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Bat fauna of Tunisia: Review of records and new records, morphometrics and echolocation data

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Abstract. New records of 18 bat species from Tunisia are reported; these include *Rhinolophus ferrumequinum*, *R. hipposideros*, *R. euryale*, *R. mehelyi*, *R. blasii*, *Asellia tridens*, *Rhinopoma cystops*, *Tadarida teniotis*, *Miniopterus schreibersii*, *Eptesicus isabellinus*, *Pipistrellus* cf. *kuhlii*, *P.* cf. *pipistrellus*, *Otonycteris hemprichii*, *Plecotus gaisleri*, *Hypsugo* cf. *savii*, *Myotis capaccinii*, *M. emarginatus*, and *M. punicus*. For at least five species, our records represent the first records in nearly last 30 years and we report for the first time on the possible presence of *Nyctalus leisleri* in northern Tunisia. We provide a critical review of records of *Rhinolophus euryale* and *R. mehelyi* from Tunisia, many of which were incorrect. We also propose a new synonymy for *Rhinolophus* (*Euryalus*) *barbarus* Andersen et Matschie, 1904 and *R.* (*E.*) *meridionalis* Andersen et Matschie, 1904.

Tunisia, Chiroptera, Maghreb, North Africa, taxonomy, echolocation

Introduction

The bat fauna of Tunisia remains relatively poorly known among North African faunas with only 19 species recorded to date in the country (Dalhoumi et al. 2011). Among these 19 species, two are only known from one locality (*Hypsugo savii* and *Pipistrellus rueppellii*; Vaughan et al. 1977, ACR 2011) while no less than seven others have been recorded at less than six sites (*Myotis cappaccinii*, *M. emarginatus*, *Otonycteris hemprichii*, *Pipistrellus pipistrellus*, *Rhinolophus blasii*, *Tadarida teniotis* and *Rhinopoma cystops*). Apart from *Myotis punicus* and *Pipistrellus kuhlii*, which have been reported in more than 40 localities, the distribution of other species is globally poorly known. Furthermore, species identification problems, especially between the three medium-sized *Rhinolophus* species (*R. blasii*, *R. euryale* and *R. mehelyi*) have obscured the distribution of these species in Tunisia (cf. Aellen & Strinati 1970, Cockrum 1976a, b) and most probably across the Maghreb (e.g. Kowalski & Rzebik-Kowalska 1991, Benda et al. 2004c). Additionally, many of these records are based on single or a few individuals as opposed to colonies, of which very few are known for any species.

Studies on bats of Tunisia started in the 19th century with Hartmann (1868) who recorded the presence of *Rhinolophus ferrumequinum* and *Miniopterus schreibersii*. Then Fitzinger (1870) reported a third species *Vesperugo marginatus* (= *Pipistrellus kuhlii*), before Dobson (1878) added *Vespertilio murinus* (= *Myotis punicus*) from Tunis. *Phyllorhina Tridens* (= *Asellia tridens*) and *Vesperugo isabellinus* (= *Eptesicus isabellinus*) were then added to the list of bats of Tunisia by Lataste (1887), while *Plecotus auritus* (= *P. gaisleri*) was first reported by Anderson (1892). Three new species (*Rhinolophus* (*Euryalus*) *barbarus* [= *R. euryale*], *Rhinolophus hipposideros* and

Rhinopoma microphyllum [= *R. cystops*]) were identified from Tunisia by Andersen & Matschie (1904), Gadeau de Kerville (1908) and Olivier (1909). It was only between the 1950s and 70s that additional seven species were discovered (Deleuil & Labbé 1955, Aellen & Strinati 1969, 1970, Cockrum 1976a, Vaughan et al. 1977, Kock & Nader 1984). Only *Pipistrellus rueppellii* has been recently added to the list of species of Tunisia based on examination of a specimen held at the Zoologisches Forschungsinstitut und Museum Alexander Koenig in Bonn (ZFMK) (ACR 2011).

In the present contribution, we report on new records of bats from Tunisia (including maternity colonies) made mainly during four expeditions in May 2008, June 2009, May 2011 and July 2012. We also provide a critical review of records of *Rhinolophus euryale* and *R. mehelyi* from Tunisia, many of which we believe were incorrect. Furthermore, based on this review of past records (some of which are linked to specimens in museums) and information on morphology of specimens, we propose a new synonymy for *Rhinolophus* (*Euryalus*) *barbarus* Andersen et Matschie, 1904 and *R.* (*E.*) *meridionalis* Andersen et Matschie, 1904. Finally, we also present data on echolocation of bats from Tunisia for the first time. Our records are based on visual inspections, captures, searches for dead animals, recording of echolocation calls and examination of museum specimens.

Material and Methods

Bats were investigated using common techniques such as mist-netting, hand-netting, flip-netting and collection and observations in buildings and underground sites. As many species are difficult to catch but can be recognized well by their echolocation calls (e.g. Walters et al. 2012), we also extensively recorded echolocation calls at night.

Forearm length, P4.1 (first phalanx of the fourth finger), P4.2 (second phalanx of the fourth finger), and CM3 (length of upper tooth-row between the canine and third molar, both included) were measured with calipers to the nearest 0.1 mm. Statistical analyses were carried out in R v2.15.2 (R Development Core Team 2012). Prior to running t-tests, normality and homoscedasticity of the data was checked with the Shapiro-Wilk test (function ' shapiro.test' in R v2.15.2) and Bartlett test (function 'bartlett.test' in R v2.15.2), respectively.

Calls were recorded in real time using D1000X ultrasound detectors (Pettersson Elektronik AB, Uppsala, Sweden). Sampling frequency was set to 384 kHz, allowing to records sound up to 192 kHz. Most bats were recorded when free flying or hanging, while a subset was recorded in the hand (mainly *Rhinolophus* species) or on release. Recordings were then analysed using BatSoundPro software v3.31 (Pettersson Elektronik AB, Uppsala, Sweden).

Abbreviations of museum names are as follows:

MNHG – Natural History Museum of Geneva, Geneva, Switzerland;
MNHN – National Museum of Natural History, Paris, France;
ZMB – Zoological Museum (Museum für Naturkunde), Berlin, Germany;
TTU – Texas Tech University Museum, Lubbock, USA.

Species List

Rhinolophus ferrumequinum (Schreber, 1774)

New Records. Zaghouan mines, 26 June 2009, 1 adult ♂ captured; 26 July 2012, a colony of minimum 15 inds. observed, 2 ♂♂ captured (1 adult and 1 juvenile). – Carrières les grottes (N of El Haouariya), 23 May 2011, 4 inds. in torpor, 1 adult ♂ observed. – Oued Ain, 24 May 2011, echolocation recordings. – Carrières Fatjun (NW of El Haouariya), 25 May 2011, maternity colony of 15 inds., 1 adult ♀ observed. – El Feidja National Park, 21 July 2012, maternity colony estimated at 300 inds. (with juveniles), 23 inds. (21 adult ♀♀, 1 juvenile ♀ and 1 adult ♂) were observed. – Djebel Gloub Thirane (10 km W of Fernana), 22 July 2012, 1 ind. in a mine and 2 inds. in a cave, all in torpor. – Beni M'tir mine, 23 July 2012, 4 adult ♂♂ captured. – Hôtel des Chênes (near Ain Drahem), 23 July 2012, 2 inds. observed. – Ras Rajel mine, 24 July 2012, 2 inds. observed – Ras Rajel, 24 July 2012, 1 ind. observed in an abandoned house. – Djebel Ressas mine, 25 July 2012, recordings of the species at the mine entrance.

Reclassified Record. 6 km west of Nefza and 25 km East of Tabarka on road P7, 11 May 1975, specimen TTU 72263 collected by D. Khadhari and identified as *R. mehelyi*. Noseleaf characters and size (FA=55 mm) matching *R. ferrumequinum*, skull not examined.

In Tunisia, *R. ferrumequinum* is known from the entire country except the south (i.e. the Saharan bioclimatic zone). All our current findings fall within the previously described range of the species. Most records published to date were from isolated or hibernating individuals. Our data report on three maternity colonies, one of which (El Feidja NP) is presently the largest maternity colony

Fig. 1. Photographs showing Tunisian habitats; (A) Djebel Ressas; (B) Ichkeul; (C, D) Dghoumes; (E) Beni Mtir; (F) Djebel Zaghouan.

known for the species in Tunisia. Given the distinct echolocation peak frequency of *R. ferrum-equinum* in Tunisia (SJP, unpubl. data), the recordings of individuals with the peak frequency of around 85–88 kHz can be attributed without doubt to the species. Morphologically, no obvious difference was observed in the field between Tunisian and European specimens (Fig. 3 A).

Rhinolophus hipposideros (Borkhausen, 1797)

New Records. Pine woodland 5 km NE of Ain Sebaa, 10 September 2004 (data used in Rebelo & Brito 2007 but species record unpublished; H. Rebelo, pers. comm). – Grotte Sidi Amer (NE of El Haouariya), 23 May 2011, 1 ind. observed. – Hôtel des Chênes (near Ain Drahem), 23 July 2012, at least 9 inds. present, 7 observed (2 adult and 3 juvenile ♀♀, 2 adult ♂♂). – Djebel Gloub Thirane (10 km W of Fernana), 22 July 2012, total of 2 inds. in two mines, both in torpor. – Zaghouan mines, 26 July 2012, 1 ind. observed.

The species seems to be relatively rare in Tunisia and has been mostly reported from the northernmost part of the country (the humid climatic zone). Similarly to *R. ferrumequinum*, most published records are from isolated or hibernating individuals, hence our report of the maternity colony in the Hôtel des Chênes represents the first known reproduction colony in the country. It is interesting to note that the bats were present in various rooms of this abandoned hotel (and beneath the roof), suggesting that the species also roosts in buildings in Tunisia. It might therefore be of interest to search for maternity colonies of the species in underground sites but also in buildings. Although recordings were made from a limited number of individuals (n=9), the peak frequency of the species seems to be distinctly higher than other sympatric *Rhinolophus* species (>112 kHz); hence based on the present knowledge, the species can also be identified from recordings only. Similarly to *R. ferrumequinum*, no obvious morphological differences were observed in the field between Tunisian and European specimens (Fig. 3 B).

Rhinolophus euryale Blasius, 1853

New Records. Ichkeul National Park, 19 July 2012, recordings with peak frequency 102.8–103.0 kHz. – El Feidja National Park, 21 July 2012, maternity colony estimated to be at least 150 inds. (with juveniles), 70 inds. (45 adult and 7 juvenile ♀♀; 9 adult and 9 juvenile ♂♂) were observed. – Beni M'tir mine, 23 July 2012, 8 adults captured (6 ♀♀ and 2 ♂♂).

Reclassified Record. El Feidja National Park head Quarter, 19 June 1996, 30 inds. collected (TTU 70917–70946), originally described as *R. mehelyi* in Gharaibeh (1997).

Rhinolophus euryale and *R. mehelyi* were not distinguished until Matschie (1901) re-examined museum specimens and described the latter. The two species are morphologically very similar and their identification has been the subject of much debate ever since. In many cases, *R. euryale* were identified as *R. mehelyi* and *vice versa* (e.g. Almaça 1967, Benda et al. 2006), hence it is difficult to know how reliable the previously published records are (e.g. Cockrum 1976a, Kowalski & Rzebik-Kowalska 1991). Further complications arise with the presence in Tunisia of a third species of similar size, *R. blasii*, species that has also been misidentified as *R. euryale* but also as *R. mehelyi* (Aellen & Strinati 1970, Aulagnier & Destre 1985, Benda et al. 2004c).

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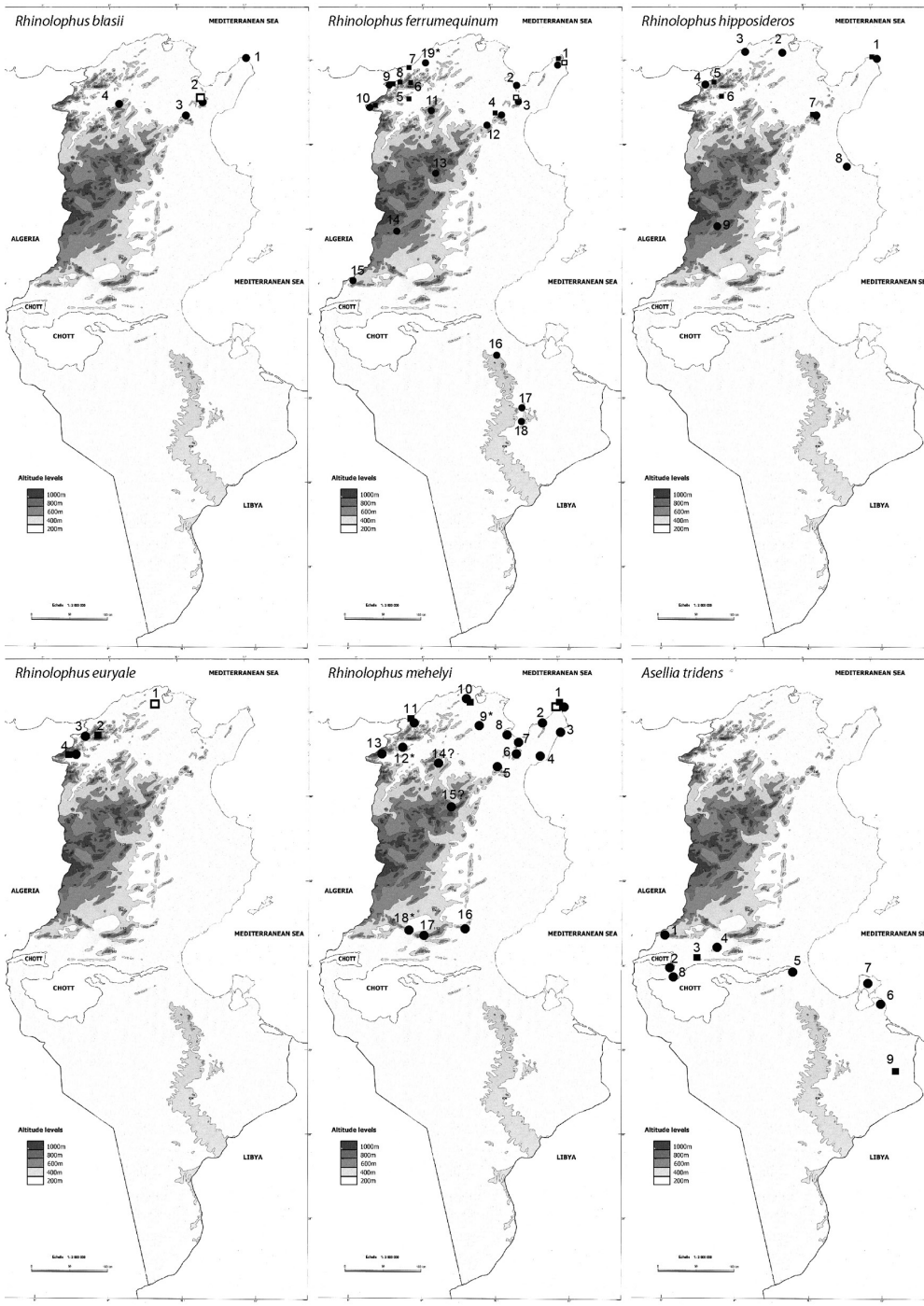
Fig. 2. Map of records of *Rhinolophus blasii*, *R. ferrumequinum*, *R. hipposideros*, *R. euryale*, *R. mehelyi* and *Asellia tridens*. Squares represent new data and circles previously reported or published data. For the new data, full squares denote captured individuals while empty squares represent echolocation detection. Labels with an asterisk represent previously reported or published data for which the species identity has been reclassified and labels followed by an exclamation mark are records with species identity still to be confirmed.


Rhinolophus blasii
MEDITERRANEAN SEA
ALGERIA
CHOTT
LIBYA
Altitude levels
1000m
800m
600m
400m
200m
Rhinolophus ferrumequinum
Rhinolophus hipposideros
Rhinolophus euryale
Rhinolophus mehelyi
Asellia tridens

The first record of *Rhinolophus* (*Euryalus*) *barbarus* Andersen et Matschie, 1904 (synonym of *R. euryale* according to the most recent literature, e.g. Simmons 2005) in Tunisia was made by Andersen & Matschie, who reported on four individuals collected near Tebourba by von Lühe in March 1898. Although the second author described *R. mehelyi*, the size mentioned for forearm length of *R. barbarus* is 49–51 mm (7 ♂♂) and 50.5 mm (1 ♀) (average=50.3 mm), measurements that are above the average for *R. euryale* (see e.g. Miller 1912: 44.6–49.0 mm, mean=47.4 mm, n=30; Dinale 1972: 45–49 mm, mean=47.4 mm, n=55; Felten et al. 1977: 45–50 mm, mean=47.1 mm, n=106; Kowalski & Rzebik-Kowalska 1991: 46–49.5 mm, mean=48.2 mm, n=13; Gory & Jeantet 1999: 44–50 mm, mean=47.26 mm, n=78; Benda et al. 2003: 45.0–52.5 mm, mean=48.7 mm, n=156; Dietz et al. 2006: 45–51 mm, mean=47.7 mm, n=911), but agree well with those of *R. mehelyi* (Miller 1912: 48.8–51.4 mm, mean=50.3 mm, n=12; Baker et al. 1974: 47.7–50.2 mm, mean=50.9, n=29; Kowalski & Rzebik-Kowalska 1991: 47.5–53 mm, mean=50.3 mm, n=80; Gory & Jeantet 1999: 49–53.5 mm, mean=51.17 mm, n=88; Benda et al. 2003: 47.0–53.5 mm, mean=50.2 mm, n=9; Dietz et al. 2006: 48.2–54.8 mm, mean=51.4 mm, n=766). Furthermore, the measurements of 62 adults of *R. euryale* from Tunisia (this study; n=62; El Feidja National Park [n=54] and Beni M'Tir [n=8]) gave values ranging from 45.4 to 49.6 mm with an average at 47.3 mm, while the average was 50.3 mm in *R. mehelyi* (this study; n=99; El Haouariya [n=57], Ras Rajel [n=41] & Ichkeul [n=1]; range=47.2–52 mm) (see also Kahmann 1958). Based on our Tunisian data mentioned above, *R. barbarus* forearm length is significantly larger than in *R. euryale* (t-test, $p<0.001$) while not significantly different from *R. mehelyi* (t-test, $p=0.65$).

Dietz et al. (2006) showed that a discriminant analysis with the length of the first phalanx of the fourth finger (P4.1) and forearm length enabled good (at least 95% correct) discrimination of the five European *Rhinolophus* species in Bulgaria. We therefore created a linear discriminant function (function 'lda' in R v2.15.2, R Development Core Team 2012) using these two measurements and the second phalanx of the fourth finger (P4.2), as Miller (1912) mentioned that the P4.1/P4.2 ratio was different between *R. mehelyi* and *R. euryale*. For this, we used measurements made by the same person (SJP) on 42 adults of *R. mehelyi* and 61 adults of *R. euryale* from northern Tunisia. Using the leave-one out cross validation procedure, the overall classification rate of the function was 94.2% (98.4% for *R. euryale* and 88% for *R. mehelyi*). Only the largest *R. euryale* (n=1, FA=49.6) and the smallest *R. mehelyi* (n=5, FA range=47.2–48.8) individuals were mis-classified by the function, though their probability to belong to one or the other species were sometimes not very different (e.g. 0.58 *vs*. 0.42 for two individuals). If only individuals with a probability to belong to one species above 0.9 were identified to species, then the individuals classified (90/104, 86.4%) are classified with 100% accuracy. Using this function and measurements provided in Andersen & Matschie (1904), we calculated the probability that individuals referred to as *R. barbarus* (four of which are from Tebourba, Tunisia) and *R. meridionalis* belong to either *R. euryale* or *R. mehelyi*. All nine individuals for which measurements are provided in Andersen & Matschie (1904) (including the type specimens of *R. barbarus*, ZMB 12967 and *R. meridionalis* ZMB 12976; Turni & Kock 2008) have a probability above 0.99 of belonging to *R. mehelyi*. This comparison of published data with our new data set strongly suggests that the names *R. barbarus* Andersen et Matschie, 1904 and *R. meridionalis* Andersen et Matschie, 1904 are both synonyms of the name *R. mehelyi* Matschie, 1901 rather than of *R. euryale* Blasius, 1853. We believe a re-examination of the type specimen of *R. barbarus* Andersen et Mastchie 1904 to be necessary and refrain to consider the Tunisian record of *R. euryale* from Andersen & Matschie (1904) as reliable.

The second record to be confirmed is that by Gadeau de Kerville (1908) who reported on a colony with 96 ♂♂ and 26 ♀♀ in the Djebel Gloub cave on 18 May 1906. We visited the collection of

Fig. 3. Photographs of some bat specimens from Tunisia; (A) *Rhinolophus ferrumequinum*; (B) *R. hipposideros*; (C) *Asellia tridens*; (D) *Rhinopoma cystops*; (E) *Miniopterus schreibersii*; (F) *Pipistrellus* cf. *kuhlii*; (G) *Plecotus gaisleri*; (H) *Myotis punicus*; (I) *Eptesicus isabellinus*; (J), *Pipistrellus* cf. *kuhlii*; (K), *P.* cf. *pipistrellus*; (L) *Myotis capaccinii*; (M) *M. emarginatus*; (N) *Myotis punicus*.

the Natural History Museum in Paris where at least two specimens collected by this author and coming from Kroumiria (May–June 1906) have been deposited (cf. Trouessart 1906). Given the shape of the lancet and upper connecting process (cf. Fig. 4), the two specimens (♀♀, MNHN 1906-17 and 1983-1932) are in fact clearly *R. mehelyi*. The forearm length of 49.1 and 50.0 mm corroborates this view. It is interesting to note that specimens collected by the same author in Syria (Djéroud [Jeiroud]; series MNHN 1911-580 A–D) and identified as *R. euryale* were also in fact most likely *R. mehelyi* (Benda et al. 2006), and upon re-examination of the material, we agree with the reclassification of Benda et al. (2006). In his book on the fauna of Tunisia, Blanc (1935) reports three localities where he found *R. euryale*. Nevertheless, Blanc did not record either *R. mehelyi* or *R. blasii* and, in the absence of any measurement data or specimens and given the localities reported, we believe these reports were most likely *R. mehelyi* or *R. blasii*. Dalhoumi et al. (2011) mention that two specimens from near Gafsa (Kaphza, Tunis) are deposited in the collections of the Museum für Naturkunde Berlin (ZMB). This is correct but it seems unlikely that these specimens were the same as those described in Blanc (1935), as the collector name for the specimens in the ZMB collection is Bodmeyer and not Blanc who clearly says in his book that he himself caught the animals. We checked these two specimens held in the collection (ZMB 50137, 50138) and the two animals are very clearly *R. mehelyi* although they were labeled as *R. euryale meridionalis*. Dalhoumi et al. (2011) also reported a specimen of *R. euryale* from El Hamma de Gabès in the ZMB collection. This specimen (ZMB 12961) collected by Spatz in 1898 has the same collection number as a paratype of *Rhinolophus* (*Euryalus*) *toscanus* Andersen et Matschie, 1904 (ZMB 12961; Turni & Kock 2008). However, presently, only one specimen with the number ZMB 12961 could be found in the collection and it has not yet been established which of the two specimens it is (November 2012, N. Lange, pers. comm.). Until this issue is resolved, the record of *R. euryale* from El Hamma de Gabès should not be used.

In his identification key of bats, Laurent (1937) reports *R. euryale barbarus* from Tebourba, Mateur and Gafsa but does not refer to specimens or specific measurements of individuals, hence it is impossible to judge on the validity of these identifications. Nevertheless, given that *R. e. barbarus* is most likely synonymous with *R. mehelyi*, these would most probably be records of *R. mehelyi*. The next record of *R. euryale* comes from Deleuil & Labbé (1955) who described a new subspecies, *R. euryale tuneti* present in El Haouariya (Cap Bon) and between Testour and El Aroussa. Nevertheless, as pointed out by many authors, the specimens used in the original description of *R. euryale tuneti* are probably a combination of *R. mehelyi* and *R. blasii* but not *R. euryale* (Aellen & Strinati 1970, Cockrum 1976b); we share their opinion based on the measurements and pictures provided in the original description by Deleuil & Labbé (1955). Cockrum (1976b) designed a neotype for *R. mehelyi tuneti* Deleuil et Labbé, 1955 as they could not find the specimens that they thought were lost. We have recently found one specimen collected by Deleuil & Labbé at the El Haouariya cave and labeled as *R. euryale tuneti* (though there is no doubt it is a *R. mehelyi*). Nevertheless we are still looking for further specimens from this original collection before formally describing type specimens. Various researchers who visited the El Haouariya cave always reported the presence of *R. mehelyi* but never *R. euryale* (Kahmann 1958, Aellen & Strinati 1969, 1970, Cockrum 1976b, this study) suggesting the view that only *R. mehelyi* is present in El Haouariya (and rarely *R. blasii*, cf. paragraph on *R. blasii* for further details). Aellen & Strinati (1970) collected two recent but damaged radius bones (MNHG 1144.066) that they tentatively assigned to *R. euryale* but without certainty, hence this record should not be considered as a reliable record of *R. euryale*.

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Fig. 4. Photographs showing the details of the noseleaf of *Rhinolophus mehelyi* (columns 1 and 3) and *R. euryale* (columns 2 and 4) from Tunisia. Each row presents the details of one individual per species.


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The first reliable record of *R. euryale* for Tunisia is from an unpublished report by Cockrum (1976a) who collected eight specimens in a mine, 5 km north of Ain Draham. Four of these specimens are now deposited in the Museum of Texas Tech University (TTU 72183–72186) and examination of the shape of the lancet and upper connecting process of TTU 72183–72184 confirms the identification. Furthermore, based on his interpretation and discussion following Deleuil & Labbé (1955) and Aellen & Strinati (1970), we strongly believe Cockrum knew how to separate the three medium-sized *Rhinolophus* bats, hence we consider his record as valid.

Finally, one ♀ *R. euryale* was caught in the attic of a house in the El Feidja NP in May 2000 (Zava & Masseti 2007). Given the size of the animal (FA=46 mm) and the fact that we found a colony of at least 150 individuals in the same house in July 2012, we also consider this record is valid.

We identified *R. euryale* in the Ichkeul NP from recordings only. The species could eventually be confused with *R. mehelyi* which has a slightly higher peak frequency. However, out of more than 90 volant *R. mehelyi* recorded in northern Tunisia, none had a peak frequency as low as 103 kHz. Hence we are confident that these recordings are from *R. euryale*.

The foraging ecology of *R. euryale* has been studied in different parts of Europe and all studies consistently identify woodlands as the most important habitat for the species while open areas are avoided (Russo et al. 2002, Aihartza et al. 2003, Goiti et al. 2003, 2004, 2006, 2008, Russo et al. 2005, Dietz 2007). A similar situation has been observed in more arid environments in Iran (SJP, pers. obs.) suggesting that across its range, the species needs woodlands for foraging. If the situation is similar in Tunisia, the species would then be most likely limited to the northern part of the country where a suitable habitat is available (e.g. Fig. 1 B, Ichkeul NP where echolocation calls of the species have been recorded).

From our discussion above and previously published reports, it is quite clear that *R. mehelyi* and *R. euryale* have been regularly confused in the field and in museum collections. This led us to only accept two records in which there is sufficient evidence that the species has been correctly identified. As a consequence, we might disregard correct records but this is inevitable. Combining previously published data considered as reliable and the data from the present study, there are now only four known sites with *R. euryale* in Tunisia, the species being relatively rare and distributed in the northernmost part of the country, similarly to *R. hipposideros*.

Rhinolophus mehelyi Matschie, 1901

New Records. El Haouariya Cave, 24 May 2011, estimated colony of ca. 300 adults, 54 adult inds. (26 ♀♀; 28 ♂♂) were observed. Many adult ♀♀ had offspring probably a few weeks old. – Oued Ain, 24 May 2011, 3 adult ♀♀ captured, echolocation recordings. – Ichkeul National Park cave, 19 July 2012, capture of one adult ♂ – Beni M'tir mine, 23 July 2012, 1 ind. recorded – Ras Rajel, 24 July 2012, estimated colony of ca. 1000 inds. (with juveniles), 41 adult inds. (33 ♀♀; 8 ♂♂) were observed.

Reclassified Records. Near Tebourba, 12 March 1898, 4 specimens (2 ♂♂, 1 ♀ and 1 unsexed; leg. Lühe), originally described as paratypes of *R.* (*E.*) *barbarus*. The specimens ZMB 12973–12975 are present in the ZMB collection. Specimen ZMB 12972 was exchanged with MHNG in 1909 (Turni & Kock 2008) but was not localised in the MHNG collection (November 2012; M. Ruedi, pers. comm.). – Gafsa (Kaphza, Tunis), without date, 2 unsexed animals in alcohol (ZMB 50137–50138) originally described as *R. euryale meridionalis*. – Djebel Gloub, 18 May 1906, 2 ♀♀ in alcohol (MNHN 1906-17 and 1983-1932) originally described as *R. euryale* (Gadeau de Kerville 1908).

R. mehelyi has been recorded in at least 16 sites in Tunisia (Dalhoumi et al. 2011). Nevertheless, as explained above in the paragraph dealing with *R. euryale*, some records might have been mis-

identification of *R. euryale* or even *R. blasii*. The four specimens collected by von Lühe in March 1898 near Tebourba and described by Andersen & Matschie (1904) under the name *Rhinolophus* (*Euryalus*) *barbarus*, are herein re-identified as *R. mehelyi* (see above) and hence constitute the first record of *R. mehelyi* for Tunisia. Following our re-examination of the specimens MNHN 1906-17 and 1983-1932 reported above, the second confirmed record of *R. mehelyi* from Tunisia would be specimens collected by Gadeau de Kerville in 1906 in Djebel Gloub (Kroumiria). Specimens by Bodemeyer from Gafsa might predate these two confirmed records but we did not obtain a collection date for these specimens. All other records of probable *R. mehelyi* discussed in the *R. euryale* paragraph above and not associated with specimens or with detailed descriptions are difficult to assign with certainty to either of the two species, hence they are not included in the maps (Fig. 2).

Nevertheless, it seems that most of these records are probably from *R. mehelyi*. We will not analyze or discuss in detail the description of *R. mehelyi tuneti* Deleuil et Labbé, 1955 as this has already been done by others and as mentioned above, we agree with their conclusion. Individuals identified by Kahmann (1958), Deleuil & Labbé (1955) [except specimens of *R. blasii*], Baker et al. (1974), Cockrum (1976a), and Felten et al. (1977) are without much doubt *R. mehelyi*. Gharaibeh (1997) added two localities for *R. mehelyi* but surprisingly, mentioned a colony in the HQ of the El Feidja NP, the same place where Zava & Masseti (2007) and ourselves identified *R. euryale*. To our knowledge, breeding colonies of *R. mehelyi* have never been found in a building similar to the park HQ and we suspect these to be *R. euryale* rather than *R. mehelyi*. These individuals were originally identified as *R. euryale* (B. Gharaibeh field notes, B. Gharaibeh pers. comm.) and their forearm length supports this original identification. We therefore reclassified this record as *R. euryale* along with the 30 specimens (TTU 70917–70946) collected by Gharaibeh (1997) and associated with this record. Dalhoumi et al. (2011) mentioned that Zava & Masseti (2005) [though it is in fact 2007 as correctly presented in the references] found a colony of 30 *R. mehelyi* in the El Feidja NP (Kef en Negcha) on 31 May 2000. This report is erroneous as Zava & Masseti (2007) clearly mention the capture of 2 individuals in the vicinity of Kef en Negcha but do not mention any colony. Dalhoumi et al. (2011) most likely mixed up the information from Zava & Masseti (two individuals captured) and the report by Gharaibeh (1997) who collected 30 specimens (though these were most likely *R. euryale*, cf. above comments) from a colony found in the HQ of the El Feidja National Park (Dalhoumi, pers. comm.). Based on records entered in museum or institutional databases available online, it appears that specimens of the medium-sized *Rhinolophus* from Tunisia (mainly *R. mehelyi*) are deposited in at least seven collections not mentioned herein. We do not mention these records as we did not have the opportunity to investigate these specimens. Nevertheless, it seems that most if not all specimens have been collected from localities already mentioned in the present study (data not shown), hence they are unlikely to change significantly the distribution of the species in question. Based on the current knowledge, *R. mehelyi* is more widely distributed in Tunisia and more commonly encountered than *R. euryale*.

As highlighted above, many authors have mis-identified *R. euryale* and *R. mehelyi*, especially in North Africa, but not only (e.g. Strinati & Aellen 1958, Almaça 1967). We believe this confusion might partly come from the slightly unusual morphology of the connecting process of the noseleaf in many *R. mehelyi*. In most if not all descriptions and identification keys, the connecting process of *R. euryale* is given as 'slightly horn-shaped, being pointed in profile and forward curving (slightly downwards)' while it is 'relatively blunt in profile and only slightly longer than the lower process' in *R. mehelyi* (Dietz & von Helversen 2004). While the description of the connecting process for *R. euryale* holds true in most cases in Tunisia (but see Fig. 4 G), the description does not apply to Tunisian (and maybe North-African) *R. mehelyi* (see Fig. 4 D, H, L, P and T). The

connecting process of Tunisian *R. mehelyi* is quite variable as shown in Fig. 4 where we have illustrated a range of variants, the first (D) and fourth one (P) being the most widely encountered. Besides a few isolated cases, this variation has not been observed in other parts of the range of *R. mehelyi* (SJP, unpubl. data). Nevertheless, similarly to across its range, *R. mehelyi* lancet is abruptly narrowed above the middle to a distinctly linear tip, allowing the distinction with *R. euryale* that has a lancet narrowing gradually to its tip, with only a slight constriction (see Fig. 1 in Strinati & Aellen 1958, Dietz & Von Helversen 2004, SJP, unpubl. data). Another criterion that can help to distinguish *R. mehelyi* and *R. euryale* is explained and illustrated in Mucedda et al. (1999). When looking at the animal's face, *R. euryale* has its eyes partially covered by the margin of the noseleaf (more specifically the cells of the lancet) while in *R. mehelyi*, the eyes are distant from the noseleaf (see Fig. 1 in Mucedda et al. 1999; this study, Fig. 4). Although the presence of darker hair around the eyes has sometimes been mentioned as a way to identify *R. mehelyi*, this criterion does not work as many *R. euryale* across the species range have these characteristics (SJP, unpubl. data). It is generally true that adult *R. mehelyi* have a clearer general aspect compared to *R. euryale*, especially the belly; nevertheless, some *R. mehelyi* are darker than *R. euryale* specimens which precludes the use of coloration as the main criterion to differentiate between the two species, even when in sympatry (SJP, unpubl. data). It is interesting to note that some *R. mehelyi* from Ras Rajel were light to moderate ginger, including the belly, which is similar to previous reports from Sardinian *R. mehelyi* (Lanza et al. 2002).

The foraging ecology of *R. mehelyi* has been studied in Iberia and the Balkans and the studies consistently identified woodlands as an important habitat for the species but contrary to *R. euryale*, the species was also found to forage in semi-open habitats (Russo et al. 2005, Dietz 2007, Salsamendi et al. 2012). Whether *R. mehelyi* can forage in completely open habitats is yet unknown. Nevertheless, an important colony of the species was observed in the Mesopotamia plain (western Iran) where the habitat in a 15 km radius was completely open (SJP, pers. obs.) suggesting that either the species travels further for foraging (though it has to travel over 15 km in open habitat) or that the species forages in open habitats. Either way, *R. mehelyi* seems more able to cope with more open habitats than *R. euryale* and hence, the species could be expected to reach the Chott region and eventually the Libyan border along the coast and the Djebel Nefousa mountains (Hanák & Elgadi 1984).

Rhinolophus blasii (Peters, 1866)

New Record. Djebel Ressas mine, 25 July 2012, recordings of the species at the mine entrance (peak frequency 95–97 kHz).

Unfortunately, we did not catch bats in Djebel Ressas (Fig. 1 A) and hence, it is not possible to be completely confident on the identity of the animals recorded. Nevertheless, a peak frequency of 95–97 kHz is below the minimum peak frequency recorded anywhere in *R. euryale* range (Russo et al. 2001, Salsamendi et al. 2005, Siemers et al. 2005, Russo et al. 2007, Papadatou et al. 2008, SJP, unpubl. data). This frequency range corresponds well with *R. blasii* (Siemers et al. 2005: 92.2–98.2 kHz, mean=95.2 kHz, n=89; Papadatou et al. 2008: 91.7–96.1 kHz, mean=94 kHz, n=37). No recordings of *R. blasii* from North Africa are available for comparison but the present

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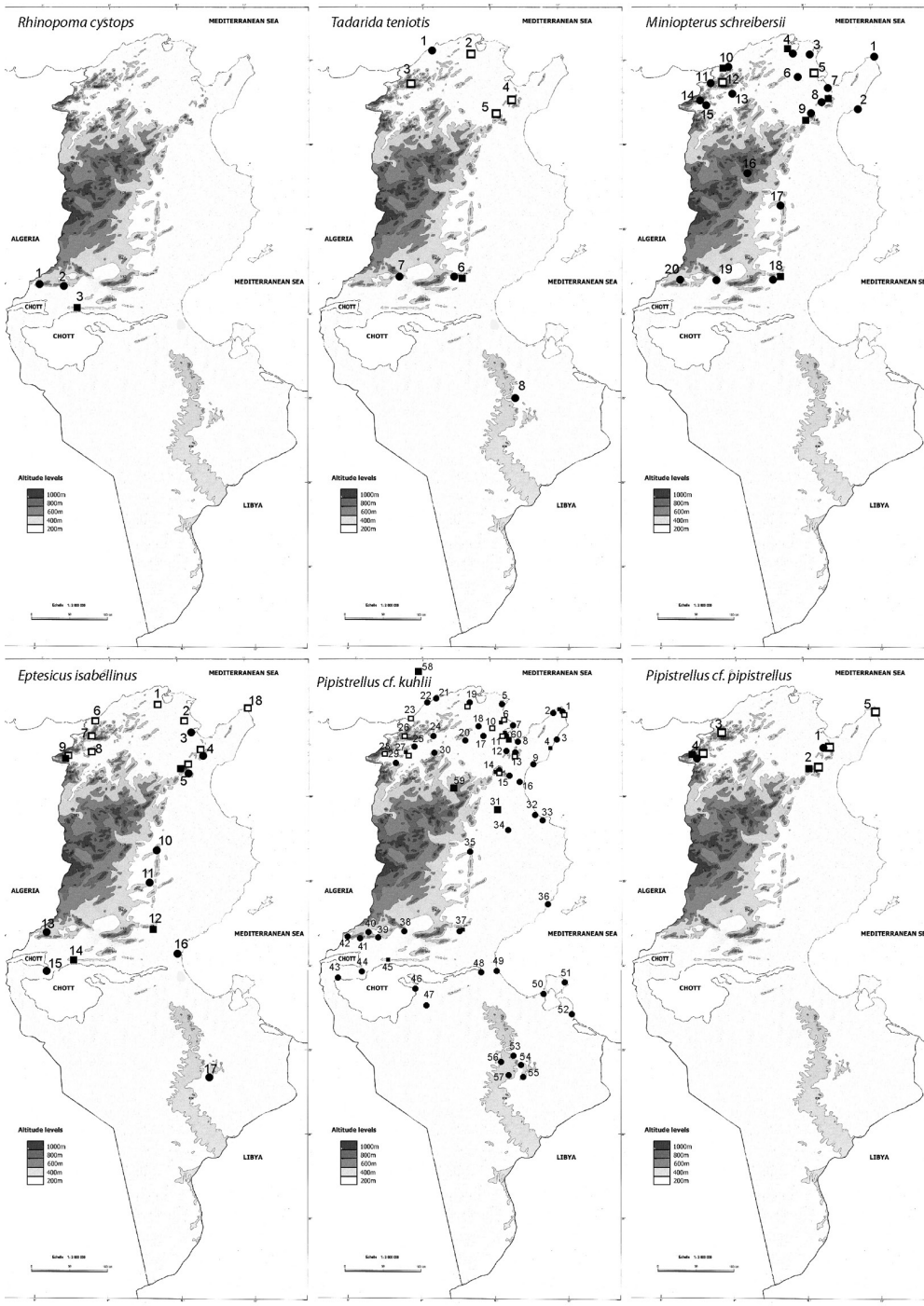
Fig. 5. Map of records of *Rhinopoma cystops*, *Tadarida teniotis*, *Miniopterus schreibersii*, *Eptesicus isabellinus*, *Pipistrellus* cf. *kuhlii*, and *P.* cf. *pipistrellus*. Squares represent new data and circles previously reported or published data. The same symbols as in Fig. 2.


Rhinopoma cystops
Tadarida teniotis
Miniopterus schreibersii
Eptesicus isabellinus
Pipistrellus cf. kuhlii
Pipistrellus cf. pipistrellus
MEDITERRANEAN SEA
ALGERIA
CHOTT
LIBYA
Altitude levels
1000m
800m
600m
400m
200m

recordings (R0025764 & R0025775) can be later compared to reference calls of the region. *R. blasii* has been previously captured in Djebel Ressas by Cockrum (1976a), so our acoustic detection of the species at the same site is not surprising (Fig. 2). Five specimens collected in Djebel Ressas are deposited in the Museum of Texas Tech University (TTU 72178–72182) along with 21 specimens collected in Djebel Zaghouan (TTU 72157–72177). We examined three of these specimens (TTU 72157, 72171, and 72180) and agree with Cockrum identifications.

Asellia tridens (Geoffroy, 1813)

New Records. Dghoumes National Park, 15 May 2008, capture of 1 adult ♀ (Fig. 3 C). – Sidi Toui National Park, August 2009, capture of 2 inds. from a colony of 50 inds.

The species was recorded from seven localities in Tunisia (cf. Dalhoumi et al. 2011). It was encountered mainly around the Chott region from Redayef to Gerba and Zarzis. Our new records (Fig. 1 C) extend the current range further south and east (Fig. 2). Prospections should be extended further south to search for the species.

Rhinopoma cystops Thomas, 1903

New Record. Cave in Djebel Morra (Dghoumes National Park), 15 May 2008, 7 inds. were observed (6 ♂♂; 1 ♀; Fig. 3 D) among a colony (not counted).

The distribution of *Rhinopoma cystops* in Tunisia is similar to that of *Asellia tridens*, mostly distributed around the Chott region. Our data (Fig. 1 D) do not extend the current range of the species in the country (Fig. 5).

Tadarida teniotis (Rafinesque, 1814)

New Records. Bouhedma National Park, 14 Septembre 2006, 1 ♂ & 1 ♀ captured (specimens TT 14906BHM & TT 14906BHF, Department of Biology, Faculty of Science, University of Tunis El-Manar, Tunisia). – Ichkeul National Park, 19 July 2012, echolocation recording. – Beni M'tir Dam, 23 July 2012, echolocation recording and visual observation. – Beni M'tir mine (outside), 23 July 2012, echolocation recording. – Djebel Resas, 25 July 2012, echolocation recording. – Zaghouan mine (outside), 26–27 July 2012, echolocation recording. – Zaghouan City, 26 July 2012, echolocation recording. – Sidi Bougabrine, 27 July 2012, echolocation recording.

This species is not easy to capture and very few records are available although they are spread throughout most of the country (Fig. 5). Our new data on animals captured or recorded show that the species might be common in some areas (e.g. the northernmost part). In Beni M'tir, there was an important activity of the species around the Dam (Fig. 1 E) and the species could be heard nearly constantly through the night from the top of the Dam. Given this significant activity combined with information we obtained from people maintaining the dam (bats roosting "on the walls of the Dam"), we suspect that *Tadarida* uses the Dam for roosting and maybe for breeding.

Miniopterus schreibersii (Kuhl, 1817)

New Records. Bou Hedma National Park, 13 May 2008, one adult ♀ captured. – Zaghouan mine, 29 June 2009, one adult ♀ captured. – River, 4.9 km SW of Sidi Thabet, 26 May 2011, echolocation recordings. – Ichkeul National Park, 19 July 2012, estimated colony of *ca*. 1500 inds., 24 adults specimens were studied (♀♀: 16 adults & 4 juveniles; ♂♂: 2 adults & 2 juveniles); echolocation recordings. – Ichkeul tunnel, 19 July

2012, 1 dead animal collected. – Ras Rajel Mine, July, 24 2012, 1 ind. observed in the colony of *R. mehelyi*. – Beni M'tir lake, 23 July 2012, echolocation recordings. – Beni M'tir Dam, 23 July 2012, echolocation recording. – Sidi Bougabrine, 26 July 2012, one adult ♂ captured.

Miniopterus has been recorded at more than 20 localities in the northern half of Tunisia (N of the Chott region; Fig. 5) (cf. Dalhoumi et al. 2011). Although the species seems rather common based on the number of records, no important breeding colonies of the species were known. We identified the first breeding colony of *Miniopterus* in the Ichkeul NP, in the same cave as *Myotis capaccinii* and *M. punicus*. Morphologically, no obvious difference was observed in the field between Tunisian and European specimens (Fig. 3 E).

Eptesicus isabellinus (Temminck, 1840)

New Records. Bou Hedma National Park, 10–13 May 2008, 35 adult inds. (26 ♀♀ and 9 ♂♂) were captured. – Dghoumes National Park, 15 May 2008, 1 adult ♀ captured (Fig. 3 I). – Zaghouan mine (inside), 27 June 2009, 5 adult ♂♂ were captured; 26 July 2012, echolocation recordings. – Oued Ain, 24 May 2011, echolocation recordings. – River, 4.9 km Southwest of Sidi Thabet, 26 May 2011, echolocation recordings. – El Feidja National Park, July 21 2012, 3 adults were captured from rock crevices (2 ♂♂, one ♀); echolocation recordings. – Sidi Bougabrine, 27 June 2009, 11 adult ♂♂ were captured; 27 July 2012, 10 ♂♂ were captured (9 adults, one juvenile), echolocation recordings. – Ichkeul National Park, 19 July 2012, echolocation recordings. – Oued 2 km South-West of Fernena, 22 July 2012, echolocation recordings. – Beni M'tir mine (outside), 23 July 2012, echolocation recordings. – Beni M'tir Dam, 23 July 2012, echolocation recording. – Ras Rajel mine (outside), 24 July 2012, echolocation recordings. – Djebel Resas mine (outside) and lake, 25 July 2012, echolocation recordings. – Zaghouan City, 26 July 2012, echolocation recordings.

Eptesicus isabellinus is known from 10 sites in Tunisia, from the north of the country down to Tataouine in the south, illustrating the plasticity of the species in terms of habitats (cf. Dalhoumi et al. 2011).

Morphologically, *E. isabellinus* is relatively similar to *E. serotinus* (Schreber, 1774) from Europe and it was for a long time recognized as a North-African subspecies of *E. serotinus*. Only recently, genetic analyses showed that *E. isabellinus* is clearly separated from *E. serotinus* and deserves to be considered as a separate species (e.g. Ibañez et al. 2006). Criteria to differentiate between the two species include the paler colour of *E. isabellinus* (in general), its smaller size, characteristics of its tragus, its width being greater and its height shorter, and finally, the thumb, fifth finger and tail being proportionately smaller than in *E. serotinus* (Dobson 1880). Lataste (1887) also noted that the tragus was more bent inwards in *E. isabellinus*. Our data on Tunisian *E. isabellinus* forearm length (n=64, FA range=45.0–53.6 mm, mean=49.24 mm) and CM^3 (n=52, CM^3 range=6.1–7.7 mm, mean=7.1 mm) confirm that *E. isabellinus* is smaller than *E. serotinus* from Europe (FA: n=65, range=46.2–56.8 mm, mean=51.69 mm; CM3: n=100, range=7.06–8.52 mm, mean=7.71 mm, Benda et al. 2006). Forearm length and CM^3 measurements of Tunisian *E. isabellinus* are however very similar to measurements of their conspecifics from Algeria (FA: n=52, range=45–51.5 mm, mean=48.65mm; CM3: n=35, range=6.5–7.3 mm, mean=7 mm, Kowalski & Rzebik-Kowalska 1991). The coloration of specimens captured is also clearly paler than that of *E. serotinus* from France (terra typica).

We have found this species in various habitats from wetlands to lakes, rivers, forests and cities (Fig. 5). The capture of five males at the entrance of the Zaghouan mines in June 2009 reveals that the species might also use underground sites, at least in transit, a situation similar to Algeria (Kowalski & Rzebik-Kowalska 1991).

Hypsugo cf. *savii* (Bonaparte, 1837)

New Records. Sidi Bougabrine, 27 June 2009, 2 adult ♂♂ captured; 27 July 2012, 17 inds. captured (♂♂: 12 adults and 2 juveniles; ♀♀: 2 adults and 1 juvenile), echolocation recordings. – Zaghouan mines (outside), 29 June 2009, 5 ♂♂ (1 juvenile & 4 adults) were captured; 26 July 2012, echolocation recordings. – Oued Ain, 24 May 2011, echolocation recordings. – Beni M'tir mine (outside), 23 July 2012, echolocation recordings. – Beni M'tir dam, 23 July 2012, echolocation recordings. – Djebel Ressas Mines, 25 July 2012, echolocation recordings – Djebel Ressas Lake, 25 July 2012, echolocation recordings. – Zaghouan City, 26 July 2012, echolocation recordings.

Surprisingly, this taxon was only known from the capture of three males at a single site in Tunisia (Djebel Zaghouan; Vaughan et al. 1977) (Fig. 6). Therefore, very little is known about the biology, ecology or repartition of the species in Tunisia.

Specimens captured and reported in the present study appear generally more massive than the nominal form of *H. savii* in Europe. The measurements of forearm length (this study: n=20, range=31.6–37.0 mm, mean=34.25 mm; Benda et al. 2006: Europe / Middle East, n=23, range=31.3–36.5 mm, mean=33.88 mm) or CM^3 (this study: n=6, range=4.3–4.8 mm, mean= 4.50 mm; Benda et al. 2006: CM3 Europe / Middle East, n=23, range=4.28–4.75 mm, mean=4.61 mm) only moderately reflect this impression.

Volant juveniles were captured as early as at the end of June, suggesting that females give birth at least as early as at the end of May (but possibly earlier). The capture of juveniles also represents the first proof of reproduction of the taxon in Tunisia. In terms of foraging habitats, the species has been recorded in the city of Zaghouan, near a water body or rocky habitats, always in Mediterranean environments (Fig. 1 F). In Morocco, this taxon seems to appreciate rocky habitats (Benda et al. 2004c), which also seems to be the case in Tunisia.

Molecular analyses, essentially based on mitochondrial DNA have revealed the presence of three lineages, one in eastern Europe, one in western Europe and one in North Africa and Iberia with divergence levels high enough to suggest the presence of cryptic species (Ibañez et al. 2006, Mayer et al. 2007, Garcia-Mudarra et al. 2009). Nevertheless, a recent study investigating samples from more geographic locations has revealed a more complex situation with for example samples from Sardinia, Morocco, Sicily, Canary Islands and Turkey forming a monophyletic group. Other samples from Sardinia grouped with samples from mainland Europe (Iberia and Switzerland) and a new lineage (actually, only one sample) from Israel was also reported. Some authors have referred to the North-African taxon as *Hypsugo* cf. *darwinii* (Tomes, 1859), described from Palma, Canary Islands (Tomes 1859, Mayer et al. 2007, Veith et al. 2011), while others used *H. savii ochromixtus* (Cabrera, 1904), described from Menorca, Balearic Islands (Cabrera 1904, Horáček et al. 2000). We do not follow these classifications as it is not yet clear if there is only one *Hypsugo* linegae/species in the Canary or Balearic Islands and if the *Hypsugo* from the Canary or Balearic Islands are morphologically and genetically (at the nuclear level) similar to the *Hypsugo* from North Africa. Furthermore, molecular analyses carried out so far only included a limited number of samples from a limited number of localities in North Africa and we cannot exclude the presence of a further cryptic species in the region. Hence, in the absence of an integrative study combining a larger and more widespread sampling, molecular analyses across multiple nuclear DNA markers, morphometric and acoustic studies, we only refer to this taxon as *H.* cf. *savii* species complex. We nevertheless recognise that the specimens are unlikely to belong to *H. savii* s. str.

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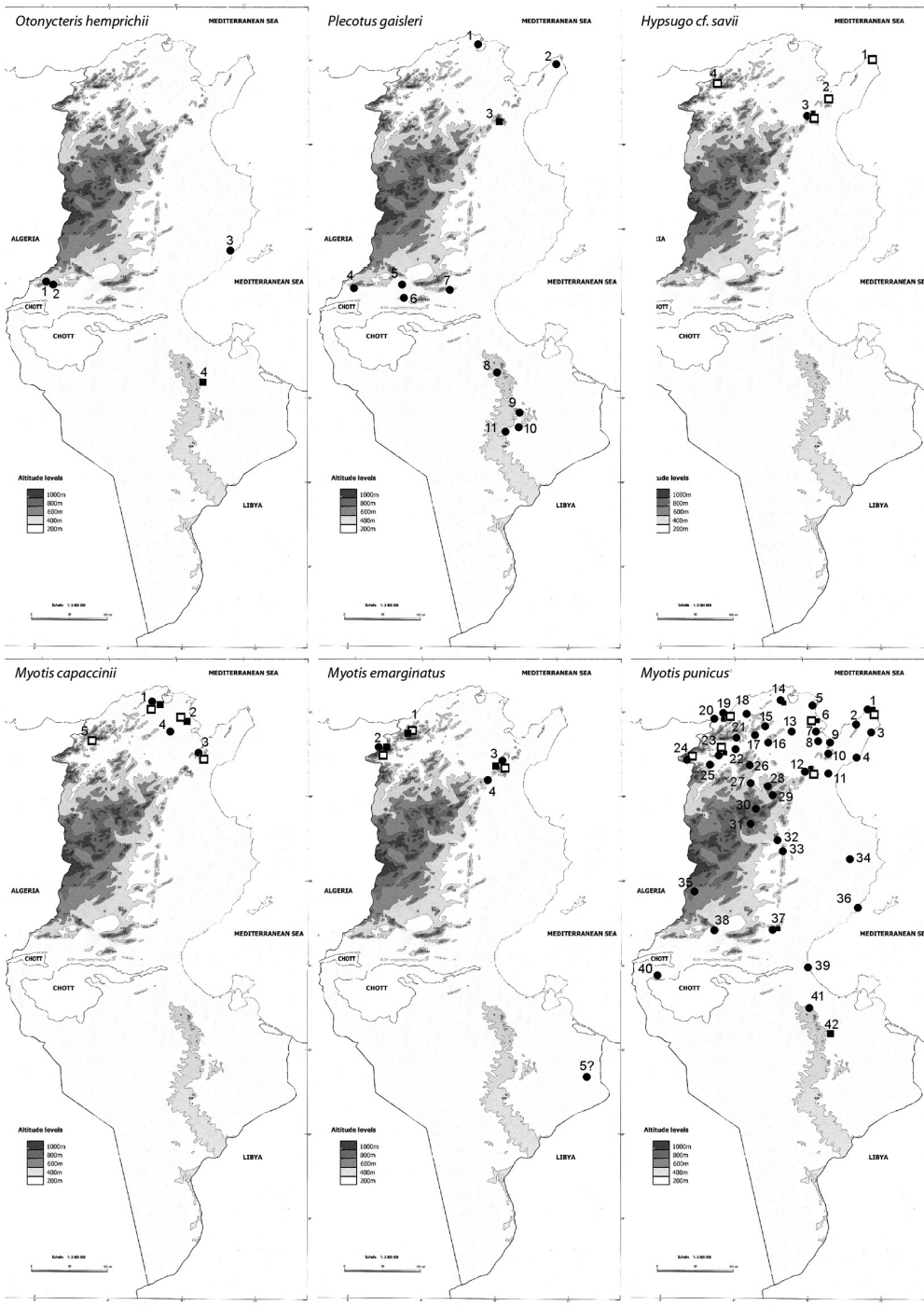
Fig. 6. Map of records of *Otonycteris hemprichii*, *Plecotus gaisleri*, *Hypsugo* cf. *savii*, *Myotis capaccinii*, *M. emarginatus*, and *M. punicus*. Squares represent new data and circles previously reported or published data. The same symbols as in Fig. 2.


Otonycteris hemprichii
Plecotus gaisleri
Hypsugo cf. savii
Myotis capaccinii
Myotis emarginatus
Myotis punicus
MEDITERRANEAN SEA
ALGERIA
CHOTT
LIBYA
Altitude levels
1000m
800m
600m
400m
200m

Pipistrellus cf. *pipistrellus* (Schreber, 1774)

New Records. Sidi Bougabrine, 27 June 2009, capture of one adult ♀ (included in Hulva et al. 2010); 27 July 2012, 23 adult inds. captured; echolocation recordings. – Oued Ain, 24 May 2011, echolocation recordings. – El Feidja, National Park, 20 July 2012, 2 adult ♂♂ captured (Fig. 3 K); echolocation recordings. – El Feidja, National Park, 21 July 2012, 1 ♀ adult and 2 ♂♂ captured, echolocation recordings. – Beni M'tir lake, 23 July 2012, echolocation recordings. – Beni M'tir dam, 23 July 2012, echolocation recordings. – Ras Rajel, 24 July 2012, echolocation recordings. – Djebel Ressas Mines, 25 July 2012, echolocation recordings. – Djebel Ressas Lake, 25 July 2012, echolocation recordings. – Zaghouan, mines, 29 June 2009, 2 adult ♂♂ captured inside; 27 July 2012, 1 adult ♂ captured outside; echolocation recordings. – Zaghouan, city, 26 July 2012, capture of 2 adult ♂♂ and 1 adult ♀; echolocation recordings.

Previously, *P*. cf. *pipistrellus* has only been recorded from two sites in Tunisia, Djebel Ressas in 1974 and 1975 (Vaughan et al. 1977; specimens No. TTU 956897, 956898) and El Feidja (DFG, 1988 in Dalhoumi et al. 2011), although the second record would be difficult to confirm as there are no detailed measurements or indications of specimens associated with it. Our captures confirm the presence of the species in El Feidja and Zaghouan and echolocation call recordings of the species were made from four new sites, two around Beni M'tir, at Ras Rajel and in Djebel Ressas. Nevertheless, the limited number of records of the species sharply contrasts with the numerous records of *P*. cf. *kuhlii* nearly throughout the country (Fig. 5). These data suggest that *P*. cf. *pipistrellus* does not have a homogeneous distribution throughout the country but a rather localized distribution, most likely mainly in the northern and most humid part of the country.

Taxonomy in the *Pipistrellus* species complex has been a subject of many studies, although many of them only included mitochondrial DNA and could not fully resolve species boundaries, especially in the Maghreb and Mediterranean Islands (e.g. Hulva et al. 2007). However, it appears that *P*. cf. *pipistrellus* from the Maghreb forms a lineage on its own and the most recent study also looking at nuclear DNA, although with a limited number of samples (n=3 from Tunisia), tends to show that they are also different at the nuclear level (Hulva et al. 2010). Interestingly, although in the mitochondrial DNA the Maghreb populations are more closely related to *P*. *pipistrellus* s. str., at the nuclear level, they appear more closely related to *Pipistrellus hanaki* Hulva et Benda, 2004 (from Libya and Crete) and *Pipistrellus pygmaeus cyprius* Benda, 2007 (from Cyprus). Further genetic and morphological studies on the Maghrebian *P*. cf. *pipistrellus* populations are necessary to clarify their taxonomic identity, which could well represent a new species. Given these uncertainties in the exact taxonomic assignment of this taxon from Tunisia, we refer to them as *P*. cf. *pipistrellus*.

Morphologically, animals captured in Tunisia (n=31, FA range = 26.9–31.3 mm, mean=29 mm) are smaller than *P*. *pipistrellus* s. str. specimens (n=20, FA range=30.20–33.20 mm, mean= 31.67 mm, Benda et al. 2004a) but are similar in size to *P*. *pipistrellus* s. l. reported from Morocco (n=9, FA range=28.5–31 mm, mean=29.78 mm) and Algeria (n=12, FA range=27.3–29.9 mm, mean=28.33 mm; Benda et al. 2004a). The genitalia colouration of some individuals (♂♂ and ♀♀) was slightly yellowish, similar to *P*. *pygmaeus* (Leach, 1825). In terms of colouration, the animals were globally dark brown with basal parts of the hair being black. The skin of the face was also globally dark brown to black but became clearer between the eye and the base of the ears (Fig. 3K).

The capture of lactating females and juveniles brings here the first proof of reproduction of the species in Tunisia. Additionally, recordings of foraging individuals inform us about some foraging grounds of the species. Individuals were observed foraging in the El Feidja village, flying back and forth 2–6 meters above the road that was partially illuminated by public lights, a situation also observed in the city of Zaghouan. In Ras Rajel, individuals were observed foraging above

sheep pastures, some 10–30 meters away from the forest. Near Beni M'tir, the species was recorded along a small road going through a forest near the shore of the lake. In terms of roosting, two males were found in a mine in Zaghouan in June but this could simply be a transient site as regularly observed in Europe (BA, pers. obs.). Otherwise, no colonies were found but the species might roost in cliffs as observed in Morocco and Algeria (BA, pers. obs.).

Pipistrellus cf. *kuhlii* (Kuhl, 1817)

New Records. La Galite island, May 2012, 1 ind. collected. – Siliana, not dated but after 2000, one juvenile found dead in the city. – Naâssen, 2005, 1 ind. collected (PK.N05, Biology department of the faculty of Science of Tunis, University of Tunis El-Manar, Tunisia). – Bou Hedma National Park, 10–13 May 2008, 21 adult inds. (17 ♀♀ and 4 ♂♂; Fig. 3 F) were captured. – Dghoumes National Park, 15 May 2008, 2 adult ♂♂ captured (Fig. 3 J). – El Haouariya, 24 May 2011, two adult ♂♂ captured. – El Haouariya, Oued el Ain, 24 May 2011, 4 adult specimens (1 ♂, 3 ♀♀) captured, echolocation recordings. – Carrières Fatjun (NW of El Haouariya), 25 May 2011, one dead specimen collected (BA private collection). – River, 4.9 km SW of Sidi Thabet, 26 May 2011, echolocation recordings. – Pool, 4.7 km SW of Sidi Thabet, 27 May 2011, capture of 10 inds., echolocation recordings. – Tazarka, 13 June 2012, one colony was observed in an old house. – Parc du Belvédère, Tunis, 17 July 2012, echolocation recordings. – 4.5 km NE of Tebourba, echolocation recordings. – Road C32, 3.6 km S of Jedeida, echolocation recordings. – Bridge on RN7, 2.2 km SE of Jedeida, echolocation recordings. – Ichkeul National Park, 19 July 2012, echolocation recordings. – El Feidja National Park, July 20–21 2012, echolocation recordings. – Oued 2 km SW of Fernena, 22 July 2012, 2 juvenile ♂♂ captured, echolocation recordings. – Beni M'tir mine (outside), 23 July 2012, echolocation recordings. – Beni M'tir dam, 23 July 2012, 1 juvenile ♂ captured, echolocation recordings. – Ras Rajel, 24 July 2012, echolocation recordings. – Djebel Ressas, 25 July 2012, echolocation recordings. – Zaghouan mines (outside), 26 July 2012, echolocation recordings. – Zaghouan City, 26 July 2012, 1 adult and 1 juvenile ♀♀ captured, echolocation recordings. – Tunis (Omrane Supérieur), 28 July 2012, colony in a house, 2 juvenile ♀♀ observed, echolocation recordings.

The species is most certainly the most commonly found bat and most widespread in Tunisia with its presence from the northernmost part (including La Galite islands, 38 km off the north coast) down to Tataouine in the south (Fig. 5) (Dalhoumi et al. 2011). As across its distribution range, the species has been recorded in a large diversity of habitats from anthropic to wild and humid to arid. In Tunisia, most of known colonies of the species are in buildings (Dalhoumi et al. 2011, this study) and only occasionally in trees (Hizem & Allegrini 2009).

In Tunisia, females arrive at maternity colonies as early as in April until May (Deleuil & Labbé 1955). The earliest lactating females were captured around mid-May (10–13 May; this study) and the last one at the end of July (Deleuil & Labbé 1955, Hizem & Allegrini 2009). In May, lactating and pregnant females can be captured on the same day. The earliest captures of flying juveniles were on 22 July. Given this information on reproduction dates, we can estimate that females most likely give birth between mid-May and mid-June, which is one month earlier than what has been observed in Iberia (Palomo et al. 2007) but in agreement with dates from Algeria (Kowalski & Rzebik-Kowalska 1991).

The important fur colour variation observed in *P.* cf. *kuhlii* has been partly described by Deleuil & Labbé (1955) who nevertheless did not provide explanations for such variation. They described some forms that are rather dark and somehow similar to *P. pipistrellus* and other very light. During the present study, we have observed variation in fur colour from ginger/yellowish to greyish/white (Fig. 3 F & J), but never dark individuals.

Forearm lengths in Tunisian specimens (n=33, range=32.0–35.0 mm, mean=33.80 mm) are similar to those of specimens from the rest of North Africa (n=103, range=31.0–36.4 mm, me-

an=33.71 mm; Benda et al. 2004c) and only slightly smaller than those of *P. kuhlii* from Europe and the Middle East (n=137, range=27.8–36.5 mm, mean=34.17 mm; Benda et al. 2004c). The same trend is observed with CM^3 measurements, with Tunisian specimens (this study, n=23, range=4.40–5.10 mm, mean=4.80 mm) being most similar to the rest of North Africa (n=111, range=4.51–5.27 mm, mean=4.88 mm; Benda et al. 2004c) and only slightly smaller than in Europe and the Middle East (n=151, range=4.42–5.23 mm, mean=4.97 mm; Benda et al. 2004c). It is important to take the CM^3 measurement as it seems to be a relatively good criterion to differentiate *P.* cf. *kuhlii* from *P. deserti* (the latter generally having a CM3<4.5 mm; Benda et al. 2004c, BA unpubl. data).

Recent molecular studies based only on mitochondrial DNA have revealed the presence of different lineages in Europe and North Africa, potentially indicating the presence of cryptic species (e.g. Ibañez et al. 2006, Garcia-Mudarra et al. 2009, Veith et al. 2011). Given the results of the recent molecular data and the morphological and phenotypic variation observed, we do not feel confident in assigning Tunisian specimens to the nominal form, hence we refer to *Pipistrellus* cf. *kuhlii*. More investigations are clearly necessary to clarify the taxonomy in this species complex.

Otonycteris hemprichii Peters, 1859

New Record. Farm near Ghomrassen, no date but after 2000, 1 ind. found dead in a lake.

The species was recorded from only three localities in Tunisia (cf. Dalhoumi et al. 2011). It was recorded north of the Chott region and near Tataouine (Fig. 6). Our new record extends the current range of the species further south and adds one new locality for this species that seems restricted to arid and Saharan parts of the country.

Plecotus gaisleri Benda, Kiefer, Hanák et Veith, 2004

New Records. Zaghouan mine, 29 June 2009, 6 ♂♂ captured (1 adult [Fig. 3 G], 5 juveniles); 26 July 2012, 1 adult ♂ captured.

The species is found across most of the country (Fig. 6), although from the number of records, it seems more abundant in the southern part. The species is very distinct from other species present in Tunisia so previous records attributed to the species can be considered as reliable. Nevertheless, in the last 10 years, the species has been a subject of a certain number of taxonomical changes and is now considered as a full species, *P. gaisleri*. This change is based mainly on genetic and morphometric characters, most of which (e.g. bacular and cranial) are only measurable on voucher specimens. The morphological criteria to differentiate *P. gaisleri* from other western Palaearctic *Plecotus* species in the field are not straightforward. Based on external appearance and forearm length, our specimens agreed well with the description of the species (Benda et al. 2004b), but shall there be another sympatric *Plecotus* species present, we would not be able to ascertain our specimens are for sure *P. gaisleri*.

Myotis punicus Felten, 1977

New Records. Ghomrassen, not dated but after 2000, 1 ind. observed. – Bou Hedma National Park, 13 May 2008, 2 adult inds. (1 ♀ and 1 ♂) were captured. – Zaghouan mine, 29 June 2009, 14 ♂♂ (12 adults and 2 juveniles); 27 July 2012, 6 inds. captured (1 adult and 1 juvenile ♀♀; 3 adult and 1 juvenile ♂♂), echolocation recordings. – Carrières les grottes (N of El Haouariya), 23 May 2011, 8 inds. – El Haouariya Cave, 24 May 2011, estimated breeding colony of min. 50 inds., 6 inds. (2 adult ♀♀; 3 adult and 1 juvenile ♂♂) were observed. – Oued Ain, 24 May 2011, echolocation recordings. – Pool, 4.7 km SW of Sidi Thabet, 27 May

2011, echolocation recordings. – River, 4.9 km SW of Sidi Thabet, 26 May 2011, echolocation recordings. – Cave, 4.6 km SW of Sidi Thabet, 26 May 2011, bones and skulls of several animals found. – Ichkeul National Park, 19 July 2012, estimated breeding colony of at least 750 inds., 5 inds. (2 juveniles ♀♀; 1 adult & 2 juvenile ♂♂) were observed (Fig. 3 H), echolocation recordings. – Ichkeul tunnel III, 19 July 2012, one dead body found. – El Feidja National Park, 21 July 2012, echolocation recordings. – Djebel Gloub Thirane Mines, 22 July 2012, 1 ind. in torpor. – Djebel Gloub Thirane cave, 22 July 2012, 1 ind. in torpor. – Ras Rajel mines, 24 July 2012, ca. 25 inds. (Fig. 3 N), echolocation recordings. – Djebel Ressas, 25 July 2012, echolocation recordings. – Old water reservoir, Sidi Bougabrine, 27 July 2012, 2 inds. roosting. – Oued 2 km SW of Fernena, 22 July 2012, echolocation recordings.

Myotis punicus has been previously reported from the whole country except the Saharan climatic region (Fig. 6) (cf. Dalhoumi et al. 2011). Our data complement previously known localities and the records from the Bou Hedma National Park and Ghomrassen represent new localities from the south of the country, the latter being the southernmost locality known in the country for the species. To our knowledge, the colony from the Ichkeul National Park represents the largest breeding colony of the species in Tunisia.

It is also interesting to note that on 24 May 2011, in the El Haouariya colony, we captured young animals of the year that were already flying. This suggests that they were born at least some 3–4 weeks earlier, which corresponds to late April. This represents an early date to give birth, much earlier than in the closely related species *Myotis myotis* or *M. blythii* in Europe or Western Asia (e.g. Sharifi 2004).

Myotis capaccinii (Bonaparte, 1837)

New Records. River, 4.9 km SW of Sidi Thabet, 26 May 2011, 3 adults were captured (2 ♀♀, 1 ♂, the latter deposited in the Department of Biology, Faculty of Science, University of Tunis El-Manar, Tunisia, specimen No. 260511_2), echolocation recordings. – Ichkeul National Park, 19 July 2012, estimated breeding colony of ca. 1000 inds., 50 inds. (♀♀: 18 adults & 7 juveniles; ♂♂: 17 adults & 8 juveniles) were observed (Fig. 3 L). – Beni M'tir lake, 23 July 2012, echolocation recordings and visual observation of bats hunting over the water. – Djebel Ressas mine, 25 July 2012, echolocation recordings. – Djebel Ressas lake, echolocation recordings and visual observation of bats hunting over the water.

M. capaccinii was previously reported in Djebel Ressas (Vaughan et al. 1977) and then more recently in the Ichkeul National Park by Noblet & Nefzi (1991, in Dalhoumi et al. 2011). Our new data are interesting in many respects. First we report on the first breeding colony of the species in Tunisia; given its size (the largest known colony of the species in North Africa), this colony merits full protection. Second, our record from Beni M'tir substantially extends the currently known range of the species in Tunisia, and hence, the population might not be isolated but is probably in contact with the Algerian population of the species that is present along the coast (Kowalski & Rzebik-Kowalska 1991). The species distribution in Tunisia is most likely limited to the northernmost part of the country (Fig. 6). Recordings and capture over water bodies are necessary to identify foraging grounds of the species and caves need to be surveyed to locate breeding colonies.

Myotis emarginatus (Geoffroy, 1806)

New Record. El Feidja National Park, 20 July 2012, estimated breeding colony of ca. 1000 individuals, 30 inds. (♀♀: 15 adults & 7 juveniles; 8 juvenile ♂♂) were observed (Fig. 3 M); echolocation recordings. – Beni M'tir mine, 23 July 2012, 2 ♀ (1 adult, 1 juvenile) captured; echolocation recording. – Sidi Bougabrine, 27 July 2012, one adult ♂ captured.

The situation of this species is somehow similar to the situation of *M. capaccinii*; the species was only recorded in the 1970s from two sites, Djebel Oust and Djebel Zaghouan. Then, more recently, Gharaibeh (1997) and subsequently Zava & Masseti (2007) reported the species from the El Feidja NP with the presence of a colony comprising up to 50 individuals. In July 2012, we estimated the colony size to be around 1000 animals (adults & juveniles), which, to our knowledge, constitutes the largest colony known in North Africa. Dalhoumi et al. (2011) provided a new record of the species from Sidi Toui, near the border with Libya and cite "De Smet (*in litt.*)" as the source of the data. Given that the record is some 450 km south-east of the nearest record of the species (Djebel Zaghouan) and in the absence of more information on the nature of this record, we do not consider this record as certain. Nevertheless, if this record is confirmed, this would represent the southernmost record of the species in Tunisia (Fig. 6).

Conclusion

We present here new records on 18 of the 19 species of bats recorded in Tunisia. For at least five species, our records represent the first records in nearly 30 years (*Rhinolophus blasii*, *Asellia tridens*, *Hypsugo* cf. *savii*, *Pipistrellus* cf. *pipistrellus*, and *Otonycteris hemprichii*). *Hypsugo* cf. *savii* had been reported from only one site in Tunisia and we have now added three new localities and confirmed its presence in the original locality where it was first discovered. We also report for the first time on the possible presence of *Nyctalus leisleri* in northern Tunisia. Other species that should be searched for are *Nyctalus lasiopterus* (northern Tunisia), *Barbastella barbastellus* (forests in Kroumiria), *Myotis* aff. *nattereri* sp. B (northern Tunisia; Ibañez et al. 2006, Puechmaille et al. 2012) and *Pipistrellus deserti* (southernmost part of Tunisia).

The combination of capture, visual and acoustic techniques allowed to record every species but one previously recorded in the country with a cumulated total number of survey days of less than three weeks. Although we captured 16 of the 18 species from which we report data, many records come from echolocation call recordings only. The echolocation recordings were analysed to obtain species presence data but they were not analysed to obtain abundance data per site. Given the large number of recordings (n≈2000), they were not analysed in details and we might have missed some species recorded. Nevertheless, only identifications with high confidence were included (unless otherwise stated). In different sites in the northern part of the country, we have obtained calls that are most probably from *Nyctalus leisleri* but given that the species echolocation calls vary geographically (e.g. Buckley et al. 2011) and that in some situations it can be confused with *Eptesicus*, we are not completely confident on the acoustic identification of the species. Hence this species should not be considered as a part of the Tunisian fauna until a specimen is captured. Generally, more acoustic studies are needed in Tunisia and North Africa to describe in details echolocation characteristic of each species (cf. Benda et al. 2010). In many species, echolocation calls vary across their range and having 'local' reference calls is important (Papadatou et al. 2008).

Our review of past records of the medium-sized *Rhinolophus* species revealed many identification errors, especially for records before 1950. In fact, most identifications were incorrect and hence, no record should be trusted unless material is available to check the identifications (e.g. specimens) or some detailed measurements (e.g. FA, P4.1, P4.2) or characteristics (lancet and connecting process shape) are provided. Records from after the 1950s are far from being error-free but present less mis-identifications. Our results also indicate that the current synonymy of *Rhinolophus* (*Euryalus*) *barbarus* Andersen et Matschie, 1904 and *R.* (*E.*) *meridionalis* Andersen et Matschie, 1904 with *R. euryale* Blasius, 1853 are most probably incorrect. These two names

created by Andersen & Matschie (1904) should rather be considered as synonyms of *R. mehelyi* Matschie, 1901. It is worth noting that the status of the name *Rhinolophus algirus* Loche, 1867 still needs to be clarified. Based on the very succinct original description of the species, *R. algirus* seems to be a medium-sized *Rhinolophus* species (*R. euryale* or *R. mehelyi* but possibly *R. blasii*). Given the description of the fur colour (matching *R. mehelyi*), the size indication and the rarity of *R. euryale* in Algeria, we believe that *R. algirus* is possibly a synonym of *R. mehelyi*; if so, the latter would then become a junior synonym of *R. algirus*. Nevertheless, only the examination of the original material (that we were not able to locate) could solve this taxonomic uncertainty.

The three medium-sized *Rhinolophus* species (*R. blasii*, *R. euryale* and *R. mehelyi*) are morphologically quite similar and their differences can appear very subtle unless one has seen numerous individuals of each species. There is also some geographic variation in the shape of the upper connecting process of *R. mehelyi* and some individuals from Tunisia (and possibly other parts of North Africa) can have an atypical upper connecting process more similar to *R. euryale*. Recording of echolocation calls can provide additional information about species identity with the three different species having most likely different peak frequencies, at least in the northern part of Tunisia where we recorded them (SJP, unpubl. data).

As we have highlighted for three species (*Pipistrellus* cf. *kuhlii*, *Pipistrellus* cf. *pipistrellus* and *Hypsugo* cf. *savii*), the taxonomic status of some bat species in Tunisia, and more generally in North Africa remains to be examined in details. These should include simultaneous morphological, genetic (including nuclear DNA) and acoustic studies. In addition, a large number of studies have investigated the phylogeography of European faunas after the last glacial maximum but nearly all of them have ignored North Africa as potential refugia.

As noted by Dalhoumi et al. (2011), with currently 19 species identified in Tunisia, the list is certainly not complete. Although a fair number of papers were published in the 1960–70s on bats from Tunisia, very few have been published since. Clearly more prospection is necessary to gain a better knowledge on the bat fauna of Tunisia. Information on species presence, distribution and ecology are crucially needed and will be very useful to set up protection and conservation actions.

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Appendix 1

Names of all localities reported in distribution maps in Figs. 2, 5 and 6.

Rhinolophus blasii. 1. El Haouariya. 2. Djebel Ressas; 3. Djebel Zaghouan; 4. Testour.

Rhinolophus ferrumequinum. 1. El Haouariya; 2. Djebel Bokornin; 3. Djebel Ressas; 4. Djebel Zaghouan; 5. Djebel Gloub Thirane; 6. Beni M'tir; 7. Ras Rajel; 8. Hôtel des Chênes; 9. Ain Drahem; 10. El Feija National Park; 11. El Akhouèt; 12. Djebel Ouest; 13. Djebel Barbrou; 14. Feriana; 15. Redayef; 16. Toujane; 17. Tataouine; 18. Foum Tataouine; 19. 6 km west of Nefza and 25 km East of Tabarka on road P7.

Rhinolophus hipposideros. 1. El Haouariya, 2. Ichkeul; 3. Nefza; 4. Ain Drahem; 5. Hôtel des Chênes; 6. Djebel Gloub Thirane; 7. Djebel Zaghouan; 8. Sousse; 9. Kasserine.

Rhinolophus euryale. 1. Ichkeul National Park; 2. Beni M'tir; 3. Ain Drahem; 4. El Feija National Park.

Rhinolophus meheleyi. 1. El Haouariya cave & Grottes romaines, 2 km N, Djebel Sidi Abiod; 2. El Ouidane; 3. Menzel Temime; 4. Nabeul; 5. Djebel Zaghouan (mine); 6. Djebel Ressas (mine); 7. Entouna; 8. Tunis; 9. Near Tebourba; 10. Djebel Ichkeul; 11. Ras Rajel; 12. Djebel Gloub; 13. Kef en Negcha; 14. Ghar Kraiz; 15. Djebel Serdj; 16. Bou Hedma; 17. Djebel Orbata; 18. Gafsa (Quarry).

Asellia tridens. 1. Redayef; 2. Elhamma de Tozeur 3. Dghoumes National Park; 4. M'dhila; 5. Elhamma de Gabes; 6. Zarzis; 7. Gerba; 8 Tozeur; 9. Sidi Toui National Park.

Rhinopoma cystops. 1. Redayef; 2. Gorge de Selja; 3. Dghoumes National Park.

Tadarida teniotis. 1. Sidi Mechreg; 2. Ichkeul; 3.Beni M'tir; 4. Djebel Ressas; 5. Djebel Zaghouan; 6. Bouhedma National Park. 7. Gorge de Selja; 8. Ksar Hadadda.

Miniopterus schreibersii. 1. El Haouariya cave; 2. Nabeul; 3. Utique; 4. Ichkeul National Park; 5. Sidi Thabet; 6. Tebourba; 7. Entouna; 8. Djebel Ressas; 9. Djebel Zaghouan; 10. Ras Rajel; 11. Ain Drahem; 12. Beni Mtir; 13. Bulla Regia; 14. El Feija National Park; 15. Ghar Dimaou; 16. Djebel Barbrou; 17. El Hamrouni; 18. Bouhedma National Park; 19. Gafsa; 20. Redayef; 21. Ain Dhab.

Eptesicus isabellinus. 1. Ichkeul National Park; 2. Sidi Thabet; 3. Tunis; 4. Djebel Ressas; 4. Jabal Zaghouan; 6. Ras Rajel; 7. Beni M'tir; 8. Djebel Gloub Thirane (Fernana); 9. El Feija National Park; 10. El Hamrouni; 11. Sidi Bouzid; 12. Bouhedma National Park; 13. Redayef; 14. Dghoumes National Park; 15. Tozeur; 16. Gabes; 17. Foum Tataouin; 18. Oued Ain.

Pipistrellus* cf. *kuhlii. 1. El Haouariya; 2. Sidi Daoued; 3. Lebna; 4. Tazarka; 5. Oued Madjerda; 6. Sidi thabet; 7. Cartage. 8. Mornag; 9. Hammamet; 10 Tebourba; 11. Tunis; 12. Oudhna; 13. Djebel Ressas; 14 Djebel Zaghouan; 15. Oued Zriba; 16. Ennfidha ville; 17. Masicault; 18. Elbaten; 19. Ichkeul National Park; 20. El Hamaïn; 21. Nefza; 22. Sidi Mechreg; 23. Ras Rajel; 24. Beja 25. Bulla Regia; 26. Beni Mtir; 27. Djebel Gloub (fernana); 28. El Feija National Park; 29. Chemtou; 30. Ain Jammala; 31. Sbikha; 32. Hammam-Sousse; 33. Sousse; 34. Kairouan; 35. El Hamrouni; 36. Sfax; 37. Bouhedma National Park; 38. Gafsa; 39. Bled Douarah; 40. Moularès; 41. Redeyef; 42. Tamerza; 43. Nefta: 44. Tozeur; 45. Dghoumes National Park; 46. Kebili; 47. Douz; 48. El Hamma de Gabès; 49. Gabès; 50. Adjim; 51. Djerba; 52. Zarzis, 53. Ksar Haddada; 54. Tataouine; 55. Foum Tataouine; 56. Ghomrassen. 57. Douirat; 58. Galite island; 59. Siliana; 60. Naâssen.

Pipistrellus* cf. *pipistrellus. 1. Djebel Ressas; 2. Djebel Zaghouan; 3. Beni Mtir; 4. El Feija National Park; 5; Oued Ain (El Haouariya).

Plecotus gaisleri. 1. Bizerte; 2. El Haouariya; 3. Djebel Zaghouan; 4. Redayef; 5. Gafsa; 6. Djebel Ank; 7. Bouhedma; 8. Toujane; 9. Tataouine; 10. Foum Tataouin; 11. Douiret.

***Hypsugo* cf. *savii*.** 1. Oued Ain (El Haouariya); 2. Djebel Ressas; 3. Djebel Zaghouan; 4. Beni M'tir.

Myotis cappaccinii. 1. Ichkeul National Park; 2. Sidi Thabet; 3 Djebel Ressas; 4. Tebourba; 5. Beni Mtir.

Myotis emarginatus. 1. Beni M'tir; 2. El Feija National Park; 3. Djebel Zaghouan; 4. Djebel Oust; 5. Sidi Toui National Park (unconfirmed record).

Myotis punicus. 1. El Haouariya; 2. El Ouidane; 3. Menzel Temim; 4. Nabeul; 5. Utique; 6. Sidi Thabet; 7. Tunis, 8. Entouna; 9. Djebel Gattuna; 10. Djebel Ressas; 11. Hammam Djedidi; 12. Djebel Zaghouan; 13. Tebourba; 14. Ichkeul National Park; 15. Djebel Kalina; 16. Testour; 17. Beja; 18. Djebel Abiod; 19. Ras Rajel; 20. Tabarka; 21. Bulla Regia; 22. Kef El Agab; 23. Djebel Gloub; 24. El Feidja; 25. Chemtou;

26. Ghar Kraiz; 27. El Akhouat; 29. Damous Saïd; 28. Aïn Dhab; 30. Makthar; 31. Djebel Barbrou; 32. Djebel Trozza; 33. El Hamrouni; 34. El Djem; 35. Feriana; 36. Sfax; 37. Bouhedma National Park; 38. Gafsa; 39. Nefta; 40. Toujane; 41. Djebel Saikra; 42. Ghomrassen.

Appendix 2

Gazetteer of the original localities

4.5 km Northeast of Tebourba	36°50' N, 09°52' E	ca. 67 m a. s. l.
Beni M'tir Dam	36°44' N, 08°44' E	ca. 487 m a. s. l.
Beni M'tir mine	36°43' N, 08°44' E	ca. 445 m a. s. l.
Beni M'tir lake	36°44' N, 08°42' E	ca. 495 m a. s. l.
Bouhedma National Park	34°28' N, 09°38' E	ca. 120 m a. s. l.
Bridge on RN7, 2.2 km coutheast of Jedeida	36°50' N, 09°56' E	ca. 61 m a. s. l.
Carrières Fatjun (NW of El Haouariya)	37°04' N, 10°98' E	ca. 33 m a. s. l.
Carrières les grottes (N of El Haouariya)	37°03' N, 10°59' E	ca. 11 m a. s. l.
Cave in Djebel Morra (Dghoumes National Park)	34°04' N, 08°35' E	ca. 80 m a. s. l.
Cave, 4.6 km southwest of Sidi Thabet	36°52' N, 10°01' E	ca. 94 m a. s. l.
Dghoumes National Park	34°02' N, 08°33' E	ca. 16 m a. s. l.
Djebel Gloub Thirane cave	36°38' N, 08°36' E	ca. 453 m a. s. l.
Djebel Gloub Thirane Mines	36°39' N, 08°36' E	ca. 430 m a. s. l.
Djebel Resas	36°36' N, 10°19' E	ca. 500 m a. s. l.
Djebel Resas lake	36°36' N, 10°19' E	ca. 152 m a. s. l.
Djebel Ressas mine	36°36' N, 10°19' E	ca. 580 m a. s. l.
El Feidja National Park	36°29' N, 08°18' E	ca. 767 m a. s. l.
El Haouariya	37°03' N, 11°00' E	ca. 30 m a. s. l.
El Haouariya Cave	37°06' N, 11°03' E	ca. 160 m a. s. l.
Galite Island	37°31' N, 08°56' E	ca. 170 m a. s. l.
Ghomrassen	33°06' N, 10°17' E	ca. 340 m a. s. l.
Grotte Sidi Amer (NE of El Haouariya)	37°06' N, 11°03' E	ca. 122 m a. s. l.
Hôtel des Chênes (near Ain Drahem)	36°43' N, 08°40' E	ca. 798 m a. s. l.
Ichkeul National Park	37°08' N, 09°41' E	ca. 39 m a. s. l.
Ichkeul National Park cave	37°08' N, 09°40' E	ca. 221 m a. s. l.
Ichkeul tunnel	37°06' N, 09°39' E	ca. 49 m a. s. l.
Ichkeul tunnel III	37°06' N, 09°38' E	ca. 49 m a. s. l.
Naâssen	36°43' N, 10°12' E	ca. 15 m a. s. l.
Old water reservoir, Sidi Bougabrine	36°22' N, 10°06' E	ca. 719 m a. s. l.
Oued 2 km southwest of Fernena	36°38' N, 08°40' E	ca. 299 m a. s. l.
Oued Ain	37°05' N, 11°02' E	ca. 59 m a. s. l.
Parc du Belvédère, Tunis	36°49' N, 10°10' E	ca. 10 m a. s. l.
Pine woodland 5 km NE of Ain Sebaa	36°59' N, 08°57' E	ca. 122 m a. s. l.
Pool, 4.7 km southwest of Sidi Thabet	36°52' N, 10°00' E	ca. 13 m a. s. l.
Ras Rajel	36°56' N, 08°53' E	ca. 139 m a. s. l.
Ras Rajel mine	36°57' N, 08°51' E	ca. 102 m a. s. l.
River, 4.9 km southwest of Sidi Thabet	36°52' N, 10°00' E	ca. 13 m a. s. l.
Road C32, 3.6 km south of Jedeida	36°49' N, 09°55' E	ca. 62 m a. s. l.
Sidi Bougabrine	36°22' N, 10°06' E	ca. 710 m a. s. l.
Siliana	36°05' N, 09°20' E	ca. 421 m a. s. l.
Tazarka	36°32' N, 10°50' E	ca. 13 m a. s. l.
Tunis (Omrane Supérieur)	36°50' N, 10°07' E	ca. 153 m a. s. l.
Zaghouan City	36°23' N, 10°08' E	ca. 270 m a. s. l.
Zaghouan mines	36°23' N, 10°08' E	ca. 438 m a. s. l.