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New findings of mites on small mammals in the Yungas Forest of Argentina

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In Argentina, studies on the systematics of parasitic mites on small mammals have been limited mainly to rodent mites from the Pampas region, followed by some studies in the northeastern region. The mites collected in the province of Jujuy, particularly in the locality of Las Capillas, have not been previously analyzed. The objective of this study was to contribute to the knowledge of the faunal composition of mites parasitizing small mammals in the Yungas eco-region, Jujuy province, Argentina. Specimens of mites deposited in the "Colección de Mamíferos Anexo Lillo, Dra. Analía G. Autino (CMLA)", Universidad Nacional de Tucumán, from bats and rodents were examined. The specimens were fixed in 70 % alcohol and prepared following conventional techniques for taxonomic identification. The specimens were compared to the original descriptions of the species and to specimens in the CMLA. A total of 153 mites of the order Mesostigmata were analyzed, resulting in the identification of 11 species, eight genera, and three families. Three species parasitized the order Chiroptera and eight parasitized the order Rodentia. A total of 152 mites were identified in the adult stage, including 14 males and 138 females, and one protonymphal stage. All species represent new records for the locality Las Capillas, except *Gigantolaelaps gilmorei*. The following species are reported for the first time for the Jujuy Province: *Androlaelaps fahrenholzi*, *Laelaps mazzai*, *Mysolaelaps microspinosus*, *Eulaelaps stabularis*, *Chiroptonyssus robustipes*, *Macronyssus crosbyi* and *Periglischrus iheringi*, as well as the genera *Androlaelaps*, *Mysolaelaps*, *Eulaelaps*, *Chiroptonyssus*, *Macronyssus* and *Periglischrus* and the families Macronyssidae and Spinturnicidae. Twenty mite-host associations were recognized for Las Capillas. The results increase the inventory of the acarological fauna of small mammals in the northwestern Argentina and particularly in the Yungas of the province of Jujuy, which constitutes an area of influence of bacterial pathogens.

En Argentina, los estudios sobre la sistemática de los ácaros parásitos en pequeños mamíferos han estado restringido principalmente a ácaros de roedores de la región pampeana, seguidos de algunas investigaciones en la región noreste. Los ácaros colectados en la provincia de Jujuy, particularmente en la localidad de Las Capillas, no han sido analizados previamente. El objetivo del presente estudio fue contribuir al conocimiento de la composición faunística de ácaros parásitos de pequeños mamíferos en la ecorregión de las Yungas, provincia de Jujuy, Argentina. Se examinaron ejemplares de ácaros depositados en la "Colección de Mamíferos Anexo Lillo, Dra. Analía G. Autino (CMLA)", Universidad Nacional de Tucumán, provenientes de murciélagos y roedores. Los ejemplares fueron fijados en alcohol 70 % y preparados siguiendo las técnicas convencionales para su identificación. Los especímenes se compararon con descripciones originales de especies y con especímenes depositados en la CMLA. Un total de 153 ácaros pertenecientes al orden Mesostigmata fueron analizados, resultando en la identificación de 11 especies, ocho géneros y tres familias. Tres especies parasitaron el orden Chiroptera y ocho el orden Rodentia. Se identificaron 152 ácaros en estado adulto, incluyendo 14 machos y 138 hembras, y uno en estadio protoninfal. Todas las especies representan nuevos registros para la localidad Las Capillas, excepto *Gigantolaelaps gilmorei*. Se reportan por primera vez para la provincia de Jujuy las siguientes especies: *Androlaelaps fahrenholzi*, *Laelaps mazzai*, *Mysolaelaps microspinosus*, *Eulaelaps stabularis*, *Chiroptonyssus robustipes*, *Macronyssus crosbyi* y *Periglischrus iheringi*, así como los géneros *Androlaelaps*, *Mysolaelaps*, *Eulaelaps*, *Chiroptonyssus*, *Macronyssus* y *Periglischrus* y las familias *Macronyssidae* y *Spinturnicidae*. Asimismo, se reconocieron 20 asociaciones ácaro-hospedador para Las Capillas. Los resultados aumentan el inventario de la fauna acarológica de pequeños mamíferos en el noroeste argentino y particularmente en las Yungas de la provincia de Jujuy que constituye un área de influencia de bacterias patógenas.

Keywords: Bats; Mesostigmata; Northwestern Argentina; rodents.

Introduction

In Argentina, studies on the systematics of parasitic mites on small mammals have been restricted mainly to mites of rodents from the Pampas region, followed by some investigations in the northeastern region (Lareschi and Mauri 1998; Lareschi 2023), while records for the northwestern region are extremely scarce (Lareschi and Mauri 1998; Lareschi *et al.* 2003; López Berrizbeitia *et al.* 2013). Las Capillas is located in the province of Jujuy in the northwestern Argentina (NWA). It corresponds to a mountain forest vegetation in very good condition and has remained isolated from human impact for more than 50 years. It has been recognized as an "Area of Importance for the Conservation of Bats" (AICOM; in Spanish, it stands for "Area de Importancia para la Conservación de los Murciélagos") by the Latin American Bat Conservation Network (RELCOM, or "Red Latinoamericana para la Conservación de los Murciélagos"; see www.relcomlatinoamerica.net) on 2013.

Gamboa Alurralde *et al.* (2016) recorded the three main orders of small mammals in Las Capillas: marsupials (Didelphimorphia), bats (Chiroptera), and rodents (Rodentia). The first is represented by two species from the family Didelphidae, the second by 24 species from four families (Noctilionidae, Phyllostomidae, Molossidae, and Vespertilionidae), and the third by 13 species from two families (Cricetidae and Ctenomyidae).

The mites collected at this locality have not been analyzed previously, thus new findings of geographic and host distribution for parasitic mites of small mammals (Chiroptera and Rodentia) from the Yungas Forest in the Jujuy province, Argentina are added.

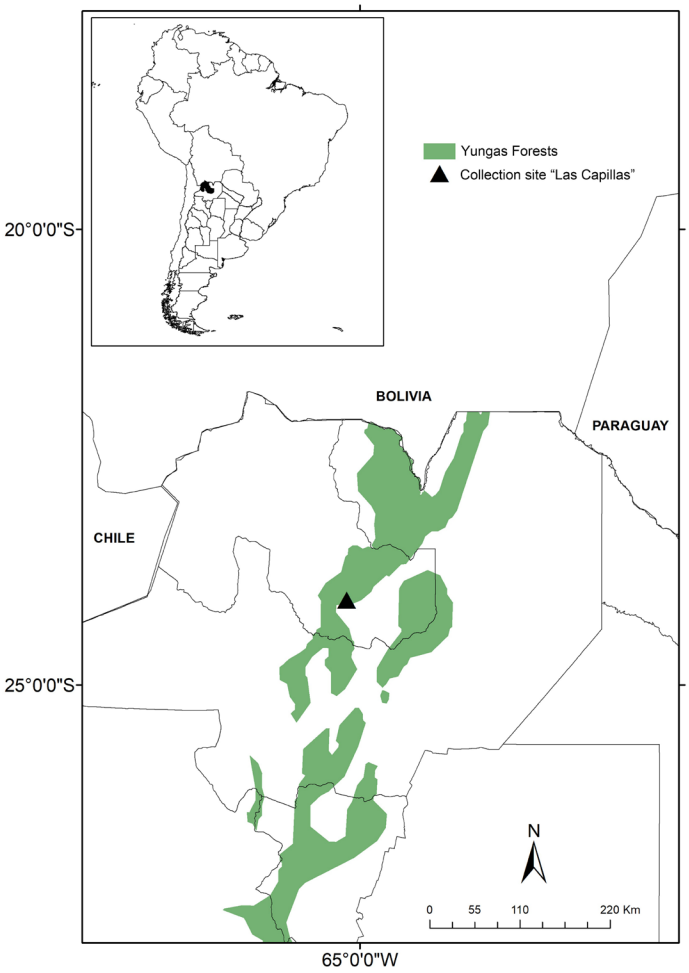

Figure 1. Map illustrating the Jujuy Province and the Yungas Forests eco-region. The black dot (triangle) shows the collection site of mite species, "Las Capillas".

Materials and methods

Study area. The fieldwork was conducted within "Finca Las Capillas" (-24° 04′ 27.93″ S, -65° 08′ 42.08″ W), an area of 3,500 ha located approximately 2 km north of "Las Escaleras", Manuel Belgrano Department, Jujuy Province, Argentina (Figure 1). The area corresponds to the montane forest district, a part of the Yungas eco-region, which is extended approximately between 700 and 1,500 m (Burkart *et al.* 1999; Brown and Pacheco 2006). The observed vegetation is typical of the district, which is dominated by tall trees such as *Cedrela angustifolia*, *Enterolobium contortisiliquum*, *Anadenanthera colubrina*, *Cinnamomum porphyrium*, and *Myrcianthes pungens*. There are also smaller trees, such as *Allophyllus edulis* and *Celtis brasiliensis*, among others, that do not exceed 20 m. Bushes such as *Urera baccifera*, *Piper tucumanum*, and *Solanum* spp., as well as herbs ranging from smaller forms to taller than 2 m (Cabrera 1976), are present. Epiphytes are abundant, and lichens, ferns, bromeliads and mosses are dominant, which are present in more than 70 % of the trees (Brown *et al.* 2001). The climate in this altitudinal belt is warm and humid, and the temperature and humidity vary in relation to altitude, latitude, topography, and slope exposure. Annual precipitation varies between 900 and 1,000 mm. Rainfalls are concentrated mainly in summer, and last for about 5 to 6 months. During the cooler months, the condensed water mist that characterizes these "cloud forests" is captured and cooperates to partially compensate for the lack of rains in that season (Burkart *et al.* 1999). The area includes a hydrographic system that is part of the Basin of the Mojotoro-San Francisco-Lavayen rivers and the sub-basin of the Negro-Upper San Francisco rivers. The main river at the study area is Las Capillas, which changes its name to Negro River before it flows into the San Francisco River (Paoli *et al.* 2011).

Collection and preparation of specimens. An important number of mites (Arachnida: Acari) from the study area were deposited in the "annexes" Analía G. Autino (CMLA) of the Colección Mamíferos Lillo, Universidad Nacional de Tucumán (UNT). These specimens are the results of surveys carried out for several years; all specimens were analyzed during this study.

Specimens were removed from hosts with a toothbrush/forceps, preserved in a solution of 70 % ethyl alcohol, and prepared following conventional techniques for taxonomic identification (Krantz and Walter 2009; Morales-Malacara *et al.* 2020).

Nomenclature follows Krantz and Walter (2009) and keys and descriptions of Fonseca (1939a, b), Furman (1972), Herrin and Tipton (1975), Morales-Malacara (2001) and Lareschi (2010b, 2011) were used. Specimens were compared with original descriptions of species and with specimens stored in the CMLA.

Voucher specimens of small mammals are deposited at the Colección Mamíferos Lillo (CML), Facultad de Ciencias Naturales e Instituto Miguel Lillo, UNT. A single host has not yet received a collection number; therefore, the collection catalog number is indicated, and its acronym corresponds to PIDBA (specimen catalog of the Argentine Biodiversity Research Institute). To corroborate the taxonomic identification of small mammals, we followed Patton *et al.* (2015), Barquez and Díaz (2020), and Teta and Jayat (2021). The basic checklist used was based on American Society of Mammalogists (ASM; Mammal Diversity Database 2024).

Results

A total of 153 mites belonging to 11 species, eight genera, and three families were studied. These mites were recorded on three species of bats, *Artibeus planirostris* (Phyllostomidae), *Myotis albescens* (Vespertilionidae) and *Tadarida brasiliensis* (Molossidae), and eight species of rodents, *Akodon budini*, *Akodon simulator*, *Calomys callosus*, *Calomys musculinus*, *Calomys venustus*, *Euryoryzomys legatus*, *Oligoryzomys brendae*, and *Oligoryzomys flavescens* (Cricetidae). Information of each mite species and respective hosts are given in the following species accounts.

Systematics

Order Mesostigmata

Family Laelapidae

Androlaelaps fahrenholzi (Berlese, 1911)

Distribution in Argentina: Buenos Aires, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, La Rioja, Misiones, Neuquén, Rio Negro, Santa Fe, San Juan, San Luis, Tucumán (Lareschi 2023); herein this species is added to Jujuy Province.

Material examined: 1 ♂ (CMLA 1075), ex *A. budini* (CML 12340), 1 ♂ (CMLA 1076), ex *A. simulator* (CML 12348).

Remarks: *Androlaelaps fahrenholzi* constitutes a species complex (Lareschi 2011) and although, our specimens present the typical characteristics of the complex such as the inflated *pilus dentalis* and the presence of the serrated Z5 seta (Savchenko 2022), these will need to be reviewed and studied with other taxonomic techniques, such as morphogeometric and molecular methods.

It has been recorded from a great number of mammal species worldwide, mainly rodents, marsupials, and several birds (Furman 1972). In Argentina, it was cited on mammals of the orders Rodentia, Didelphimorphia, Microbiotheria, Cingulata, and Chiroptera (Lareschi and Mauri 1998). The record on *A. budini* represents a new mite-host association.

Gigantolaelaps gilmorei Fonseca, 1939

Distribution in Argentina: Jujuy and Salta (Lareschi 2023).

Material examined: 5 ♀ (CMLA 1077 to 1081), ex *E. legatus* (CML 4317).

Remarks: It is one of the largest species of the genus *Gigantolaelaps* (Fonseca 1939a). It can be distinguished from all other species of the genus by the following characters: rectangular sternal plate with the posterior edge wider than the anterior edge, with a slightly pronounced median projection, and without accessory setae (Furman 1972). This species has a close association with *E. legatus* (originally cited as *Oryzomys russatus*) in southeastern Brazil and Argentina, and in Paraguay with *Euryoryzomys nitidus* (originally cited as *Oryzomys nitidus*). *Gigantolaelaps gilmorei* was recorded on *A. simulator*, but it was considered an accidental association (Lareschi *et al.* 2004).

Gigantolaelaps oudemansi Fonseca, 1939

Distribution in Argentina: Chaco, Jujuy, and Tucumán (Lareschi and Mauri 1998; Lareschi 2023).

Material examined: 18 ♀ (CMLA 1082 to 1099), ex *E. legatus* (CML 12383, 8330).

Remarks: According to Furman (1972), there are three general morphological forms of the species, which were used to separate it into three groups based on the size of the dorsal plate and the size and shape of the proximal and distal setae of the coxa I. The specimen examined in this study corresponds to "group 1", which is characterized by both setae of coxa I being setiform, subequal, or the distal seta being up to 1.2 times longer than the proximal seta.

The species was found parasitizing *Oecomys concolor* in the Chaco province (Lareschi and Mauri 1998), *O. brendae* (originally cited as *Oligoryzomys destructor*) in the Tucumán province and *E. legatus* (originally cited as *Oryzomys russatus*) in the Jujuy province (Lareschi *et al.* 2003).

Gigantolaelaps wolffsohni (Oudemans, 1910)

Distribution in Argentina: Buenos Aires, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Jujuy, Misiones, Salta, San Luis, and Tucumán (Lareschi 2023).

Material examined: 8 ♀ (CMLA 1100 to 1104, 1111 to 1113), ex *O. brendae* (CML 9523, 12371, 2 released); 6 ♀ (CMLA 1105 to 1110), ex *O. flavescens* (CML 12370, 12380).

Remarks: This species can be distinguished from all other species of the genus by the following characters: the anteroventral seta of the coxa I spiniform and distal setiform, the dorsal plate with setae J5 very long, about 2/3 the length of setae Z5. Furthermore, the posterior margin of the plate is convex (Furman 1972). Although this species was previously cited on *O. flavescens* and *O. brendae* (Savchenko *et al.* 2021), in Jujuy province, only one specimen of the order Rodentia without identification was reported as host (Lareschi and Mauri 1998; Lareschi 2023),

therefore, the recorded associations in this study are new to the province. *Gigantolaelaps wolffsohni* was also reported on other rodents of the genera *Holochilus*, *Scapteromys*, and *Mus* (Lareschi 2023).

Laelaps mazzai Fonseca, 1939

Distribution in Argentina: Buenos Aires, Chaco, Chubut, Córdoba, Corrientes, Entre Ríos, Formosa, Salta, and Santa Fe (Espinoza-Carniglia *et al.* 2023; Lareschi 2023); herein this species is added to Jujuy Province.

Material examined: 9 ♀ (CMLA 1116, 1117, 1119, 1120 to 1125) and 1 ♂ (CMLA 1118), ex *C. callosus* (CML 12386, 12387), 8 ♀ (CMLA 1126 to 1133), ex *C. musculinus* (CML 12390), 19 ♀ (CMLA 1134 to 1149, 1152, 1153, 1227), ex *C. venustus* (CML 12388, 12393), 2 ♀ (CMLA 1114, 1115), ex *O. flavescens* (CML 12370); 2 ♀ (CMLA 1150, 1151), ex *O. brendae* (CML 12369).

Remarks: This species can be distinguished from all other species of the genus by the following characters: hypertrichia, dorsal plate with 60 to 75 pairs of setae, coxa I with proximal seta longer than distal seta, both spiniform (Furman 1972). This mite is mainly associated with species of the genus *Calomys* from Argentina, Brazil, Paraguay, and Venezuela (Espinoza-Carniglia *et al.* 2023). In Argentina, it was also recorded parasitizing other genera of rodents as *Akodon*, *Eligmodontia, Necromys, Oxymycterus*, *Reithrodon*, and *Mus* (Lareschi *et al.* 2006; Lareschi 2023). The association with *O. brendae* is recorded for the first time.

Laelaps paulistanensis Fonseca, 1936

Distribution in Argentina: Buenos Aires, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Jujuy, La Rioja, Misiones, Río Negro, and Tucumán (Lareschi 2023).

Material examined: 2 ♀ (CMLA 1160, 1161), ex *C. musculinus* (CML 12390); 18 ♀ (CMLA 1154, 1155, 1162 to 1177), ex *O. brendae* (CML 9523, 12369, 12371, 1 released); 4 ♀ (CMLA 1156 to 1159), ex *O. flavescens* (CML 12370, 12380).

Remarks: This species can be distinguished from all other species of the genus by the following characters: dorsal plate with 36 to 45 pairs of setae, coxa I with spiniform proximal seta and piliform distal seta longer than the proximal seta (Furman 1972). *Laelaps paulistanensis* was cited on rodents of genera *Akodon*, *Calomys*, *Ctenomys*, *Euryoryzomys*, *Holochilus*, *Mus, Oecomys*, *Oligoryzomys*, *Oxymycterus*, *Reithrodon* and *Scapteromys* and one record on a marsupial, *Lutreolina* (Didelphimorphia; Lareschi and Mauri 1998; Savchenko *et al.* 2021). In Jujuy, it was found on *E. legatus* (Lareschi *et al.* 2003), but the associations reported here were expected since these hosts were previously recorded in other provinces as Buenos Aires, Misiones, and Tucumán (Lareschi *et al.* 2003, 2019; Navone *et al.* 2009; Lareschi 2010a, 2023; Colombo *et al.* 2013).

Mysolaelaps microspinosus Fonseca, 1936

Distribution in Argentina: Buenos Aires, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, La Rioja, Misiones, San Luis, Tucumán (Lareschi 2023); herein this species is added to Jujuy Province.

Material examined: 17 ♀ (CMLA 1178-1187, 1196 to 1202), ex *O. brendae* (CML 9523, 12371); 8 ♀ (CMLA 1188 to 1195), ex *O. flavescens* (CML 12370, 12380).

Remarks: This species can be distinguished from all other species of the genus by the following characters: sternal setae, approximately equal in size, first and second pairs of genitoventral setae less than ½ length of third and fourth pairs, metapodial plate smaller than stigma and genitoventral plate slightly concave posteriorly (Furman 1972). *Mysolaelaps microspinosus* is mainly associated with cricetid rodents of the tribe Oryzomyini, parasitizing the genus *Oligoryzomys* in Argentina, Brazil, Chile, and Uruguay, and the genus *Oryzomys* in Venezuela (Savchenko *et al.* 2021). It also was recorded on rodents of the tribes Akodontini and Phyllotini and even other families (Caviidae and Muridae; Savchenko *et al.* 2021; Lareschi 2023). López Berrizbeitia *et al.* (2013) erroneously cited this species for Jujuy.

Subfamily Haemogamasinae

Eulaelaps stabularis (Koch, 1839)

Distribution in Argentina: Buenos Aires, Córdoba, Rio Negro, San Luis, and Tucumán (Lareschi and Mauri 1998; Lareschi 2023); herein this species is added to Jujuy Province.

Material examined: 1 ♀ (CMLA 1203), ex *A. simulator* (CML 12348).

Remarks: This species can be distinguished from all other species of the genus by the following characters: movable digit bidentate, metapodial plate larger than stigma, genitoventral plate straight posteriorly, peritreme extending to posterior third of coxa I, peritrematal plate swollen and truncated subsequently, simple striae; posterior pore small and epistome with approximately six fine, simple processes (Uchikawa and Rack 1979). In Argentina, was recorded on cricetid rodents (*Akodon*, *Calomys*, *Graomys*, *Necromys*, *Oligoryzomys*, *Reithrodon* and *Scapteromys*) and caviids (*Cavia*; Lareschi 2023). Only one record of *A. simulator* (Lareschi *et al.* 2003) was previously known for the NWA, in the Tucumán province.

Family Macronyssidae

Chiroptonyssus robustipes (Ewing, 1925)

Distribution in Argentina: Buenos Aires, Córdoba, La Rioja, San Juan, San Luis, Salta, Rio Negro, and Tucumán (Lareschi and Mauri 1998); herein this species is added to Jujuy Province.

Material examined: 3 ♂ (CMLA 1205-1207), 2 ♀ (CMLA 1204, 1208) and 1 protonymph (CMLA 1209), ex *T. brasiliensis* (2 released).

Remarks: This species can be distinguished from all other species of the genus by the following characters: idiosomal setae serrated and base of tritosternum with a denticulate expansion, gena III with 10 setae. In females, absence of sternal glands. In males, IV femur with prominent internal spine (Radovsky 2010). This species presents a significant prevalence on *T. brasiliensis* (Pesenti *et al.* 2014), although it has also been reported on other genera of bats as *Myotis, Neoeptesicus, Mormoops* and *Nyctinomops* (Durden *et al.* 1992; Lareschi 2023).

Macronyssus crosbyi (Ewing and Stover, 1915)

Distribution in Argentina: Formosa, Rio Negro (Lareschi and Mauri 1998); herein this species is added to Jujuy Province.

Material examined: 3 ♀ (CMLA 1211- 1213) and 1 ♂ (CMLA 1210), ex *M. albescens* (CML 4315, PIDBA 1540).

Remarks: Females of this species can be distinguished by the following characters: the sternal plate with moderately developed anterolateral sculpture, sternal glands with thick striae and epiginal plate with striations; in males, dorsal plate with M11 strongly noticeable and thickened (Radovsky 2010). This species is associated with the family Vespertilionidae, mainly of the genus *Myotis* and some records on the genus *Eptesicus* (now *Neoeptesicus*; Radovsky 1967). In Argentina, was reported parasitizing to *Myotis chiloensis* and *Myotis nigricans* (Lareschi 2023), but the association with *M. albescens* had previously only been recorded in Paraguay (Presley *et al.* 2015).

Family Spinturnicidae

Periglischrus iheringi Oudemans, 1902

Distribution in Argentina: Salta (Lareschi and Mauri 1998); herein this species is added to Jujuy Province.

Material examined: 7 ♂ (CMLA 1214, 1215, 1221 to 1225), 6 ♀ (CMLA 1216 to 1220, 1226), ex *A. planirostris* (CML 4158, 2 released).

Remarks: This species can be distinguished from all other species of the genus by the following characters: in females, pyriform sternal plate; in males, the first pair of setae of the genitoventral plate extends to or beyond the insertion of the second pair of setae and intercoxa area IV with eight pairs of setae (7 + 1 adanal; Herrin and Tipton 1975). The existence of morphologic variations among individuals from different populations suggests that this species may be a species complex (Morales-Malacara 2001; Gomes-Almeida *et al.* 2024). *Periglischrus iheringi* is mainly associated with the family Phyllostomidae, preferably with species of the genus *Artibeus*, but it was also recorded on species of the families Emballonuridae, Noctilionidae, Molossidae, and Mormoopidae (Herrin and Tipton 1975; Lareschi and Mauri 1998). The association with *A. planirostris* is recorded for the first time for Argentina.

Discussion

These results contribute to our knowledge of the mite fauna of NWA and particularly in the Jujuy province. Based on our studies in NWA, one new genus and species are added, increasing the total list of Mesostigmata mites of bats and rodents in the region, to 17 species of 11 genera. In the Jujuy province, seven species are added, increasing the total list of mites to 12 species of nine genera, including the first records of the families Macronyssidae and Spinturnicidae and the genera *Androlaelaps*, *Eulealaps*, *Mysolaelaps*, *Chiroptonyssus*, and *Periglischrus*. One of the families of mites most represented, in terms of the number of individuals and hosts, was Laelapidae. This family comprised eight species (*A. farhenholzi*, *E. stabularis*, *G. gilmorei*, *G. oudemansi*, *G. wolffsohni*, *L. mazzai*, *L. paulistanensis*, and *M. microspinosus*). Two species, *C. robustipes* and *M. crosbyi* (Macronyssidae) were recorded on bats. They included both adult males and females and one nymph (*C. robustipes*). Twenty mite-host associations were recorded, of which two are new to Argentina and two are reported for the first time.

The knowledge for most of the mite species represented in this study, is still scarce. In particular, three species of mites (*G. gilmorei*, *M. crosbyi*, and *P. iheringi*) were recorded in only two provinces in Argentina. This may be due to the sampling effort and the complexity of the study of these arthropods. For some taxa, the differentiation of morphological characters is complex, the intraspecific variation that may exist is still unknown, which makes it difficult in some cases to determine whether it is a simple variation or a different species.

We emphasize the importance of joint research between parasitologists and mammalogists to ensure proper identification of both parasites and their hosts, and to allow a better understanding of these taxa, not only from a systematic point of view, but also from an ecological and epidemiological point of view, since the study area belongs to an area of influence of bacterial pathogens.

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