	13.4	6.6	12.84	12.45	–	3.11	6.18	4.61	4.17	5.58	4.82	9.46	3.18	5.18
NMP 49851	Sinawan	f	a	6.5	48	43	35.5	14.7	6.2	13.31	12.84	8.70	3.24	6.42	4.71	4.11	5.76	4.95	9.38	3.15	5.63
NMP 49853	Sinawan	f	a	5.2	50	41	33.5	14.7	6.3	12.98	12.62	8.62	3.20	6.52	4.69	4.06	5.58	4.74	9.39	3.07	5.02
NMP 49859	Sinawan	f	a	4.7	49	42	33.4	14.5	6.2	12.97	12.58	–	3.21	6.35	4.73	4.23	5.55	4.74	9.45	2.86	4.98
NMP 49893	Wadi Al Kuf	m	a	5.4	43	42	34.0	13.2	6.1	13.24	12.78	8.57	3.28	6.57	4.71	4.42	5.73	4.79	9.80	2.97	5.20
NMP 49917	Wadi Jarmah	m	a	5.2	46	41	33.5	13.0	5.3	13.51	12.98	8.91	3.33	6.75	4.81	4.41	5.76	4.96	9.86	3.17	5.37
NMP 49918	Wadi Jarmah	m	a	5.2	44	42	34.4	12.2	5.5	13.35	13.02	–	3.41	6.64	4.92	4.46	5.82	4.91	9.74	3.21	5.24
NMP 49921	Wadi An Nazrat	m	a	5.7	50	41	35.6	14.0	6.4	13.58	13.21	8.98	3.37	6.60	4.76	4.45	5.92	5.27	10.09	3.05	5.57
NMP 49923	Wadi An Nazrat	f	a	7.3	53	42	35.5	14.0	5.6	13.61	13.13	8.80	3.45	6.47	4.82	4.65	6.18	5.17	10.12	3.18	5.58
NMP 49930	Ad Dirsiyah	f	a	7.5	56	41	35.8	14.1	6.2	13.42	13.17	8.96	3.19	6.49	4.75	4.40	5.92	5.02	9.97	3.31	5.36
NMP 49931	Ad Dirsiyah	f	a	8.2	53	43	35.1	15.3	5.1	13.71	13.43	9.17	3.42	6.71	4.82	4.39	5.93	5.07	10.13	3.18	5.32
NMP 49933	Ar Rajmah	f	a	7.2	52	43	35.7	14.3	6.0	13.78	13.37	9.05	3.40	6.77	5.24	4.37	6.02	5.22	10.02	3.31	5.49
NMP 49934	Ar Rajmah	f	a	6.4	46	43	34.0	13.8	6.1	13.07	12.65	8.95	3.17	6.48	4.74	4.44	6.02	4.98	9.54	3.06	5.32
NMP 49936	Ar Rajmah	m	a	5.4	45	39	33.8	13.7	5.8	13.27	12.89	8.82	3.22	6.48	4.69	4.39	5.74	5.00	9.62	3.08	5.30
NMP 49937	Ar Rajmah	m	a	6.4	51	44	35.8	14.3	7.2	13.84	13.34	9.03	3.35	6.68	4.83	4.49	5.86	5.22	9.93	3.28	5.53
NMP 49939	Jalu	f	a	6.6	50	39	33.8	14.3	6.2	12.57	12.37	8.24	3.17	6.34	4.43	3.98	5.49	4.66	9.19	3.03	4.98
NMP 49953	Ain Sharshara	f	a	6.1	49	39	34.0	14.4	6.5	13.02	12.59	8.62	3.55	6.71	4.82	4.25	5.75	5.11	9.58	2.96	5.47
NMP 49954	Ain Sharshara	f	a	5.9	49	40	33.0	12.6	6.3	12.83	12.54	8.62	3.27	6.59	4.63	4.32	5.96	4.63	9.37	3.19	5.13
NMP 49955	Ain Sharshara	m	a	6.1	47	40	32.8	13.3	5.5	13.28	12.77	8.69	3.48	6.56	4.76	4.25	5.82	4.92	9.62	3.05	5.18
NMP 49958	Ain Sharshara	f	a	5.2	46	39	34.5	14.5	6.4	13.17	12.75	8.68	3.40	6.48	4.67	4.18	5.75	4.93	9.67	3.18	5.25
NMP 49959	Ain Sharshara	m	a	4.6	43	39	31.0	13.5	5.2	12.62	12.25	8.42	3.43	6.39	–	4.07	5.54	4.77	8.92	3.03	5.23
NMP 49960	Ain Sharshara	f	a	5.8	50	38	33.7	13.7	6.4	13.20	12.62	8.46	3.38	6.55	4.61	4.31	5.67	4.93	9.48	3.00	5.31
NMP 49968	Nanatalah	m	a	5.0	46	39	34.1	15.0	6.1	12.92	12.61	8.52	3.31	6.39	4.42	4.30	5.81	4.97	9.56	3.17	5.31
NMP 49969	Nanatalah	m	a	6.1	46	41	33.1	15.3	6.0	13.12	12.67	8.62	3.14	6.51	4.55	4.13	5.74	4.89	9.44	3.12	5.32
NMP 49970	Nanatalah	m	a	5.5	44	41	33.3	12.9	5.8	13.30	12.77	8.68	3.37	6.42	4.62	4.23	5.68	4.95	9.62	3.04	5.35
NMP 49972	Nanatalah	f	a	5.7	47	38	33.9	14.7	6.3	13.13	12.67	–	3.47	6.43	4.40	4.15	5.64	5.01	9.48	2.92	5.27
NMP 49973	Nanatalah	f	a	6.0	48	40	34.7	14.3	5.8	12.95	12.63	8.62	3.02	6.43	4.68	4.32	5.73	4.92	9.67	3.09	5.18
NMP 49974	Nanatalah	f	a	6.4	49	40	33.8	14.4	6.0	12.98	12.67	8.42	3.16	6.36	4.58	4.12	5.68	4.88	9.33	3.10	5.18
NMP 49981	Sabratha	m	a	5.2	44	42	33.4	14.2	6.5	12.92	12.52	–	3.26	6.52	4.74	4.34	5.62	5.00	9.35	3.02	5.25

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCb	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Pipistrellus kuhlii																					
NMP 49982	Sabratha	m	a	5.3	49	41	33.0	14.4	6.0	12.92	12.65	8.52	3.26	6.38	4.75	4.10	5.66	4.85	9.33	3.02	5.27
NMP 49983	Sabratha	m	a	4.9	44	40	32.6	13.5	5.7	12.88	12.50	–	3.17	6.35	4.59	4.24	5.62	4.78	9.33	2.98	5.12
NMP 95035	Ain Zeyanah	f	a	6.5	45	41	34.3	11.0	7.0	12.82	12.62	8.56	3.33	6.35	4.57	4.27	5.63	4.88	9.62	3.13	5.24
NMP 95036	Ain Zeyanah	f	a	8.0	45	43	33.5	12.0	6.8	13.14	12.62	8.44	3.13	6.41	4.65	4.08	5.64	4.62	9.41	2.87	4.89
NMP 95038	Tarabulus	f	a	–	43	37	34.2	11.5	6.5	12.88	12.67	8.59	3.42	6.54	4.66	4.28	5.71	4.68	9.34	2.82	5.13
NMP 95040	Tarabulus	f	a	6.7	51	44	33.4	11.7	6.0	13.11	12.93	9.03	3.42	6.57	4.62	4.22	5.78	4.98	9.79	2.93	5.32
NMP 95043	Ain Zeyanah	–	a	–	–	–	–	–	–	12.93	12.47	8.68	3.26	6.67	4.68	4.23	5.88	4.91	9.23	3.24	5.17
NMP 95044	Ain Zeyanah	f	a	8.5	49	37	32.9	12.0	7.0	13.36	12.98	–	3.53	6.62	4.74	4.39	5.76	4.81	9.68	2.98	5.13
NMP 95045	Ain Zeyanah	f	a	8.5	49	40	34.3	12.0	6.5	13.52	13.17	8.87	3.35	6.38	4.83	4.15	6.07	4.88	9.76	2.97	5.28
NMP 95046	Ain Zeyanah	f	a	9.5	48	41	33.1	11.0	6.0	13.49	13.18	9.02	3.33	6.78	4.82	4.34	5.92	4.92	9.68	2.96	5.29
NMP 95047	Ain Zeyanah	f	a	9.0	49	40	34.0	11.0	6.5	13.47	13.18	8.72	3.34	6.48	4.76	4.29	5.88	5.13	9.57	3.08	5.37
NMP 95048	Ain Zeyanah	f	a	9.5	51	43	33.6	11.0	6.0	13.63	13.12	8.94	3.32	6.62	4.92	4.38	6.04	5.11	9.73	3.08	5.33
NMP 95049	Ain Zeyanah	f	a	9.0	52	42	32.9	11.0	6.0	13.23	12.84	8.66	3.41	6.59	4.86	4.37	5.87	4.94	9.58	3.11	5.28
NMP 95050	Ain Zeyanah	f	a	9.5	51	41	34.4	11.5	6.5	13.79	13.28	8.91	3.52	6.61	4.91	4.41	5.93	5.08	9.78	2.98	5.43
NMP 95051	Ain Zeyanah	f	a	10.0	52	43	34.7	11.5	7.0	13.58	13.26	8.72	3.34	6.66	4.96	4.27	5.84	4.98	9.75	3.14	5.37
NMP 95052	Ain Zeyanah	f	a	–	46	40	32.3	12.0	7.0	13.17	13.04	8.62	3.22	6.42	4.72	4.39	5.98	4.91	9.58	3.02	5.24
NMP 95053	Ain Zeyanah	m	a	6.0	47	38	33.4	11.5	6.5	13.42	12.82	–	3.38	6.71	4.55	4.38	5.77	4.98	9.75	2.98	5.28
NMP 95054	Ain Zeyanah	m	a	6.0	46	41	31.8	11.5	7.0	13.14	12.88	8.58	3.28	6.43	4.74	4.34	5.75	5.01	9.32	3.01	5.32
NMP 95055	Ain Zeyanah	m	a	6.5	50	39	33.7	11.0	7.0	13.52	13.16	9.16	3.38	6.68	4.88	4.75	5.93	5.24	9.63	3.28	5.48
NMP 95056	Ain Zeyanah	m	a	6.0	47	38	32.6	11.0	7.0	13.34	13.05	–	3.37	6.53	4.63	4.31	5.54	4.96	9.81	3.04	5.36
NMP 95057	Ain Zeyanah	f	a	9.0	48	38	34.9	12.0	7.0	13.38	13.22	8.97	3.34	6.61	4.75	4.34	5.88	5.04	9.68	3.11	5.38
NMP 95058	Ain Zeyanah	f	a	8.5	49	42	35.4	12.0	6.0	13.43	13.18	8.78	3.18	6.42	4.73	4.38	5.82	5.09	9.78	3.18	5.34
NMP 95059	Ain Zeyanah	f	a	8.0	50	40	33.0	12.0	6.5	13.13	12.87	8.47	3.21	6.43	4.74	4.03	5.72	4.98	9.53	2.88	5.31
NMP 95060	Wadi Al Kuf	m	a	6.8	47	40	33.0	12.0	7.0	13.29	12.82	8.96	3.17	6.42	5.03	4.21	5.68	4.84	9.67	3.12	5.22
NMP 95061	Wadi Al Kuf	f	a	6.5	48	37	33.6	11.5	7.0	13.94	13.47	9.03	3.44	6.68	4.71	4.39	5.94	6.04	9.93	3.04	5.48
NMP 95064	Ain Zeyanah	f	a	8.0	46	41	32.9	11.5	6.0	12.79	12.42	8.44	3.48	6.48	4.63	4.28	5.54	4.78	9.38	2.93	5.23
NMP 95065	Ain Zeyanah	f	a	10.0	48	42	36.2	11.5	7.0	13.62	13.27	8.82	3.28	6.56	4.63	4.27	6.03	4.98	9.77	3.06	5.38
NMP 95066	Ain Zeyanah	f	a	8.0	47	42	35.2	11.0	7.0	13.14	12.98	8.93	3.27	6.76	4.63	4.34	5.89	5.09	9.98	2.88	5.48
NMP 95068	Sabratha	f	a	7.5	51	40	33.8	11.5	7.0	13.08	12.62	8.72	3.16	6.52	4.68	4.26	7.66	4.82	9.74	3.06	5.14
NMW 21961	Tarabulus	f	a	–	–	–	–	–	–	12.03	11.77	–	3.18	5.93	4.58	4.04	5.58	4.59	–	–	–
NMW 30119	Wadi Jarmah	m	a	6.0	50	42	34.3	12.5	–	13.22	12.74	9.01	3.18	6.58	5.03	4.64	5.77	5.08	9.63	3.24	5.41
NMW 30120	Ain Az Zarqa	m	a	6.0	48	37	32.4	11.2	–	13.01	12.63	–	3.29	6.47	4.63	4.41	5.83	4.93	9.48	3.21	5.34
NMW 30121	Ain Az Zarqa	f	a	6.0	53	39	34.3	12.8	–	13.38	12.93	8.97	3.31	6.54	4.88	4.25	5.83	5.03	9.74	3.17	5.37
NMW 30122	Ain Az Zarqa	f	a	5.8	51	40	33.6	12.9	–	13.34	13.11	8.82	3.21	6.38	4.76	4.39	5.93	4.97	9.91	3.25	5.39
NMW 30123	Ain Az Zarqa	f	a	6.5	50	38	34.0	14.1	–	13.29	12.93	8.86	3.31	6.28	4.92	4.42	5.87	4.72	9.77	3.15	5.33
NMW 30124	Ain Az Zarqa	f	a	5.0	50	37	32.1	13.5	–	12.93	12.37	8.32	3.48	6.31	4.61	4.09	5.53	4.92	9.13	2.98	5.27
NMW 30125	Ain Az Zarqa	f	a	7.0	52	41	34.4	13.8	–	13.34	12.96	9.09	3.42	6.73	4.93	4.38	5.72	4.96	9.88	3.11	5.39
NMW 30126	Ain Az Zarqa	f	a	6.0	49	41	34.6	12.4	–	13.44	12.91	8.67	3.28	6.43	4.92	4.36	5.73	4.93	9.58	2.92	5.34
NMW 30127	Ain Az Zarqa	f	s	5.5	49	38	34.0	13.7	–	12.93	12.44	–	3.23	6.29	4.63	4.13	5.74	4.88	9.34	2.93	5.14
NMW 30128	Ain Az Zarqa	m	s	6.2	50	42	33.3	11.3	–	13.22	12.74	8.66	3.27	6.52	4.67	4.23	5.84	4.96	9.53	3.18	5.36
NMW 30129	Wadi Al Kuf	m	a	6.8	51	38	34.6	13.8	–	13.78	13.28	8.81	3.43	6.69	4.83	4.36	5.98	5.22	9.78	3.05	5.47
NMW 30130	Shahhat	f	s	7.0	50	40	35.8	13.9	–	13.34	12.98	8.79	3.48	6.38	4.56	4.23	5.98	4.91	9.56	3.07	5.27

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCb	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Pipistrellus kuhlii																					
NMW 30131	Wadi Al Kuf	f	s	4.5	44	33	31.8	12.6	–	12.23	11.68	8.18	3.23	6.24	4.42	3.82	5.48	4.78	8.91	2.83	5.12
Vansonia rueppellii																					
NMP 49878	Al Jaghbub	f	a	4.1	44	33	30.4	12.2	5.3	12.02	11.27	7.58	3.18	6.32	4.37	3.42	4.67	4.08	8.18	2.18	4.18
Nyctalus lasiopterus																					
NMP 49885	Wadi Minshiyah	f	s	37.2	89	58	57.2	23.7	8.0	20.88	21.15	–	5.63	11.18	7.32	8.52	10.27	8.75	16.57	4.98	9.42
NMP 49886	Arqub Shafshaf	m	a	40.7	92	59	60.1	21.1	8.0	21.42	21.97	15.28	5.61	11.12	7.78	8.78	10.30	8.98	16.65	4.84	9.62
NMP 49887	Arqub Shafshaf	m	a	35.0	90	57	59.7	23.3	7.8	21.08	21.55	14.89	5.51	10.75	7.65	8.65	10.13	8.74	16.65	4.76	9.44
NMP 49888	Arqub Shafshaf	m	a	39.1	91	59	60.6	23.8	8.8	21.02	21.58	15.92	5.72	11.28	7.83	8.97	10.48	8.90	16.83	5.08	9.55
NMW 30109	Shahhat	m	a	–	–	–	–	–	–	21.59	22.07	15.71	5.34	11.28	7.52	8.89	10.33	9.04	16.97	5.02	9.52
NMW 30110	Shahhat	m	a	51.0	100	69	60.9	25.0	–	21.69	22.35	15.91	5.48	11.21	8.13	9.17	10.32	9.14	17.33	5.12	9.53
NMW S81/59	Wadi Al Kuf	m	a	44.0	90	55	59.4	20.8	–	21.27	21.63	15.42	5.73	10.91	7.91	9.13	10.27	8.91	17.07	4.93	9.43
Nyctalus leisleri																					
NMP 95063	Wadi Al Kuf	m	a	13.0	63	42	41.2	14.0	7.5	15.32	15.31	9.93	4.33	7.86	5.42	5.65	6.91	5.79	11.34	2.96	6.17
Otonycteris hemprichii																					
NMP 49964	Nanatalah	m	a	20.4	74	54	63.5	41.3	17.8	23.30	21.84	14.29	4.23	10.17	7.23	6.31	9.66	8.36	15.97	7.37	9.18
Plecotus gaisleri																					
NMP 48330	Shahhat	m	a	8.6	52	48	38.7	36.5	16.0	17.05	16.02	8.93	3.50	8.30	5.47	3.93	6.22	5.82	10.77	3.07	6.18
NMP 48331	Shahhat	m	a	8.4	55	50	39.4	37.5	16.8	17.08	15.92	9.02	3.53	8.76	5.43	3.88	6.14	5.71	10.78	3.22	6.32
NMP 49857	Ain Az Zarqa	f	a	7.8	56	44	40.9	36.2	16.9	16.88	15.96	8.94	3.48	8.08	5.41	4.01	6.27	5.75	10.94	3.11	6.27
NMP 49858	Ain Az Zarqa	f	a	8.2	56	51	40.9	36.2	16.2	17.24	16.25	8.98	3.38	8.27	5.44	3.92	6.14	5.89	11.36	3.29	6.42
NMP 49883	Wadi Minshiyah	f	a	9.1	53	49	39.4	37.5	16.3	17.18	16.17	9.05	3.52	8.39	5.69	4.15	6.32	5.86	11.13	3.22	6.21
NMP 49899	Wadi Al Kuf	m	a	7.1	50	49	39.8	34.3	17.2	17.18	16.04	9.10	3.62	8.46	5.52	3.94	6.17	5.82	11.17	3.35	6.19
NMP 49900	Wadi Al Kuf	m	a	8.1	53	47	37.9	34.2	16.6	16.71	15.74	8.78	3.48	8.15	5.57	3.92	6.30	5.71	10.75	3.09	6.07
NMP 49905	Wadi Al Kuf	m	a	7.8	50	50	38.2	35.8	15.0	16.65	15.68	8.92	3.44	8.29	5.43	3.98	6.28	5.65	10.74	3.18	6.07
NMP 49906	Wadi Al Kuf	m	a	8.1	52	48	38.6	37.3	16.5	17.15	16.03	8.95	3.50	8.19	5.47	3.90	6.27	5.75	10.84	2.83	6.12
NMP 49907	Wadi Al Kuf	m	a	7.1	55	46	36.9	36.0	16.9	16.54	15.63	8.83	3.45	8.04	5.36	3.93	6.12	5.86	10.75	3.03	5.93
NMP 49911	Wadi Al Kuf	f	a	8.3	55	48	40.2	36.8	17.2	17.08	16.07	8.93	3.47	8.07	5.48	4.02	6.34	5.83	11.07	3.17	6.25
NMP 49916	Qasr Shahdayn	m	a	7.2	48	46	37.9	36.3	17.5	17.13	15.96	9.10	3.58	8.40	5.38	3.97	6.13	5.79	10.85	3.25	6.22
NMP 49920	Wadi Jarmah	m	a	7.6	48	50	38.8	38.3	16.7	17.16	15.89	9.14	3.49	8.34	5.65	4.07	6.31	5.47	11.13	3.17	6.25
NMP 49926	Wadi An Nazrat	m	a	7.5	50	46	39.2	37.8	17.2	17.31	16.33	8.84	3.46	8.20	5.49	4.12	6.23	5.94	11.07	3.29	6.31
NMP 49927	Wadi An Nazrat	m	a	7.4	54	51	40.1	37.1	17.3	16.76	15.68	8.94	3.48	8.17	5.62	4.03	6.32	5.73	10.72	2.96	6.14
NMP 49965	Nanatalah	m	s	6.9	50	46	39.5	37.0	16.8	16.76	15.81	9.10	3.44	8.31	5.28	3.56	6.20	5.75	10.85	3.02	6.27
NMP 49966	Nanatalah	f	a	8.7	56	48	41.8	35.3	17.3	17.63	16.42	9.22	3.37	8.47	5.34	4.05	6.54	5.94	11.48	3.34	6.39
NMP 90120	Shahhat	m	a	7.5	48	52	37.6	35.0	17.5	16.88	15.73	–	3.50	8.28	5.38	3.95	6.18	5.72	10.79	3.14	6.15
NMP 90121	Qaryat Faioyah	m	a	8.0	49	47	40.0	36.0	17.0	17.43	16.21	9.12	3.45	8.32	5.54	4.05	6.18	5.78	10.94	3.37	6.22
NMW 30132	Wadi Al Kuf	f	a	–	–	–	39.5	–	–	16.81	15.79	8.93	3.43	8.29	5.38	3.98	6.23	5.64	10.82	3.27	6.11
NMW 30133	Wadi Al Kuf	f	a	–	–	–	39.1	–	–	17.02	16.02	8.72	3.48	8.38	5.41	3.98	6.13	5.81	–	–	6.12
NMW 30134	Wadi Al Kuf	f	a	–	–	–	39.6	–	–	17.37	16.38	9.14	3.48	8.47	5.48	4.08	6.27	5.74	11.21	3.56	6.19
NMW 30135	Wadi Al Kuf	m	a	–	–	–	38.9	–	–	17.08	16.11	8.88	3.43	8.14	5.58	3.92	6.08	5.76	10.82	3.08	6.13
NMW 30136	Wadi Al Kuf	f	a	–	–	–	39.8	–	–	17.07	16.02	8.82	3.56	8.18	5.53	3.98	6.18	5.68	10.83	3.09	6.14

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCb	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Plecotus gaisleri																					
NMW 30137	Wadi Al Kuf	m	a	–	–	–	35.8	–	–	16.91	15.77	8.92	3.49	8.36	5.56	4.01	6.07	5.82	10.83	3.21	6.21
NMW 30138	Wadi Al Kuf	m	a	–	–	–	38.1	–	–	16.93	15.93	8.76	3.58	7.98	5.67	4.03	6.11	5.68	10.81	3.23	6.08
NMW 30139	Qasr Shahdayn	m	a	–	–	–	37.9	–	–	16.62	15.82	8.81	3.37	8.31	5.46	3.93	6.28	5.73	11.08	3.17	6.29
NMW 30140	Qasr Shahdayn	m	a	–	–	–	37.5	–	–	16.74	15.78	8.98	3.54	8.33	5.51	4.06	6.21	5.74	10.46	3.28	6.26
NMW 30141	Qasr Shahdayn	m	a	–	–	–	37.2	–	–	16.35	15.37	8.76	3.48	8.18	5.49	3.91	6.13	5.54	10.54	3.18	5.83
NMW 30142	Qasr Shahdayn	m	a	–	–	–	38.5	–	–	16.93	16.03	9.14	3.45	8.67	5.48	4.04	6.21	5.76	10.82	3.31	6.13
NMW 30143	Wadi Al Kuf	f	s	–	–	–	–	–	–	16.51	15.47	8.61	3.46	8.08	5.47	3.75	5.93	5.57	10.54	3.11	5.93
NMW 30144	Wadi Al Kuf	m	a	–	–	–	37.5	–	–	16.81	15.82	8.94	3.59	8.43	5.68	3.98	6.11	5.74	10.82	3.24	6.14
NMW 30145	Wadi Al Kuf	m	a	–	–	–	38.6	–	–	16.79	15.71	8.86	3.48	8.12	5.47	3.98	6.41	5.63	10.76	3.09	6.06
NMW 30146	Wadi Al Kuf	m	s	–	–	–	38.2	–	–	16.41	15.32	8.58	3.48	8.08	5.61	3.83	5.94	5.58	10.34	3.09	5.84
NMW 30147	Wadi Al Kuf	m	s	–	–	–	37.8	–	–	16.74	15.61	8.84	3.52	8.08	5.44	3.98	6.04	5.76	10.64	3.29	6.11
NMW 30148	Wadi Al Kuf	f	a	–	–	–	38.9	–	–	17.04	15.92	8.82	3.42	8.18	5.43	3.93	6.31	5.69	10.88	3.23	5.99
Plecotus christii																					
MSNG 47016	Al Jaghbub	m	a	–	–	–	37.9	–	–	15.92	–	8.22	3.17	8.08	–	3.47	5.79	5.32	9.78	2.91	5.64
MSNG 26219a	Al Jaghbub	m	a	–	–	–	36.6	–	–	16.38	14.97	8.43	3.14	8.04	5.47	3.47	5.92	5.28	10.27	2.96	5.81
MSNG 26219b	Al Jaghbub	m	s	–	–	–	36.2	–	–	–	–	–	–	–	–	–	–	5.08	9.94	2.88	3.51
MSNG 26220a	Al Jaghbub	m	a	–	–	–	37.0	–	–	–	–	–	3.23	–	–	3.42	6.07	5.34	10.23	–	5.69
MSNG 26220b	Al Jaghbub	f	a	–	–	–	38.3	–	–	16.75	15.38	8.74	3.04	8.31	5.48	3.48	5.93	5.47	10.52	3.10	5.86
NMP 49862	Al Jaghbub	m	a	5.8	51	46	36.4	35.6	17.4	16.02	14.97	8.62	3.27	8.02	5.52	3.33	5.87	5.27	10.08	2.87	5.62
NMP 49863	Al Jaghbub	f	a	7.8	54	47	40.2	35.9	17.4	16.62	15.57	8.47	3.21	8.08	5.42	3.47	5.94	5.36	10.41	2.90	5.76
Miniopterus schreibersii																					
NMP 95042	Tarabulus	–	a	–	–	45	–	10.3	–	14.89	14.48	8.56	3.56	7.89	6.18	4.38	6.24	5.91	10.75	2.73	6.18
NMW 30149	Wadi Al Kuf	f	a	–	–	–	42.5	–	–	14.66	14.08	8.11	3.47	7.68	5.94	4.36	6.17	5.77	10.37	2.46	6.07
NMW 30150	Wadi Al Kuf	f	a	–	–	–	42.8	–	–	14.48	13.97	8.16	3.43	7.63	6.08	4.41	6.23	5.68	10.18	2.43	6.04
NMW 30151	Wadi Al Kuf	m	a	–	–	–	42.0	–	–	14.58	14.11	8.08	3.51	7.62	6.23	4.42	6.18	5.67	10.27	2.44	6.08
NMW 30152	Wadi Al Kuf	m	a	–	–	–	43.8	–	–	14.71	14.28	8.36	3.54	7.73	6.18	4.48	6.21	5.74	10.41	2.56	6.04
NMW 30153	Wadi Al Kuf	m	a	–	–	–	42.8	–	–	14.72	14.17	8.37	3.52	7.93	6.41	4.37	6.21	5.74	10.49	2.57	6.13
NMW 30154	Wadi Al Kuf	f	a	–	–	–	42.6	–	–	14.73	14.17	8.27	3.53	7.74	6.22	4.43	6.21	5.78	10.36	2.43	6.17
NMW 30155	Wadi Al Kuf	m	a	–	–	–	42.4	–	–	14.44	14.08	8.33	3.43	7.63	6.08	4.53	6.24	5.74	10.32	2.55	6.11
NMW 30156	Wadi Al Kuf	f	a	–	–	–	42.3	–	–	14.58	13.86	8.04	3.38	7.73	6.18	4.36	6.18	5.67	9.94	2.42	6.02
Tadarida teniotis																					
NMP 49881	Wadi Darnah	m	a	24.7	83	51	56.9	30.7	5.8	23.57	22.84	13.98	4.52	11.27	7.39	5.46	9.08	8.42	16.98	4.13	9.03
NMP 49912	Wadi Al Kuf	m	s	26.3	84	50	58.8	28.4	5.8	23.18	22.58	13.92	4.69	11.44	7.28	5.58	9.34	8.74	16.65	4.17	9.46
NMP 49913	Wadi Al Kuf	m	a	28.2	86	47	58.8	29.2	6.7	23.74	23.21	14.14	4.57	11.74	7.17	5.51	9.11	8.75	16.95	4.36	9.63
NMP 49914	Wadi Al Kuf	f	a	30.1	83	58	57.7	29.8	5.9	22.95	21.92	14.07	4.59	11.57	7.29	5.12	9.41	8.40	16.29	4.34	9.07
NMP 49928	Wadi An Nazrat	m	a	28.7	89	51	58.1	32.4	7.2	23.43	22.53	14.14	4.71	11.32	7.32	5.51	9.24	8.88	16.42	3.90	9.38
NMP 49929	Wadi An Nazrat	f	a	33.5	86	54	60.7	34.3	7.0	24.25	23.70	13.95	4.38	11.28	7.18	5.36	9.37	9.11	16.93	4.12	9.64
NMW 30157	Wadi Jarmah	m	a	34.0	90	27	57.1	30.0	–	23.51	23.07	14.23	4.62	11.63	7.36	5.71	9.08	8.65	16.78	4.08	9.36
NMW 30158	Wadi Jarmah	m	a	35.0	90	47	56.2	30.6	–	23.28	22.75	14.11	4.67	11.87	7.56	5.64	9.57	8.89	16.53	4.12	9.66
NMW 30159	Wadi Al Kuf	m	a	25.2	81	52	53.4	25.0	–	22.63	22.02	13.63	4.54	11.32	7.31	5.42	9.29	8.73	16.01	3.71	9.26
NMW 30160	Wadi Al Kuf	f	a	31.0	93	55	58.2	29.0	–	23.94	23.48	14.28	4.58	11.82	7.39	5.67	9.41	9.06	17.19	4.23	9.84

coll. No.	site	sex	age	G	LC	LCd	LAt	LA	LT	LCr	LCb	LaZ	LaI	LaN	AN	CC	M^3M^3	CM^3	LMd	ACo	CM_3
Tadarida teniotis																					
NMW 30161	Wadi Al Kuf	f	a	30.0	90	46	56.9	25.7	–	23.47	22.93	14.32	4.71	11.81	7.18	5.64	9.36	8.72	16.28	4.19	9.36
NMW 30162	Wadi Al Kuf	f	a	27.5	89	49	59.3	26.7	–	23.46	23.05	14.08	4.41	11.53	7.23	5.66	9.31	8.91	16.83	4.18	9.63
NMW 30163	Wadi Al Kuf	f	a	29.5	90	44	56.7	24.8	–	23.66	23.08	13.93	4.43	11.48	7.17	5.70	9.49	8.94	16.48	4.03	9.57
NMW 30164	Wadi Al Kuf	f	a	30.5	91	47	57.4	21.9	–	23.85	23.31	14.44	4.83	12.07	7.44	5.83	9.49	8.83	16.56	4.04	9.39
NMW 30165	Wadi Al Kuf	f	a	32.0	92	50	58.9	29.6	–	24.25	23.73	14.38	4.74	11.98	7.31	5.95	9.63	9.08	17.07	4.27	9.63
NMW 30166	Wadi Al Kuf	m	a	29.0	91	46	58.7	29.2	–	23.58	22.98	14.38	4.54	11.69	7.46	5.73	9.53	8.91	16.93	4.23	9.68
NMW 30167	Wadi Al Kuf	m	a	30.8	88	46	58.6	28.9	–	24.02	23.41	14.17	4.64	11.51	7.14	5.93	9.93	9.07	16.74	4.02	8.73
NMW 30168	Wadi Al Kuf	m	a	30.4	91	48	57.6	30.4	–	23.68	23.17	13.94	4.33	11.51	7.31	5.53	9.23	8.34	16.51	4.38	6.67
NMW 30169	Wadi Al Kuf	f	a	34.2	87	49	58.7	31.1	–	23.59	23.11	13.88	4.53	11.42	7.11	5.58	9.47	8.76	16.68	4.43	9.34