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Research Note

Bolivian Ectoparasites: A Survey of the Fleas of *Ctenomys* (Rodentia: Ctenomyidae)

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ABSTRACT: We present the results of a multiyear survey of the fleas from ctenomyid rodents across many different habitats from throughout Bolivia. New species records for Bolivia include *Tiamastus palpalis* and *Ectinorus (Panalius) galeanus*. New records of fleas from *Ctenomys* in Bolivia include *Gephyropsylla klagesi*, *Sphinctopsylla inca*, and *Tetrapsyllus tristis*.

KEY WORDS: Rodentia, Ctenomyidae, *Ctenomys*, ectoparasites, fleas, Siphonaptera.

In the Neotropical region, 1 of the rodent groups that has not been investigated extensively for the presence of ectoparasites is the Ctenomyidae (tucotucos). Species of *Ctenomys* Blainville, 1826 are rodents that are highly specialized and adapted for burrowing and living underground (Nevo, 1979). Because of these adaptations, their bodies have several characters specific to a subterranean lifestyle, including reduced pinnae, fusiform body shape, loose skin, and a tactile tail (Anderson, 1997). In Bolivia, populations of ctenomyids occur in suitable habitat from a northern limit just southwest and southeast of the southern tip of Lake Titicaca (*Ctenomys leucodon* Waterhouse 1848) southward through the highlands of the Altiplano (*Ctenomys opimus* Wagner 1848), and through the foothills of the Andes into the lowlands (several species, see Fig. 1; Anderson [1997]; Gardner et al. [in press]). Individuals of most species of *Ctenomys* are probably solitary except during the mating season, and little work has been published on the behavior of the majority of known species with the exception of *Ctenomys sociabilis* Pearson and Christie, 1985 (see Tammone et al. [2012]; Pearson and Christie [1985]; Lacey et al. [1997]).

Bolivia is characterized as a country of megabiological diversity that is located where tropical, temperate, mountainous, and lowland-savanna biomes converge and is part of the south-central

Neotropical Region (Anderson, 1997). In Bolivia, species of *Ctenomys* occupy friable soils across a diversity of habitats: from lowland semideciduous forest and sandy habitats in the Department of Santa Cruz, through wet montane meadows in the puna of the Andes, to high-altitude Altiplano desert (Anderson, 1997). Tuco-tucos build complex burrow systems, usually with several entrances, with soil mounds near burrows and feeding holes close to the plants they consume (Lacey et al., 1997; Lara et al., 2007; Tammone et al., 2012; Gardner, personal observation).

The objective of the study presented herein was to describe the diversity of fleas occurring on species of rodents of the genus *Ctenomys* collected from throughout Bolivia.

MATERIALS AND METHODS

From 1984 to 1995, animals were collected from many localities throughout Bolivia with the use of gopher traps set in burrows (see Fig. 1 for a map of general study locations). Fleas were collected from mammals following the guidelines approved by the American Society of Mammalogists (Gannon and Sikes, 2007) and all collections of mammals were made before animal use and care rules were established in the United States (Gannon and Sikes, 2007; Sikes and Gannon, 2011). Following the methods of Gardner (1996), captured animals were assigned a field identification number, and the locality, date of capture, and general ecological data were recorded in field notebooks (see Gardner [1996]). The animal was then killed by chloroform vapor inhalation, brushed and inspected for ectoparasites, and searched for endoparasites (chloroform was used instead of other kinds of euthanizing chemicals to ensure that all ectoparasites were dead, thus preventing fleas and mites from transferring to other hosts). All arthropods were preserved in glass vials in 70% ethanol until examination. Most specimens were collected by S.L.G., but some were collected by other parasitologists on other expeditions.

In the laboratory, flea preparation followed Linardi and Guimaraes (2000): Fleas were cleared with 10% KOH, dehydrated through a series of ETOH (70–100%), cleared with beechwood creosote, transferred to xylene, and mounted permanently on glass microscope slides in gum damar covered with a Number 1 coverslip. Taxonomic

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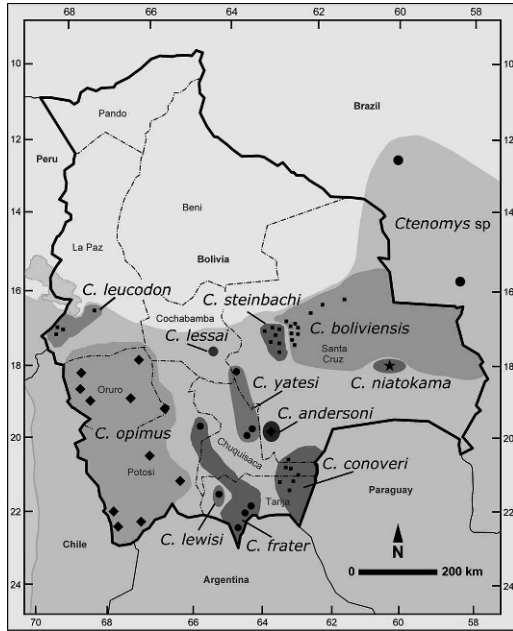


Figure 1. Map of the general collection localities and approximate ranges of distribution of species of *Ctenomys* in Bolivia and surrounding countries. Light gray areas indicate approximate range of distribution of *Ctenomys*. Darker areas denote known ranges of species. Black dots represent approximate known collection localities. Map created by S.L.G.

identifications were made with the use of both keys provided in Smit (1987) and Johnson (1957), as well as the original description of the species. Ectoparasite specimens were deposited in the Harold W. Manter Laboratory of Parasitology, University of Nebraska–Lincoln, Nebraska (HWML). Specimens of mammals were deposited in the American Museum of Natural History, Department of Mammalogy (AMNH), the Museo Noel Kempff Mercado (MNKN) in Santa Cruz de la Sierra, Bolivia, the National Museum of Natural History, La Paz, Colección Boliviana de Fauna (CBF), or the Division of Mammals, Museum of Southwestern Biology, H.W. Manter Laboratory Parasite Collection (HWML). Numbers assigned to each specimen deposited in the HWML are given in the section where each species is treated below. To ensure ease of use and compatibility with previous publications, names of mammals, and specific locations we follow Anderson (1997).

RESULTS

Eighty-eight individual fleas were collected from 7 species of *Ctenomys* from throughout suitable habitats in Bolivia. Species of *Ctenomys* examined include *Ctenomys leucodon* Waterhouse, 1848; *Ctenomys opimus* Wagner, 1848; *Ctenomys lewisi* Thomas, 1926; *Ctenomys frater* Thomas, 1902; *Ctenomys yatesi* Gardner, Salazar-Bravo, and Cook

(in press); *Ctenomys lessai* Gardner, Salazar-Bravo, and Cook (in press); *Ctenomys steinbachi* Thomas, 1907; *Ctenomys andersoni* Gardner, Salazar-Bravo, and Cook (in press); *Ctenomys conoveri* Osgood, 1946; *Ctenomys boliviensis* Waterhouse, 1848; and *Ctenomys niatokama* Gardner, Salazar-Bravo, and Cook (in press).

FLEAS COLLECTED

Family Rhopalopsyllidae: Subfamily Rhopalopsyllinae *Rhopalopsyllus* sp. Baker, 1905

Locality, deposition, and host records: Chuquisaca: 2 km East of Chuhuayaco, 19°43'S; 63°51'W, 1,200 m, 8 August 1990, 2 females from *C. yatesi*, catalog number CBF1099, Manter Laboratory of Parasitology Collection numbers (HWML) HWML 74795-74796.

Records: Fleas belonging to this genus have previously been reported from marsupials, edentates, and caviomorph rodents in the Neotropics (Smit, 1987). Occurs throughout the Neotropical region.

Remarks

These specimens were identified only to the level of the genus due to the lack of enough material for a definitive identification to species.

Tiamastus palpalis Rothschild, 1911

Locality, deposition, and host records: Santa Cruz: Cerro Itahuaticua, 19°48'S; 63°31'W, 810 m, 9 July 1990, 34 females and 24 males from 6 individuals of *C. andersoni*, museum catalog numbers: AM263931 (HWML74804-74805), AM263932 (HWML74327-74346, HWML74348), MSB63389 (HWML74305-74311), MNKN604 (HWML74806-74817), and AM 263935 (HWML74312-74326, HWML74347).

Type host: *Ctenomys brasiliensis* Blainville, 1826, collected 13 August 1902.

Type locality: Santiago del Estero Province, Argentina.

Records: Other reported hosts for the species are the following: *Ctenomys haigi* Thomas 1917; *Ctenomys juris* Thomas, 1920; *Cerdocyon thous* Linnaeus, 1766; *Conepatus chinga rex* Thomas, 1898; and *Microcavia australis* (I. Geoffroy and d'Orbigny, 1833). *Tiamastus palpalis* was found in different localities throughout Argentina: El Chaguaral (Mendoza Province), Puesto Pugin and San Rafael

(Santiago del Estero Province) (Smit, 1987), Province of Jujuy, San Pedro (Johnson, 1957).

Remarks

This is the first record of *T. palpilis* from *Ctenomys* in Bolivia.

Polygenis sp. Jordan, 1939

Locality, deposition, and host records: Santa Cruz: 5.5 km northeast of Vallegrande by road, 18°28'S; 64°08'W, 1,800 m, 5 June 1991, 2 females from *C. yatesi* museum catalog numbers: AM264548 (HWM L74826-74827).

Type species: Type species of the genus is *Pulex roberti* Rothschild (1905).

Records: Species of *Polygenis* are widely distributed throughout most of South America, Central America, and Mexico. The range of species in this genus has a northern limit of distribution of Texas, Louisiana, Arkansas, Alabama, Georgia, and Florida (Smit, 1987).

Remarks

Specimens of *Polygenis* were identified only to the level of the genus due to the lack of sufficient material.

Gephyropsylla klagesi Rothschild, 1904

Locality, deposition, and host records: Santa Cruz de la Sierra: 15 km south, 17°53'S; 63°7'W, 400 m, 14 July 1987, 1 female and 1 male from *C. boliviensis*, museum catalog numbers: MSB58665 (HWML74798-74799).

Type host: Type host for *G. klagesi* is a spiny rat, probably *Proechimys* sp., on May 17, 1903 (Johnson, 1957).

Type locality: State of Bolívar, Caura River, La Vuelta, Venezuela.

Records: Other reported hosts include the following: *Proechimys* spp.; *Proechimys decumanus* Thomas, 1899; *Akodon mollis* Thomas, 1894; *Neacomys spinosus* Thomas, 1882; *Didelphis marsupialis* Linnaeus, 1758 (see localities in Smit, 1987); *Dasyprocta* sp.; *Dasyprocta punctata cariegata* Tschudi, 1845; *Dasyprocta novemcinctus* Linnaeus, 1758; *Leopardus pardalis* Linnaeus, 1758; *Philander opossum* Linnaeus, 1758; *Proechimys chrysaerolus* Thomas, 1898; *Proechimys semispinosus* Tomes,

1860 (see Costa Lima and Hathaway, 1946). Reported localities for *G. klagesi* are Brazil—Amazonia, Anápolis, Fordlandia, Marajó Island, and São Benedito (Smit, 1987), State of Goiás, Anápolis, and Minas Gerais (Johnson, 1957). French Guiana—Cayenne. Peru—Aguas verdes, La Palma, Papayal. Surinam—Coronie and Lelydorp. Trinidad—sine loco. Venezuela—Barinitas, El Dorado, Maripa, States of Apura, Barinas, Bolívar, Carabobo, Monagas, Sucre, Territorio Federal Amazonas, Táchira, Trujillo, Zulio (Smit, 1987). Colombia—Intendencia del Meta, Restrepo (Johnson, 1957).

Remarks

This is the first record of *G. klagesi* from a ctenomyid in Bolivia.

Family Rhopalopsyllidae: Subfamily Parapsyllinae

Ectinorus galeanus Jordan, 1939

Locality, deposition, and host records: Oruro: 2.5 km NE of Huancaroma, 17°39'S; 67°28'W, 3,720 m, 6 August, 1984, 1 female from *C. opimus*, museum catalog numbers AM260837 (HWML74797); Oruro: 16 km west of San Andrés de Machaca, 17°01'S; 69°05'W, 3,776 m, 3 August 1993, 1 female from *C. leucodon* Waterhouse, 1848, museum catalog numbers MSB70576 (HWML74793); Tarija: 8 km west of Rancho Tambo, 21°27'S; 64°24'W, 2,700 m, 24 September 1986, 1 female and 3 males from *C. frater* Thomas, 1902, museum catalog numbers: AM 263010 (HWML74789-14791); Cochabamba: 0.5 km south of Lluthu Pampa, 17°45'0"; 64°59'0", 2,500 m, 31 May 1991, 2 females and 2 males from *C. lessai* (Gardner et al., in press), museum catalog numbers MSB67111 (HWML74349-74352); Santa Cruz: 10 km southeast of Montero, 17°25'S; 63°11'W, 250 m, 3 June 1988, 1 female from *C. boliviensis* MSB 59433 (HWML74800).

Type host: The type host for *E. galeanus* is *Galea musteloides* Meyen, 1832, collected May 1938.

Type locality: Las Casuarinas, San Juan Province, Argentina.

Records: Other reported hosts include: Caviids (*Galea* and *Microcavia*; Smit, 1987). *Cavia* sp., *G. musteloides*, *Lagostomus maximus* Desmarest, 1817, *Microcavia australis* (see Costa Lima and Hathaway [1946]; Autino and Lareschi [1998]). *Ectinorus galeanus* was collected on the following localities: Argentina—El Ojito, El Quemado, Estancia La

Cristina, Fortín Uno, La Paz, Las Carpas, Las Casuarinas, Las Flores, Malargüe (Mendoza Province), Puesto Pugin, Quines, San Rafael, Santa Rosa (Santiago del Estero Province), Sierra de la Ventana (Buenos Aires Province) (Smit, 1987).

Remarks

This is the first record of *E. galeanus* from *C. boliviensis* in Bolivia.

Tetrapssyllus tristis Johnson (1957)

Locality, deposition, and host records: La Paz: 14 km southwest of San Andrés de Machaca, 8 October 1986, 2 females from *C. leucodon*, museum catalog numbers: MSB57192 (HWML74802-74803); La Paz: 16 km west of San Andrés de Machaca, 17°01'S, 69°05'W, 3,776 meters, 3 August 1993, 1 male from *C. leucodon*, museum catalog numbers: MSB70576 (HWML74793); La Paz: 16 km west of San Andrés de Machaca, 17°01'15"S; 69°05'45"W, 3,776 m, 3 August 1993, 8 females and 1 male from *C. leucodon*, museum catalog numbers MSB238732 (HWML74818-74825).

Type host: The type host for *T. tristis* is *Abrothrix jelskii* (Thomas, 1894), collected on 1 February 1952.

Type locality: Department of Puno, Pampa de Ancomarca, Peru.

Records: Other reported hosts are the following: *Ctenomys peruanus* Sandborn and Pearson, 1947 and *C. opimus*. *Tetrapssyllus tristis* was recorded from following additional localities: Peru—Lago Suche, Pampa de Ancomarca, Pampa Queullecota (Smit, 1987), and Department of Moquegua, Lago Suche (Johnson, 1957).

Remarks

This is the first record of this flea from a Bolivian ctenomyid.

Family Stephanocircidae: Craneopsyllinae *Sphinctopsylla inca* Rothschild, 1914

Locality, deposition, and host records: Cochabamba: 0.5 km of Lluthu Pampa, 17°45'S; 64°59'W, 2,500 m, 31 May 1991, 1 female from *C. lessai* AM264557 (HWML74801).

Type host: The "type host" for *S. inca* is an unidentified rodent.

Type locality: Department of Puno, Pampa de Ancomarca, Peru.

Records: The reported hosts of this species are the following: *Thomasomys* Coues, 1884 sp., *Auliscomys pictus* Thomas, 1884, *Phyllotis osilae* J. A. Allen, 1901 (see records in Johnson, 1957). *Sphinctopsylla inca* has been reported from the following geographic localities: Ecuador—Province of Chimborazo; Peru—Department of Junin, Carhuamayo, and Department of Puno, Pomata.

Remarks

This is the first record of *S. inca* on *C. lessai* from Bolivia.

DISCUSSION

Previous reports of fleas from species of *Ctenomys* are almost all from countries other than Bolivia, with most coming from Argentina (Jordan, 1942; Costa Lima and Hathaway, 1946; Smit, 1955; Beaucourmu and Castro, 2003). Prior reports of fleas from *Ctenomys* in Bolivia are limited to records of *Tetrapssyllus tantillus* (Jordan and Rothschild, 1923), *T. tristis* (Johnson, 1957), and *Tetrapssyllus bleptus* (Jordan and Rothschild, 1923) from *C. opimus* (see references in Smit, 1987), while *Polygenis byturus* (Jordan and Rothschild, 1923) was collected from an unidentified species of *Ctenomys* from Bolivia (Johnson, 1957). To our knowledge, no other works have been published on the fleas of tuco-tucos from Bolivia up to the present time.

The fleas reported herein have some degree of specificity, since they occur mainly on ctenomyid rodents. Hopkins (1957) mentioned that *E. galeanus* is probably specific to species of *Galea* and *Microcavia*. However, we found *E. galeanus* on 5 different species of *Ctenomys*. According to Hopkins (1957), the genera *Tiamastus* and *Polygenis* occur mostly on rodents, and sometimes marsupials. *Sphinctopsylla inca* is recorded for the first time from an hystricognath rodent, and this species is usually reported from cricetid (Muridae) rodents. In addition, this is the first record for this flea in Bolivia, having previously been reported only from mammals examined in Peru and Ecuador.

Although several prior studies have been conducted on the siphonapterofauna of mammals in the Neotropical region, there is still a lack of information on fleas and their diversity in this area (Jordan, 1939, 1942; Autino and Lareschi, 1998; Linardi and Guimarães, 2000; Beaucourmu and Castro, 2003; Alarcón, 2003; Lareschi et al., 2006). In this study, we present several first records for fleas from Bolivian *Ctenomys*.

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