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Some new records of bats from Morocco (Chiroptera)

Něco nových nálezů netopýrů z Maroka (Chiroptera)

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Abstract. New records of bats resulting from two surveys in 2008 and 2010, focused mainly on southern regions of Morocco, are presented. Altogether 19 bat species were recorded in Morocco s.str. and only one species, *Pipistrellus kuhlii* s.l., was documented from the Western Sahara. This bat remains the only bat species known from this vast desert area. Some notes on the distribution and echolocation of the recorded taxa are added, including the first data on echolocation characteristics of the recently recognised species *Eptesicus isabellinus* and *Plecotus gaisleri*.

Key words. Bats, North Africa, Maghreb, Western Sahara, distribution, echolocation.

INTRODUCTION

The bat fauna of Morocco is relatively well known (see the reviews by Aulagnier & Thevenot 1986 and Benda et al. 2004), 30 species are reported to occur in the country (Thevenot & Aulagnier 2006). However, some species are still known only from a few records and the knowledge of their distribution range in Morocco remains rather incomplete.

Two or three different periods are detectable in the history of bat faunal research in Morocco (cf. Aulagnier 1991, Benda et al. 2004). Basic evidence of cave bats with only very occasional records of non-troglophilous species occurred in the initial period. The data gathered in that era, closed in the 1960s, were completely summarised by Aulagnier & Thevenot (1986). In the 1980s, a geographically broadly conceived project of analyses of owl pellets was performed to obtain the distribution data on bats (Aulagnier 1989). However, in that time also another type of research started to be applied occasionally in Morocco, mist-netting at places of supposed bat foraging (Arlettaz & Aulagnier 1988, Ibañez 1988, Fonderflick et al. 1998, Benda et al.

2004). Only very recently, the data on bats have been obtained using bat detectors (Leiron et al. 2008, Dieuleveut et al. 2010).

Therefore, the list of bat fauna of Morocco was completed during the last 25 years and it could be potentially enriched only by 1–2 species (at maximum) (see the review by Benda et al. 2004). However, some regions of the country remain only poorly documented in term of the composition and abundance of their bat fauna. The least known region of Morocco, concerning its fauna of bats, certainly is the territory of the Western Sahara (Monteil 1951, Aulagnier & Thevenot 1986, Bergier & Thévenot 2008, Bergier et al. 2010). From this vast territory of 266,000 square kilometres, only one bat record is available – a finding of *Pipistrellus kuhlii* in Laâyoune was published by Ibañez & Fernández (1989).

In this paper we report new bat records from Morocco, made during two field surveys in April 2008 and October 2010. To obtain a slightly different type of the data on bat occurrence than predominate in the faunal evidence (see above), we used mainly two methods not yet broadly applied to study bats in Morocco: mist-netting and recording of echolocation calls. During both surveys, we also attempted to document bat occurrence in the Western Sahara.

METHODS

Bats were documented with the help of all common techniques of bat field studies (mist-netting, hand-netting, collection and/or observation in caves, detection of echolocation calls by bat detectors), although the netting and detecting absolutely prevailed (see List of records). The collected specimens should be finally deposited in two collections, National Museum (Natural History), Prague (NMP) and Institute of Vertebrate Biology AS CR, Brno; since the final deposition of the specimens has not yet been solved, all the collected specimens are mentioned under their field protocol numbers and in their tentative depository, the NMP collection. The collection numbers are associated with preparation type of the specimens, noted as [A] (alcoholic specimen) or [S+A] (alcoholic specimen with the skull extracted).

Call recordings were made with the help of portable ultrasound detector D240x set (Pettersson Elektronik AB, Uppsala, Sweden), using a combination of the heterodyne and time-expansion modes and connected to the Edirol R-09 recorder (Roland Corp., Japan). The analysed frequencies were recorded under natural conditions, usually near the sites where the bats were also mist-netted which allowed us to be confident in bat species determination. Two echolocation call sequences of *Plecotus gaisleri* were recorded when handling the bat and hand-releasing it inside the mine at Mibladene (see List of the sites examined). The recordings were analysed with the BatSound 4.00 software (Pettersson Elektronik AB, Uppsala, Sweden). Time-expanded sequences (expansion factor 10) were digitised at the sampling rate 48 kHz with 16-bit precision and saved as *wav files. An FFT of 512 points with Hamming window was used for analyses; oscillograms, power spectra and spectrograms were evaluated. The following parameters of the call were measured: total pulse duration (D), start frequency (SF), end frequency (EF; both SF and EF at –30 dB below the peak power spectral intensity), frequency of maximum energy (Fmax) and inter-pulse interval (IPI, the time between the end of one pulse and the beginning of the consecutive call).

LIST OF THE SITES EXAMINED (Fig. 1)

1. Derdara, ca. 6 km SW of Chefchaouen, netting above a stream, detecting at the stream and in a cork oak forest nearby; 35° 07' N, 05° 18' W, 360 m a. s. l.; 2 October 2010; *Eptesicus isabellinus*, *Hypsugo savii*, *Pipistrellus pipistrellus*, *P. kuhlii*, *Nyctalus leisleri*, *Barbastella barbastellus*;
2. Tafeer, valley ca. 2 km N of the road crossing, netting above pools and detecting along a dried stream bed; 35° 04' N, 05° 39' W, 73 m a. s. l.; 3 October 2010; *Eptesicus isabellinus*, *Hypsugo savii*, *Pipistrellus pipistrellus*, *P. kuhlii*;

3. Mansouria, resort and camping place, detecting at the shore between these two places and among houses of the resort; 33° 44’ N, 07° 19’ W, 5 m a. s. l.; 4 October 2010; *Pipistrellus kuhlii*;
4. Oued Marrout valley, under Dar-el-Âroussi forestry, netting and detecting above the river and at the entrance of a small lava cave (Fig. 2); 33° 20’ N, 06° 00’ W, 660 m a. s. l.; 5 October 2010; *Myotis punicus*, *Eptesicus isabellinus*, *Hypsugo savii*, *Pipistrellus kuhlii*;
5. Bekrite, cedar forest ca. 5 km E of the village (Fig. 3), netting above a stream; 33° 02’ N, 05° 14’ W, 1760 m a. s. l.; 28 April 2008; *Pipistrellus pipistrellus*, *P. kuhlii*, *Nyctalus leisleri*;

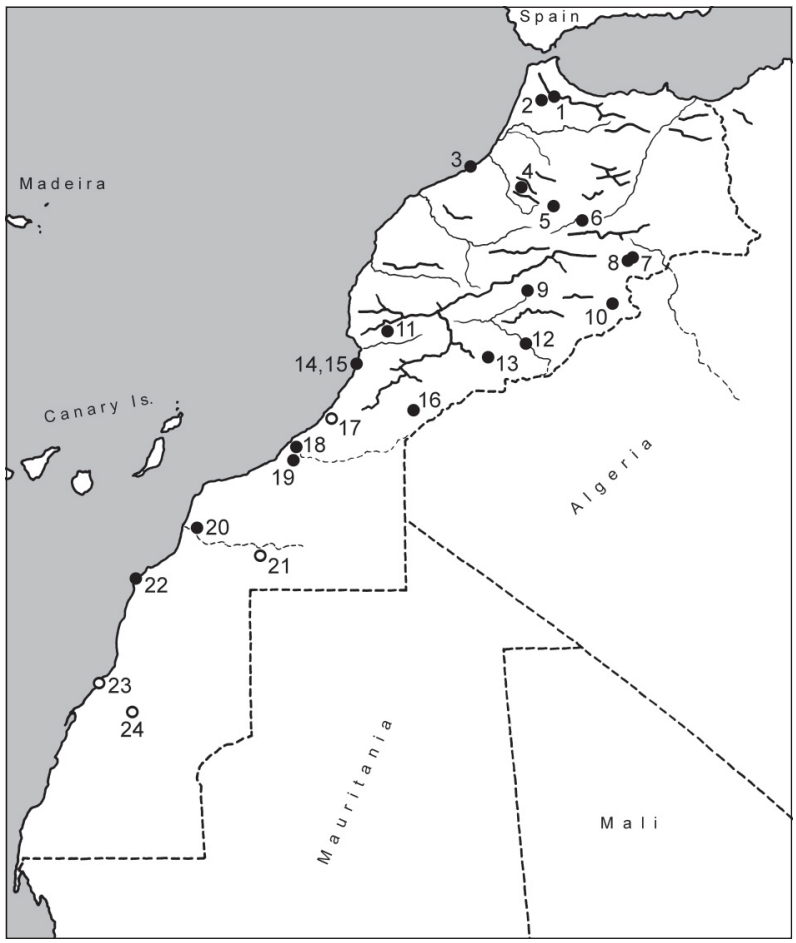


Fig. 1. Sketch map of Morocco showing the examined sites. The site numbers correspond to those in the List of the sites examined. Closed circles – sites with bat records, open circles – sites with no bat records; bold lines – courses of main mountain ridges, thin lines – water courses.
Obr. 1. Schematická mapa Maroka s vyznačením sledovaných lokalit. Čísla v mapě se shodují s čísly v seznamu lokalit (List of the sites examined). Plné kroužky – lokality s nálezy netopýrů, prázdné kroužky – lokality bez nálezů; silné čáry – průběhy hlavních horských hřebenů; tenké čáry – vodní toky.

6. Mibladene, abandoned mines, netting at entrances of four mines and detecting in the area; 32° 45' N, 04° 39' W, 1405 m a. s. l.; 6 October 2010; *Plecotus gaisleri*, *Tadarida teniotis*;
7. Takoumit, oasis, netting above a water pool and at the entrance of a small cave in a hill above the oasis; 32° 05' N, 03° 46' W, 1115 m a. s. l.; 26 April 2008; *Rhinolophus hipposideros*, *R. blasii*, *Eptesicus isabellinus*, *Hypsugo savii*, *Pipistrellus kuhlii*, *Plecotus gaisleri*;
8. Tazouguerte, Kef Azigza cave (Fig. 4), prospecting of the cave and netting at the cave entrance; 32° 02' N, 03° 47' W, 1060 m a. s. l.; 26–27 April 2008 & 7 October 2010; *Rhinopoma cystops*, *Rhinolophus blasii*, *Myotis punicus*, *Plecotus gaisleri*, *Miniopterus schreibersii*;
9. Gorges du Dadès, ca. 4 km NE of Aït-Ali, netting above a river and detecting in the valley; 31° 31' N, 05° 56' W, 1750 m a. s. l.; 24 April 2008 & 7 October 2010; *Rhinolophus hipposideros*, *Eptesicus isabellinus*, *Hypsugo savii*, *Pipistrellus pipistrellus*, *P. kuhlii*, *Tadarida teniotis*;
10. Oued Rheris, 5 km W of Rissani, netting above rest water pools in the valley (Fig. 5); 31° 17' N, 04° 19' W, 758 m a. s. l.; 25 April 2008; *Eptesicus isabellinus*, *Pipistrellus kuhlii*, *P. rueppellii*;
11. Argana, Asif n'Aït Moussa river valley, netting and detecting at the river in the valley; 30° 45' N, 09° 09' W, 725 m a. s. l.; 24 October 2010; *Eptesicus isabellinus*, *Hypsugo savii*, *Pipistrellus pipistrellus*;
12. Vallée du Drâa, NW of Tissergate, ca. 21 km NW of Zagora, netting and detecting at the river; 30° 27' N, 05° 59' W, 753 m a. s. l.; 23 April 2008; *Eptesicus isabellinus*, *Pipistrellus kuhlii*, *Tadarida teniotis*;
13. Tassetift, oasis, netting above pools and in corridors between palms in palmeria; 30° 23' N, 06° 52' W, 890 m a. s. l.; 22 April 2008; *Asellia tridens*, *Eptesicus isabellinus*, *Pipistrellus kuhlii*, *Otonycteris hemprichii*;
14. Sidi Binzarne, ca. 2 km W of Sidi Rbat, netting at an abandoned canalisation tube opening (Fig. 6); 30° 04' N, 09° 40' W, 12 m a. s. l.; 12 April 2008; *Hipposideros tephrus*, *Nycteris thebaica*;
15. Massa, W of Sidi Rbat, netting at a rocky overhang; 30° 02' N, 09° 39' W, 10 m a. s. l.; 12 April 2008; *Hipposideros tephrus*;
16. Âït-Rahhal, Akka oasis, netting at the river and in palmeria (Fig. 7); 29° 26' N, 08° 16' W, 570 m a. s. l.; 21 April 2008 & 9 October 2010; *Asellia tridens*, *Eptesicus isabellinus*, *Pipistrellus kuhlii*, *P. rueppellii*;
17. Oued Noun, a small oasis under the Bou-Jerif fortress, netting at rest water pools in the valley; 29° 06' N, 10° 20' W, 67 m a. s. l.; 20 April 2008;
18. Hasi Tafnidilt, Oued Drâa, netting at rest water pools in the valley and in the fortress, detecting in the fortress; 28° 33' N, 10° 59' W, 41 m a. s. l.; 13 April 2008; *Eptesicus isabellinus*;
19. Tantan, Oued Ben Khlil, netting and detecting above rest water pool in the valley; 28° 27' N, 11° 06' W, 39 m a. s. l.; 19 April 2008; *Pipistrellus kuhlii*;
20. Laâyoune, Oued As Saquia al Hamra (Fig. 8), netting and detecting at a tributary of the main valley at the NE edge of the town; 27° 10' N, 13° 11' W, 17 m a. s. l.; 14 April 2008; *Pipistrellus kuhlii*;
21. Desert hills 24 km WSW of Smara, netting and detecting at entrances of pseudokarst caves; 26° 40' N, 11° 54' W, 308 m a. s. l.; 18 April 2008;
22. Boujdour, netting and detecting at a water hole near sea coast; 26° 08' N, 14° 30' W, 5 m a. s. l.; 17 April 2008 & 23 October 2010; *Pipistrellus kuhlii*;
23. Coastal cliffs ca. 51 km SW of Echtoucan, netting and detecting at a spring and a pool of sulphuric water; 24° 25' N, 15° 12' W, 45 m a. s. l.; 15 April 2008;
24. Bir Anzarane, oasis (Fig. 9), netting and detecting at a well and a water hole; 23° 53' N, 14° 32' W, 204 m a. s. l.; 16 April 2008.

LIST OF RECORDS

***Rhinopoma cystops* Thomas, 1903**

Tazouguerte [8], Kef Azigza cave, 26–27 April 2008: several inds. obs. in the cave, 8 ♂♂ ad. net. (NMP pb3888–3893, 3934 [S+A], 3894 [A]) at the cave entrance; 7 October 2010: 15 inds. obs. in the cave.

Figs. 2–5. Examples of sites examined in northern part of Morocco (photo by J. Červený & A. Reiter)
Obr. 2–5. Příklady zkoumaných lokalit severní části Maroka (foto J. Červený & A. Reiter).
2 – Oued Marrout valley, under Dar-el-Âroussi forestry [4]. 3 – cedar forest at Bekrite [5]. 4 – view from the Kef Azigza cave at Tazouguerte [8]. 5 – Oued Rheris at Rissani [10].

Figs. 6–9. Examples of sites examined in southern part of Morocco (photo by J. Červený)
Obr. 6–9. Příklady zkoumaných lokalit jižní části Maroka (foto J. Červený)
6 – Sidi Binzarne, Souss-Mass NP [14]. 7 – Âït-Rahhal in the oasis of Akka [16]. 8 – Laâyoune, Oued As Saquia al Hamra [20]. 9 – oasis of Bir Anzarane [24].

***Rhinolophus hipposideros* (Borkhausen, 1797)**

Takoumit [7], at a small cave above the oasis, 26 April 2008: 2 ♀♀ ad. net. (NMP pb3921, 3922 [S+A]); – Gorges du Dadès [9], above the river ca. 4 km NE of Aït-Ali, 7 October 2010: 1 ♀ ad. net. (NMP pb4775 [S+A]).

***Rhinolophus blasii* Peters, 1867**

Takoumit [7], at a small cave above the oasis, 26 April 2008: 1 ♀ sad. net. (NMP pb3923 [S+A]); – Tazouguerte [8], Kef Azigza cave, 26–27 April 2008: 2 inds. obs. in the cave, 5 ♂♂ ad., 4 ♀♀ ad. net. (NMP pb3895–3897, 3899–3902, 3935 [S+A], 3898 [A]) at the cave entrance.

***Hipposideros tephrus* Cabrera, 1906**

Sidi Binzarne [14], at an abandoned canalisation tube, 12 April 2008: a group of ca. 30–40 inds. obs., 4 ♂♂ ad., 3 ♀♀ ad. net. (NMP pb3833–3838 [S+A], pb3839 [A]; Fig.10); – Massa [15], at a rocky overhang, 12 April 2008: 1 ♂ ad. net. (NMP pb3840 [S+A]).

***Asellia tridens* (Geoffroy, 1813)**

Tassetift [13], at pools in palmeria, 22 April 2008: 4 ♀♀ ad. net. (NMP pb3842–3844 [S+A]); – Âït-Rahhal [16], Akka oasis, palmeria, 21 April 2008: several foraging inds. det. & obs.

***Nycteris thebaica* Geoffroy, 1818**

Sidi Binzarne [14], at an abandoned canalisation tube, 12 April 2008: 1 ♂ ad., 1 ♀ ad. net. (NMP pb3831, 3832 [S+A]; Fig. 11).

***Myotis punicus* Felten, 1977**

Oued Marrout valley [4], at a small lava cave entrance, 5 October 2010: 1 ♂ ad. net. (NMP pb4760 [S+A]); – Tazouguerte [8], Kef Azigza cave, 26–27 April 2008: 10 inds. obs. in the cave, 5 ♂♂ ad. net. (NMP pb3900, 3901, 3936, 3937 [S+A], 3905 [A]) at the cave entrance.

***Eptesicus isabellinus* (Temminck, 1840)**

Derdara [1], at a stream, 2 October 2010: 1 ind. det. & rec.; – Tafeer [2], pools in a dried stream bed ca. 2 km N of the village, 3 October 2010: 1 ind. net., 1 ind. det. & rec. passing by; – Oued Marrout valley [4], at a small lava cave entrance, 5 October 2010: 1 ♂ ad., 2 ♀♀ sad. net. (NMP pb4761, 4762 [S+A], 4763 [A]), 1 ind. det. & rec. passing along the river; – Takoumit [7], at a small cave above the oasis, 26 April 2008: 1 ♂ ad. net. (NMP pb3925 [S+A]); – Gorges du Dadès [9], above the river ca. 4 km NE of Aït-Ali, 24 April 2008: 1–2 inds. det.; – Oued Rheris [10], above rest water pools, 25 April 2008: 1 ♀ ad. net. (NMP pb3858 [S+A]); – Argana [11], Asif n'Aït Moussa river valley, 24 October 2010: 2 inds. det. & rec. passing by; – Vallée du Drâa, NW of Tissergate [12], river valley, 23 April 2008: 1–2 inds. repeatedly det. & obs.; – Tassetift [13], at pools in palmeria, 22 April 2008: 4 ♀♀ ad., 1 ♀ ad. net. (NMP pb3845–3848 [S+A], pb3849 [A]; Fig. 12)); – Âït-Rahhal [16], Akka oasis, palmeria, 21 April 2008: 1 ind. det. & obs.; – Hasi Tafnidilt [18], Oued Drâa, fortress ruins, 13 April 2008: 1 ind. obs. passing by.

***Hypsugo savii* (Bonaparte, 1837)**

Derdara [1], above a stream, 2 October 2010: 1 ♀ sad. net. (NMP pb4756 [S+A]); – Tafeer [2], pools in a dried stream bed ca. 2 km N of the road crossing, 3 October 2010: 2 inds. det., 1 ind. rec. passing by; – Oued Marrout valley [4], at the river, 5 October 2010: 1 ind. det. & rec. passing by; – Takoumit [7], at a small cave above the oasis, 26 April 2008: 8 ♂♂ ad. net. (NMP pb3927–3933 [S+A], pb3926 [A]); – Gorges du Dadès [9], above the river ca. 4 km NE of Aït-Ali, 24 April 2008: 1 ♂ ad. net. (NMP pb3854 [S+A]); – Argana [11], Asif n'Aït Moussa river valley, 24 October 2010: 3 inds. det. & rec. passing by.

***Pipistrellus pipistrellus* (Schreber, 1774)**

Derdara [1], above a stream, 2 October 2010: 1 ♂ ad., 1 ♀ ad. net. (NMP pb4751, 4752 [S+A]), min. 3 inds. det. & rec.; – Tafeer [2], pools in dried stream bed ca. 2 km N of the road crossing, 3 October 2010:

4 inds. det. & rec. passing by; – Bekrite [5], above a stream in a cedar forest ca. 5 km E of the village, 28 April 2008: 4 ♂♂ ad., 4 ♀♀ ad., 1 ♀ sad. net. (NMP pb3942–3946, 3948–3950 [S+A], 3947 [A]; Fig. 14); – Gorges du Dadès [9], valley ca. 4 km NE of Aït-Ali, 24 April 2008, 7 October 2010: several inds. det., obs. & rec. hunting around street lamps; – Argana [11], Asif n'Aït Moussa river valley, 24 October 2010: 1 ind. det. & rec. passing by.

***Pipistrellus kuhlii* (Kuhl, 1817) and *P. deserti* Thomas, 1902**

Derdara [1], above a stream and in surrounding cork oak forests, 2 October 2010: 2 ♂♂ ad. net. (NMP pb4753, 4754 [S+A]), numerous foraging inds. det. & rec.; – Tafeer [2], pools in a dried stream bed ca. 2 km N of the road crossing, 3 October 2010: 2 ♂♂ ad. net. (NMP pb4758, 4759 [S+A]), numerous foraging inds. det. & rec.; – Mansouria [3], summer resort and adjacent sea coast, 4 October 2010: 2 foraging inds. det. & rec.; – Oued Marrout valley [4], above the river, 5 October 2010: 1 ♂ sad., 1 ♀ ad. net. (NMP pb4764, 4765 [S+A]), numerous foraging inds. det. & rec.; – Bekrite [5], above a stream in a cedar forest ca. 5 km E of the village, 28 April 2008: 1 ♀ ad. net. (NMP pb3941 [S+A]; Fig. 16); – Takoumit [7], at a water pool in the oasis, 26 April 2008: 1 ♂ ad., 2 ♀♀ ad. net. (NMP pb3918–3920 [S+A]); – Gorges du Dadès [9], valley ca. 4 km NE of Aït-Ali, 7 October 2010: several inds. det., obs. & rec. hunting around street lamps; – Oued Rheris [10], above rest water pools, 25 April 2008: 4 ♂♂ ad., 14 ♀♀ ad. net. (NMP pb3872–3886 [S+A], pb3870, 3871, 3887 [A]; Fig. 17); – Vallée du Drâa, NW of Tissergate [12], river valley, 23 April 2008: 1–2 inds. repeatedly det. & obs.; – Tassetift [13], at pools in palmeria, 22 April 2008: 2 ♂♂ ad., 1 ♀ ad., 1 ♀ sad. net. (NMP pb3850, 3851, 3853 [S+A], 3852 [A]); – Âït-Rahhal [16], Akka oasis, palmeria, 21 April 2008: numerous foraging inds. det. & obs.; 8–9 October 2010: 1 ♂ ad. net. (NMP pb4776 [S+A]), several foraging inds. det., obs. & rec.; – Tantan [19], above a rest water pool in a valley in the town, 19 April 2008: numerous foraging inds. det. & obs.; – Laâyoune [20], As Saquia al Hamra, at the NE edge of the town, 14 April 2008: 1 flying ind. repeatedly det. & obs.; – Boujdour [22], at a water hole on the beach, 17 April 2008: 1–2 inds. det.; 23 October 2010: 1–2 foraging inds. det. & rec.

***Pipistrellus rueppellii* (Fischer, 1829)**

Oued Rheris [10], above rest water pools, 25 April 2008: 7 ♂♂ ad., 4 ♀♀ ad. net. (NMP pb3860–3866, 3868, 3869 [S+A], pb3859, 3867 [A]; Fig. 15); – Âït-Rahhal [16], Akka oasis, palmeria, 21 April 2008: numerous foraging inds. det. & obs.; 8–9 October 2010: numerous foraging inds. det.

***Nyctalus leisleri* (Kuhl, 1817)**

Derdara [1], above a stream, 2 October 2010: 1 ♀ sad. net. (NMP pb4755 [S+A]); – Bekrite [5], above a stream in a cedar forest ca. 5 km E of the village, 28 April 2008: 2 ♀♀ ad. net. (NMP pb3939, 3940 [S+A]).

***Barbastella barbastellus* (Schreber, 1774)**

Derdara [1], above a stream, 2 October 2010: 1 ♀ sad. net. (NMP pb4757 [S+A]).

***Otonycteris hemprichii* Peters, 1859**

Tassetift [13], palmeria, 22 April 2008: 1 foraging ind. det. & obs.

***Plecotus gaisleri* Benda, Kiefer, Hanák et Veith, 2004**

Mibladene [6], at mine entrances, 6 October 2010: 7 ♂♂ ad., 1 ♂ sad., 6 ♀♀ ad., 1 ♀ sad. net. (coll. 7 inds., NMP pb4767–4772 [S+A], 4766 [A]; Fig. 13), 3 inds. det. & rec.; – Takoumit [7], at a small cave above the oasis, 26 April 2008: 1 ♂ ad. net. (NMP pb3924 [S+A]); – Tazouguerte [8], Kef Azigza cave, 26–27 April 2008: 2 inds. obs. in the cave, 1 ♂ ad. net. (NMP pb3938 [S+A]) at the cave entrance.

***Miniopterus schreibersii* (Kuhl, 1817)**

Tazouguerte [8], Kef Azigza cave, 26–27 April 2008: a colony of ca. 400 inds. obs. in the cave, 5 ♂♂ ad., 1 fa, 5 faG, 1 fs net. (NMP pb3907–3914, 3916, 3917 [S+A], 3906, 3915 [A]) at the cave entrance; 7 October 2010: 1 ♂ ad., 1 ♂ sad. coll. (NMP pb4773, 4774 [S+A]).

Figs. 10–13. Examples of Afrotropical elements and North African endemics in the bat fauna of Morocco (photo by J. Červený & A. Reiter).
Obr. 10–13. Příklady severoafrických endemitů a aftrotropických prvků ve fauně netopýrů Maroka (foto J. Červený & A. Reiter).
10 – *Hipposideros tephrus*, Sidi Binzarne [14]. 11 – *Nycteris thebaica*, Sidi Binzarne [14]. 12 – *Eptesicus isabellinus*, Tassetift [13]. 13 – *Plecotus gaisleri*, Mibladene [6].

Figs. 14–17. Portraits of pistrelle bats (*Pipistrellus*) of the Moroccan fauna (photo by J. Červený)
Obr. 14–17. Portréty zakrslých netopýrů (*Pipistrellus*) fauny Maroka (foto J. Červený)
14 – *Pipistrellus pipistrellus*, Bekrite [5]. 15 – *Pipistrellus rueppellii*, Oued Rheris [10]. 16 – *Pipistrellus kuhlii*, Bekrite [5] (colouration of the Mediterranean populations). 17 – *Pipistrellus* (*kuhlii*) *deserti*, Oued Rheris [10] (colouration of desert populations).

***Tadarida teniotis* (Rafinesque, 1814)**

Mibladene [6], above the mine area, 6 October 2010: 1 ind. det. & rec. passing by; – Gorges du Dadès [9], above the river ca. 4 km NE of Aït-Ali, 24 April 2008: 2 ma, 1 fs net. (NMP pb3855, 3856 [S+A], pb3857 [A]); – Vallée du Drâa, NW of Tissergate [12], river valley, 23 April 2008: 1–2 inds. repeatedly det. & obs.; – Âït-Rahhal [16], Akka oasis, palmeria, 8–9 October 2010: 1 ind. det. & rec. passing by.

COMMENTS ON DISTRIBUTION

During two field surveys focused mainly on the southern regions of Morocco, we documented occurrence of 19 bat species (in the sense by Thevenot & Aulagnier 2006), i.e. 63.3% of the known bat fauna of the country. Most of the records were made at sites lying within the known distribution ranges of the respective species in Morocco as given by Aulagnier & Thevenot (1986), Benda et al. (2004) and Dieuleveut et al. (2010), and the records only increase the number of their occurrence spots. Several records, however, slightly shift margins of the yet known ranges in Morocco. The finding of *Rhinolophus hipposideros* in the oasis of Takoumit lies out of the continuous range of this species in southeastern Morocco as it was depicted by Dieuleveut et al. (2010). Several new records of *Eptesicus isabellinus* more precisely describe the southern margin of the species range in Morocco (cf. Aulagnier & Thevenot 1986, Dieuleveut et al. 2010); the margin is now marked by a line connecting (from NE to SW) the newly documented sites of Oued Rheris, Tissergate, Tassetift, Akka, and Hasi Tafnidilt. Most of the records of *Pipistrellus pipistrellus* lie within the range as delineated by Aulagnier & Thevenot (1986) and Benda et al. (2004), however, the record from Argana represents a distinct shift of the western margin of the range more than 300 km along the southern slope of the Haut Atlas Mts.

In several species, the records were made at sites documented by previous authors and the new findings suggest existence of prosperous populations there. This is true mainly for two sites, where roosts of nursery colonies were found; the abandoned canalisation tube at Sidi Binzarne and the Kef Azigza cave at Tazouguerte. The former site (No. 14; Fig. 6), situated in the Souss-Massa National Park and hosting colonies of *Hipposideros tephrus* and *Nycteris thebaica*, was examined already in 1986, 1987 and 1989 (Arlettaz & Aulagnier 1988, Benda et al. 2004). The new visit in 2008 confirmed presence of both species in their artificial shelter. The latter site (No. 8; Fig. 4) was documented in detail by Aulagnier & Destre (1985) as a shelter of *Rhinopoma cystops*, *Rhinolophus ferrumequinum*, *R. blasii* (under *R. euryale*), *Asellia tridens*, *Myotis punicus*, *Plecotus gaisleri*, and *Miniopterus schreibersii*. With the exceptions of *R. ferrumequinum* and *A. tridens*, all these species were observed there by Benda et al. (2004, 2006) as well as during the presented surveys.

Records of *Pipistrellus kuhlii* s.l. (including the *deserti* morphotype as re-defined by Benda et al. 2004) markedly prolonged the distribution range of this form, which remains the only bat known from the Western Sahara. Otherwise, this bat was found at many sites throughout Morocco within the previously described range (Aulagnier & Thevenot 1986, Benda et al. 2004, Dieuleveut et al. 2010), while the sites of Tantan, Laâyoune and Boujdour enlarged the range compared to that by Aulagnier & Thevenot (1986). Ibañez & Fernández (1989) published a record from Laâyoune, which until now represented the only available bat finding from the Western Sahara and remains the only one based on collected specimens – our new records are based solely on recordings of echolocation calls. From the newly collected Moroccan *kuhlii*-like bats, most of the examined specimens belong to the *kuhlii* morphotype. The *deserti* morphotype (Fig. 17) was found only in two series, from the Oued Rheris at Rissani (Fig. 5) and from the oasis of Tassetift. From the former site, three out of 15 individuals, and

from the latter site, one out of four bats, conformed to the main identification size character of *P. deserti* sensu Benda et al. (2004), i.e. their largest length of skull did not exceed 12.3 mm. Being rigorous, these two sites represent new localities of *Pipistrellus deserti* in Morocco, and this bat is thus known from four sites in this country (cf. Benda et al. 2004): Anagam, Tamtattouchte, Rissani, and Tassetift.

The bat fauna of the Western Sahara can be characterised as extremely poor both in diversity and abundance, being a rule in harsh deserts. While in Morocco s.str. (i.e. in the borders before 1975), some bats were recorded (at least as a call of a passing individual by a detector) at all examined sites with the exception of the Oued Noun (No. 17), in the Western Sahara s.str., a bat call was detected only at two out of five examined sites (Fig. 1). In both cases, they were populated sites with abundant anthropogenic roosting and foraging opportunities. In true desert sites, although favourable for bats at first sight, no bats were observed.

COMMENTS ON ECHOLOCATION

At almost all sites, we made recordings of bat echolocation calls which served as a basis for the faunal report above. In some cases, we gathered representative numbers of call samples enabling us to describe parameters of the calls. In three species, whose echolocation has not yet been studied in detail – especially not in North Africa – we provide some characteristics and notes below.

Eptesicus isabellinus. Recordings were made at four sites, species identity was confirmed by netted individuals at Tafeer and Oued Marrout, calls from further sites showed a similar acoustic design. In all cases, the bats were observed flying in open space rather far from cluttered

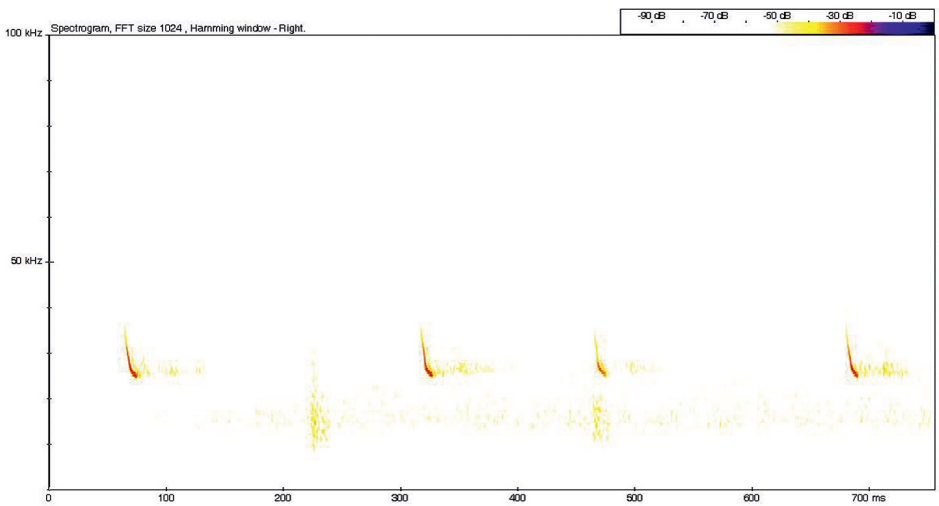


Fig. 18. Spectrogram of echolocation calls of *Eptesicus isabellinus* recorded at Derdara, Morocco: an individual flying above a stream.
Obr. 18. Spektrogram echolokačních hlasů netopýra tripolitánského (*Eptesicus isabellinus*) zaznamenaných v Derdaře, Maroko: jedinec poletující nad potokem.

Table 1. Descriptive parameters of echolocation calls of three bat species from Morocco. Mean ± SD (upper lines) and value range (lower lines) are shown for each parameter: n – number of calls analysed (in parentheses the number of call sequences from which calls were obtained); SF – start frequency, Fmax – frequency with maximum energy; EF – end frequency; D – pulse duration; IPI – inter-pulse interval
Tab. 1. Popisné parametry echolokačních hlasů tří druhů netopýrů Maroka. Pro každý parametr je ukázán průměr ± směrodatná odchylka (horní řádky) a rozsah hodnot (dolní řádky): n – počet analysovaných výkřiků (v závorce počet hlasových sekvencí z nichž byly výkřiky získány); SF – počáteční frekvence; Fmax – frekvence s maximální energií; EF – koncová frekvence; D – trvání pulsu; IPI – mezipulsní interval

species / druh	n	SF [kHz]	Fmax [kHz]	EF [kHz]	D [ms]	IPI [ms]
Eptesicus isabellinus	23 (5)	35.1±1.0	26.9±0.7	23.3±0.8	9.7±2.8	244.2±66.7
		33.7–36.3	25.8–28.3	22.4–24.2	5.6–16.3	128.5–362.7
Pipistrellus pipistrellus	50 (7)	53.3±4.6	47.9±2.9	46.3±3.0	7.4±1.7	123.9±46.2
		45.6–62.7	42.9–51.8	40.0–50.7	5.2–12.4	73.4–250.1
Plecotus gaisleri	58 (2)	41.7±1.7	31.9±2.0	21.7±2.3	1.4±0.3	40.9±23.5
		37.2–44.5	28.3–37.0	16.1–26.5	0.9–1.9	12.9–95.7

habitats. Under these conditions the calls had FM/QCF characteristics (Table 1, Fig. 18). The shapes of the individual calls were similar to those reported for *Eptesicus serotinus* (Schreber, 1774) from southern Europe (Russo & Jones 2002, Papadatou et al. 2008) with lower values of all parameters except for IPI which was longer than in *E. serotinus*.

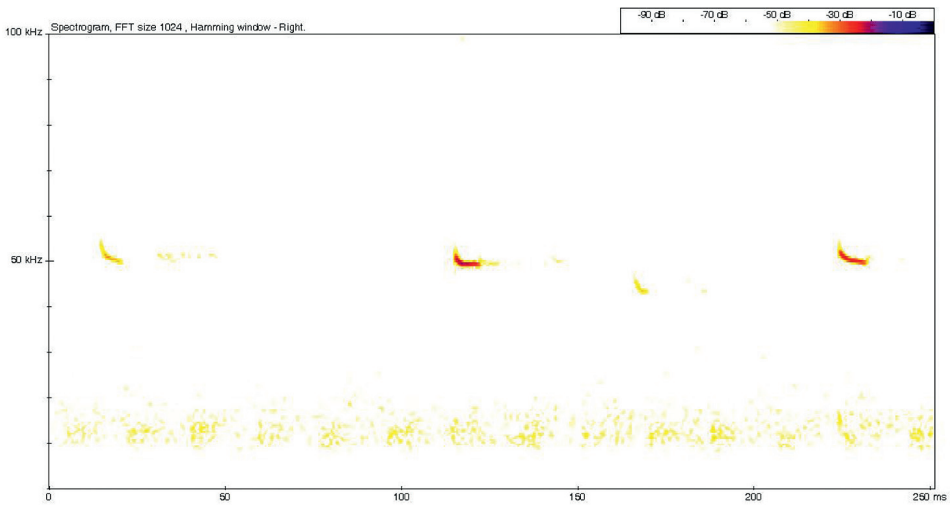
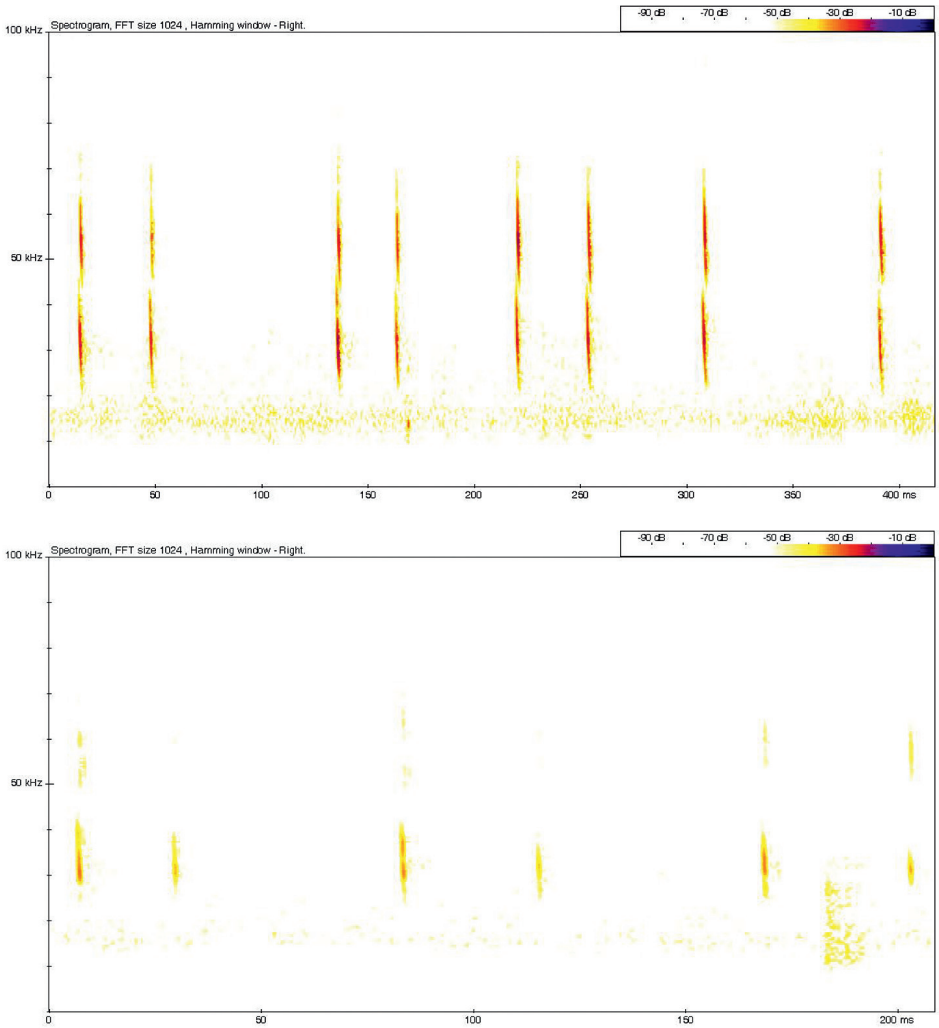


Fig. 19. Spectrogram of echolocation calls of *Pipistrellus pipistrellus* recorded in the Gorges du Dadès, Morocco: several individuals hunting around the street lamps.
Obr. 19. Spektrogram echolokačních hlasů netopýra hvízdavého (*Pipistrellus pipistrellus*) zaznamenaných v roklině Dadès, Maroko: několik jedinců lovících kolem pouličních lamp na dně kaňonu.

Pipistrellus pipistrellus. Recordings were made at four sites, results of the analyses are given in Table 1 (Fig. 19). The parameters obtained were similar to those reported from the European populations (e.g. Russo & Jones 2002, Jahelková 2003, Papadatou et al. 2008) with values of Fmax lying in between the values from Central and southern Europe. With the exception of



Figs. 20, 21. Spectrograms of echolocation calls of *Plecotus gaisleri* recorded at mines of Mibladene, eastern Morocco. 20 (above) – handled individual; 21 (below) – the same, hand-released individual.
Obr. 20, 21. Spektrogramy echolokačních hlasů ušana berberského (*Plecotus gaisleri*) zaznamenaných u dolů mibladenských ve východním Maroku. 20 (nahoře) – jedinec v ruce držený. 21 (dole) – týž jedinec z ruky vypuštěný.

several calls from Derdara and Gorges du Dadès, we did not observe in Moroccan populations the call pattern commonly observed in the Middle East (Benda et al. 2006), where the maximum frequency regularly exceeded 50 kHz.

Plecotus gaisleri. Characteristics of echolocation calls (Table 1, Figs. 20, 21) are based on the analysis of the recordings obtained from a handled and hand-released individual at the Mibladene mines (No. 6). These observations represent the first reports on echolocation in this species. Maximum frequencies of the calls were on average 31.9 kHz, average pulse duration 1.4 ms and average inter-pulse intervals 40.9 ms. Almost all parameters showed lower average values than reported in the closely related southern European congener *Plecotus austriacus* (Fisher, 1829) (Russo & Jones 2002, Papadatou et al. 2008, Teixeira & Jesus 2009). The design of echolocation in *P. gaisleri* is more similar to that of *P. christii* Gray, 1838, a species also living in more or less open habitats of North Africa (Benda et al. 2008); in the latter species higher SF and EF values and longer IPI were also found than in most of other *Plecotus* species. Unfortunately, echolocation characteristics of the two bat species most related to *P. gaisleri*, the Canarian *P. teneriffae* Barrett-Hamilton, 1907 and Balkan *P. kolombatovici* Đulić, 1980, are not available for comparison.

SOUHRN

V příspěvku jsou presentovány nové nálezy netopýrů učiněné během dvou výzkumných cest v létech 2008 a 2010 směrovaných především do jižních částí Maroka. Celkem 19 druhů netopýrů bylo nalezeno v severních oblastech Maroka (tj. v Maroku s.str.) a pouze jediný druh, *Pipistrellus kuhlii* s.l., byl dokumentován ze Západní Sahary. Tento druh tak zůstává jediným netopýrem známým z tohoto rozsáhlého pouštního území. K přehledu je doplněno něco poznámek ohledně rozšíření a echolokačních charakteristik některých druhů netopýrů, včetně ponejprv uvedených údajů o echolokaci nedávno rozlišených druhů *Eptesicus isabellinus* a *Plecotus gaisleri*.

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