

Taxonomy and systematics

## **Ectoparasites associated with rodents (Rodentia) and marsupials (Didelphimorphia) from northeastern Argentina: new host and locality records**

### ***Ectoparásitos asociados con roedores (Rodentia) y marsupiales (Didelphimorphia) del nordeste de Argentina: nuevos registros de huéspedes y localidad***

Alicia Paola Benitez-Ibalo <sup>a, \*</sup>, Leonardo Dionel Aguiar <sup>b</sup>, Ingrid María Desireé Di Benedetto <sup>a, c</sup>, Atilio José Mangold <sup>c, d</sup>, Francisca Milano <sup>a</sup>, Valeria Natalia Debárbora <sup>a, c</sup>

<sup>a</sup> Laboratorio Biología de los Parásitos, Facultad de Ciencias Exactas y Naturales y Agrimensura, Universidad Nacional del Nordeste, Avenida Libertad 5470, Corrientes, Argentina

<sup>b</sup> Laboratorio de Herpetología, Facultad de Ciencias Exactas y Naturales y Agrimensura, Universidad Nacional del Nordeste, Avenida Libertad 5470, Corrientes, Argentina

<sup>c</sup> Consejo Nacional de Investigaciones Científicas y Técnicas, Godoy Cruz 2290 (C1425FQB) Ciudad Autónoma de Buenos Aires, Argentina

<sup>d</sup> Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Rafaela, CC 22, CP 2300 Rafaela, Santa Fe, Argentina

\*Autor para correspondencia: paoben.26\_@hotmail.com (A.P. Benitez-Ibalo)

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#### **Abstract**

Taxonomically, ectoparasites represent a very diverse group, which includes: fleas, lice, mites, and ticks, among others. The aim of this work is to extend the knowledge about the ectoparasite fauna associated with rodents and marsupials from Corrientes Province. For this purpose, 2 suburban sites in Corrientes City were sampled: Santa Ana de los Guácaras and San Patricio. Fifty-four mammal hosts were examined. Among the marsupials, 2 species were collected: *Lutreolina crassicaudata* Desmarest, 1804 and *Didelphis albiventris* Lund, 1840. The analyzed rodents included 3 species: *Cavia aperea* Erxleber, 1777, *Oxymycterus rufus* Fischer, 1814 and *Oligoryzomys* sp. Bangs, 1900. In total, 469 ectoparasites were collected including 5 genera of mites: *Androlaelaps* Berlese, 1903, *Gigantolaelaps* Nesbitt, 1951, *Laelaps* Koch, 1836, *Mysolaelaps* Fonseca, 1935, and *Ornithonyssus* Sambon, 1928; 3 species of ticks, *Amblyomma ovale* Koch, 1844, *A. dubitatum* Neumann, 1899, and *Ixodes loricatus* Neumann, 1899; 2 species of fleas: *Polygenis axius* Jordan & Rothschild, 1923 and *Polygenis bohlsi* Wagner, 1901, and 3 different lice, *Trimenopon hispidum* Burmeister, 1838, *Gliricola* sp. Schrank, 1781, and *Gyropus* sp. Nitzsch, 1818. These results provide host and locality records and new parasite-host associations.

**Keywords:** Mites; Ticks; Lice; Fleas

## Resumen

Los ectoparásitos representan un grupo muy diverso taxonómicamente, que incluye a las pulgas, piojos, ácaros y garrapatas, entre otros. El objetivo de este trabajo es ampliar el conocimiento sobre la fauna de ectoparásitos asociada a roedores y marsupiales de la provincia de Corrientes. Para este propósito, se tomaron muestras de 2 sitios suburbanos en la ciudad de Corrientes: Santa Ana de los Guácaras y San Patricio. Se examinaron 54 huéspedes mamíferos. Entre los marsupiales, se recolectaron 2 especies: *Lutreolina crassicaudata* y *Didelphis albiventris*. Los roedores analizados incluyen 3 especies: *Cavia aperea*, *Oxymycterus rufus* y *Oligoryzomys* sp. El número total de ectoparásitos recolectados fue de 469, que incluyen 5 géneros de ácaros: *Androlaelaps* Berlese, 1903, *Gigantolaelaps* Nesbitt, 1951, *Laelaps* Koch, 1836, *Mysolaelaps* Fonseca, 1935 y *Ornithonyssus* Sambon, 1928; 3 especies de garrapatas: *Amblyomma ovale*, *A. dubitatum* e *Ixodes loricatus*; 2 especies de pulgas: *Polygenis axisus* y *Polygenis bohlsi*, y 3 piojos diferentes: *Trimenopon hispidum*, *Gliricola* sp. y *Gyropus* sp. Estos resultados proporcionan nuevos registros de huéspedes y localidad, así como, nuevas asociaciones parásito-huésped.

*Palabras claves:* Ácaros; Garrapatas; Piojos; Pulgas

## Introduction

Taxonomically, ectoparasites, mostly arthropods, represent a very diverse group that include lice, fleas, mites, ticks, among others (Lareschi, 2017). They exploit food and habitat resources offered by their hosts. Likewise, they acquire health importance as vectors due to their capacity to transmit a wide variety of pathogens such as protozoa, viruses, bacteria and fungi (Mullen & Durden, 2002). Thus, fleas and ticks that feed on small mammals are important vectors of several species bacteria of the genera *Bartonella* and *Rickettsia* (Linardi & Guimaraes, 2000; Lipatova et al., 2015).

Specifically, rodents, which are frequent hosts of ectoparasites, assume a role in the transmission of pathogens, since they are natural reservoirs of different parasites, bacteria and viruses. Their high dispersal and reproduction ability favors the transmission (Gómez-Villafañe et al., 2005).

Regarding the knowledge in Argentina, most of the studies on ectoparasites associated with rodents and marsupials are derived from the province of Buenos Aires and provinces of the northwest and south of the country (Autino & Lareschi, 1998; Beldoménico et al., 2005; Castro & Cicchino, 1999; Cicchino & Castro, 1984; Colombetti et al., 2008; Colombo et al., 2013; Guglielmone & Nava, 2014; Lareschi & Linardi, 2005; Lareschi, Autino et al., 2003; Lareschi, Linardi et al., 2003; Lareschi, Buffevant et al., 2007; Lareschi, Nortarnicola et al., 2007; Lareschi et al., 2004, 2010; Nava & Lareschi, 2012; Nava et al., 2003, 2017; Navone et al., 2009; Sánchez & Lareschi, 2013, 2014, among others).

In Corrientes Province, the knowledge is scarce. Some of the studies include findings of mites and fleas that parasitize sigmodontine rodents in the Iberá Wetlands (Lareschi et al., 2006), ticks associated with the marsupial *Didelphis albiventris* (Di Benedetto et al., 2013; Gómez

et al., 2000) and rodents of families Cricetidae and Caviidae in the Iberá Reserve (Debárbora et al., 2014). The aim of this work is to extend the knowledge about the ectoparasite fauna associated with rodents and marsupials from Corrientes Province, Argentina.

## Materials and methods

During 2017, 2 suburban sites in Corrientes City were sampled: Santa Ana de los Guácaras and San Patricio. Test samples were made using different traps (Sherman and Tomahawk live-traps-type) and baits such as carrot with apple and vanilla essence, chicken and canned fish with cornmeal. It was determined that the most successful trap and bait was the Tomahawk type with the carrot and apple bait with vanilla essence. For this reason, 52 Tomahawk traps were used to capture rodents and marsupials. Four samplings were carried out at each site during 3 consecutive nights. Rodents and marsupials were processed according to the methodology described by Nava et al. (2006) and Tarragona et al. (2011), and following biosecurity protocols proposed by Mills et al. (1995). Rodent captures were handled with thick rubber gloves and immediately placed inside a double plastic bag that closed perfectly. The bags were opened at Laboratorio de Biología de los Parásitos, Facultad de Ciencias Exactas y Naturales y Agrimensura (Universidad Nacional del Nordeste), with protective clothing and biosafety masks. We examined the specimens under a hood with extractor where the ectoparasites were checked and extracted. For caged rodents, they were checked and combed in the field and then released. Marsupials (Didelphidae) were anesthetized according to Tarragona et al. (2011) with the help of a veterinarian. Specimens were combed and the ectoparasites collected with tweezers. Once recovered from anesthesia, the marsupials were returned to their habitat. Sigmodontines (Rodentia: Cricetidae) were

taxonomically identified by Carlos Galliari (Centro de Estudios Parasitológicos y de Vectores, Universidad Nacional de La Plata, Argentina). Hosts were captured under permission of the Dirección de Recursos Naturales of Corrientes Province, Argentina.

Ectoparasites were recovered by examining the fur with a magnifying lens, then preserved in 96° ethanol, and / or mounted on slides according to the routine methodology of each taxon. Mites were identified following Furman (1972) and Saunders (1975), ticks were identified following Martins et al. (2014) and Nava et al. (2017), fleas according to Smit (1987) and Linardi and Guimaraes, (2000) and lice according to Cicchino and Castro, (1998). The collected specimens are listed below, indicating the number of ectoparasite specimens of each sex, except for mites that were only determined to the genus level. Also adults were indicated, as well as host species and locality, in parentheses is mentioned the number of parasitized individuals over the number of hosts analyzed. A brief report that includes comments on previous records in the province of Corrientes and other known host species for each ectoparasite species is presented. Abbreviation NA (not available) is used when the information is undetermined. Abbreviation INTA means Instituto Nacional de Tecnología Agropecuaria.

## Results

Fifty-four mammal hosts were examined, 20 belonging to the order Didelphimorphia and 34 to Rodentia. Among the marsupials, 2 species were assessed: *Lutreolina crassicaudata* Desmarest, 1804 and *Didelphis albiventris* Lund, 1840. The rodents analyzed included 3 species: *Cavia aperea* Erxleben, 1777, *Oxymycterus rufus* Fischer, 1814 and *Oligoryzomys* sp., Bangs, 1900. The total number of ectoparasites collected was 469 specimens, 130 specimens of these belong to the order Phthiraptera, 39 to Siphonaptera, 244 to Mesostigmata and 11 to Ixodida. Below, we present the ectoparasite species list associated with the mammals collected in this study.

Order Ixodida Leach, 1815

Family Ixodidae Koch, 1844

*Amblyomma ovale*, Koch, 1844: 1 nymph on *O. rufus* (1/1), Santa Ana de los Guácaras.

Previous records: females on *Canis lupus familiaris* Linnaeus, 1758, Santa Ana de los Guácaras (Debárbora et al., 2011); female and nymphs on *D. albiventris*, San Cayetano (Di Benedetto et al., 2013).

*Amblyomma dubitatum*, Neumann, 1899: 2 nymphs on *L. crassicaudata* (2/1), Santa Ana de los Guácaras.

Previous records: females, males and nymphs on *Hydrochoerus hydrochaeris* Linnaeus, 1766, Estancia "Ayuí", Estancia "Juan Ángel", Estancia "Palmita", Laguna del Iberá, Estancia "La Armonía" (Ivancovich & Luciani, 1992). Nymphs on cattle, Monte Caseros (Guglielmone et al., 2002). Nymphs on cattle, Goya; females, males, and nymphs on *H. hydrochaeris*, Mercedes (INTA Collection). Males, nymphs, and larvae on man, Iberá II Provincial Reserve (Oscherov et al., 2006). Male and female on *Sus scrofa* Linnaeus 1758, "Rincón del Socorro" (INTA Collection). Females, males, nymphs, and larvae on *H. hydrochaeris*, 30 km SW of Colonia Carlos Pellegrini (Nava et al., 2010). Females, males, and nymphs on *S. scrofa*, Estancia "Rincón del Socorro" (Debárbora et al., 2012; Nava et al., 2010). Nymph on *Bubalus bubalis* Linnaeus, 1758, Iberá Provincial Reserve (Debárbora et al., 2012). Larvae on *Scapteromys aquaticus*, Thomas, 1920; larvae and nymphs on *C. aperea*, 37 km SW of Colonia Carlos Pellegrini (Debárbora et al., 2012). Larvae and nymphs on *Axis axis* Erxleben, 1777 and *S. scrofa*; males and larvae on *Myrmecophaga tridactyla* Linnaeus, 1758, and *Lepus europaeus* Pallas, 1778; females, males, nymphs, and larvae on *H. hydrochaeris*; nymphs and larvae on *Akodon azarae* Fischer, 1829; larvae on *Oligoryzomys flavescens* Waterhouse, 1837; larvae and nymphs on *Monodelphis dimidiata* Wagner, 1847, Estancia "Rincón del Socorro" (Debárbora et al., 2012). Females, males, nymphs, and larvae on vegetation, Mburucuya. Larvae and nymphs on vegetation, Mercedes. Females, males, and nymphs on vegetation, Provincial Route 40, km 60. Male, nymph, and larvae on vegetation, Santa Barbara (Monje et al., 2015).

*Ixodes loricatus*, Neumann, 1899: 2 females and one male on *L. crassicaudata* (3/2), Santa Ana de los Guácaras.

Previous records: females on *D. albiventris*, Corrientes (Gómez et al., 2000).

Order Siphonaptera Latreille, 1825

Family Rhopalopsyllidae Oudemans, 1909

*Polygenis axius*, Jordan & Rothschild, 1923: 12 females and 10 males on *L. crassicaudata* (22/7), 1 female and 1 male on *Oligoryzomys* sp. (2/1), Santa Ana de los Guácaras. One female and 1 male on *L. crassicaudata* (2/2); 2 males on *D. albiventris* (2/2); 1 female and 1 male on *C. aperea* (2/2); 1 female on *O. rufus* (1/1), San Patricio.

Previous records: females and males on *O. rufus*, Department of San Miguel (Lareschi et al., 2006).

*Polygenis bohlsi*, Wagner, 1901: 5 males on *L. crassicaudata* (5/5), Santa Ana de los Guácaras. One male on *L. crassicaudata* (1/1), 1 female and 1 male on

*D. albiventris* (2/1), one male on *C. aperea* (1/1), San Patricio.

Previous records: There are no previous records for this flea in Corrientes Province.

Order Phthiraptera Haeckel, 1896

Family Trimenoponidae Harrison, 1915

*Trimenopon hispidum* Burmeister, 1838: 30 nymphs, 15 females and 9 males on *C. aperea* (54/13), Santa Ana de los Guácaras. Eighteen nymphs, 26 females, and 13 males on *C. aperea* (57/12), San Patricio.

Previous records: there are no previous records for this louse in Corrientes Province.

Family Gyropidae Kellog, 1896

*Gyropus* sp. Nitzsch, 1818: 1 female on *C. aperea* (1/1), San Patricio.

Previous records: there are no previous records for this louse in Corrientes Province.

*Gliricola* sp. Schrank, 1781: 13 females and 3 males on *C. aperea* (16/1), San Patricio.

Previous records: there are no previous records for this louse species for Corrientes Province.

Order: Mesostigmata Canestrini, 1891

Family: Lealepididae Berlese, 1892

*Androlaelaps* sp. Berlese, 1903: 20 adults on *O. rufus* (20/1), Santa Ana de los Guácaras.

Previous records: females on *A. azarae*, Department of San Miguel (Lareschi et al., 2006).

*Gigantolaelaps* sp. Nesbitt, 1951: 6 adults on *Oligoryzomys* sp. (6/2), Santa Ana de los Guácaras.

Previous records: female on *Ol. flavescens*, Department of San Miguel (Lareschi et al., 2006).

*Laelaps* sp. Koch, 1836: 4 adults on *Oligoryzomys* sp. (4/1), Santa Ana de los Guácaras.

Previous records: females on *Holochilus brasiliensis* Desmarest, 1819, Loreto (Lareschi et al., 2001). Females on *Oligoryzomys delticola* Thomas, 1917, *Calomys callidus* Thomas, 1916, *O. rufus*, Department of San Miguel (Lareschi, et al., 2006).

*Mysolaelaps* sp. Fonseca, 1935: 13 adults on *Oligoryzomys* sp. (13/2), Santa Ana de los Guácaras.

Previous records: female on *O. flavescens*, Department of San Miguel (Lareschi et al., 2006).

Family: Macronyssidae Oudemans, 1936

*Ornithonyssus* sp. Sambon, 1928: one specimen on *L. crassicaudata* (1/1); 10 specimens on *Oligoryzomys* sp. (10/1); 4 specimens on *O. rufus* (4/1); 17 specimens on *C. aperea* (17/2), Santa Ana de los Guácaras; 169 specimens on *C. aperea* (169/10), San Patricio.

Previous records: there are no previous records for this mite in Corrientes Province.

## Discussion

Currently, 409 species of native mammals to Argentina are recognized, of which approximately 85 species are registered for the Corrientes Province (Barquez et al., 2006; Parera, 2018). In this work, we report 10 taxa of ectoparasites associated with 3 species of rodents and 5 associated with 2 species of marsupials from Corrientes.

Rodents of the families Cricetidae and Echimyidae are the main hosts for larvae and nymphs of *A. ovale* (Guglielmone & Nava, 2014). They present a wide distribution, records of this species are found from the central-northern area of Argentina throughout the Neotropics to the Nearctic region up to USA. While in Argentina there are records associated with other hosts such as canids reported as the main hosts for adults in Chaco, Misiones, Formosa, Entre Ríos, Salta, Jujuy, Mendoza, La Rioja (Guglielmone & Mangold, 1986; Guglielmone & Nava, 2014; Ivancovich & Luciani, 1992; Sinkoc et al., 1998). In the province of Corrientes, records for *A. ovale* have been found on *C. familiaris* and *D. albiventris* (Debárbora et al., 2011; Di Benedetto et al., 2013). In this research, a new association of nymphs of *A. ovale* with the cricetid *O. rufus* is recorded, being the first parasite-host association for the country and South America.

On the other hand, *A. dubitatum* a tick that feeds on a wide range of mammals, and also immature stages have even been found on birds (Flores et al., 2014; Nava et al., 2010). However, in this work we collected nymphs of this species associated with the marsupial *L. Crassicaudata*, which had been previously registered as a host of this tick species in Brazil (Blanco et al., 2017; Saraiva et al., 2012). Therefore, this represents a new host association in Argentina. Considering that this marsupial is commonly found near bodies of water, and in the study area, there are lagoons with populations of *H. hydrochaeris*, which is one of its primary host, it is not common to find this association.

Regarding *I. loricatus*, a Neotropical parasite of marsupials and rodents (Nava et al., 2004), was reported in central and northern Argentina (Guglielmone et al., 2011; Tarragona et al., 2018). For Corrientes, Gómez et al. (2000) mention *I. loricatus* infecting *D. albiventris*,

although in this research the species was found on *L. crassicaudata*.

In northwestern Argentina, Lareschi, Autino et al. (2003) provided records of hosts and distribution areas of mites associated with wild rodents; the families Laelapidae and Macronyssidae are mentioned. Presence of Laelapidae mites of the genera *Gigantolaelaps*, *Androlaelaps*, *Mysolaelaps* and *Laelaps* were found in association with cricetid rodents, coinciding with those reported by Lareschi et al. (2001, 2006) for the province of Corrientes. On the other hand, *Ornithonyssus* sp. were reported in association with *A. azarae*, *O. rufus*, *S. Aquaticus*, and *O. flavescens* in Buenos Aires, Salta and Tucumán (Capri & Mauri, 1971; Colombo et al., 2013; Lareschi, 1996; Lareschi, Autino et al., 2003; Liljeström & Lareschi, 2002). The records presented in this work are new for the province of Corrientes, expanding the distribution range of the species in the country.

In reference to parasitic insects, some groups show a high level of specificity for their hosts such as lice (Pérez, 2015). In this study, the findings of *Gliricola* sp., *Gyropus* sp. and *T. hispidum* associated with rodents of the family Caviidae, reaffirm the above mentioned, as well as the works of Werneck (1948), Emerson and Price (1975). In discrepancy with Ronald and Wagner (1976) and Valim et al. (2004), they mention a lower abundance while in this work the opposite occurs being *T. hispidum*, the most abundant of all the analyzed ectoparasites.

In Argentina, there are studies of *T. hispidum* and *Gliricola porcelli* found on *C. aperea* for the provinces of Buenos Aires and Entre Ríos, while *Gyropus ovalis* was found in the mentioned provinces and in Chaco province as well (Castro & Cicchino, 1987; Castro et al., 1996; Werneck, 1948). Since there are no studies on these parasite-host associations in the province of Corrientes, this work would be the first contribution on the subject. Although these lice are chewers, they can cause damage to their hosts when infestations are high, producing alopecia or secondary infections due to excessive scratching (Owen, 1968; Paterson, 1967).

In the Neotropical region, the fleas parasitize mainly small mammals, as caviomorph rodents and sigmodontine, as well as marsupials of the order Didelphimorphia (Krasnov, 2008). In Argentina, *P. axius* has been mentioned infecting rodents and marsupials (Linardi & Guimaraes, 2000; Nava & Lareschi, 2012). Lareschi, Nortarnicola et al. (2007) report the first records of fleas of the genus *Polygenis* parasitizing cavid rodents in the province of Cordoba. In Corrientes, Lareschi et al. (2006) recorded specimens of this genus on *O. rufus* for San Miguel, coinciding with what was found in this research. Additionally, we report *L. crassicaudata* as a new host for *P. axius*. On the other

hand, *P. bolhsi* has been mentioned in Argentina infecting *Didelphis* sp., *C. aperea*, *A. azarae*, *Akodon dolores* Thomas, 1916, *Calomys laucha* Fischer, 1814, *Deltamys kempfi* Thomas, 1917, *Graomys griseoflavus* Waterhouse, 1837, *S. aquaticus* and *Mus musculus* Linnaeus, 1758 (Autino & Lareschi, 1998; Lareschi et al., 2004; Lareschi et al., 2016), in accordance with what was found in this work, it can be considered a generalist species and has already been registered in other countries of South America (Smit, 1987). The distribution of this genus is expanded to the province of Corrientes due to the results of this work. Although Lareschi et al. (2016) mention *P. bolhsi* for the province of Corrientes, this corresponds to a study conducted in the province of Mendoza, since the previous reports were for Entre Ríos, Buenos Aires, Córdoba and Chaco provinces (Autino & Lareschi, 1998).

The first records for the province of Corrientes are: *P. bolhsi*, *T. hispidum*, *Gyropus* sp., *Gliricola* sp., and *Ornithonyssus* sp. Furthermore, from an epidemiological perspective, the finding of ticks and fleas in wildland-urban interface sites constitutes a warning about the possibility of contact between these ectoparasites and people, and their consequent potential for pathogen transmission. In this sense, there are records in the Corrientes Province of *A. dubitatum* carrying pathogens *Rickettsia bellii*, *Rickettsia* sp. strain cooperi and *Rickettsia* sp. strain Atlantic rainforest. The latter is pathogenic for humans (Monje et al., 2015), and of *A. ovale* with *Hepatozoon canis* and *Rickettsia* sp. strain Atlantic rainforest in Brazil (Forlano et al., 2005; Nieri-Bastos et al., 2016). Similarly, fleas of the genus *Polygenis* are vectors of a variety of bacteria such as *Bartonella* sp. and *Salmonella* sp. (de Sousa et al., 2018; Linardi & Guimaraes, 2000). Thus, the need to carry out studies aimed to clarify the role of these ectoparasites in the transmission of pathogens to humans becomes evident.

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