

First records of bats from the Alatish National Park, north-western Ethiopia (Chiroptera)

První nálezy netopýřů v Národním parku Alatiš, severozápadní Etiopie (Chiroptera)

Первые сведения о рукокрылых национального парка Алатиш, Северо-западная Эфиопия (Chiroptera)

Sergei V. KRUSKOP¹, Petr BENDA^{2,3}, Denis A. VASENKOV⁴
& Leonid A. LAVRENCHENKO⁴

¹ Zoological Museum of Moscow State University, Ul. Bolshaya Nikitskaya 2, Moscow 125009, Russia; kruskop@zmmu.msu.ru

² Department of Zoology, National Museum (Natural History), Václavské nám. 68, CZ–115 79 Praha 1, Czech Republic; petr_benda@nm.cz

³ Department of Zoology, Faculty of Science, Charles University, Viničná 7, CZ–128 44 Praha 2, Czech Republic

⁴ A. N. Severtsov Institute of Ecology and Evolution RAS, Leninskii pr. 33, Moscow 119071, Russia; llavrenchenko@gmail.com; denvas@ngs.ru

received on 10 October 2016

Abstract. The paper presents results of a first attempt to survey bats of the Alatish National Park (north-western Ethiopia). Twenty-one bat species belonging to eight families and twelve genera were documented for the first time in the Park, at least two bat species (*Hipposideros abae*, *Pipistrellus nanulus*) were found new for the fauna of Ethiopia. The Alatish National Park is an area of high conservation value due to its high bat species diversity and a complex structure of the fauna including elements with various zoogeographic affinities.

Key words. Bats, Alatish National Park, Ethiopia, *Hipposideros abae*, *Pipistrellus nanulus*, *Neoromicia*, new records.

INTRODUCTION

The vast lowlands, lying west of the Ethiopian highlands, represent an area of high biological diversity (YALDEN et al. 1996). The Alatish National Park is situated in a flat plain (500–900 m a. s. l.) in the north-western part of Ethiopia, some 500 km north-west of Addis Ababa (11° 47' – 12° 32' N, 35° 15' – 35° 49' E; Fig. 1). Topographically, the territory of the Park falls within a flat to undulating plain with a general slope inclination from south to north, interrupted by valleys, streams, scattered hills and seasonal wetlands. However, almost 97% of the area represents a flat plain. The drainage system in and around the Park includes the rivers of Alatish, Ayima (Dinder) and Galegu, their tributaries and wet meadows (Fig. 1). They are intermittent rivers with a seasonal character. In the dry season (December–April) the river beds consist mostly of sand soils with small pools at some areas in the river course. Generally, the vegetation of the Alatish

NP falls into four major categories (see Figs. 2–5): (1) riverine woodlands dominated by *Acacia* and *Ficus*; (2) open wooded grasslands, characterised by scattered trees mainly of *Anogeissus leiocarpa* and *Combretum* sp. and a dense grass cover; (3) mixed woodlands, where *Combretum* and *Terminalia* species are abundant; (4) hilly area woodland vegetation, rich with diverse woody species such as *Ficus* trees and lower canopy species like *Oxythenanthera abyssinica*. Moreover, there are narrow strips of seasonal wetlands (mayas) along the floodplain rivers which are dominated by different types of herbs such as *Hygrophila auriculata* with scattered trees (*Acacia* sp., *Terminalia* sp. and *Balanites aegyptiaca*).

The Alatish National Park was established only recently, in 2006, partly forming a new trans-boundary conservation area with the Dinder National Park in the (North) Sudan, designated already in 1935 following the London Convention of 1933 on the Conservation of the African Flora and Fauna. The two national parks share about 75 km of a common border exhibiting common ecosystems.

A recent exploration has revealed that the Alatish National Park hosts a rather rich fauna of mammals and birds (TADESSE HABTAMU & AFEWORK BEKELE 2008, GIRMA MENGESHA & AFEWORK BEKELE 2008a, b). The particularly rich fauna of small non-volant mammals contains at least 23 rodent and six shrew species (TADESSE HABTAMU & AFEWORK BEKELE 2008). On the other hand, our knowledge on bats of this region is very patchy and scarce. For instance, only two bat species (*Lavia frons*, *Nycteris* sp.) were reported for the Dinder National Park (HASHIM & MAHGOUB 2008). From the ANP area, no information on bats has been available so far. Here we report the results of a first bat survey done in the area of the Alatish National Park.

MATERIAL AND METHODS

Fieldwork was undertaken in two periods, from 22 March to 21 April 2010 and 7–9 November 2012, i.e., during the first and the last weeks of the dry season in the region. The climate of the ANP area is semiarid; according to our field data, the average air temperature was 35 °C (from 21 °C at night to 47 °C at daytime in the shadow) during the first period of the investigation; it exceeded 38 °C for more than 9 h a day (IVLEV et al. 2011). The relative humidity of air varied in the range 1–28% (on average, 13%). No precipitation was observed during the two survey periods.

The main part of work was done in the neighbourhood of three campsites of the Alatish National Park (Fig. 1), **Amjale**, 12° 30' N, 35° 38' E, 535 m a. s. l. (Fig. 2); **Bermil**, 12° 23' N, 35° 44' E, 562 m a. s. l. (Fig. 3); and **Megenagne**, 12° 12' N, 35° 40' E, 564 m a. s. l. (Fig. 4). In addition, bats were collected at several other sites, **Gelego**, 12° 14' N, 35° 53' E, 650 m a. s. l. (Fig. 5); **Grara**, 12° 21' N, 35° 44' E, 560 m a. s. l.; **Megbiya Ber**, 12° 16' N, 35° 43' E, 607 m a. s. l.; and **Mehadid**, 12° 18' N, 35° 46' E, 587 m a. s. l. A variety of primary and disturbed habitats was surveyed including riverine woodlands (Amjale, Bermil, Gelego, Grara and Megenagne sites), mixed woodlands (Amjale, Megbiya Ber, Megenagne), populated places and landscapes transformed by man (Gelego, Bermil, Grara, Mehadid).

Bats were captured with the use of nylon mist-nets of various size, set at bat foraging sites and across flight paths, and also by a mobile flap-trap (BORISSENKO 1999). The captured individuals were examined to determine sex, age and reproductive condition. Standard external measurements were also taken. Voucher specimens of each species were taken for confirmation of the record and further investigation, including verification of their taxonomic position and status. The collected specimens were preserved in 70% ethanol or prepared as a dry skin and skeleton. Tissue samples taken from freshly sacrificed specimens were preserved in 96% alcohol and stored in Eppendorf tubes for further genetic analyses. Voucher specimens were catalogued and deposited at the Zoological Museum of Moscow State University, Russia (ZMMU), National Museum Prague, Czech Republic (NMP), and Natural History Museum of the Addis Ababa University, Ethiopia.

For morphological comparison, some bat specimens housed in the Royal Ontario Museum, Toronto, Canada (ROM), Natural History Museum Geneva, Switzerland (MHNG), Zoological Institute of the Russian Academy of Sciences, Saint-Petersburg, Russia (ZIN), and the above mentioned collections from Moscow and Prague were used. For the purpose of species identification of the collected bats, DNA barcodes (sequences of the 5'-fragment of *cox-1* mitochondrial gene, up to 658 bp) were made for most of the processed specimens as a part of the Barcoding of Life project [<http://barcodinglife.com>], housed at the Biodiversity Institute of Ontario, Guelph University, Canada. A standard cocktail of primers acceptable for various mammalian species (IVANOVA et al. 2007) was used to get PCR-products of the *cox-1* gene. Analogous data from the Kenyan bats were used for comparison.

Abbreviations: A = alcohol specimen, B = skin, S = skull.

RESULTS

During the bat survey in the Alatish National Park, we documented occurrence of 21 bat species belonging to eight families and twelve genera. All relevant data (taxonomic identification,

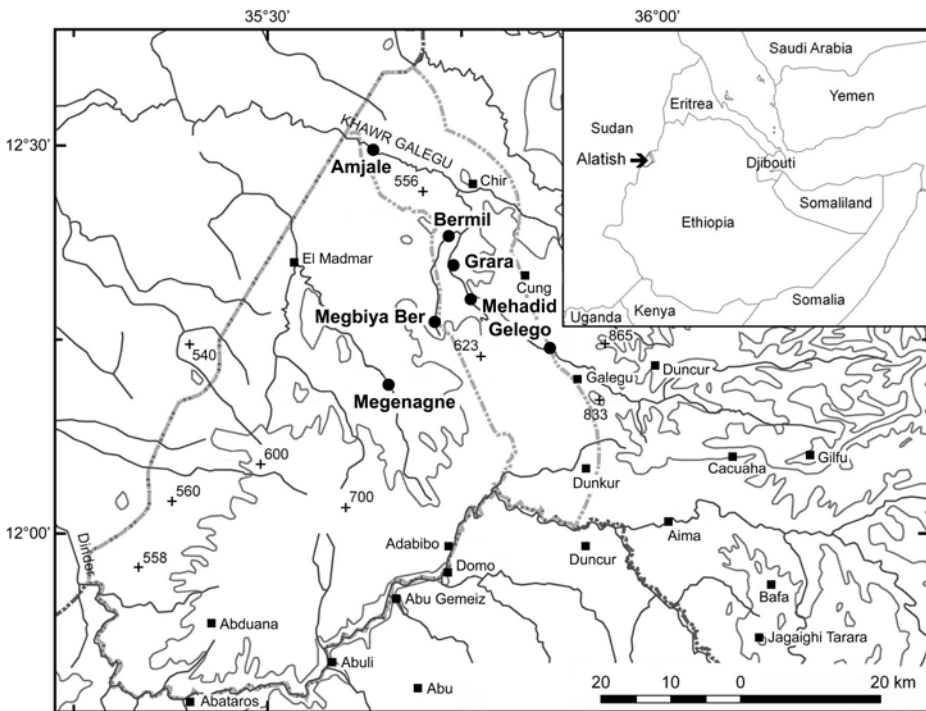


Fig. 1. Map of the Alatish National Park. Legend: circles – collection sites, squares – settlements, pale grey dash-and-dot bold line – borders of the national park and its buffer zone, dark grey dash-and-dot bold line – state border, dark grey dashed bold line – province borders, plus symbols – altitude points.

Obr. 1. Mapa Národního parku Alatiš. Vysvětlivky: kroužky – místa sběrů, čtverce – sídla, světle šedá silná čerchovaná čára – hranice národního parku a ochranné zony, tmavě šedá silná čerchovaná čára – státní hranice, tmavě šedá silná přerušovaná čára – hranice provincií, křížky – výškové body.



Fig. 2. Dry bed of the Galegu river near the Amjale campsite in March (photo by L. A. LAVRENCHENKO).
Obr. 2. Suché koryto řeky Galegu u tábořiště Amjale v březnu (foto L. A. LAVRENČENKO).



Fig. 3. Mixed woodland savannah near the Bermil campsite in April (photo by L. A. LAVRENCHENKO).
Obr. 3. Smišená stromová savana u tábořiště Bermil v dubnu (foto L. A. LAVRENČENKO).



Fig. 4. Grassland with scattered trees near the Megenagne scout point near the Alatish river in November (photo by P. BENDA).

Obr. 4. Step s rozptýlenými stromy nedaleko základny strážců Megenagne nedaleko řeky Alatiš v listopadu (foto P. BENDA).



Fig. 5. The Galegu river near the Galegu town in March (photo by L. A. LAVRENCHENKO).

Obr. 5. Řeka Galegu nedaleko města Galegu v březnu (foto L. A. LAVRENČENKO).

geographic range, ecological context and other information) for each mammal species are summarised below. These species accounts add to our scarce knowledge of many poorly-known species, and provide the first major sketch of the bat community of the Alatish NP as a whole. The bat taxonomy used here follows SIMMONS (2005) and HAPPOLD & HAPPOLD (2013), unless otherwise stated.

***Rhinolophus landeri* Martin, 1838**

MATERIAL. 1 ♀ (ZMMU S-189598 [A]), Megegnagne, 17 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ind. (ZMMU S-189599 [S]), Megegnagne, 19 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (NMP 95919 [S+A]), Megbiya Ber, 7 November 2012, leg. P. BENDA.

One adult female of *Rhinolophus landeri* was captured by a hand-net inside a building at Megegnagne and a large amount of bat droppings was seen in the same building and a mummified *Rhinolophus* carcass was discovered under the roof. Another female of this small horseshoe bat was collected by a hand-net in a building at Megbiya Ber, where two horseshoe bats were observed to roost.

R. landeri is a widespread bat of the savannah zone of sub-Saharan Africa, including a big part of western Ethiopia (HAPPOLD 2013a). The Alatish records are situated about 100 km south of the nearest previously published locality of this species on the Ethiopian-Sudanese border (Gallabat; LARGEN et al. 1974). Only slightly more distant localities of this bat are situated in the areas along the Blue Nile both in Ethiopia and in the Sudan (KOOPMAN 1975).

***Hipposideros tephrus* Cabrera, 1906**

MATERIAL. 1 ♂, 1 ♀ (ZMMU S-189538 [A], S-189539 [S+A]), Amjale, 4 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189540 [S+A]), Grara, 14 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

One female and two adult males of leaf-nosed bats of the *Hipposideros caffer* group were netted at Grara and Amjale. Until recently, the *caffer*-like leaf-nosed bats from Ethiopia were referred to *H. caffer* (Sundevall, 1846) (YALDEN et al. 1996, LAVRENCHENKO et al. 2004, BERNARD & HAPPOLD 2013a), however, a revision based on a molecular genetic analysis showed this group to be much more complex comprising at least eight species instead of two (VALLO et al. 2008).

We refer our specimens to *H. tephrus* based on their *caffer*-like external appearance and small body size (forearm length 46.4–50.2 mm, mean 47.9 mm; condylo-canine length of skull 14.75 mm, 14.97 mm; upper tooth-row length 5.93 mm, 5.93 mm), in combination with known distribution of this form across the Sahel zone of Africa (VALLO et al. 2008). Provisional genetic data obtained from BOLD suggest that the Alatish leaf-nosed bats are most related though not identical to other supposed *H. tephrus* from south-eastern Ethiopia (unpubl. results). The nearest known locality of *Hipposideros caffer* s.l. (referable to *H. tephrus* sensu VALLO et al. 2008) is Gallabat, Sudan (LARGEN et al. 1974, KOOPMAN 1975), situated only some 70 km north-east of the Alatish sites.

***Hipposideros* cf. *centralis* Andersen, 1906**

MATERIAL. 1 ♀ (ZMMU S-189529 [A]), Amjale, 30 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♀♀ (ZMMU S-189530, S-189531 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189532 [A]), Amjale, 4 April 2010, leg. D. A. VASENKOV & L. A.

LAVRENCHENKO; – 1 ♀ (ZMMU S-189533 [A]), Bermil, 10 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 1 ♀ (ZMMU S-189534, S-189535 [A]), Grara, 14 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189536 [A], S-189537 [S+B]), Grara, 15 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

Six adult females and two adult males of large-sized individuals of the *Hipposideros caffer* group (forearm length 50.0–54.1 mm, mean 51.8 mm; condylo-canine length of skull 16.09 mm, upper tooth-row length 6.94 mm) were captured at Amjale, Bermil and Grara, showing sympatric and even syntopic occurrence with the small-sized leaf-nosed bats of the same group in the Alatish NP (see above). These bats, previously generally considered as *H. ruber* (Noack, 1893) (KOCK 1969, YALDEN et al. 1996, HAPPOLD 2013b), are referable to *H. centralis*, the only large-sized form of the group known from north-eastern Africa (VALLO et al. 2008). However, belonging of the Alatish specimens to the populations of Uganda and north-eastern DR Congo (cf. VALLO et al. 2008) could be proven only by a molecular genetic comparison. The Alatish records of this form were made at ca. 250 km northward from the nearest known locality provided for *H. ruber centralis* in Ethiopia (Didessa river mouth; LARGEN et al. 1974).

Hipposideros abae Allen, 1917

MATERIAL. 1 ♀ (ZMMU S-189528 [A]), Bermil, 11 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

An adult female of *Hipposideros abae* was collected at Bermil. In its body size (weight 11.8 g, forearm length 59.8 mm) and the relatively simple structure of the nose-leaf possessing three lateral leaflets on each side (Fig. 6), the specimen corresponds to the samples of *H. abae* from

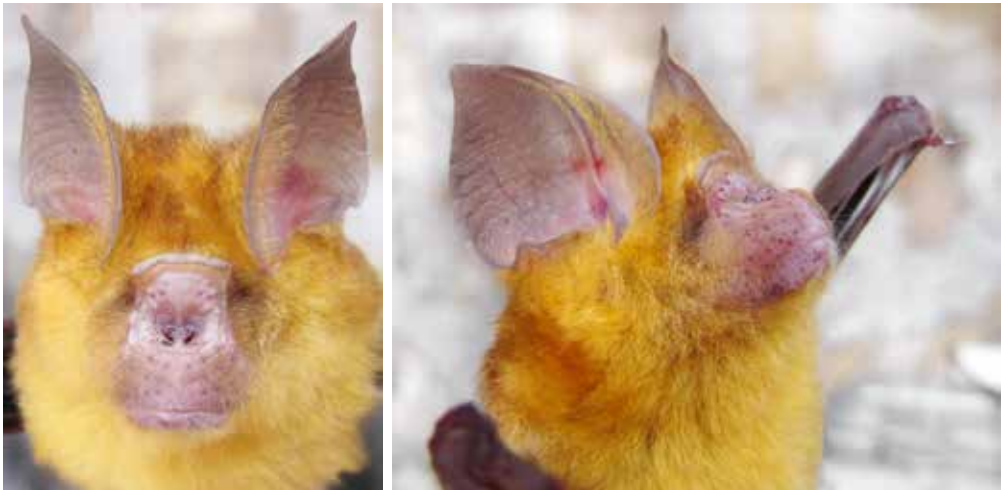


Fig. 6. Face of an adult female of *Hipposideros abae*, captured at Bermil, Alatish National Park (photo by D. A. VASENKOV).

Obr. 6. Obličej dospělé samice vrápence abánského (*Hipposideros abae*) odchycené u Bermilu v Národním parku Alatiš (foto D. A. VASENKOV).

West Africa in the NMP and ZMMU collections. *H. abae* is a West African bat species, occurring in the belt of forest and savannah habitats stretching from Senegal to South Sudan and north-western Uganda (HAPPOLD 2013c). Its collection from the Alatish NP represents the first record of this bat in Ethiopia and the easternmost known spot of its occurrence as well, fairly remote from the previously known distribution limits. The nearest locality of *H. abae* is known from Seriba Ghats in the western part of the South Sudan, ca. 950 km south-west of the new site at Bermil in the Alatish NP (KOOPMAN 1975).

***Triaenops afer* Peters, 1877**

MATERIAL. 1 ♂ (ZMMU S-189629 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189630 [A]), Amjale, 4 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189631 [A]), Bermil, 9 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189632 [S+B]), Bermil, 10 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♀♀ (ZMMU S-189633 [A], S-189634 [S+B]), Bermil, 11 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂ (ZMMU S-189612 [A], S-189613 [S+B]), Gelego, 22 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189614 [A]), Gelego, 24 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 7 ♂♂, 4 ♀♀ (ZMMU S-189615–189625 [A]), Gelego, 26 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂, 1 ♀ (ZMMU S-189626, S-189627 [A], S-189628 [S+B]), Gelego, 27 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (NMP 95925 [A]), Megenagne, 8 November 2012, leg. P. BENDA.

Seven adult females and seventeen adult males of *Triaenops afer* were netted at Amjale, Bermil, Gelego, Grara and Megenagne. This species was found to be one of the most frequent bats across the Alatish NP. Until recently, name of this form has been treated as a synonym of *T. persicus* Dobson, 1871 (LARGEN et al. 1974, YALDEN et al. 1996, LAVRENCHENKO et al. 2004, etc.); however, the separate species position of the African continental population was shown as a result of the genus revision, and the Ethiopian populations should be treated as *T. afer* (BENDA & VALLO 2009). This bat is a common species throughout Ethiopia (YALDEN et al. 1996), the nearest known locality of this bat to the Alatish records is situated about 230 km south, near the Didessa river mouth (LARGEN et al. 1974).

***Lavia frons* (Geoffroy, 1810)**

MATERIAL. 1 ♂, 1 ♀ (ZMMU S-189541, S-189542 [A]), Amjale, 7 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

Only two specimens of *Lavia frons*, an adult male and an adult female, were collected at Amjale. However, foraging individuals of this species were commonly observed in the vicinity of this campsite, mainly in the woodland, but were also seen above the Galego river. During our research, these bats were frequently observed flying among trees and were the only bats witnessed to forage in evening hours before sunset.

L. frons is a widespread bat of the savannah zone of tropical Africa, including the lower parts of Ethiopia (HAPPOLD 2013d). Our collection site lies at least 240 km south of the nearest published locality of the species in Ethiopia at the Setit river (LARGEN et al. 1974). However, the nearest known record in the Sudan was made only 60 km west of Amjale, in El Abiad on the Dinder river (KOCK 1969).

***Coleura afra* (Peters, 1852)**

MATERIAL. 1 ♂, 1 ♀ (ZMMU S-189523, S-189524 [A]), Megegnagne, 19 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189525 [A]), Megegnagne, 21 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

Two adult males and one adult female of *Coleura afra* were captured at Megegnagne. This bat has a patchy distribution throughout the savannah zone of the Afro-tropics, abundant records are available from the Nile regions of the Sudan and East Africa (HAPPOLD 2013e). The nearest known record of this bat in Ethiopia was made at Lake Hertale, about 600 km south-east of the Alatish locality (LARGEN et al. 1974); however, the nearest record of this bat in the Sudan was made 180 km south-west, in Wisco (KOOPMAN 1975). The Alatish record represents the first locality of *C. afra* in the northern part of Ethiopia and substantially increases the knowledge of its distribution limits in the region.

***Nycteris hispida* (Schreber, 1775)**

MATERIAL. 1 ♂ (ZMMU S-189571 [A]), Amjale, 29 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂, 2 ♀♀ (ZMMU S-189572–189575 [A]), Amjale, 30 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 1 ♀ (ZMMU S-189576, S-189577 [A]), Amjale, 31 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189578 [S+B]), Amjale, 2 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO. – 1 ♂ (ZMMU S-189579 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

Three adult females and six adult males of *Nycteris hispida* were netted at Amjale. This bat is one of the most common members of the family in Africa, in the Sudan it was recorded only ca. 100 km north-east of the Alatish site, at Gallabat (VAN CAKENBERGHE & DE VREE 1993). However, the nearest Ethiopian records of the species were made at Gambela, situated some 480 km southward (LARGEN et al. 1974, own unpubl. record). The Alatish record represents the northernmost site of *N. hispida* in Ethiopia and demarcates the north-eastern margin of the distribution range of this bat in Africa as well.

***Nycteris thebaica* Geoffroy, 1818**

MATERIAL. 2 ♀♀ (NMP 95920, 95921 [S+A]), Megbiya Ber, 7 November 2012, leg. P. BENDA.

Two subadult females of *Nycteris thebaica* were caught at Megbiya Ber by a hand-net in a building, to which they flew in during night. This species belongs to the most widespread bats of Africa and is common in the savannah lowlands of the Sudan, South Sudan and occurs in the adjacent parts of Ethiopia (BERNARD & HAPPOLD 2013b). The nearest known locality of *N. thebaica* is Gallabat, Sudan (LARGEN et al. 1974, KOOPMAN 1975), situated only ca. 100 km north of the Alatish site.

***Nycteris macrotis* (Dobson, 1876)**

MATERIAL. 1 ♂, 2 ♀♀ (NMP 95922, 95923 [S+A], 95924 [A]), Megbiya Ber, 7 November 2012, leg. P. BENDA.

Three specimens of *Nycteris macrotis* were collected at Megbiya Ber; a subadult female was netted in a woodland over the dry bed of a stream and a subadult female and an adult male were

caught by a hand-net in a building, to which they flew in during night. This bat is widespread across the savannah zone of sub-Saharan Africa, in Ethiopia and the Sudan it has a rather patchy distribution (COTTERILL & HAPPOLD 2013a). Similarly as in the preceding species, the nearest known locality of *N. macrotis* is Gallabat, Sudan (LARGEN et al. 1974, KOOPMAN 1975), situated only some 100 km north of the Alatish site.

Nycteris cf. *parisii* De Beaux, 1924

MATERIAL. 1 ♂ (ZMMU S-189580 [A]), Megegnagne, 21 April 2010, leg. D. A. VASENKOV & L. A. LAVRENTCHENKO.

One adult male of a small-sized *Nycteris* species (forearm length 40.6 mm), allocated to the complex of *N. woodi* Andersen, 1914, was caught over the dry stream bed at Megegnagne. Since no molecular genetic analysis of this complex is yet available, its taxonomic composition and species delimitations are rather uncertain. Results of a multivariate analysis of morphometric features (VAN CAKENBERGHE & DE VREE 1985) support the idea that *N. parisii* and *N. benuensis* Aellen, 1952 represent rather synonyms of *N. woodi*. However, based on the baculum morphology comparison, THOMAS et al. (1994) suggested a full species level for *N. parisii* (cf. HAPPOLD & HAPPOLD 2013). In that case, just the latter species should occur in Ethiopia, while the distribution range of *N. woodi* s.str. is restricted to south-eastern Africa, with northern limits in south-western Tanzania (COTTERILL 2013b). However, the shape of the baculum of the Alatish specimen definitely better resembles that of *N. woodi* than *N. parisii*: it has a simple (neither thickened nor trifid) tip and the length of about 3 mm (Fig. 7). However, only one specimen was examined by us from the Alatish NP and only one baculum of *N. parisii* was described

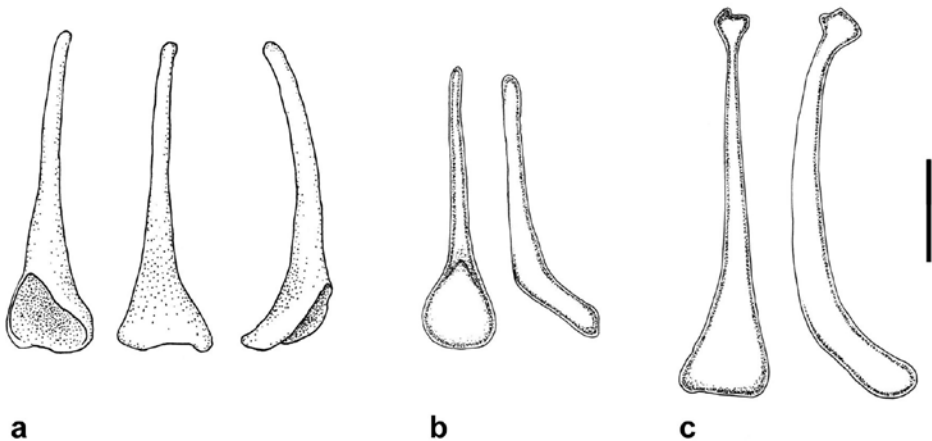


Fig. 7. The baculum (penial bone) of *Nycteris* cf. *parisii* from the Alatish NP (a) in comparison to the bacula of *Nycteris woodi* (b) and *N. parisii* (c); a – original; b and c – after THOMAS et al. (1994). Scale bar = 1 mm.

Obr. 7. Bakulum (penisová kost) patrně rýhonosa somálského (*Nycteris parisii*) z Národního parku Alatiš (a) ve srovnání s bakuly rýhonosa jihoafrického (*Nycteris woodi*) (b) and somálského (*N. parisii*) (c); a – original; b a c – podle THOMASOVÉ et al. (1994). Měřítko = 1 mm.

by THOMAS et al. (1994). Therefore, the definition of morphological delimitations of these forms requires further studies. Until that, we suggest to treat our specimen tentatively as *N. cf. parisii* in accordance with the view by HAPPOLD & HAPPOLD (2013). *N. parisii* is a very rare bat, known from only five records made in the savannah belt between northern Cameroon and southern Somalia (COTTERILL 2013a). Until now, this bat was reported from Ethiopia from two sites (YALDEN et al. 1996), from Asaita in the Ethiopian north-east, some 630 km of the Alatish locality, and from Gemu Gofa in the Ethiopian south-west, some 670 km away.

***Chaerephon pumilus* (Cretzschmar, 1830)**

MATERIAL. 1 ♂ (ZMMU S-189519 [S+B]), Amjale, 2 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189520 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 1 ♀ (ZMMU S-189516, S-189517 [A]), Gelego, 26 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189518 [A]), Gelego, 27 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189521 [A]), Grara, 14 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189522 [A]), Grara, 15 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 9 ♀♀ (NMP 95927–95934 [S+A], 95935, 95936 [A]), Mehadid, 9 November 2012, leg. P. BENDA.

An adult female and six adult males of *Chaerephon pumilus* were captured at Amjale, Gelego and Grara. A maternity colony of this species, composed of several tens of bats, was discovered in a building in Mehadid (a large part of the colony was hidden in an inaccessible attic of this house). Ten adult individuals were collected from this colony, five of the females were pregnant (each contained a foetus of the crown-rump length 8.8–25.9 mm, mean 20.9 mm), five females were lactating (one female was simultaneously lactating and pregnant, possessing the smallest foetus of the five females).

C. pumilus is a widespread bat of the savannah zone of the Afro-tropics, its range covers also large parts of Ethiopia and the Sudan (HAPPOLD 2013f). The Alatish records were made 75–90 km south of the nearest previously published locality of this bat, Gallabat at the border between Ethiopia and the Sudan (LARGEN et al. 1974, KOOPMAN 1975).

***Chaerephon nigeriae* Thomas, 1913**

MATERIAL. 1 ♀ (ZMMU S-189514 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189515 [S+A]), Amjale, 4 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

An adult male and an adult female of *Chaerephon nigeriae* were captured at Amjale, at about 530 m a. s. l. Previously, this bat was reported from Ethiopia only in the central part of the country at medium altitudes above 900 m a. s. l. (LARGEN et al. 1974, YALDEN et al. 1996). The Alatish record was made at least 580 km north-west of the closest previously published Ethiopian locality of the species, Lake Koka (YALDEN et al. 1996). So, our record significantly expands the distribution limits of *C. nigeriae* in Africa to the north and demonstrates its occurrence also in lower altitudes.

***Mops midas* (Sundevall, 1843)**

MATERIAL. 1 ♀ (ZMMU S-189546 [A]), Bermil, 9 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

An adult female of *Mops midas* was caught at Bermil. This species is a widespread bat of the Afro-tropics, however, showing a very patchy distribution range (COTTERILL & HAPPOLD 2013b).

The Alatish record was made about 160 km north-east of Fazogli on the Blue Nile, the nearest locality of *M. midas* in the Sudan (KOCK 1969) and some 380 km south-west of Keren in Eritrea (YALDEN et al. 1996).

***Neoromicia guineensis* (de Bocage, 1889)**

MATERIAL. 1 ♂ (ZMMU S-189552 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189562 [B]), Bermil, 8 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189564 [A]), Bermil, 11 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♀♀ (ZMMU S-189567 [A], S-189568 [S+A]), Grara, 15 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189569 [A]), Megegnagne, 18 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

A subadult and two adult males and three adult females of *Neoromicia guineensis* were captured at Amjale, Bermil, Grara and Megegnagne. In their measurements (forearm length 27.6–31.6 mm, mean 29.55 mm; greatest length of skull 11.77 mm; upper tooth-row length 4.09 mm) and genetic traits, these bats correspond to *N. guineensis* from south-western Ethiopia (Fig. 8; cf. LAVRENCHENKO et al. 2004).

The Alatish records were made at least 440 km north of the nearest previously published Ethiopian locality in Gambela (LARGEN et al. 1974). Another Ethiopian record was made in Bokonkorio, in the extreme east of the country (YALDEN et al. 1996), though it is also a more southern locality than the Alatish ones. So, our Alatish record is probably the most northern within Ethiopian borders and thus expands the known Ethiopian distribution range of *N. guineensis*; however, more northern records are known extraliminally of Ethiopia (BENDA et al. 2011, VAN CAKENBERGHE & HAPPOLD 2013a).

***Neoromicia* sp. (aff. *guineensis* de Bocage, 1889)**

MATERIAL. 1 ♂ (ZMMU S-189550 [A]), Amjale, 2 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂ (ZMMU S-189553 [S+A], S-189554 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂, 2 ♀♀ (ZMMU S-189555, S-189557–189559 [A]), Amjale, 4 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂ (ZMMU S-189560 [A], S-189561 [S+B]), Amjale, 5 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189563 [S+B]), Bermil, 10 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂, 1 ♀ (ZMMU S-189547 [S+A], S-189548, S-189549 [A]), Gelego, 26 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 2 ♂♂ (ZMMU S-189565, S-189566 [A]), Grara, 14 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189570 [S+B]), Megegnagne, 18 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

Four adult females and thirteen adult males of small-sized individuals of *Neoromicia* were captured at Amjale, Bermil, Gelego, Grara and Megegnagne. This species was found to be one of the most frequent bats across the Alatish NP. Morphologically similar to *N. guineensis* (forearm length 27.5–29.9 mm, mean 28.46 mm; greatest length of skull 11.19–11.37 mm, mean 11.28 mm; upper tooth-row length 3.63–3.82 mm, mean 3.77 mm), these bats were separated at a comparable level from Ethiopian *N. guineensis* and *N. cf. zuluensis* (Roberts, 1924) and with a larger distance from *N. somalica* by a preliminary molecular genetic analysis (Fig. 8). Based on the available comparative material, we cannot affiliate these specimens to any species known at present. Further comparative material and further studies of the *Neoromicia* bats from the whole sub-Saharan Africa are needed to elucidate this subject and consequential problems – bats of this genus represent one of the most complex issue of the vespertilionid taxonomy in Africa (see e.g. MONADJEM et al. 2013, DECHER et al. 2016).

Neoromicia somalica (Thomas, 1901)

MATERIAL. 1 ♀ (ZMMU S-189551 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189556 [S+A]), Amjale, 4 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

An adult male and an adult female of *Neoromicia somalica* were captured at Amjale (forearm length 30.1 mm, 30.6 mm; greatest length of skull 12.42 mm; upper tooth-row length 4.36 mm). This species is widely distributed in the Sudanian savannah belt between Guinea and Somalia, including a large part of Ethiopia (VAN CAKENBERGHE & HAPPOLD 2013b). The Alatish record was made at least 320 km north-west of the nearest previously published Ethiopian locality, the Fincha river (LARGEN et al. 1974), though only ca. 200 km west of Bahir Dar, where the closest unpublished record was made (own data).

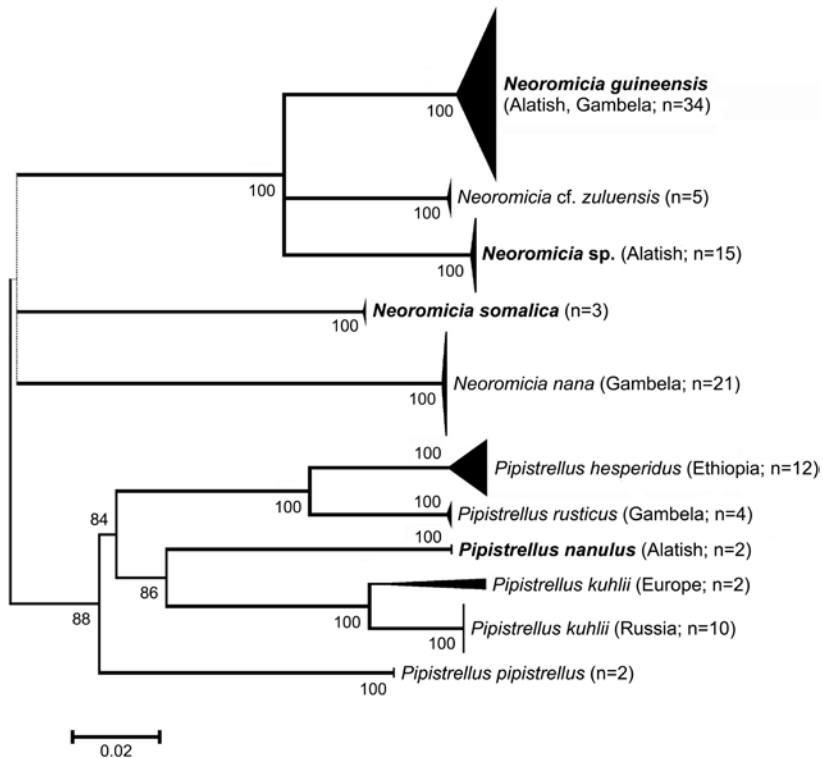


Fig. 8. Neighbour-joining tree (Kimura-2-Parameter) for several African and West-Palaeartic *Neoromicia* and *Pipistrellus*, calculated on the cox-1 mt-gene sequences. Bootstrap values (calculated for 1000 replications) only above 70% are shown.

Obr. 8. Dendrogram vytvořený metodou spojování sousedních objektů (Kimura-2-Parameter) pro některé africké a západopalearktické zástupce rodů *Neoromicia* a *Pipistrellus* spočtený ze sekvencí mitochondriálního genu cox-1. Hodnoty bootstrapu (spočtené pro 1000 replikací) jsou uvedeny pouze nad 70 % podpory.

Pipistrellus nanulus Thomas, 1904

MATERIAL. 1 ♂, 1 ♀ (ZMMU S-189547 [S+A], S-189549 [A]), Gelego, 26 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

An adult male and an adult female of small-sized bats of the genus *Pipistrellus* (Fig. 9) were captured at Gelego (forearm length 27.8 mm, 28.8 mm; greatest length of skull 11.26 mm; upper tooth-row length 4.01 mm). These bats are not assignable to any bat species ever known from Ethiopia; they possess dental features typical for the *Pipistrellus kuhlii* group: minute upper premolars, well-developed lower small premolars, canines without any jags on posterior blades, very small outer upper incisors and nyctalodont structure of lower molars. Based on the analysis of the *cox-1* sequences, they are grouped to the *P. kuhlii* group (Fig. 8), and based on the comparison with other African *Pipistrellus* specimens (mainly from the MHNG and ROM collections), they are most similar to *Pipistrellus nanulus* – these specimens agree in general appearance and in a very small body and skull size (see above; condylo-canine length of skull 10.61 mm in the Alatish specimen, vs. 10.40–10.95 mm in the examined comparative samples). *P. nanulus* occurs mainly in West Africa between Guinea and Gabon, however, there is also a separate area of its distribution in western Kenya, southern Uganda and north-eastern DR Congo (VAN CAKENBERGHE & HAPPOLD 2013c). This latter distribution area lies roughly 1300 km south of the Alatish locality. If this identification of the Alatish specimens is correct, this record represents a finding of a new species for the Ethiopian fauna and it also extends the distribution range of *P. nanulus* substantially to the north-east (see VAN CAKENBERGHE & HAPPOLD 2013c).

Nycticeinops schlieffenii (Peters, 1859)

MATERIAL. 1 ♂ (ZMMU S-189583 [A]), Amjale, 30 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189584 [S+A]), Amjale, 31 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.



Fig. 9. Portraits of *Pipistrellus nanulus* from Gelego, Alatish National Park (photo by D. A. VASENKOV).
Obr. 9. Portréty netopýra efulenského (*Pipistrellus nanulus*) z Gelego, Národní park Alatiš (foto D. A. VASEŇKOV).

CHENKO; – 1 ♀ (ZMMU S-189585 [A]), Amjale, 2 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189586 [A]), Amjale, 3 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189587 [A]), Amjale, 4 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189588 [S+B]), Amjale, 5 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189589 [S+B]), Bermil, 7 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 2 ♀♀ (ZMMU S-189590, S-189591, S-189593 [A], S-189592 [S+B]), Bermil, 8 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 1 ♀ (ZMMU S-189581, S-189582 [A]), Gelego, 26 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 1 ♀ (ZMMU S-189594, S-189595 [A]), Grara, 14 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂, 1 ♀ (ZMMU S-189596 [A], S-189597 [S+B]), Megegnagne, 18 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

Nineteen individuals (eight males and eleven females) of *Nycticeinops schlieffenii* were netted at Amjale, Bermil, Gelego, Grara and Megegnagne. This species was found to be one of the most frequent bats across the Alatish NP. *N. schlieffenii* is widespread across the dry habitats of the Afro-tropics, including the low situated regions of Ethiopia and the Sudan (HAPPOLD 2013g, own unpubl. data). The Alatish records were made at least 390 km south-west of the nearest known Ethiopian locality of *N. schlieffenii*, the Asam river (LARGEN et al. 1974), and ca. 160 km of the nearest Sudanese locality of this bat, Kamisa (KOCK 1969).

***Scotophilus leucogaster* (Cretzschmar, 1830)**

MATERIAL. 2 ♂♂, 1 ♀ (ZMMU S-189600–189602 [A]), Bermil, 9 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO. – 1 ♀ (ZMMU S-189603 [S+B]), Bermil, 11 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189604 [A]), Grara, 14 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189605 [S+A]), Megegnagne, 18 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (NMP 95926 [S+A]), Megegnagne, 8 November 2010, leg. P. BENDA.

Two adult females and five adult males of *Scotophilus leucogaster* were captured at Bermil, Grara and Megegnagne. Although the taxonomy of the genus *Scotophilus* is still not completely clear (see TRUJILLO et al. 2009, VALLO et al. 2011, 2013, etc.), this species is easily distinguishable from similar-sized congeners by its pure white ventral pelage (ROBBINS et al. 1985). The Alatish specimens conform to *S. leucogaster* in size (forearm length 49.5–51.8 mm, mean 50.88 mm; condylo-basal length of skull 16.93 mm, 17.08 mm; upper tooth-row length 6.33 mm, 6.39 mm; vs. 49.9–53.4 mm, 16.6–17.4 mm, and 6.1–6.7 mm, reported by ROBBINS et al. 1985) and are slightly smaller than Ethiopian *S. colias* Thomas, 1904 (forearm length 49.0–52.5 mm, upper tooth-row length 6.4–7.1 mm; LAVRENCHENKO et al. 2004). As it was reported for the Yemeni populations (VALLO et al. 2011), *S. leucogaster* inhabits more lowland and dry habitats than *S. colias*, and this well corresponds with our observations. The taxon mentioned by LARGEN et al. (1974) as *S. nigrita flavigaster* is now considered to be a synonym of *S. leucogaster leucogaster* (SIMMONS 2005). The Alatish records were made at least 140 km west of the nearest published Ethiopian locality, Dungulbar (as *S. n. flavigaster*; LARGEN et al. 1974).

***Scotophilus nigrnellus* de Winton, 1899**

MATERIAL. 1 ♀ (ZMMU S-189610 [S+B]), Bermil, 9 April 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189606 [A]), Gelego, 23 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189607 [A]), Gelego, 25 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♀ (ZMMU S-189608 [S+A]), Gelego, 26 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO; – 1 ♂ (ZMMU S-189609 [A]), Gelego, 27 March 2010, leg. D. A. VASENKOV & L. A. LAVRENCHENKO.

Two adult males and three adult females of rather small-sized bats of the genus *Scotophilus* were netted at Bermil and Gelego (forearm length 45.9–48.0 mm, mean 46.86 mm; condylo-basal length of skull 15.88 mm, 15.92 mm; upper tooth-row length 5.52 mm, 5.84 mm). These specimens possess a very pale brown ventral pelage; based on this feature and the body and skull size, these bats correspond roughly to *S. nigritellus* s.str. (VALLO et al. 2013). This species has been for a long time confused with *S. viridis* (Peters, 1852), a bat distributed in south-eastern Africa and typical by a yellowish-green ventral pelage. Under the latter name, ROBBINS et al. (1985) reported two records of a small-sized *Scotophilus* from Ethiopia, the nearest one made at Mabil, 240 km south-east of the Alatiš localities, the other one from Gambela, ca. 480 km south. However, the nearest locality of this bat is Borit, Sudan, some 150 km south-west of the Alatiš sites (ROBBINS et al. 1985).

CONCLUSIONS

The survey in the Alatiš National Park has brought the first data on bats from the Ethiopian section of primary habitats of the Sudanian savannah zone in the wide plain adjacent to the Blue Nile lowland and continuing the Dinder National Park of the Sudan. Twenty-one bat species were documented from the area of the Alatiš NP and its buffer zone, at least two of these species represent new species for the Ethiopian fauna, *Hipposideros abae* and *Pipistrellus nanulus*; in both of them the distribution range margins are now extensively shifted to the north-east. However, also in other bat species the Alatiš records represent substantial shifts of their range margins, at least within their Ethiopian distribution; the most remarkable findings in this respect are those of *Coleura afra*, *Nycteris* cf. *parisii* (no less than 600 km away from the known Ethiopian localities), *Chaerephon nigeriae* (more than 500 km), *Nycteris hispida* and *Neoromicia guineensis* (more than 400 km).

On the other hand, the relatively high number of bat species discovered in the Alatiš NP can hardly be considered as complete, the fauna of the adjacent areas of the Sudan is even richer in certain aspects and some five to ten bat species could be expected in the Park, considering the Sudanese bat occurrence (KOOPMAN 1975). For instance, the survey did not reveal an occurrence of any fruit bat in the Alatiš NP, although at least *Eidolon helvum* (Kerr, 1792) and *Epomophorus labiatus* (Temminck, 1837) should be present there, at least seasonally. Their absence in our catch is perhaps caused by the dry season when the survey was carried out. If various parts of year including the wet season were covered by the bat survey, the faunal list of the Park could be enriched substantially.

Anyway, the results of the present survey demonstrate richness of the primary savannah habitats of the Alatiš National Park and certainly contribute to justification of the protection of this area and also, a success of the conservation programme in the respective park, at least at the level of small mammal diversity.

SOUHRN

Národní park Alatiš, ležící v rovinaté sudanské savaně v severozápadní Etiopii, byl založen roku 2006 a netopýři v něm dosud nebyli zkoumáni či kdy dříve zaznamenáni. Poprvé byla provedena inventarisace netopýřů na jaře roku 2010 a pak v listopadu 2012. Výsledkem je překvapivé zjištění poměrně vysokého počtu 21 druhů netopýřů náležejících osmi čeledím a 12 rodům. Dva z těchto druhů, vrápenec abánský (*Hipposideros abae*) a netopýř efulenský (*Pipistrellus nanulus*), byli nalezeni v Etiopii vůbec poprvé, jejich areály rozšíření se díky těmto zjištěním zvětšily o zhruba 1000 km severovýchodně. Vysoká diver-

sita fauny netopýřů je známkou vysoké biologické hodnoty Národního parku Alatiš, který nepochybně zasluhuje ochranu, neboť představuje biogeograficky unikátní území jak v rámci Etiopie tak i zony sudanské savany severní části Afriky.

РЕЗЮМЕ

Проведена инвентаризация фауны рукокрылых национального парка Алатиш (Северо-западная Эфиопия). В результате исследований обнаружены 19 новых для исследуемой территории видов и 2 вида, новых для Эфиопии в целом (*Hipposideros abae*, *Pipistrellus nanulus*). Впервые составленный на основании собственных данных список рукокрылых национального парка включает 21 вид, относящийся к 8 семействам и 12 родам. Природоохранное значение национального парка Алатиш определяется как высоким видовым богатством рукокрылых, так и общим разнообразием их зоогеографических связей.

A c k n o w l e d g e m e n t s

We are indebted to the Ethiopian Wildlife Conservation Authority, Addis Ababa, for permission to work and collect in the Alatiš National Park. SVK, DAV and LAL are especially obliged to project coordinators, Dr. Andrei DARKOV (Joint Ethiopian-Russian Biological Expedition, Second Phase – JERBE III) and ATO GIRMA YOSEF (Ministry of Science and Technology, Addis Ababa) for management of the expedition. We are sincerely grateful to Alex BORISSENKO, Natalia IVANOVA and Paul HEBERT (Canadian Centre for DNA Barcoding, Guelph, Canada) for the preliminary molecular genetic analyses of the Alatiš bats. The comparative studies were carried out with the support of the Natural History Museum Geneva and with the kind help of Judith EGER (Toronto, Canada) and Manuel RUEDI (Geneva, Switzerland). Preparation of this review was partly supported by the Government of the Russian Federation (theme # AAAA-A16-116021660077-3; RSF grant # 14-50-00029) for SVK and by the Ministry of Culture of the Czech Republic (# DKRVO 2016/15, 00023272) for PB.

REFERENCES

- BENDA P. & VALLO P., 2009: Taxonomic revision of the genus *Triaenops* (Mammalia: Chiroptera: Hipposideridae) with description of a new species from southern Arabia and definitions of new genus and tribe. *Folia Zoologica*, **58** (Monograph 1): 1–45.
- BENDA P., AL-JUMAILY M. M., REITER A. & NASHER A. K., 2011: Noteworthy records of bats from Yemen with description of a new species from Socotra. *Hystrix, n. s.*, **22**: 23–56.
- BERNARD R. T. F. & HAPPOLD M., 2013a: *Hipposideros caffer* Sundevall's leaf-nosed bat. Pp.: 375–378. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- BERNARD R. T. F. & HAPPOLD M., 2013b: *Nycteris thebaica* Egyptian slit-faced bat. Pp.: 457–460. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- BORISSENKO A. V., 1999: A mobile trap for capturing bats in flight. *Plecotus et al.*, **2**: 10–19 (in Russian, with a summary in English).
- COTTERILL F. P. D., 2013a: *Nycteris parisi* Parisi's slit-faced bat. Pp.: 461–463. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- COTTERILL F. P. D., 2013b: *Nycteris woodi* Wood's slit-faced bat. Pp.: 456–457. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.

- COTTERILL F. P. D. & HAPPOLD M., 2013a: *Nycteris macrotis* Large-eared slit-faced bat. Pp.: 451–453. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- COTTERILL F. P. D. & HAPPOLD M., 2013b: *Tadarida midas* Midas free-tailed bat. Pp.: 518–520. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- DECHER J., HOFFMANN A., SCHAER J., NORRIS R. W., KADJO B., ASTRIN J., MONADJEM A. & HUTTERER R., 2015: Bat diversity in the Simandou Mountain Range of Guinea, with the description of a new white-winged vespertilionid. *Acta Chiropterologica*, **17**: 255–282.
- GIRMA MENGESHA & AFEWORK BEKELE, 2008a: Diversity, distribution, relative abundance and habitat association of larger mammal fauna of Alatish National Park, Ethiopia. *Acta Zoologica Sinica*, **54**: 20–29.
- GIRMA MENGESHA & AFEWORK BEKELE, 2008b: Diversity and relative abundance of birds of Alatish National Park, North Gondar, Ethiopia. *International Journal of Ecology and Environmental Sciences*, **34**: 215–222.
- HAPPOLD M., 2013a: *Rhinolophus landeri* Lander's horseshoe bat. Pp.: 340–341. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HAPPOLD M., 2013b: *Hipposideros ruber* Noack's leaf-nosed bat. Pp.: 393–395. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HAPPOLD M., 2013c: *Hipposideros abae* Aba leaf-nosed bat. Pp.: 372–373. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HAPPOLD M., 2013d: *Lavia frons* Yellow-winged bat. Pp.: 406–408. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HAPPOLD M., 2013e: *Coleura afra* African sheath-tailed bat. Pp.: 422–424. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HAPPOLD M., 2013f: *Tadarida pumila* Little free-tailed bat. Pp.: 528–530. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HAPPOLD M., 2013g: *Nycticeinops schlieffeni* Schlieffen's twilight bat. Pp.: 595–597. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HAPPOLD M. & HAPPOLD D. C. D., 2013: *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- HASHIM I. M. & MAHGOUN K. S., 2008: Abundance, habitat preference and distribution of small mammals in Dinder National Park, Sudan. *African Journal of Ecology*, **46**: 452–455.
- IVANOVA N. V., ZEMLAK T. S., HANNER R. H. & HEBERT P. D. N., 2007: Universal primer cocktails for fish DNA barcoding. *Molecular Ecology Notes*, **7**: 544–548.
- IVLEV YU. F., LAVRENCHENKO L. A., CHERNOVA O. F. & AFEWORK BEKELE, 2011: Response to overheating in spiny mice (the genus *Acomys*) from arid regions in northwestern Ethiopia. *Doklady Biological Sciences*, **440**: 335–339.
- KOCK D., 1969: Die Fledermaus-Fauna des Sudan (Mammalia, Chiroptera). *Abhandlungen der Senckenbergische Naturforschende Gesellschaft*, **521**: 1–238.
- KOOPMAN K. F., 1975: Bats of the Sudan. *Bulletin of the American Museum of Natural History*, **154**: 355–443.
- KRUSKOP S. V. & LAVRENCHENKO L. A., 2008: Primary results of a bat survey in south-western Ethiopia, with a new Ethiopian record of *Kerivoula lanosa* (Chiroptera: Vespertilionidae). *Russian Journal of Theriology*, **7**(2): 71–76.

- LARGEN M. J., KOCK D. & YALDEN D. W., 1974: Catalogue of the mammals of Ethiopia. I. Chiroptera. *Monitore Zoologico Italiano, N. S.*, **16** (Supplemento): 221–298.
- LAVRENCHENKO L. A., KRUSKOP S. V. & MOROZOV P. N., 2004: Notes on the bats (Chiroptera) collected by the Joint Ethiopian-Russian Biological Expedition, with remarks on their systematics, distribution, and ecology. *Bonner Zoologische Beiträge*, **52**: 127–147.
- MONADJEM A., RICHARDS L., TAYLOR P. J. & STOFFBERG S., 2013: High diversity of pipistrelloid bats (Vespertilionidae: *Hypsugo*, *Neoromicia*, and *Pipistrellus*) in a West African rainforest with the description of a new species. *Zoological Journal of the Linnean Society*, **167**: 191–207.
- ROBBINS C. B., DE VREE F. & VAN CAKENBERGHE V., 1985: A systematic revision of the African bat genus *Scotophilus* (Vespertilionidae). *Annales de Musée Royal de l'Afrique Centrale, Sciences Zoologiques*, **246**: 53–84.
- SIMMONS N. B., 2005: Order Chiroptera. Pp.: 312–529. In: WILSON D. E. & REEDER D. M. (eds.): *Mammal Species of the World: A Taxonomic and Geographic Reference. Third Edition. Volume 1*. The Johns Hopkins University Press, Baltimore, xxxviii+743 pp.
- TADESSE HABTAMU & AFEWORK BEKELE, 2008: Habitat association of insectivores and rodents of Alatish National Park, northwestern Ethiopia. *Tropical Ecology*, **49**: 1–11.
- THOMAS N. M., HARRISON D. L. & BATES P. J. J., 1994: A study of the baculum in the genus *Nycteris* (Mammalia, Chiroptera, Nycteridae) with consideration of its taxonomic importance. *Bonner Zoologische Beiträge*, **44**: 299–332.
- TRUJILLO R. G., PATTON J. C., SCHLITZER D. A. & BICKHAM J. W., 2009: Molecular phylogenetics of the bat genus *Scotophilus* (Chiroptera: Vespertilionidae): Perspectives from paternally and maternally inherited genomes. *Journal of Mammalogy*, **90**: 548–560.
- VALLO P., GUILLEN-SERVENT A., BENDA P., PIRES D. B. & KOUBEK P., 2008: Variation of mitochondrial DNA in the *Hipposideros caffer* complex (Chiroptera: Hipposideridae) and its taxonomic implications. *Acta Chiropterologica*, **10**: 193–206.
- VALLO P., BENDA P. & REITER A., 2011: Yellow-bellied or white-bellied? Identity of Arabian house bats (Vespertilionidae: *Scotophilus*) revealed from mitochondrial DNA and morphology. *African Zoology*, **46**: 350–361.
- VALLO P., BENDA P., ČERVENÝ J. & KOUBEK P., 2013: Conflicting mitochondrial and nuclear parphyly in small-sized West African house bats (Vespertilionidae). *Zoologica Scripta*, **42**: 1–12.
- VAN CAKENBERGHE V. & DE VREE F., 1985: Systematics of African *Nycteris* (Mammalia: Chiroptera). Pp.: 53–90. In: SCHUCHMANN K. L. (ed.): *Proceedings of the International Symposium on African Vertebrates: Systematics, Phylogeny and Evolutionary Ecology*. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, 585 pp.
- VAN CAKENBERGHE V. & DE VREE F., 1993: Systematics of African *Nycteris* (Mammalia: Chiroptera). Part II. The *Nycteris hispida* group. *Bonner Zoologische Beiträge*, **44**: 299–332.
- VAN CAKENBERGHE V. & HAPPOLD M., 2013a: *Pipistrellus guineensis* Guinean pipistrelle. Pp.: 624–625. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- VAN CAKENBERGHE V. & HAPPOLD M., 2013b: *Pipistrellus somalicus* Somali pipistrelle (Somali serotine). Pp.: 653–654. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- VAN CAKENBERGHE V. & HAPPOLD M., 2013c: *Pipistrellus nanulus* Tiny pipistrelle. Pp.: 638–639. In: HAPPOLD M. & HAPPOLD D. C. D. (eds.): *Mammals of Africa. Volume IV. Hedgehogs, Shrews and Bats*. Bloomsbury, London, 800 pp.
- YALDEN D. W., LARGEN M. J., KOCK D. & HILLMAN J. C., 1996: Catalogue of the mammals of Ethiopia and Eritrea. 7. Revised checklist, zoogeography and conservation. *Tropical Zoology*, **9**: 73–164.