

Parasitologie

ON BAT ECTOPARASITES (NYCTERIBIIDAE, STREBLIDAE, SIPHONAPTERA, MESOSTIGMATA AND IXODIDAE) FROM CHREA NATIONAL PARK (CENTRAL ATLAS MOUNTAINS), ALGERIA

par

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Eleven species of ectoparasites were recovered from six bat species within Chréa National Park (Central part of Atlas Mountains, Algeria). Six species belong to the class Insecta and four species to class Arachnida. Insecta is represented by two orders, namely Diptera and Siphonaptera. Six species of dipteran ectoparasites were identified, belonging to Nycteribiidae (*Nycteribia latreillii*, *N. schmidlii*, *N. pedicularia*, *Penicilidia dufourii*, *Phthiridium biarticulatum*) and Streblidae (*Brachytarsina falvipinnis*). One species of Siphonaptera, *Araeopsylla gestroi*, was identified. Four species of Acari were identified as *Ixodes vespertilionis*, *I. ricinus*, *Eyndhovenia euryalis* and *Spinturnix myoti*. Two host-parasite associations are newly reported for Algeria: *Rhinolophus ferrumequinum* with *Araeopsylla gestroi*, and *Eptesicus isabellinus* with *Ixodes ricinus*.

Keywords: Bats, Ectoparasites, Chréa National Park, Algeria.

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Sur les ectoparasites des chauves-souris du Parc national de Chr  a, Alg  rie

Nous pr  sentons de nouvelles donn  es sur les ectoparasites des chauves-souris du Parc National de Chr  a (partie centrale des montagnes de l'Atlas, Alg  rie). Onze esp  ces, dont sept esp  ces d'insectes appartenant    l'ordre des Diptera (*Nycteribia latreillii*, *Nycteribia schmidlii*, *Nycteribia pedicularia*, *Penicilidia dufourii*, *Phthiridium biarticulatum*, *Brachytarsina falvipinnis*) et des Siphonaptera (*Araeopsylla gestroi*) et quatre esp  ces d'Acarina (*Ixodes vespertilionis*, *Ixodes ricinus*, *Eynhovenia euryalis*, *Spinturnix myoti*) ont   t   retrouv  es chez six esp  ces de chauves-souris. Ainsi, deux nouvelles associations h  te-parasite sont signal  es en Alg  rie : *Rhinolophus ferrumequinum* et *Araeopsylla gestroi*, *Eptesicus isabellinus* et *Ixodes ricinus*.

Mots-cl  s : Chauves-souris, ectoparasites, Parc national de Chr  a, Alg  rie.

Introduction

Arthropod ectoparasites are small organisms that live and feed on the skin of various hosts, some of which are known to be potential vectors of diseases (HOPLA *et al.*, 1994). According to RITZI & WHITAKER (2003), mammals are known hosts of ectoparasites, especially bats and rodents. Bats, the only mammals capable of true powered flight, are widely distributed and have a broad range of habitats, which makes them natural hosts of many ectoparasites (DICK *et al.*, 2003; BENDJEDDOU, 2017). They are excellent models for studying host-parasite relationships, because their taxonomy and behaviours are extremely diverse (KURTA *et al.*, 2007). In Algeria, assessment of the bat ectoparasite fauna is far from complete. Recently, BENDJEDDOU *et al.* (2017) provided a list of 22 species of ectoparasites, including Nycteribiidae, Streblidae, Siphonaptera, Heteroptera, Mesostigmata, Argasidae and Ixodidae, associated with 19 bat species. However, there remains a lack of data since most studies treat the north-east, south-east and southern parts of the country. Till now, the bat soft tick *Argas vespertilionis* is the only species that has been reported from the central part of Algeria (BENDJEDDOU *et al.*, 2017).

The present study documents the ectoparasites associated with bats collected from Chr  a National Park (central part of the Atlas Mountains), Algeria.

Material and methods

Study area

Chr  a National Park is located in central area of Algeria (36  19' – 36  30'N and 2  38' – 3  02'E), about 40 km south-west of Algiers, just south of the village of Blida (Figure 1). It covers around 27 000 ha of higher mountains (900-1550 m) in the Mitidja area. The climate is fresh and humid, with a mean annual rainfall of 950-1200 mm, monthly mean of temperatures between 3-7  C in winter and 18-23  C in summer; snow is relatively frequent (50-100 cm annually) (SBABDJI, 2012). The

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park includes a mixture of different ecosystems, including evergreen sclerophyllous forests, lakes, mountains, woodlands or scrubs. Bats were studied at three localities within Chréa National Park:

- Hammam Melouane cave: ($36^{\circ}25'36''\text{N}$ - $2^{\circ}58'24''\text{E}$ – 887 m a.s.l.) a small cave, 7 m high, 4 m wide and about 8 m deep. The surrounding area corresponds in part to native woodland of Atlas Cedar;
- Chiffa tunnels (gorges de la Chiffa): ($36^{\circ}24'0.01''\text{N}$ - $2^{\circ}46'0.01''\text{E}$ – 239 m a.s.l.) abandoned tunnels dating from the colonial period;
- Bouarfa: ($36^{\circ}26'04''\text{N}$ - $2^{\circ}50'08''\text{E}$ - 487 m a.s.l.) semi urbanized habitat.

Bats and ectoparasites collection

Bats were collected from three localities within Chrea national park, during the summers of 2016 and 2017. Both hand-nets and mist-nets were used to capture

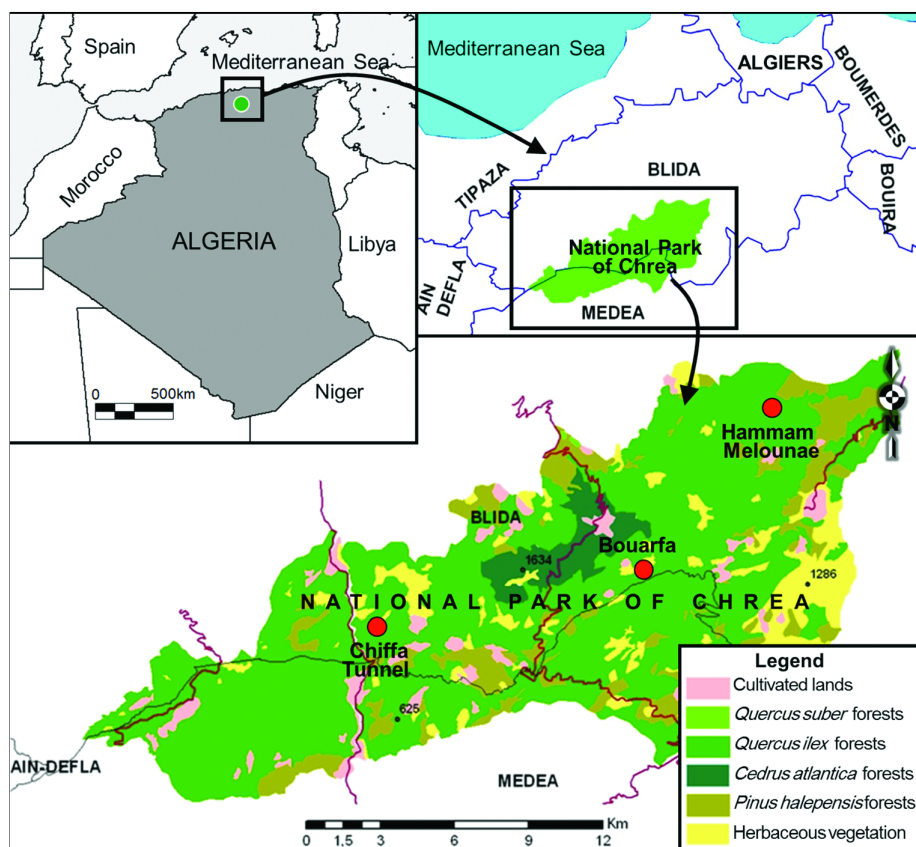


Figure 1

Map showing location of Chrea National Park and the study sites.
Carte de localisation du Parc national de Chréa et des sites d'étude.

bats on underground roots and in open habitats. Bats were identified according to DIETZ & VON HELVERSEN (2004) and DIETZ (2005). Each bat was individually examined and its ectoparasites were stored and labelled in a vial containing 75% alcohol. “N” and “NP” designate the number of bats examined and the number of recovered parasites, respectively. Collected ectoparasites were identified using HOPKINS & ROTHSCCHILD (1956), RUDNICK (1960), DUSBABEK (1962), USINGER (1966), RADOVSKY (1967), THEODOR (1967), BEAUCOURNU (1961) and HURKA (1982).

Results and discussion

Bat species

A total of 61 bats, representing six species (Family Rhinolophidae: *Rhinolophus blasii* (N=05), *Rhinolophus ferrumequinum* (N=40); Family Vespertilionidae: *Eptesicus isabellinus* (N=04), *Myotis punicus* (N=03), *Pipistrellus kuhlii* (N=08); Family Miniopteridae: *Miniopterus schreibersii* (N=01)), were collected from the three localities in Chr  a National Park (Table 1).

Ectoparasites

Eleven species of ectoparasites, belonging to three orders, were recovered from five bat species from Chr  a National Park. Six species of bat flies (Diptera: Streblidae) were recovered: *Brachytarsina falvipinnis* and (Diptera: Nycteribiidae) *Nycteribia latreillii*, *Nycteribia schmidlii*, *Nycteribia pedicularia*, *Penicilidia dufouri* and *Phthiridium biarticulatum*. The order Siphonaptera was represented by a single species (*Araeopsylla gestroi*) while two ixodid ticks (*Ixodes vespertilionis* and *Ixodes ricinus*) and two species of Mesostigmatid mites (*Eyndhovenia euryalis* and *Spinturnix myoti*) were collected (Table 2).

Class Arachnida

Family Ixodidae

- *Ixodes vespertilionis* (Koch, 1844)

We found this tick on three different bat species: *Rh. blasii* (N=2, NP=2), *Rh. ferrumequinum* (N=8, NP=1) and *M. schreibersii* (N=1, NP=1), in Chiffa tunnels, 10 May 2017. **Remarks:** *Ixodes vespertilionis* is distributed in Eurasia, Africa and Australia (KOLONIN, 2007). It parasitizes many bat species of the families Rhinolophidae and Vespertilionidae (KRISTOFIK & DANKO, 2012). BENDJEDDOU *et al.* (2016) studied the seasonal infestation of *I. vespertilionis* on *M. punicus* at two sites in northeastern Algeria. This tick was also recorded from four other Algerian bat species: *M. emarginatus*, *M. capaccini*, *Rh. ferrumequinum* and *M. schreibersii* (BENDJEDDOU *et al.*, 2017; KHELFAOUI *et al.*, 2018).

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Table 1

Bat species collected at the study sites.
Liste des chauves-souris collectées et leurs localisations.

Localities	Bat species
Hamam Melouane cave	<i>Myotis punicus</i>
Chiffa tunnels	<i>Rhinolophus blasii</i> <i>Rhinolophus ferrumequinum</i> <i>Miniopterus schreibersii</i>
Bouarf	<i>Eptesicus isabellinus</i> <i>Pipistrellus kuhlii</i>

Table 2

Ectoparasites recovered from six species of bats in Chréa National Park.
Ectoparasites collectés sur les six espèces de chauves-souris examinées au Parc national de Chréa.

Ectoparasite species	Host species
<i>Ixodes vespertilionis</i>	<i>Rhinolophus blasii</i> <i>Rhinolophus ferrumequinum</i> <i>Miniopterus schreibersii</i>
<i>Ixodes ricinus</i>	<i>Eptesicus isabellinus</i> * <i>Pipistrellus kuhlii</i>
<i>Eyndhovenia euryalis</i>	<i>Rhinolophus blasii</i>
<i>Spinturnix myoti</i>	<i>Rhinolophus blasii</i> <i>Rhinolophus ferrumequinum</i> <i>Myotis punicus</i>
<i>Araeopsylla gestroi</i>	<i>Rhinolophus ferrumequinum</i> *
<i>Brachytarsina falvipinnis</i>	<i>Rhinolophus blasii</i> <i>Rhinolophus ferrumequinum</i> <i>Myotis punicus</i>
<i>Nycteribia latreillii</i>	<i>Rhinolophus blasii</i> <i>Rhinolophus ferrumequinum</i>
<i>Nycteribia schmidlii</i>	<i>Rhinolophus ferrumequinum</i>
<i>Nycteribia pedicularia</i>	<i>Rhinolophus ferrumequinum</i> <i>Myotis punicus</i> <i>Miniopterus schreibersii</i>
<i>Penicillidia dufourii</i>	<i>Rhinolophus ferrumequinum</i>
<i>Phthiridium biarticulatum</i>	<i>Rhinolophus blasii</i> <i>Rhinolophus ferrumequinum</i>

* New host-parasite record.

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- *Ixodes ricinus* (Linnaeus, 1758)

This tick species was collected on two bat species: *E. isabellinus* (N=4, NP=1) and *P. kuhlii* (N=8, NP=2), at Bouarfa, 17 June 2016. **Remarks:** This tick species is mostly associated with artiodactyls and reptiles. In Algeria it was already recorded on lizard species (SOUALAH-ALILA *et al.*, 2015). It has also been found to parasitize some bat species in Europe and North Africa, but this was considered accidental (ŠEVČÍK *et al.*, 2010; BENDJEDDOU *et al.*, 2017). *E. isabellinus* and *P. kuhlii* are thus new hosts for this tick species, although this association is accidental.

Family Spinturnicidae

- *Eyndhovenia euryalis* (Canestrini, 1884)

This mite was found on *Rh. blasii* (N=3, NP=4) in Chiffa tunnels, 7 July 2017. **Remarks:** This mite was reported earlier on *P. gaisleri* and *Rh. blasii* (BENDJEDDOU *et al.*, 2017). It was first reported in Algeria by DEUNFF (1977) and is distributed across Europe, reaching China and Australia (KRIŠTOFÍK & DANKO, 2012).

- *Spinturnix myoti* (Kolenati, 1856)

We found this species on *M. punicus* (N=3, NP=34) in Melouane Hammam cave (18 June 2016), on *Rh. blasii* (N=2, NP=4) and *Rh. ferrumequinum* (N=8, NP=3), and in Chiffa tunnels (10 May 2017). **Remarks:** This bat mite has a wide distribution in Europe, North Africa and Asia (KRIŠTOFÍK & DANKO, 2012). It is mostly associated with bats of the genus *Myotis*, but has been reported from other genera as well (STANYUKOVICH, 1997). This mite species was reported from *M. punicus* in Algeria and Libya (BENDJEDDOU *et al.*, 2013, 2017; BENDA *et al.*, 2014; KHELFAOUI *et al.*, 2018).

Order Siphonaptera

- *Araeopsylla gestroi* (Rothschild, 1906)

This flea was collected from *Rh. ferrumequinum* (N=26, NP=1) in Chiffa tunnels, 2 March 2017. **Remarks:** This is a rare bat flea, associated with bats of the genus *Tadarida*, and is distributed in the western and central parts of the Palaearctic (MEDVEDEV & KOTTI, 2012). In Algeria, it has been reported from *T. aegyptiaca* (BENDJEDDOU *et al.*, 2017). *Rh. ferrumequinum* is a new host for this bat flea.

Order Diptera

Family Streblidae

- *Brachytarsina flavipennis* (Macquart, 1851)

This fly was collected from *M. punicus* (N=3, NP=5) in Hammam Melouane cave, 18 June 2016, from *Rh. ferrumequinum* (N=26, NP=3) in Chiffa tunnels, 2 March 2017, and from *Rh. blasii* (N=2, NP=2) and *Rh. ferrumequinum* (N=8, NP=2) in Chiffa tunnels, 10 May 2017. **Remarks:** The main hosts of *Brachytarsina flavipennis* are species of the genera *Rhinolophus* and *Myotis* (HURKA, 1962; SCHEFFLER, 2012). In Algeria, it was previously reported from *Rhinolophus* species,

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M. capaccinii, *M. punicus*, *M. schreibersii* and *T. aegyptiaca* (ANCIAUX DE FAVEAUX, 1976; AMR & QUMSIYEH, 1993; BENDJEDDOU *et al.*, 2017; KHELFAOUI *et al.*, 2018).

Family Nycteribiidae

- *Nycteribia latreillii* (Leach, 1817)

This species was found on *Rh. blasii* (N=2, NP=3) and *Rh. ferrumequinum* (N=8, NP=2) in Chiffa tunnels, 10 May 2017. **Remarks:** *Nycteribia latreillii* has a wide distribution across southwestern Asia to continental Europe and North Africa (HŮRKA, 1964). In North Africa, it was found on *M. schreibersii* in Morocco and Tunisia, and on *M. punicus* in Libya (HŮRKA, 1982). In Algeria, it was first recorded by BENDJEDDOU *et al.*, (2017) in association with five bat species (*M. emarginatus*, *M. capaccinii*, *M. punicus*, *Rh. blasii* and *P. gaisleri*).

- *Nycteribia schmidlii* (Schiner, 1853)

This species was found on *Rh. ferrumequinum* (N=26, NP=8), in Chiffa tunnels, 2 March 2017. **Remarks:** *N. schmidlii* is distributed in southern Europe and North Africa reaching central Asia (HŮRKA, 1964). It was reported on *A. tridens* in Palestine (THEODOR & MOSCONA, 1954) and on *M. schreibersii* in Turkey (ALBAYRAK, 2003). In Algeria, it has been found on *M. schreibersii* (FALCOZ, 1923; AMR & QUMSIYEH, 1993), *Rh. mehelyi* (FALCOZ, 1923; AMR & QUMSIYEH, 1993), *Rh. ferrumequinum* (THEODOR & MOSCONA, 1954), *M. blythi* (AMR & QUMSIYEH, 1993), *Rh. clivosus* (BENDJEDDOU *et al.*, 2017), *R. cystops* (BENDJEDDOU *et al.*, 2017) and *Rh. blasii* (KHELFAOUI *et al.*, 2018).

- *Nycteribia pedicularia* (Latreille, 1805)

This species was found on *M. punicus* (N=3, NP=4) in Hammam Melouane cave, 18 June 2016, and on *Rh. ferrumequinum* (N=26, NP=8) (2 March 2017) and *M. schreibersii* (N=1, NP=1) (10 May 2017) in Chiffa tunnels. **Remarks:** This fly is known to parasitize bat species such as *M. emarginatus*, *M. capaccinii*, *Rh. blasii*, *Rh. ferrumequinum* and *T. teniotis* (THEODOR & MOSCONA, 1954; HŮRKA, 1964; WALTER & EBENAU, 1997). In Algeria, it has been found on *M. schreibersii*, *Rh. euryale*, *Rh. mehelyi* and *M. punicus* (AMR & QUMSIYEH, 1993; BENDJEDDOU *et al.*, 2017).

- *Penicilidia dufourii* (Westwood, 1835)

This species was found on *Rh. ferrumequinum* (N=6, NP=5) in Chiffa tunnels, 7 July 2017. **Remarks:** A wide distribution range of is reported for this bat fly, in Europe, North Africa and Asia, reaching to India (KRIŠTOFÍK & DANKO, 2012). *P. dufourii* is usually associated with bats of the genus *Myotis*, but it has also been recovered from a wide range of other species, including *M. schreibersii* and *Rh. euryale* (HŮRKA, 1980). In Algeria, it was previously recorded from *M. punicus*, *Rh. euryale*, *Rh. ferrumequinum*, *Rh. hipposideros*, *M. schreibersii* and *A. tridens* (THEODOR, 1967; AMR & QUMSIYEH, 1993; BENDJEDDOU *et al.*, 2017).

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• *Phthiridium biarticulatum* (Hermann, 1804)

We found this species on *Rh. blasii* (N=2, NP=2) and *Rh. ferrumequinum* (N=8, NP=3) in Chiffa tunnels, 10 May 2017. **Remarks:** This circum-Mediterranean fly is associated with cave dwelling bats and known to prefer those of the genus *Rhinolophus* (ŠEVČÍK *et al.*, 2013). In Algeria, this species was previously reported from *Rh. blasii*, *Rh. euryale*, *Rh. ferrumequinum*, *Rh. mehleyi*, *Rh. hipposideros*, *M. schreibersii*, *M. capaccinii* and *M. punicus*, as well as from *E. isabellinus* and *P. kuhlii* (AMR & QUMSIYEH, 1993; BENDJEDDOU *et al.*, 2017; KHELFAOUI *et al.*, 2018).

Conclusion

In summary, this preliminary investigation highlights the diversity of ectoparasite species that are associated with bats in the Chr  a National Park. Further researches, involving a wider range of bat species in the area are needed to draw up an exhaustive list.

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