

Bats of the El Kala Biosphere Reserve, northeastern Algeria (Chiroptera)

Netopýři Biosferické rezervace El Kala v severovýchodním Alžírsku (Chiroptera)

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received on 3 August 2017

Abstract. Twelve bats species representing four families (Rhinolophidae, Miniopteridae, Vespertilionidae, and Molossidae) were recorded in sites representing nine different habitats of the El Kala Biosphere Reserve and its vicinity in northeastern Algeria. *Myotis emarginatus* showed the highest frequency, it was found at five sites, *Rhinolophus hipposideros*, *Eptesicus isabellinus* and *Miniopterus schreibersii* at four sites, while *Rhinolophus euryale*, *R. blasii*, *Myotis punicus*, *Pipistrellus kuhlii* and *Tadarida teniotis* in three localities each. Species richness (total number of species within a site) ranged between 1 and 8 (mean 4.33). The annual activity pattern of all species was recorded by one netting session per month per locality in the course of two years.

Key words. Chiroptera, El Kala, Algeria, diversity, activity patterns, species richness.

INTRODUCTION

The bat fauna of Algeria was outlined by ANCIAUX DE FAVEAUX (1976) with a total of 25 species. Bats of northern Algeria were studied by GAISLER (1983, 1984), HANÁK & GAISLER (1983) and GAISLER & KOWALSKI (1986) with additions of new records. KOWALSKI et al. (1986) studied bats recorded in caves of northern Algeria, they reported 10 species there, with data on their reproductive biology, activity and associations. They provided details on the reproductive cycle of some species. The mammal fauna of Algeria including bats known in the late 1980s was summarized by KOWALSKI & RZEBIK-KOWALSKA (1991). BENDJEDDOU et al. (2014a) gave additional localities for *Tadarida teniotis*. Also, BENDJEDDOU et al. (2014b) described roost characteristics of *Myotis punicus* in northeastern Algeria. Other studies on the bats of northern Algeria include AHMIM & MOALI (2011, 2013) on the diet composition of *Myotis punicus* and four species of horseshoe bats in the Kabylia region, and BENDJEDDOU et al. (2013) on the bat ectoparasites.

At the regional level, ZAVA & MASSETI (2007) reported eight bat species from the Tunisian National Park of El Feidja, located near the northeastern Algerian-Tunisian borders and very close to the El Kala Biosphere Reserve in northeastern Algeria. PUECHMAILLE et al. (2012) presented a review on the bats of Tunisia, with reference to bats in the north-westernmost part

of the country, adjacent to northeastern Algeria. However, almost no data on bats are available from the northeastern part of Algeria (KOWALSKI & RZEBIK-KOWALSKA 1991). The present study aimed to investigate bat diversity and activity patterns in the El Kala Biosphere Reserve and its vicinity, situated in the north-easternmost corner of Algeria, and give the first systematic data on bats from this region.

MATERIAL AND METHODS

Study area

The El Kala Biosphere Reserve (BR) is located in northeastern Algeria (36° 55' to 36° 90' N; 08° 16' to 08° 43' E) and occupies about 76.5 km². It is one of the largest reserves of the country, designated to protect the most important wetlands of Algeria. The El Kala BR hosts 1590 plant species (80 endemics) and 43 mammals, 24 reptiles and amphibians and 214 birds (DJAMEL et al. 2014). It borders the Mediterranean Sea and includes a mixture of different ecosystems, including evergreen sclerophyllous forests, lakes, mountains, woodlands or scrubs as well as coastal and marine habitats. The relief of the region consists of a series of depressions, some of them with lakes and wetlands, and high hills of various shapes: domes, cliffs, ridge alignments usually covered by dense vegetation. The climate is Mediterranean with moderate rainfall, the mean annual precipitation being 630 mm. The El Kala BR includes several habitats (Fig. 1). Six sites were selected within the Reserve (R) (Fig. 2) and three around the Reserve (A) (Fig. 3) for bat research, representing all the main habitats of the region.

Djbel El Koursi (R) (36° 51' N, 08° 13' E), a semi-open habitat characterized by the complete absence of undergrowth. It consists mainly of the cork oak forest, *Quercus suber*, which can reach up to 18 m in height. The tree cover is up to 65%, with homogeneous distribution.

Soug Rguibette (R) (36° 54' N, 08° 17' E), a mixed habitat which consists of a partially abandoned agricultural land with secondarily implanted elements of trees and bushy plants.

El Kala (R) (36° 53' N, 08° 25' E), a closed and urbanized habitat, which is entirely artificial.

Ain Khiar (R) (36° 49' N, 08° 20' E), a mixed habitat, its floristic composition is characterized by the presence of *Fraxinus* sp., *Alnus glutinosa*, *Populus* sp., and *Salix* sp.

Oubeira (R) (36° 52' N, 08° 22' E), an *Eucalyptus* forest, semi-open habitat, with dense and scrubby forest around the Oubiera Lake. The undergrowth is characterized by the presence of *Calycotome villosa* and *Genista ferox*.

Tonga Lake (R) (36° 53' N, 08° 31' E), a mixed habitat with the Aleppo pine and maritime pine, also characterized by the presence of *Quercus coccifera*, *Mirtus communis*, and *Pistacia lentiscus*.

Berihane (A) (36° 51' N, 08° 08' E), an open habitat with abundance of freshwater resources and grassland areas, which is characterized by the dominant presence of *Asphodelus microcarpus*, *Urginea maritima*, *Ormenis mixta*, and *Inula squarrosa*.

Sidi Trad (A) (36° 34' N, 08° 11' E), an open habitat with rocky areas and caves; it is characterized by the herb layer composed essentially of *Asphodelus microcarpus*, *Urginea maritima*, and *Ormenis mixta*.

Zitouna (A) (36° 34' N, 08° 17' E), a *Quercus canariensis* forest; the tree layer is generally mono-specific, characterized by the presence of many dead trees, the undergrowth is poorly developed and is characterized by the presence of *Cytisus triflorus* and *Rubus ulmifolius*.

Data collection

Bats were captured using mist nets (2.5×12 m). Each bat was sexed and its forearm and the 3rd finger (Table 2) were measured using a caliper (±0.1 mm). Bats were identified according to DIETZ & VON HELVERSEN

(2004) and DIETZ (2005). Each mistnetting session, one per month in each of the nine habitats, began from 10, 20 to 30 minutes after sunset and continued for 4 hours from August 2012 to September 2014.

Data analysis

We measured the total species richness (total number of species recorded), Simpson's diversity index, and Simpson's evenness index for each site. To assess species distribution and composition, we measured species incidence (the number of sites at which a species occurred), local abundance (average number of specimens collected over the total number of sites where each species occurred), and the total number of species with which a species coexisted. We used the Spearman rank correlations to assess relationships between the species' local abundance and the number of coexisting species with the total number of sites at which a species occurred.

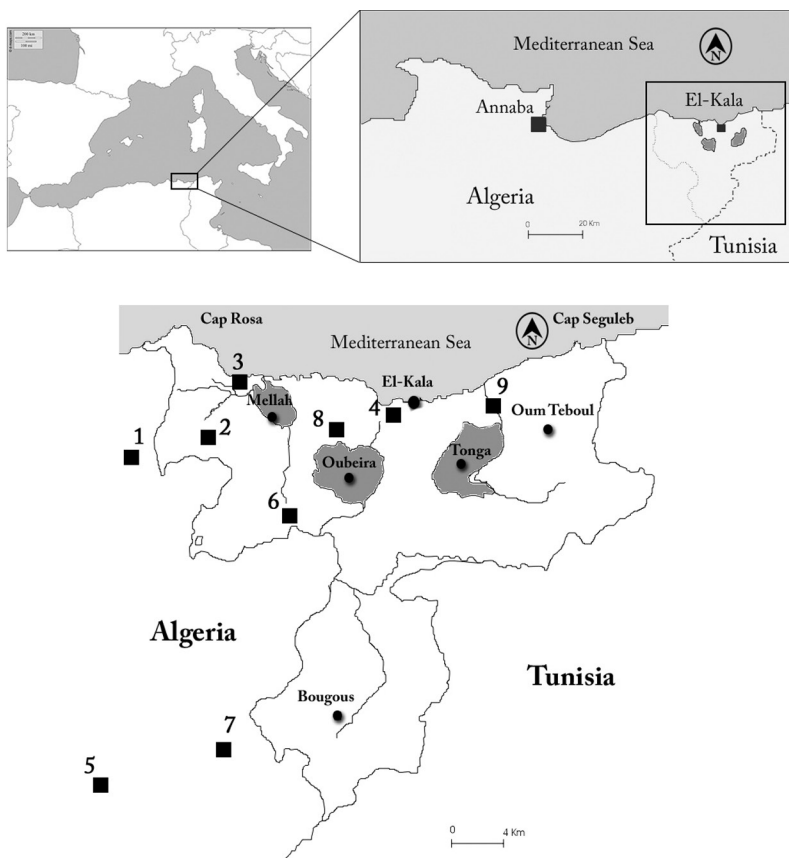


Fig. 1. Map of Algeria showing the locations of the study sites.

Obr. 1. Mapa Alžírská s vyznačenými studovanými lokalitami.

Legend / legenda: 1 – Berihane, 2 – Djbel El Koursi, 3 – Soug Rguibette, 4 – El Kala, 5 – Sidi Trad, 6 – Ain Khiar, 7 – Zitouna, 8 – Oubeira, 9 – Tonga lake.

RESULTS AND DISCUSSION

Twelve species of bats were collected from the El Kala BR and its vicinity (Table 1). Species richness (total number of species within a site) ranged between 1 and 8 with a mean of 4.33. Site scores for species diversity and evenness ranged between 0.0–0.84 and 0.51–1.0, respectively (Table 1). El Kala had the highest species richness and scored highest diversity and second highest species evenness, whereas Tonga lake showed the lowest values for all three indices. The studied sites are significantly different in terms of bat composition and abundance (Kruskal-Wallis Test Statistic between the 9 sites = 25.911, p-value 0.001, df 8).

Most species occurred in relatively few sites (3–4 sites) and were captured in an intermediate abundance (10–20 individuals), in fact, 8 out of 12 species occurred in 3–4 sites (Table 1). *Myotis emarginatus* exhibited the highest frequency, being recorded at five sites, with local abundance of 11. On the other hand, three bat species occurred in only two sites and exhibited an average abundance of >28 ind./site (Table 1).

The local abundance of a species (average number of inds./site) was negatively correlated with its incidence (Spearman-rank correlation coefficient = –0.74). On the other hand, the total number of species with which a species coexisted was marginally correlated with the number of localities at which it occurred (Spearman-rank correlation coefficient = 0.51).

The activity patterns for 12 bat species found in the El Kala Biosphere Reserve and its vicinity were studied over a period of two years (mid-2012 to mid-2014). A total of 762 individuals of bats were captured during the study period from the nine study sites. External morphometric data for 12 species of bats captured during the study are summarized in Table 2.

***Rhinolophus ferrumequinum* (Schreber, 1774) (Fig. 4B)**

Most Algerian records of the greater horseshoe bat come from the Mediterranean regions of the northern part of the country (KOWALSKI & RZEBIK-KOWALSKA 1991). This species was netted in two sites of the El Kala BR (Table 1) and was very common at Ain Khiair, with plenty of water courses and high forest coverage (Fig. 2B). At Soug Rguibette it was netted along with seven other species, while at Ain Khiair, it was associated with four species; only *Myotis emarginatus* and *Eptesicus isabellinus* were present at both localities. KOWALSKI et al. (1986) found it along with the colonies of *Rhinolophus euryale*, *R. mehelyi*, *Myotis emarginatus*, and *Miniopterus schreibersii*. A large maternity colony of *R. ferrumequinum* was discovered in the El Feidja National Park in Tunisia, near the Algerian borders and close to the El Kala BR (PUECHMAILLE et al. 2012).

A total of 61 individuals of *R. ferrumequinum* were captured during this study (Fig. 5A), they were netted from March until September with peaks in May and July (11 and 12 individuals respectively). No activity was noticed during winter, which is due to the hibernation behaviour in this bat. KOWALSKI et al. (1986) suggested that *R. ferrumequinum* prefers cool roosts during cool winters in Algeria, and torpid males were found in caves during spring and summer. KOWALSKI et al. (1986) noted a significant fluctuation in the number of individuals of this species in a cave in northern Algeria and attributed this fluctuation to frequent translocations between roosts.

***Rhinolophus hipposideros* (Borkhausen, 1797) (Fig. 4A)**

The lesser horseshoe bat shows a similar distribution as *R. ferrumequinum* in Algeria (KOWALSKI & RZEBIK-KOWALSKA 1991). *R. hipposideros* was netted at four sites in the El Kala BR

and found at the same sites with eight other bat species (Table 1). At Berihane, it was found in association with seven species, with six species at Soug Rguibette, while only with two at Zitouna (Table 1). At the two former sites, *Rhinolophus blasii*, *Myotis punicus*, and *Eptesicus isabellinus* were also present, and at the two latter sites also *Miniopterus schreibersii*. PUECH-



Fig. 2. Habitats studied in the El Kala Biosphere Reserve.

Obr. 2. Studované biotopy v Biosferické rezervaci El Kala.

Legend / legenda: A – Djbel El Kursi, B – Soug Rguibette, C – El Kala, D – Ain Khia, E – Tonga lake, F – Oubeira.

Table 1. Numbers of bats captured at nine sites in the El Kala Biosphere Reserve and its vicinity. Legend: 1 – Berihane, 2 – Djbel El Koursi, 3 – Soug Rguibette, 4 – El Kala, 5 – Sidi Trad, 6 – Ain Khiair, 7 – Zitouna, 8 – Oubeira, 9 – Tonga lake; Σ – total number of individuals, LA – local abundance, CS – total number of coexisting species, SR – species richness, SDI – Simpson's diversity index

Tab. 1. Počty netopýřů odchycených na devíti lokalitách v Biosferické rezervaci El Kala a jejím okolí. Legenda: 1 – Berihane, 2 – Djbel El Koursi, 3 – Soug Rguibette, 4 – El Kala, 5 – Sidi Trad, 6 – Ain Khiair, 7 – Zitouna, 8 – Oubeira, 9 – Tonga lake; Σ – celkový počet jedinců, LA – místní abundance, CS – celkový počet druhů zjištěných společně, SR – druhová bohatost, SDI – Simpsonův index rozmanitosti

species / druh	site / lokalita									Σ	LA	CS
	1	2	3	4	5	6	7	8	9			
<i>Rhinolophus ferrumequinum</i>	–	–	17	–	–	44	–	–	–	61	30.50	9
<i>Rhinolophus hipposideros</i>	6	–	25	1	–	–	11	–	–	43	10.75	12
<i>Rhinolophus euryale</i>	7	–	–	–	–	–	–	20	41	68	22.67	8
<i>Rhinolophus mehelyi</i>	30	29	–	–	–	–	–	–	–	59	29.50	9
<i>Rhinolophus blasii</i>	20	–	2	25	–	–	–	–	–	47	15.67	12
<i>Myotis punicus</i>	63	–	38	–	1	12	–	–	–	114	28.50	12
<i>Myotis emarginatus</i>	–	9	4	16	–	27	–	1	–	57	11.40	12
<i>Eptesicus isabellinus</i>	28	–	23	40	–	–	–	–	–	91	30.33	12
<i>Pipistrellus pipistrellus</i>	–	–	8	49	–	–	–	–	–	57	28.50	10
<i>Pipistrellus kuhlii</i>	16	–	–	30	–	12	–	4	–	62	15.50	12
<i>Miniopterus schreibersii</i>	15	–	–	50	–	–	2	–	–	67	22.33	12
<i>Tadarida teniotis</i>	–	–	–	13	9	13	1	–	–	36	9.00	9
Σ	185	38	117	224	10	108	14	25	41	–	–	–
SR	8	2	7	8	2	5	3	3	1	–	–	–
SDI	0.8	0.4	0.8	0.8	0.2	0.7	0.4	0.4	0.0	–	–	–
evenness / shoda	0.7	0.8	0.7	0.8	0.6	0.8	0.5	0.5	1.0	–	–	–

MAILLE et al. (2012) reported *R. hipposideros* from two sites in western Tunisia (Ain Drahem and Hôtel des Chênes).

Forty-three individuals of *R. hipposideros* were captured over the period of the study in the El Kala BR. Its foraging activity lasted from March until December, with a peak in July (10 individuals), while no activity was recorded in January and February (Fig. 5B). KOWALSKI et al. (1986) reported that mostly single males *R. hipposideros* were observed in the coldest caves of northern Algeria. It was captured in bushy habitats over water and desert areas in Brezina (GAISLER & KOWALSKI 1986).

***Rhinolophus euryale* Blasius, 1853 (Fig. 4C)**

The Mediterranean horseshoe bat was reported from many sites in the Mediterranean region of Algeria (KOWALSKI & RZEBIK-KOWALSKA 1991). This species was netted at three sites of the El Kala BR (Table 1); at Berihane, *R. euryale* was found in association with seven other bat species, while at Oubeira only along with one species, and at Tonga lake it was the only recorded species of bat (Table 1). KOWALSKI et al. (1986) reported findings of *R. euryale* associated with *Myotis punicus* or *Rhinolophus blasii*, *Myotis emarginatus* and *Miniopterus schreibersii*.

Sixty-two individuals of *R. euryale* were collected during this study in the El Kala BR (Table 1). The maximum number of individuals of this species was observed in July, and then declined after August to appear again in quite high numbers in March (Fig. 5C).

***Rhinolophus mehelyi* Matschie, 1901 (Fig. 4D)**

The Mehely's horseshoe bat is a strictly Mediterranean species, with distribution in Algeria extending over the coastal mountains and to the inner Saharan Atlas (KOWALSKI & RZEBIK-KOWALSKA 1991). This species was netted in two sites of the El Kala BR (Table 1); at Berihane, it was found in association with seven other bat species, while at Djbel El Koursi it was associated with one species only, *Myotis emarginatus*. KOWALSKI et al. (1986) found it along with *Rhinolophus ferrumequinum*, *Myotis punicus*, and *Miniopterus schreibersii* in the caves of northern Algeria. *R. mehelyi* seems to be rather common in northern and western Tunisia (PUECHMAILLE et al. 2012).



Fig. 3. The sites studied near the El Kala Biosphere Reserve.
Obr. 3. Studované lokality v blízkosti Biosferické rezervace El Kala.
Legenda / legend: A – Berihane, B – Zitouna, C – Sidi Trad.

Table 2. Measurements taken in the captured bat species (in millimetres); FAL – forearm length, 3rd FL – 3rd finger length of the wing

Tab. 2. Rozměry odchycených netopýřů (v milimetrech); FAL – délka předloktí, 3rd FL – délka třetího prstu křídla, mean – průměr, SD – směrodatná odchylka

bat species druh netopýra	number and sex počet a pohlaví	FAL (mean ± SD)	3rd FL (mean ± SD)
<i>Rhinolophus ferrumequinum</i>	11 ♂♂	57.98 ± 2.59	85.48 ± 4.68
	8 ♀♀	59.13 ± 1.95	88.61 ± 3.83
<i>Rhinolophus hipposideros</i>	7 ♂♂	37.64 ± 1.10	54.36 ± 1.68
	9 ♀♀	38.36 ± 0.76	54.63 ± 1.24
<i>Rhinolophus euryale</i>	6 ♂♂	48.91 ± 1.81	70.38 ± 4.42
	9 ♀♀	49.11 ± 1.10	69.58 ± 3.46
<i>Rhinolophus mehelyi</i>	5 ♂♂	52.52 ± 2.30	79.98 ± 3.75
	7 ♀♀	53.64 ± 1.53	80.51 ± 2.32
<i>Rhinolophus blasii</i>	11 ♂♂	45.24 ± 2.12	67.87 ± 1.89
	10 ♀♀	47.57 ± 2.98	69.24 ± 2.38
<i>Myotis punicus</i>	17 ♂♂	59.91 ± 2.98	98.22 ± 0.25
	13 ♀♀	60.52 ± 3.58	99.82 ± 2.75
<i>Myotis emarginatus</i>	17 ♂♂	37.08 ± 2.12	63.62 ± 2.58
	18 ♀♀	39.5 ± 2.98	65.19 ± 2.89
<i>Eptesicus isabellinus</i>	14 ♂♂	46.07 ± 1.65	81.85 ± 1.96
	13 ♀♀	47.54 ± 2.21	84.21 ± 2.95
<i>Pipistrellus pipistrellus</i>	16 ♂♂	29.09 ± 1.85	51.93 ± 1.25
	21 ♀♀	30.85 ± 2.64	52.06 ± 2.98
<i>Pipistrellus kuhlii</i>	19 ♂♂	32.53 ± 1.85	55.52 ± 1.12
	23 ♀♀	33.95 ± 2.91	57.74 ± 3.56
<i>Miniopterus schreibersii</i>	12 ♂♂	43.45 ± 2.52	81.14 ± 2.65
	11 ♀♀	45.25 ± 2.12	83.32 ± 3.85
<i>Tadarida teniotis</i>	3 ♂♂	58.65 ± 3.56	107.12 ± 2.56
	6 ♀♀	60.40 ± 4.65	109.50 ± 3.23

A total of 59 individuals of *R. mehelyi* were captured in the El Kala BR from March to November. The numbers of individuals caught were similar from April to September, and then declined with no records from December and January (Fig. 5D). KOWALSKI et al. (1986) found *R. mehelyi* to be present in Algerian caves year-round.

***Rhinolophus blasii* Peters, 1867**

The Blasius' horseshoe bat was recorded for the first time in Algeria by KOWALSKI (1979) and its distribution is known from the Mediterranean regions of the country, with some localities as far in the southwest as in the Saharan Atlas (KOWALSKI & RZEBIK-KOWALSKA 1991). In the El Kala BR, it was netted at three sites in open habitats with abundance of freshwater resources and grassland areas (Table 1); at Berihane, it was found together with seven other bat species,

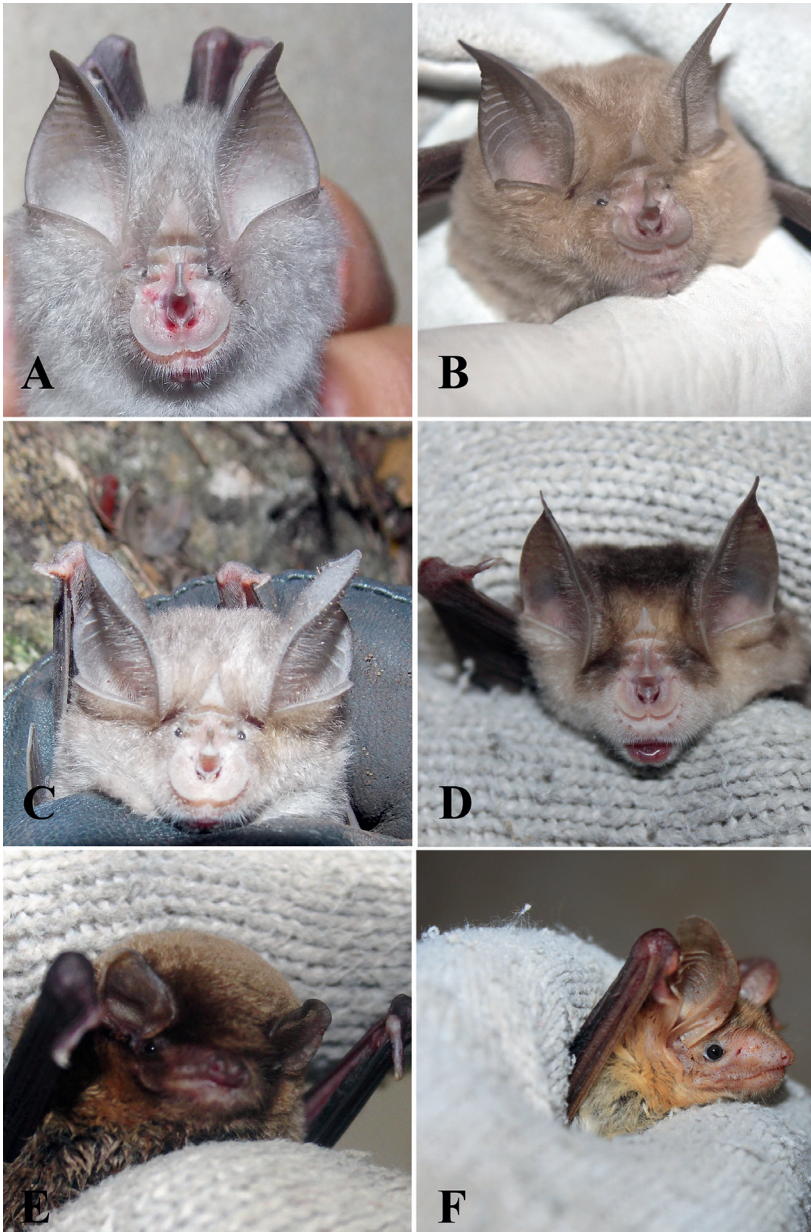


Fig. 4. Bats recorded in the El Kala Biosphere Reserve and its vicinity.

Obr. 4. Netopýři zaznamenaní v Biosferické rezervaci El Kala a jejím okolí.

Legend / legenda: A – *Rhinolophus hipposideros*, B – *Rhinolophus ferrumequinum*, C – *Rhinolophus euryale*, D – *Rhinolophus mehelyi*, E – *Miniopterus schreibersii*, F – *Myotis punicus*.

while at Soug Rguibette and El Kala it was associated with seven and eight bat species respectively (Table 1). KOWALSKI et al. (1986) found *R. blasii* in association with *Rhinolophus euryale*, *Myotis emarginatus*, and *Miniopterus schreibersii*.

A total of 47 *Blasius'* horseshoe bats were captured in the El Kala BR. The activity pattern shows a steady activity almost all year round, with the exception of January (Fig. 5E). A peak was noted in July (10 individuals). KOWALSKI et al. (1986) reported *R. blasii* to be active in the warmest parts of the mines in the cool season; in the Aokas cave, they observed *R. blasii* in larger numbers particularly at the beginning and towards the end of the cool season.

***Myotis punicus* Felten, 1977 (Fig. 4F)**

In Algeria, the Felten's myotis occurs mostly in the Mediterranean region, with exceptional records from the borders of the Saharan Atlas (KOWALSKI & RZEBIK-KOWALSKA 1991). *M. punicus* was captured at four sites of the El Kala BR (Table 1); at Berihane, it was found in association with seven other bat species. In the Aokas cave, this bat was found along with *Myotis capaccinii* and *Miniopterus schreibersii* (KOWALSKI et al. 1986).

M. punicus was the most abundantly captured species in the El Kala BR, with a total of 114 individuals (Table 1). It was netted all year round except in February. The highest number of this species was caught in July (Fig. 5F). This result corresponds with that by KOWALSKI et al. (1986) who stated *M. punicus* was the most common species in the caves of northern Algeria.

***Myotis emarginatus* (Geoffroy, 1806)**

The Geoffroy's Bat was reported from few localities in the Mediterranean areas of Algeria (KOWALSKI & RZEBIK-KOWALSKA 1991). PUECHMAILLE et al. (2012) showed only few records of this bat from Tunisia. In the El Kala BR, *M. emarginatus* was captured at five sites, it was the most frequent bat in this study. At Djebel El Koursi, it was found only along with *Rhinolophus mehelyi*, while at Soug Rguibette, it was netted along with six other bat species and at El Kala, it was found along with eight species (Table 1). Previously, it was found along with *Rhinolophus ferrumequinum*, *R. euryale*, *R. blasii* and *Miniopterus schreibersii* (KOWALSKI et al. 1986).

Fifty-seven individuals of *M. emarginatus* were caught during this study; it was absent from October to February, then appeared from March to September with a peak in July (Fig. 6G). KOWALSKI et al. (1986) reported this species to be rare in winter in caves of northern Algeria, where only single torpid individuals were present.

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

The Isabelline serotine is distributed along the coastal region and inland of Algeria to the Saharan Atlas (KOWALSKI & RZEBIK-KOWALSKA 1991). In the El Kala BR, it was captured at four sites (Table 1); at Berihane and at Soug Rguibette, *E. isabellinus* was found in association with six other bat species, however, only *Rhinolophus hipposideros* and *R. blasii* were found in both these localities. PUECHMAILLE et al. (2012) reported this species from various habitats of Tunisia, including wetlands, lakes, rivers, forests and cities.

A total of 91 individuals of *E. isabellinus* were captured from February to November in the El Kala BR. The number of bats caught reached a maximum of 14 in August. It appears that this species has two activity peaks, one just after winter and extending through the spring, and one at the beginning of summer to early autumn (Fig. 6H).

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

In Algeria, the common pipistrelle is known from the coastal regions, the Tell Atlas Mts. and few sites near the Haut Plateaux and the Aures Mts. (KOWALSKI & RZEBIK-KOWALSKA 1991). It was found in two sites in the El Kala BR (Table 1); at Soug Rguibette it was associated with six other bat species, while with nine species at El Kala (Table 1).

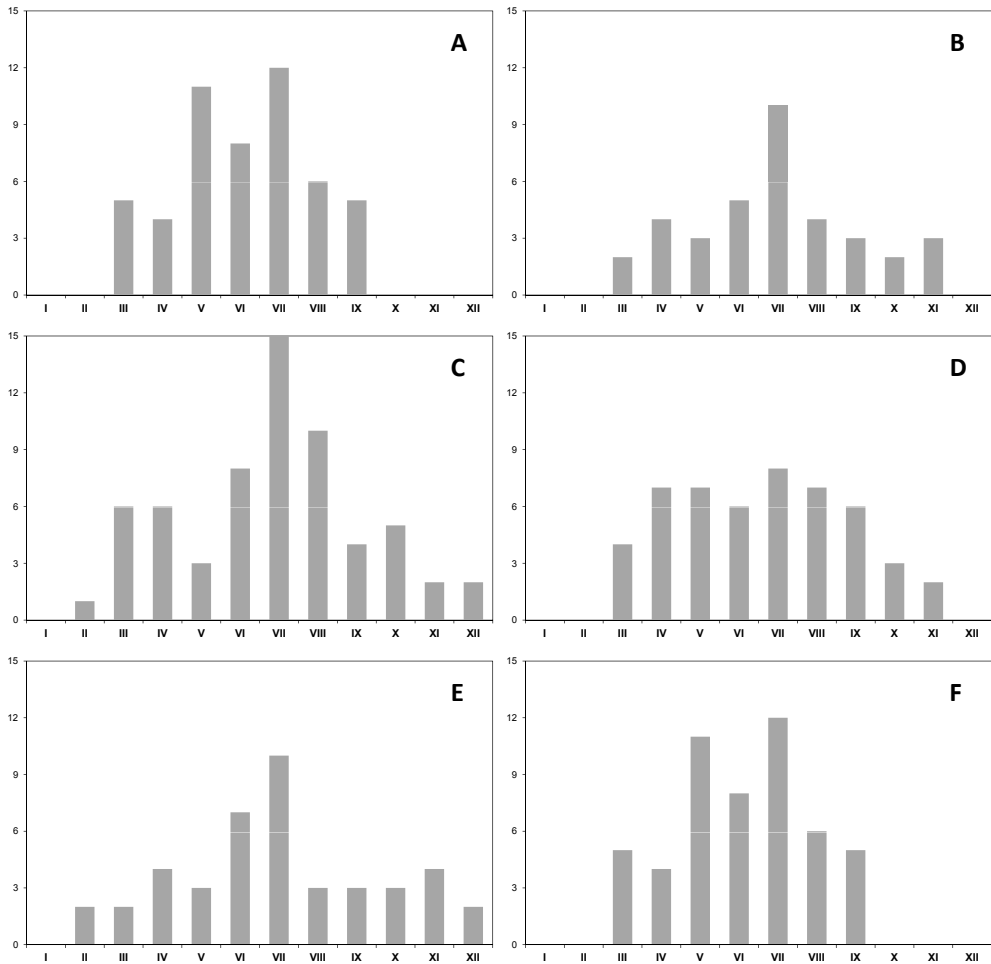


Fig. 5. Annual course of the foraging activity of bat species studied in the El Kala Biosphere Reserve.

Obr. 5. Letová aktivita studovaných druhů netopýřů v Biosferické rezervaci El Kala v průběhu roku.

Legend / legenda: A – *Rhinolophus ferrumequinum*, B – *R. hipposideros*, C – *R. euryale*, D – *R. mehelyi*, E – *R. blasii*, F – *Myotis punicus*.

Fifty-seven individuals of *P. pipistrellus* were captured during this study in the El Kala BR. The bats were active from March to December, with peaks in July and August (Fig. 6I). GAISLER & KOWALSKI (1986) netted this species over water in wooded areas of northern Algeria, however, they reported also a catch of this bat in Setif in winter months.

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

The Kuhl's pipistrelle is the most common species in northern Algeria, and its distribution extends from the coastal areas to the central parts of the Sahara, it is considered as one of the most common species in northern Algeria (KOWALSKI & RZEBIK-KOWALSKA 1991). In the El Kala BR, *P. kuhlii* was collected from three sites (Table 1), it inhabits various habitats including urban areas.

A total of 62 individuals of *P. kuhlii* were collected in the El Kala BR during the study. The highest number of bats was recorded during April and August (Fig. 6J). It is associated with human settlements in northern Algeria and was netted there also in winter (GAISLER 1984). KOWALSKI & RZEBIK-KOWALSKA (1991) reported a bimodal circadian activity pattern in this bat, one before sunset and the second around sunrise.

***Miniopterus schreibersii* (Kuhl, 1817) (Fig. 4E)**

The Schreibers' bat was recorded from numerous locations along the Mediterranean coast, at the southern margin of the Tell Atlas Mts. and deep into the Aures Mts. (KOWALSKI & RZEBIK-KOWALSKA 1991). It was captured at four sites of the El Kala BR (Table 1); at Berihane, El Kala and Ain Khia, it was associated with seven, eight and five species respectively; on the other hand, at Sidi Trad, it was found only along with *Myotis punicus*. KOWALSKI et al. (1986) found it in association with *Rhinolophus ferrumequinum*, *R. mehelyi* and *Myotis punicus*.

A total of 67 individuals of *M. schreibersii* were mistnetted in the El Kala BR (Table 1). It was absent in the catch during the period December-February, then became active in March and remained after. The highest number of captures was recorded in April and August to September (Fig. 6K). KOWALSKI et al. (1986) stated that this species is very common in caves of northern Algeria all year-round, with torpid bats observed in autumn.

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

In Algeria, the European free-tailed bat was reported only from three localities in the Tell Atlas Mts. and Aures Mts. by KOWALSKI & RZEBIK-KOWALSKA (1991). Recently, it has been recorded by BENDJEDDOU et al. (2014a) from Tamanrasset in the Hoggar Mts., in southern Algeria. In the El Kala BR, it was collected from three sites (Table 1); El Kala, Sidi Trad and Zitouna. At Zitouna it was found along with three other bat species (Table 1). Our records increase the distribution range for this bat further into the coastal area of Algeria.

Thirty-six individuals of *T. teniotis* were captured in the El Kala BR. Two activity periods were recorded in this bat during a year, one in February to March, then in September to December, with no activity during spring and summer months (Fig. 6L). This bat was netted at Amentane in the Aures Mts. in August (KOWALSKI & RZEBIK-KOWALSKA 1991) and at Tamanrasset in the Hoggar Mts. in January (BENDJEDDOU et al. 2014a).

SOUHRN

Na devíti lokalitách představujících devět různých biotopů Biosferické rezervace El Kala a jejího okolí v severovýchodním Alžírsku bylo zaznamenáno celkem dvanáct druhů netopýrů čtyř čeledí (Rhinolophidae, Miniopteridae, Vespertilionidae a Molossidae). Nejvyšší frekvenci vykázal netopýr brvitý (*Myotis emarginatus*), nalezený na pěti lokalitách; vrápenec malý (*Rhinolophus hipposideros*), neopýr tripolitánský (*Eptesicus isabellinus*) a létavec evropský (*Miniopterus schreibersii*) byli nalezeni na čtyřech lokalitách,

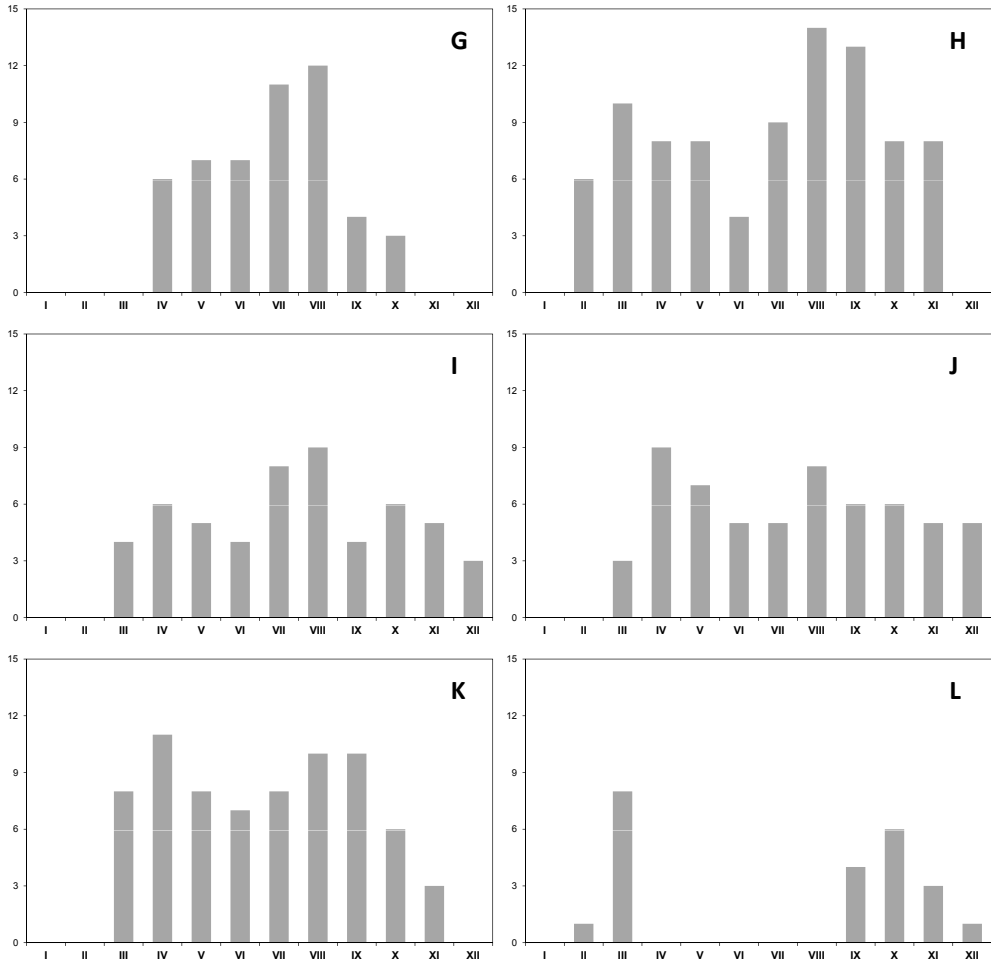


Fig. 6. Annual course of the foraging activity of bat species studied in the El Kala Biosphere Reserve; Obr. 6. Letová aktivita studovaných druhů netopýrů v Biosferické rezervaci El Kala v průběhu roku. Legend / legenda: G – *Myotis emarginatus*, H – *Eptesicus isabellinus*, I – *Pipistrellus pipistrellus*, J – *Pipistrellus kuhlii*, K – *Miniopterus schreibersii*, L – *Tadarida teniotis*.

zatímco vrápenec střeozemský (*Rhinolophus euryale*), vrápenec Blasiův (*Rhinolophus blasii*), netopýr punský (*Myotis punicus*), netopýr vroubený (*Pipistrellus kuhlii*) a morous evropský (*Tadarida teniotis*) na třech lokalitách. Druhovú bohatost (celkový počet druhů netopýrů na jediném místě) byla zaznamenána v rozmezí 1–8 (průměrně 4.33). Roční průběh letové aktivity všech druhů byl studován pomocí odchyty do sítí, jedenkrát měsíčně v průběhu dvou let.

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

The authors are much grateful to Abd El Salam GUERIRA, ranger of the El Kaala National Park, for his help during the field work. Many thanks the World Bat Library (Geneva) for providing literature and Eurobats for providing the field equipment.

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