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Flea parasites of small mammals in the Monte Desert biome in Argentina with new host and locality records

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Abstract

Fleas associated with small mammals from the Argentinean Monte Desert, were examined. The research was carried out in Ñacuñán Biosphere Reserve (34°02´S, 67°58´W), in the Chaqueña Biogeographic Subregion of the Neotropical Region. Mammal species trapped were as follows: Rodentia, Muridae, Sigmodontinae: *Akodon molinae* Contreras, 1968 (N = 44), *Graomys griseoflavus* (Waterhouse, 1837) (N = 15), *Calomys musculinus* (Thomas, 1913) (N = 12), and *Eligmodontia typus* F. Cuvier, 1837 (N = 7); Didelphiomorphia, Didelphidae, Mamorsinae: *Thylamys pusillus* (Desmarest, 1804) (N = 1). A total of 236 fleas were collected: Stephanocircidae, Craneopsyllinae: *Craneopsylla minerva wolffhuegeli* (Rothschild, 1909); Rhopalopsyllidae, Rhopalopsyllinae: *Polygenis* (*Polygenis*) *bohlsi bohlsi* (Wagner, 1901), *Polygenis* (*Polygenis*) *platensis cisandinus* (Jordan, 1939) and *Polygenis* (*Neopolygenis*) *puelche* Del Ponte, 1963; Rhopalopsyllidae, Parapsyllinae: *Ectinorus* (*Ectinorus*) *barrerai* Jordan, 1939. High values of total mean abundance (MA = 2.99) and total prevalence (P = 73.41%) were obtained. *A. molinae* (MA = 3.14; P = 93.18; flea specific richness S = 5; Shannon specific diversity index H = 1.25) and *G. griseoflavus* (MA = 6.40; P = 100%; S = 5; H = 0.76) showed the highest values of the infestation parameters. No fleas were collected from *E. typus*, possibly because of its habits. Fleas associated with *T. pusillus* are reported for the first time. Our collections extend the western limits of the distribution of both *P.* (*N.*) *puelche* and *P.* (*P.*) *b. bohlsi*. In addition, new host species are reported for every flea species and subspecies, and seven host-flea associations are mentioned for the first time.

Key words

Polygenis, *Craneopsylla*, *Ectinorus*, Siphonaptera, fleas, Argentinean Monte Desert

Introduction

The drylands of South America have been an important setting for evolution of the temperate biota of the continent. A large proportion of the dryland mammal species are not found elsewhere in the New World (Ojeda *et al.* 1998). In Argentina, the Biosphere Reserve of Ñacuñán in the lowland Monte Desert contains an important segment of the biotic diversity, landforms and disturbance regimes of the arid lands of South America, as well as the greatest number of endemic mammal species (Ojeda *et al.* 1997, 1998). Like most mammals, those species may be associated with a variety of ectoparasitic arthropods, which differ in the degree of their relation with the host, from weak to extremely strong associations. Since fleas are associated with the body and nests of their mammal hosts, transfer of fleas to unusual hosts generally occurs either through body contact, or through sharing of the same habitat (Marshall 1981). Thus, the flea species and their infestation parameters in a particular habitat are determined not only by host species composition, but also by some properties of the habitat itself (Marshall 1981; Krasnov *et al.* 1997, 1998).

Although a few earlier studies have been carried out on flea species from Mendoza Province (de la Barrera 1940, Jordan 1942, Capri and Capri 1960, Gimenez *et al.* 1964), they were lists of species, as well as morphological and taxonomic studies. Thus, the aim of the present research is to contribute to the knowledge of flea composition associated with the most representative small mammals from the Argentinean Monte Desert, as well as to analyze the abundance and prevalence for every flea species and subspecies.

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Materials and methods

The present study was carried out in the Ñacuñán Biosphere Reserve, since 1986 included in the UNESCO Man and Biosphere Reserve Network. It is situated 200 km southeast of Mendoza city in Argentina (34°02´S, 67°58´W), and the area belongs to the Monte Desert Province of the Chaqueña Biogeographic Subregion of the Neotropical Region (Morrone 2001). The Reserve is an area of 12,800 ha, with an average elevation of 540 m. The climate is semi-arid and strongly seasonal, characterized by hot, humid summers and dry, cold winters. Average annual precipitation is 326 mm and mean temperatures are lower than 10°C in winter, and above 20°C in summer. The region of Ñacuñán is a diverse mosaic of habitats. The present study was conducted in the Mesquite forest ("algarrobal"), where the tree stratum is dominated by open woodlands of *Prosopis* sp. (Ojeda 1989, Ojeda *et al.* 1998).

Rodents were captured during nine consecutive days in May of 2000 using a rectangular grid of 70 trap stations (7 × 10) 10 m apart. A live-trap (7.5 cm in width, 15 cm in length and 8 cm in height) was placed at each station. Traps were baited with an oiled apple. Rodents were anesthesized with sulphuric ether and vigorously brushed in order to collect fleas. After recovering from anesthesia, they were released at the same place where they had been previously captured. The nomenclature of the mammals follows Galliari *et al.* (1996). The fleas were preserved in 70% ethanol. In the laboratory, they were cleared in KOH, mounted on permanent slides following conventional techniques and then identified using keys and descriptions given in Hopkins and Rothschild (1956), Johnson (1957), Smit (1987) and Linardi and Guimaraes (2000). Representative specimens were deposited in the Department of Entomology, La Plata Museum (MLP), Argentina with the Collection numbers MZ113-1, MZ113-2, MZ113-3, MZ051-1, MZ051-2, MZ051-10, MZ114-1, MZ047-3, MZ031-3 and MZ128-3.

For each host species the following indices and parameters were calculated: flea specific richness (S = number of species), Shannon specific diversity index (H = – Σ [pi ln pi]), mean abundance (MA = total number of individuals of a particular parasite species in a sample of a particular host species/total number of hosts of that species, including both infested and non-infested hosts) and prevalence [P = (number of hosts infested with one or more individuals of a particular parasite species/the number of hosts examined for that parasite species) × 100] (Begon *et al.* 1988, Bush *et al.* 1997).

Results

Seventy-nine small mammals belonging to five species were trapped during the study period, and five flea species and sub-

Table I. Number of fleas collected from four representative small mammal species in the Monte Desert, Argentina

Fleas	Hosts				
	Akodon molinae	*Graomys griseoflavus*	*Calomys musculinus*	*Thylamys pusillus*	Total
Craneopsylla minerva wolffhuegeli	61*	31	0	1*	93
Polygenis (*Polygenis*) *platensis cisandinus*	48	62	1*	0	111
Polygenis (*Neopolygenis*) *puelche*	18*	1	0	0	19
Polygenis (*Polygenis*) *bohlsi bohlsi*	5*	1*	0	0	6
Ectinorus (*Ectinorus*) *barrerai*	6*	1	0	0	7
Total	138	96	1	1	236

*New host record.

Table II. Mean abundance (MA), maximum burden (m) and prevalence (P) of fleas collected from four representative small mammal species in the Monte Desert, Argentina

Fleas	Hosts							
	Akodon molinae		*Graomys griseoflavus*		*Calomys musculinus*		*Thylamys pusillus*	
	MA (m)	P (%)	MA (m)	P (%)	MA (m)	P (%)	MA (m)	P (%)
Craneopsylla minerva wolffhuegeli	1.39 (8)	63.64	2.07 (6)	86.67	0.00	0.00	1.00 (1)	100
Polygenis (*Polygenis*) *platensis cisandinus*	1.09 (4)	68.18	4.13 (16)	80.00	0.08 (1)	8.33	0.00	0.00
Polygenis (*Neopolygenis*) *puelche*	0.41 (4)	25.00	0.07 (1)	6.67	0.00	0.00	0.00	0.00
Polygenis (*Polygenis*) *bohlsi bohlsi*	0.11 (2)	9.09	0.07 (1)	6.67	0.00	0.00	0.00	0.00
Ectinorus (*Ectinorus*) *barrerai*	0.14 (3)	6.82	0.07 (1)	6.67	0.00	0.00	0.00	0.00
Total	3.14 (10)	93.18	6.40 (17)	100	0.08	8.33	1.00	100

species were collected. Species of hosts trapped were as follows: Rodentia, Muridae, Sigmodontinae: the large grass mouse *Akodon molinae* Contreras, 1968 (N = 44), the "pericote" *Graomys griseoflavus* (Waterhouse, 1837) (N = 15), the vesper mouse *Calomys musculinus* (Thomas, 1913) (N = 12) and *Eligmodontia typus* F. Cuvier, 1837 (N = 7); Didelphiomorphia, Didelphidae, Mamorsinae: the common desert opossum *Thylamys pusillus* (Desmarest, 1804) (N = 1). A total of 236 fleas (S = 5, H = 0.82) belonging to the following species and subspecies were collected: Stephanocircidae, Craneopsyllinae: *Craneopsylla minerva wolffhuegeli* (Rothschild, 1909); Rhopalopsyllidae, Rhopalopsyllinae: *Polygenis* (*Polygenis*) *bohlsi bohlsi* (Wagner, 1901), *Polygenis* (*Polygenis*) *platensis cisandinus* (Jordan, 1939) and *Polygenis* (*Neopolygenis*) *puelche* Del Ponte, 1963; Rhopalopsyllidae, Parapsyllinae: *Ectinorus* (*Ectinorus*) *barrerai* Jordan, 1939. Total MA was 2.99 and total P was 73.41%.

High values of flea species richness and diversity were found on *A. molinae* (S = 5, H = 1.25) and *G. griseoflavus* (S = 5, H = 0.76). However, no fleas were collected on *E. typus*, only one specimen of *P.* (*P.*) *p. cisandinus* on *C. musculinus*, and only one *C. m. wolffhuegeli* was taken on *T. pusillus.* The number of specimens for each flea species are detailed in Table I for the four representative hosts, as well as the totals. New host records are also indicated. The values of MA and maximum burden (m), and P for every flea species and subspecies are detailed in Table II for the four representative small mammal species.

Discussion

All five mammal species captured in the present study have been previously reported from the Monte Desert of Argentina. Their coexistence in the same habitat niches may be explained by differences in microhabitat use, morphology, body size, diet and foraging (Ojeda 1989, Campos *et al.* 2001, Ojeda pers. obs.). All flea species and subspecies recorded here have been previously collected in Argentina. *P.* (*N.*) *puelche* and *E.* (*E.*) *barrerai* only occur in the above-mentioned locality, while *C. m. wolffhuegeli* has been also recorded from Peru, *P.* (*P.*) *p. cisandinus* from Bolivia, and *P.* (*P.*) *b. bohlsi* from Bolivia, Brazil, Colombia, Ecuador, French Guyana, Paraguay, Peru and Venezuela (Smit 1987). However, the results obtained in this study extend the known distribution for *P.* (*N.*) *puelche* and *P.* (*P.*) *b. bohlsi*, since they are reported in Mendoza Province for the first time, and Ñacuñán Reserve constitutes their western limit (34°02´S, 67°58´W). Previously, *P.* (*N.*) *puelche* was reported from Buenos Aires, La Pampa and Tucumán Provinces, and *P.* (*P.*) *b. bohlsi* from Buenos Aires, Chaco, Córdoba and Entre Ríos (Autino and Lareschi 1998). Except for *C. m. wolffhuegeli* from the localities of Ramallo and San Nicolás in Buenos Aires Province (Nava *et al.* 2003), earlier studies on the remaining species and subspecies collected during this study are lists of ectoparasite-host associations, as well as morphological and taxonomic studies. In this context, this is the first study which analyzes the infestation parameters of *P.* (*N.*) *puelche*, *E.* (*E.*) *barrerai*, *P.* (*P.*) *p. cisandinus* and *P.* (*P.*) *b. bohlsi.*

New host species are reported for all flea species and subspecies that we collected in Monte Desert Biome, and seven host-flea associations are mentioned for the first time. In comparison with other South American countries, Argentina, which is situated in both the Neotropical and Andina Biogeographic Regions (Morrone 2001), has the greatest number of flea species (Smit 1987, Autino and Lareschi 1998, Linardi and Guimaraes 2000). However, most previous studies were primarily on hosts from Buenos Aires Province, whereas studies from the remaining provinces are scarce (Autino and Lareschi 1998). Presently, only *P.* (*P.*) *p. cisandinus* is known to be associated with *A. molinae* in Argentina. The present study constitutes the first report of fleas associated with *T. pusillus*, while prior research on *C. musculinus* mentioned *Polygenis* (*Polygenis*) *byturus* (Jordan et Rothschild, 1908), *Polygenis* (*Polygenis*) *rimatus* (Jordan, 1932), *P.* (*N.*) *puelche* and *C. minerva* on hosts from Buenos Aires Province and unknown Argentinean localities (Autino and Lareschi 1998). The absence of fleas associated with *E. typus* is in accord with the literature, since no fleas have been recorded from this host previously (Autino and Lareschi 1998). The elongated hind legs and saltatorial locomotion of this rodent (Mares 1975), may prevent it from being colonized by fleas. In contrast with the remaining small mammals which avoid open areas, *E. typus* was dominant in sand dunes (Ojeda 1989, Ojeda pers. obs.). Consequently, it has less possibilities of being infested by fleas that are usually associated with other host species.

Except for *E. typus* and *C. musculinus*, the total prevalence of fleas was over 90% for every small mammal species captured in Monte Desert during the present study. In contrast, in other localities situated in other biogeographic provinces which also belong to the Chaqueña Subregion, total flea prevalences are lower. Studies on species associated with rodents from marshy localities along the La Plata River, Argentina (Pampa Biogeographic Province), showed prevalences lower than 25% (Lareschi 1996, Lareschi *et al.* 2003). In Belo Horizonte, Brazil (Cerrado Biogeographic Province), the total prevalence of fleas was 37.57% (Linardi *et al.* 1984). Also, in Santa Catarina, Brazil (Paranense Biogeographic Subregion), total prevalence of fleas was 26.47% (Linardi *et al.* 1991). Since fleas are only ectoparasites as adults, and the habitat of an individual flea is a particular host in a particular habitat (Marshall 1981), the differences between prevalences between Monte Desert and each other locality may be related to both the co-evolutionary history of a host and its parasite and environmental conditions (Rall 1960). This suggestion is in accord with previous data from the Negev Highlands Desert, Israel (Krasnov *et al.* 1997). There, flea species composition in a particular habitat was determined not only by host species composition but also by some properties of the habitat itself.

All flea species and subspecies recorded in the present study were associated with both *A. molinae* and *G. griseoflavus*. Also, both *C. m. wolffhuegeli* and *P.* (*P.*) *p. cisandinus*

showed the highest values of P and MA on each of the abovementioned hosts. However, these fleas were the only ones that infested *T. pusillus* and *C. musculinus*, respectively. Because trapping was carried out during a period of high population abundance of the small mammals (Ojeda pers. obs.), when interspecific contacts are increased and each host may collect fleas while visiting nests of other mammals, the consequence of this may be the new flea-host associations recorded, as well as the high infestation parameter values.

Although the results also represent important contributions to the knowledge of Monte Desert biome biodiversity, some of the fleas collected in this study are known to transmit plague bacteria among wild and synanthropic rodents, as well as to humans in Mendoza Province (de la Barrera 1940, Gimenez *et al.* 1964). Since new host-ectoparasite associations may increase the risk of transmission of the plague, the results obtained in the present study may also have epidemiological significance.

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References

Autino A., Lareschi M. 1998. Siphonaptera. In: *Biodiversidad de Artrópodos Argentinos. Una Perspectiva Biotaxonómica* (Eds. J.J. Morrone and S. Coscarón). Sur, La Plata, 279–290.

Barrera de la J.M. 1940. Estudios sobre la peste selvática en Mendoza. *Revista del Instituto Bacteriológico de Buenos Aires*, IX (5), 565–586.

Begon M., Harper J.L., Towsend C.R. 1988. Ecología, individuos, poblaciones y comunidades. Omega, Barcelona.

Bush A.O., Lafferty K.D., Lotz J.M., Shostak A.W. 1997. Parasitology meets ecology on its own terms: Margolis *et al.* revisited. *Journal of Parasitology*, 83, 575–583.

Campos C., Ojeda R.A., Monge S., Dacar M. 2001. Utilization of food resources by small and medium-sized mammals in the Monte desert biome, Argentina. *Austral Ecology*, 26, 142–149.

Capri J.J., Capri N.A.R. 1960. Suctoria. Primeras Jornadas Entomoepidemiologicas Argentinas, 581–586.

Galliari C.A., Pardiñas U.F.J., Goin F. 1996. Lista comentada de los mamíferos argentinos. *Mastozoología Neotropical*, 3, 39–61.

Giménez D.F., Ciccarelli C.A., Barrera C.A. 1964. Siphonaptera de Mendoza. *Anales de la Sociedad Científica Argentina*, 178, 125–139.

Hopkins G.H., Rothschild M. 1956. An illustrated catalogue of Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural History). Volume II. Cotopsyllidae, Vermipsyllidae, Stephanocircidae, Ischnopsyllidae, Hypsophthalmidae, and Xiphiopsyllidae. British Museum (Natural History), London.

Johnson P.T. 1957. A classification of the Siphonaptera of South America. *Memoirs of the Entomological Society of Washington*, 5, 1–298.

Jordan K. 1942. On the Siphonaptera collected by Dr. J.M. de la Barrera in the province of Mendoza during 1939. *Revista del Instituto Bacteriológico Dr. Calos G. Malbrán*, 10, 401–460.

Krasnov B., Shenbrot G., Khokhlova I., Medvedev S., Vatschenok V., Khokhlova I.S. 1997. Host-habitat relations as an important determinant of spatial distribution of flea assemblages (Siphonaptera) on rodents in the Negev Desert. *Parasitology*, 114, 159–173.

Krasnov B., Shenbrot G., Khokhlova I., Medvedev S., Vatschenok V. 1998. Habitat dependence of a parasite-host relationship: Flea (Siphonaptera) assemblages in two gerbil species of the Negev Desert. *Journal of Medical Entomology*, 35, 303–313.

Lareschi M. 1996. Estudio preliminar de la comunidad de roedores (Rodentia: Muridae) y sus ectoparásitos (Acari, Phthiraptera y Siphonaptera) en Punta Lara (Buenos Aires). *Revista de la Sociedad Entomologica Argentina*, 55, 113–120.

Lareschi M., Notarnicola J., Navone G., Linardi P.M. 2003. Arthropod and filarioid parasites associated with wild rodents in the northeast marshes of Buenos Aires, Argentina. *Mémorias do Instituto Oswaldo Cruz*, 98, 673–677.

Linardi P.M., Botelho J.R., Pereira Neves D., Cunha H.C. 1984. Sobre alguns ectoparasitos de roedores silvestres de Belo Horizonte, MG. *Revista Brasileira de Biologia*, 44, 215–219.

Linardi P.M., Botelho J.R., Ximenez A., Padovani C.R. 1991. Notes on ectoparasites of some small mammals from Santa Catarina State, Brazil. *Journal of Medical Entomology*, 28, 183–185.

Linardi P.M., Guimaraes L.R. 2000. Sifonápteros do Brasil. MZUSP, FAPESP, Sao Paulo, Brasil.

Mares M. 1975. South American mammal zoogeography: evidence from convergent evolution in desert rodents. *Proceedings of the National Academy of Sciences, USA*, 72, 1702–1706.

Marshall A.G. 1981. The ecology of ectoparasitic insects. Academic **Press ?**, New York.

Morrone J.J. 2001. Biogeografía de América Latina y Caribe. Vol. 3. Manuales & Tesis SEA, Zaragoza.

Nava S., Lareschi M., Voglino D. 2003. Interrelationship between ectoparasites and wild rodents from northeastern Buenos Aires Province, Argentina. *Mémorias do Instituto Oswaldo Cruz*, 98, 45–49.

Ojeda R.A. 1989. Small mammal responses to the fire in the Monte Desert, Argentina. *Journal of Mammalogy*, 70, 416–420.

Ojeda R.A., Campos C.M., Gonnet J.M., Borghi C.E., Roig V.G. 1998. The Mab Reserve of Ñacuñán, Argentina: its role in understanding the Monte Desert biome. *Journal of Arid Environments*, 39, 299–313.

Ojeda R.A., Roig V.G., Borghi C.E. 1997. Diversidad y conservación de los mamíferos de Argentina: un panorama sintético. In: *Biodiversidad y Conservación de Mamíferos Neotropicales* (Eds. G. Ceballos and J. Simonetti)**. ???**

Rall Y.M. 1960. Rodents and natural nidi of plague**. Medical Publishing House. Moscow** (In Russian).

Smit F.G.A.M. 1987. An illustrated catalogue of the Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural History). 7. Malacopsylloidea (Malacopsyllidae and Rhopalopsyllidae). Oxford University, Oxford.

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