



New records of fleas (Siphonaptera: Ctenophthalmidae: Rhopalopsyllidae and Stephanocircidae) from Argentinean Patagonia, with remarks on the morphology of *Agastopsylla boxi* and *Tiarapsylla argentina*

Nuevos registros de pulgas (Siphonaptera: Ctenophthalmidae: Rhopalopsyllidae y Stephanocircidae) de la Patagonia argentina, con comentarios sobre la morfología de *Agastopsylla boxi* y *Tiarapsylla argentina*

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Abstract. A high diversity of fleas parasitizing sigmodontine rodents has been mentioned for Patagonia. Several of these fleas have been described having their type localities in the region, including several endemic taxa. For many species, however, the original descriptions are brief and there are no new morphological contributions. In the present study we report 8 species of fleas (Ctenophthalmidae, Rhopalopsyllidae and Stephanocircidae) parasitizing sigmodontine rodents from Argentinean Patagonia. Nineteen new parasite–host associations are reported and all studied fleas extend their known geographic range. Among them, *Tiarapsylla argentina* is mentioned for the first time for Patagonia; *Craneopsylla minerva*, *Sphinctopsylla ares*, *Polygenis (P.) platensis* and *Polygenis (P.) rimatus* are registered for the first time for Chubut, and *Agastopsylla boxi*, *Ectinorus (E.) ixanus* and *Ectinorus (E.) hapalus* for Santa Cruz, extending the southernmost limit of their geographical distribution. Also, for *A. boxi* and *T. argentina* we describe the morphology of the aedeagus, so far unknown. Results extend the morphological information of fleas and contribute to the knowledge of Patagonian biodiversity.

Key words: ectoparasites, aedeagus, distribution, Sigmodontinae, Chubut, Santa Cruz.

Resumen. Para la Patagonia se ha mencionado una gran diversidad de pulgas parásitas de roedores sigmodontinos. Varias de estas pulgas se han descrito con localidad tipo en la región, incluyendo varios taxones endémicos. Sin embargo, para muchas especies las descripciones originales son breves y no existen nuevos aportes morfológicos. En el presente estudio se registran 8 especies de pulgas (Ctenophthalmidae, Rhopalopsyllidae y Stephanocircidae) parasitando roedores sigmodontinos de la Patagonia argentina. Se reportan 19 asociaciones parásito–huésped nuevas, además, todas las pulgas estudiadas extienden su distribución geográfica conocida. Entre ellas, *Tiarapsylla argentina* se menciona por primera vez para la Patagonia; *Craneopsylla minerva*, *Sphinctopsylla ares*, *Polygenis (P.) rimatus* y *Polygenis (P.) platensis* se registran por primera vez para la provincia del Chubut y *Agastopsylla boxi*, *Ectinorus (E.) ixanus* y *Ectinorus (E.) hapalus* para la provincia de Santa Cruz, ampliando el límite sur de su distribución geográfica conocida. Además, se describe la morfología del aedeagus de *A. boxi* y *T. argentina*, desconocida hasta el momento. Estos resultados amplían la información morfológica de las pulgas y contribuyen al conocimiento de la biodiversidad patagónica.

Palabras clave: ectoparásitos, aedeagus, distribución, Sigmodontinae, Chubut, Santa Cruz.

Introduction

Fleas (Insecta: Siphonaptera) are hematophagous parasites exclusive of birds and mammals (Marshall, 1981). There are currently known about 2 120 species; approximately 80% of these are associated with mammalian

hosts, with 74% parasitizing rodents (Whiting et al., 2008). This high percentage of Siphonaptera–rodent associations is observed in all regions of the world (Krasnov, 2008); in the Patagonian province (*sensu* Morrone, 2006), most of the host records refer to sigmodontine rodents (Cricetidae: Sigmodontinae) (Autino and Lareschi, 1998; Hastriter and Sage, 2009, 2011; Sánchez and Lareschi, 2013). Moreover, a high diversity of Siphonaptera are distributed in this area, with about 50% of all species known for Argentina

(Beaucournu and Castro, 2003; Hastriter and Sage, 2009, 2011; Sánchez et al., 2009; Sánchez and Lareschi, 2013). Several of these species have their type localities in Patagonia and 17 are endemic to it (Johnson, 1957; Smit, 1987; Beaucournu and Castro, 2003; Hastriter and Sage, 2009; 2011). However, some of these are known only by holotype and for others there are no morphological studies after their original descriptions. In this context, the aim of this paper is to provide new morphological contributions for some species of fleas and renew the knowledge of the Siphonaptera of Patagonia, making known new records of geographical and host distribution for these parasites.

Materials and methods

Argentinean Patagonia reaches a total length of about 2 500 km and includes the political provinces of Neuquén, Rio Negro, Chubut, Santa Cruz and Tierra del Fuego (Rabassa, 2008). This biogeographic province presents a temperate to cold-temperate climate, with marked heterogeneity molded by combined influence of the latitudinal gradient of temperature, the west-east gradient of precipitation and strong westerly winds (Soriano et al., 1983; Oosterheld et al., 1998; Paruelo et al., 1998). These climatic factors are reflected in the characteristics of soils and vegetation, manifesting aridity as remarkable peculiarity of the area (Paruelo et al., 1998).

Studied fleas were collected in 20 localities of Chubut and Santa Cruz. Hosts were identified as the following sigmodontine rodents (Cricetidae): *Calomys musculinus* (Thomas, 1913), *Eligmodontia typus* F. Cuvier, 1837, *E. morgani* J. A. Allen, 1901, *Loxodontomys micropus* (Waterhouse, 1837), *Graomys griseoflavus* (Waterhouse, 1837), *Phyllotis xanthopygus* (Waterhouse, 1837), *Abrothrix longipilis* (Waterhouse, 1837), *A. olivacea* (Waterhouse, 1837), *Chelemys macronyx* (Thomas, 1894), *Akodon iniscatus* Thomas, 1919, *A. dolores* Thomas, 1916, *Reithrodon auritus* (Fisher, 1814), and *Euneomys chinchilloides* (Waterhouse, 1839).

Fleas were prepared following the conventional techniques (see Lareschi et al., 2010) and subsequently identified using a microscope equipped with a drawing tube. Fleas were drawn and photographed. For the taxonomic identifications we followed descriptions from Hopkins and Rothschild (1953, 1956, 1962, 1966, 1971), Johnson (1957) and Smit (1987). We followed the classification of Whiting et al. (2008) for the higher taxa. Voucher specimens were deposited in the Colección de Entomología of the Museo de La Plata (MLP, La Plata, Buenos Aires, Argentina) and in the Anexo de la Colección de Mamíferos of the Centro Nacional Patagónico (CENPAT) (CNP, Puerto Madryn, Chubut, Argentina). At the moment, fleas

hold a field number, which consists in the same field number of the hosts; for each individual flea of the same host a number was added, separated by a hyphen (e.g. PPA5-1; DUS494-3). Hosts were captured, processed and identified by Ulises Pardiñas and his collaborator group (Centro Nacional Patagónico, Argentina); rodents will be deposited at the Colección de Mamíferos of the CENPAT (CNP, Puerto Madryn, Chubut, Argentina). Acronyms of field numbers for each specimen correspond to: PPA (Proyecto Patagonia Agencia), DUS (número de campo Daniel Udrizar Sauthier), and LTU (Proyecto Localidades Tipo).

The studied specimens are listed below, indicating the number of each sex, field number, host species and locality. A brief report with comments on diagnostic characteristics, known host species, and geographical distribution is included. Moreover, we describe for the first time the aedeagus of some species, complementing their original descriptions.

Redescriptions

Family Ctenophthalmidae

Subfamily Ctenophthalminae

Agastopsylla boxi Jordan and Rothschild, 1923

Figures 1, 2

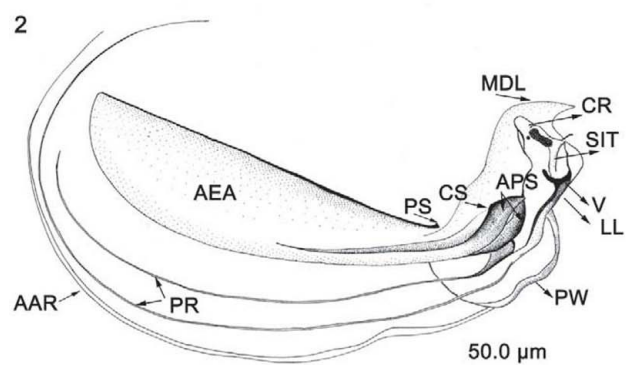
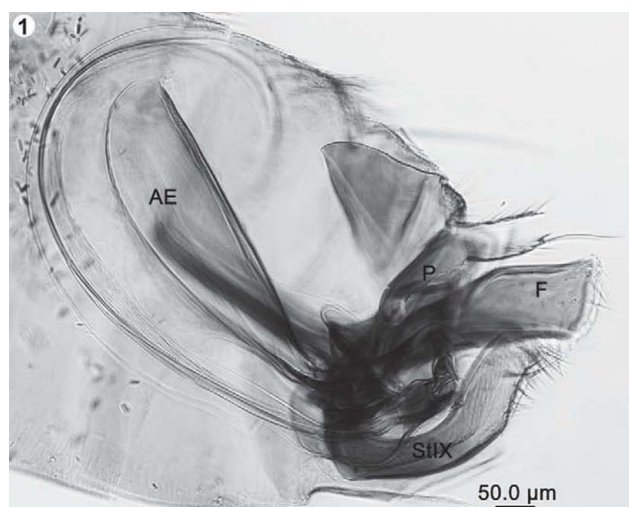
Description of the aedeagus. Aedeagal apodeme (AEA) long, portion between apex of apodeme and well-developed proximal spur (PS) about 4 times longer than broad; with 2 long apodemal struts (APS), proximal strut wider than distal strut and with pointed extension, distal strut is conical and elongated. Crescent sclerite (CS) convex, relatively long and arranged around the proximal strut. Median dorsal lobe (MDL) strongly sclerotized in the center; apical region straight. Lateral lobe (LL) elongated, narrow and straight. Sclerotized inner tube (SIT) short and oblique, base wider and apex with shape almost pointed. Crochet of aedeagus (CR) apical, arranged around the inner tube, with dorso-distal rounded margin, about 3 times longer than broad. Wall of aedeagal pouch (PW) sclerotized, upper region wider and curved than lower region. Penis rod (PR) uncoiled, subequal to longer than aedeagal apodemal rod (AAR). Sclerotized vesicle (V) located above the apex of the penis rod.

Taxonomic summary

Type host and locality. *Abrothrix longipilis* (Waterhouse, 1837); Leleque, Chubut, Argentina.

Other known hosts. Rodents (Hopkins and Rothschild, 1966; Beaucournu and Alcover, 1990).

Known geographical distribution. Southern Argentina and Chile (Beaucournu and Gallardo, 1991; Beaucournu and Castro, 2003; Sánchez and Lareschi, 2013).



Figures 1-2. *Agastopsylla boxi*, male: 1, general view of aedeagus (AE), fixed process (P), movable process (F) of the clasper, and sternite IX (StIX). 2, detail of aedeagus (AAR, aedeagal apodemal rod; AEA, aedeagal apodeme; APS, apodemal strut; CR, crochet; CS, crecent sclerite; LL, lateral lobe; MDL, median dorsal lobe; PR, penis rod; PS, proximal spurs; PW, wall of aedeagal pouch; SIT, sclerotized inner tube; V, sclerotized vesicle).

Material examined. Chubut: ex *E. chinchilloides*, Cañadón de la Madera, Sierra de Tepuel (43°52'33" S, 70°42'40" W), 1 male (PPA39); ex *E. morgani*, Carhué Niyeu, (42°49'21" S, 68°23'56" W), 1 male (PPA270); ex *R. auritus*, 2 females (PPA254, 298); ex *G. griseoflavus*, Establecimiento Gorro Frigio (43°02'26" S, 69°19'55" W), 1 male (PPA257); ex *A. iniscatus*, Pico Salamanca (45°24'32" S, 67°24'58" W), 1 female (DUS746); ex *L. micropus*, 3 females (PPA15, 58, 70), 3 males (PPA81, 84, 90); ex *P. xanthopygus*, 3 females (PPA9, 53, 89); ex *A. olivacea*, Estancia El Maitén (42°03'34" S, 71°09'48" W), 1 male (DUS176); ex *A. longipilis*, Estancia Leleque, La Potrada (42°19'56" S, 70°59'00" W), 11 females (DUS125, 133, 136, 140-144, 148, 149, LTU148, 153). Santa Cruz:

ex *A. olivacea*, Pali Aike, (50°06'30" S, 68°27'37" W), 2 males (LTU676, 678); Puerto Santa Cruz (51°56'09" S, 69°34'26" W), 1 male (LTU642).

Remarks. *Agastopsylla* is separated from all other genera of Ctenophthalminae by the reduction in the size and pigmentation of the setae of the genal comb (Hopkins and Rothschild, 1966). This genus is comprised of 4 species: *A. boxi*, *A. pearsoni* Traub, 1952, *A. nylota* Traub, 1952, and *A. hirsutor* Traub, 1952. In this study we describe the morphology of the aedeagus of *A. boxi*, unknown until now, and we include new diagnostic characters. Based on this description it can be observed that *A. boxi* shares with *A. nylota* the length of crochet and aedeagal apodeme, and with *A. pearsoni* the shape of the crescent sclerite. *Agastopsylla boxi* is unique for the following characters: shape of the apical region of dorsal lobe, which is straight; and shape of the ventral margin of the sclerotized inner tube, having a subtriangular projection.

Two subspecies have been recognized in the literature: *A. boxi boxi* Jordan and Rothschild, 1923 and *A. boxi gibbosa* Beaucournu and Alcover, 1990. Specimens examined in the present study fit the description provided for *A. b. boxi*. However, since *A. b. gibbosa* is only known by the shape of sternite IX of the male and the female is unknown (Beaucournu and Alcover, 1990), and moreover occur in sympatry with *A. b. boxi*, we consider that probably both names are synonyms.

The present finding of *A. boxi* in Puerto Santa Cruz, Santa Cruz (51°56'09" S; 69°34'26" W) extends its geographic range southward ca. 500 km. Known hosts are rodents mainly of the genus *Abrothrix* (Hopkins and Rothschild, 1966; Autino and Lareschi, 1998; Sánchez and Lareschi, 2013). In this study, rodents *A. iniscatus*, *E. morgani*, *E. chichilloides*, *L. micropus*, *P. xanthopygus* and *R. auritus* are included as new hosts for this flea.

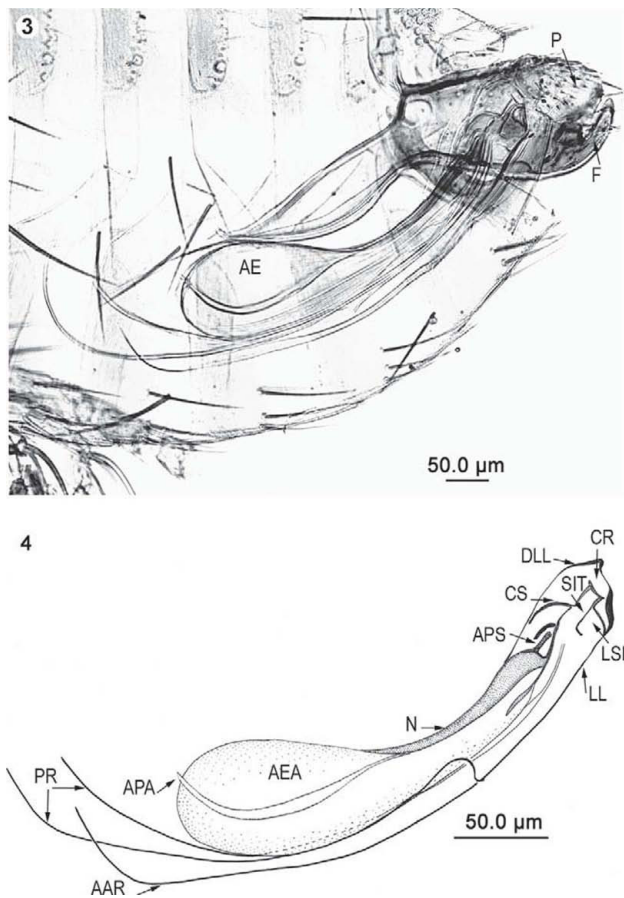
Family Stephanocircidae

Subfamily Craneopsyllinae

Tiarapsylla argentina Jordan, 1942

Figures 3, 4

Description of aedeagus. Aedeagal apodeme (AEA) long and spatulate; anterior region broad and with margin strongly rounded; middle region reduced forming the neck (N). Apical appendage (APA) short and narrow. Apodemal strut (APS) small. Crecent sclerite (CS) convex and short, arranged around the proximal strut. Median dorsal lobe (MDL) vestigial. Distolateral lobe (DLL) small. Sclerotized inner tube (SIT) short, straight and narrow; sclerite lateral of inner tube (LSI) large and basal. Crochet of aedeagus (CR) apical, completely joined to the dorsal margin of lateral lobe (LL) and extending dorsally over of distolateral lobe. Aedeagal apodemal rod (AAR) longer



Figures 3-4. *Tiarapsylla argentina*, male: 3, general view of aedeagus (AE), fixed process (P) and movable process (F) of the clasper. 4, detail of aedeagus (AAR, aedeagal apodemal rod; AEA, aedeagal apodeme; APA, apical appendage; APS, apodemal strut; CR, crochet; CS, crescent sclerite; DLL, distolateral lobe; LL, lateral lobe; LSI, large basal sclerite; N, neck; PR, penis rod; SIT, sclerotized inner tube).

than aedeagal apodeme and shorter than penis rod (PR), both lightly curved at the tip without reaching rolled.

Taxonomic summary

Type host and locality. *Ctenomys mendocinus* Phillipi, 1869; San Rafael, Mendoza (Autino and Lareschi, 1998).

Other known hosts. Rodents (Beaucournu and Kelt, 1990; Sánchez and Lareschi, 2013).

Known geographical distribution. Argentina (Beaucournu and Castro, 2003).

Material examined. Chubut: ex *R. auritus*, Carhué Niyeu (42°49'21" S; 68°23'56" W), 2 females (PPA254-1, 2), 2 males (PPA275-1, 2).

Remarks. *Tiarapsylla* differs from all the other genera of Craneopsyllinae by the prectenidial part of the frons not being conspicuously broader either subdorsally or in

the middle and because the dorsal portion of the suture that divides the helmet from the rest of the head is well developed, but the ventral part is conspicuous or poorly developed (Johnson, 1957). *Tiarapsylla* includes 3 species distributed in the Andean region: *T. titschacki* Wagner, 1937 and *T. bella* Johnson, 1956 occurring in Peru; and *T. argentina*, endemic to Argentina, distributed in Mendoza and La Pampa (Johnson, 1957; Beaucournu and Castro, 2003). Morphological characters of the specimens of *T. argentina* identified in this study are consistent with the original description of the species, among them the helmet comb is straight; the abdominal segments have a single row of setae; in the female, the bulga of the spermatheca is globular; in the male, the fixed process of the clasper has many setae and the movable process of the clasper has a short and narrow tip. In this study, so as to complement the description of the male of *T. argentina* we describe the morphology of aedeagus, so far unknown and are included as a new character of diagnostic value. Furthermore, the finding of *T. argentina* in Chubut is the first record of the species in Patagonia and extends its geographic range ca. 600 km from La Pampa, the southernmost known record. Moreover, known hosts for *T. argentina* are rodents mainly of genus *Ctenomys* (Ctenomyidae) (Autino and Lareschi, 1998). In this study it was found parasitizing *R. auritus*, representing a new host association.

Sphinctopsylla ares (Rothschild, 1911)

Taxonomic summary

Type host and locality. *Abrothrix olivacea* (Waterhouse, 1837); Cautín, Chile.

Other known hosts. Rodents and marsupials (Hopkins and Rothschild, 1956; Alarcón, 2003).

Known geographical distribution. Southern Argentina and Chile (Alarcón, 2003; Beaucournu and Castro, 2003).

Material examined. Chubut: ex *A. olivacea*, cañadón de la Madera, sierra de Tepuel (43°52'33" S; 70°42'40" W), 1 female (PPA21-1), 1 male (PPA21-2); ex *A. longipilis*, Estancia Leleque, La Potrada (42°19'56" S; 70°59'00" W), 1 female (DUS163); ex *P. xanthopygus* 1 km E Lago Blanco (45°55'33" S; 71°14'58" W), 1 male (LTU145). Santa Cruz: ex *A. olivacea*, Pali Aike (50°06'30" S; 68°27'37" W), 1 female (LTU666).

Remarks. *Sphinctopsylla* includes 6 species, 2 of these present in Argentina and only distributed in Patagonia: *S. ares* and *S. mars* (Rothschild, 1898) (Beaucournu and Castro, 2003). The finding of *S. ares* in this study is the first record of the species for Chubut; however, its occurrence in this province was expected, since it is a common species within the geographic range which comprises the southern province of Magallanes, in Chile and the provinces of Neuquén, Río Negro and Santa Cruz, in Argentina (Hastriter et al., 2001; Alarcón, 2003; Sánchez et al., 2009; Sánchez

and Lareschi, 2013). Furthermore, the known hosts of *S. ares* are rodents and marsupials (Hopkins and Rothschild, 1956; Alarcón, 2003). In this study it was found parasitizing rodents of the genera *Abrothrix* and *Phyllotis*, previously mentioned in the literature (Hopkins and Rothschild, 1956; Autino and Lareschi, 1998; Alarcón, 2003).

Craneopsylla minerva Rothschild, 1903

Taxonomic summary

Type host and locality. *Didelphys azarae* Temminck, 1824; Sapucay, Paraguay.

Other known hosts. Rodents (Johnson, 1957; Sánchez et al., 2009; Sánchez and Lareschi, 2013).

Known geographical distribution. Argentina, Brazil, Chile, Paraguay and Peru (Johnson, 1957).

Material examined. Chubut: ex *A. iniscatus*, Cabo Raso (44°20'23" S; 65°14'59" W), 2 females (DUS551, 553); ex *C. musculus*, 1 male (DUS560), 1 female (DUS575); ex *R. auritus*, Carhué Niyeu (42°49'21" S; 68°23'56" W), 1 female (PPA275); ex *A. longipilis*, 1 female (PPA286); ex *A. dolores*, Estancia Los Nogales (42°39'05" S; 67°03'37" W), 1 female (DUS761); ex *G. griseoflavus*, Isla Escondida (43°39'18" S; 65°20'05" W), 1 male (DUS529); ex *A. longipilis*, 1 km E Lago Blanco (45°55'33" S; 71°14'58" W), 1 female (LTU155); ex *A. iniscatus*, Bahía Cracker (42°57'02" S; 64°28'40" W), 1 male (DUS464); ex *E. typus*, Puerto Lobos (42°00'03" S; 65°04'19" W), 1 female (PNG12); ex *R. auritus*, Puerto Piojo (44°53'00" S; 65°40'19" W), 1 female (DUS644).

Remarks. *Craneopsylla* is a monotypic genus including the species *C. minerva*. Two subspecies have been mentioned in the literature: *C. minerva minerva* (Rothschild, 1903) and *C. m. wolffhuegeli* (Rothschild, 1909), defined only by the number of setae in the genal comb (Johnson, 1957). Specimens identified in this study are consistent with the original description of *C. m. wolffhuegeli* (Rothschild, 1909). However, we consider that diagnostic characteristics for subspecies are very weak. Thus, at the moment, we prefer to consider them as synonyms.

In Argentina, *C. minerva* is widely distributed, including Patagonia (Beaucournu and Castro, 2003; Sánchez et al., 2009; Sánchez and Lareschi, 2013); however, the present finding of *C. minerva* in Chubut represents the first mention of the genus for the province. In this study, *C. minerva* was found parasitizing previously known hosts.

Family Rhopalopsyllidae

Subfamily Rhopalopsyllinae

Polygenis (Polygenis) platensis (Jordan and Rothschild, 1908)

Taxonomic summary

Type host and locality. *Ctenomys talarum* Thomas, 1898; La Plata, Buenos Aires, Argentina.

Other known hosts. Rodents, marsupials and xenarthrans (Smit, 1987; Lareschi and Linardi, 2009).

Known geographical distribution. Bolivia, Chile, Uruguay, Brazil and Argentina (Smit, 1987; Linardi and Guimarães, 2000; Lareschi and Linardi, 2009).

Material examined. Chubut: ex *A. iniscatus*, Cabo Raso (44°20'23" S; 65°14'59" W), 3 females (DUS551-2, 554), ex *R. auritus*, 1 male (DUS566); ex *A. olivacea*, Pico Salamanca (45°24'32" S; 67°24'58" W), 1 female (DUS670); ex *A. iniscatus*, Puerto Lobos (42°00'03" S; 65°04'19" W), 1 female (DUS450); ex *E. typus*, Puerto Piojo (44°53'00" S; 65°40'19" W), 1 female (DUS618), 1 male (DUS633), ex *G. griseoflavus* 2 females (DUS588-1, 613), 2 males (DUS589, 591), ex *R. auritus*, 1 female (DUS644-1), 1 male (DUS655).

Remarks. Within Rhopalopsyllidae, *Polygenis* includes the largest number of species and subspecies (about 50) (Linardi and Guimarães, 2000). *Polygenis* in Argentina is represented by 14 species and subspecies, mainly distributed in Buenos Aires and only 3 distributed in Patagonia (Beaucournu and Castro, 2003). Within the genus, *P. (P.) platensis* is distributed in southern South America, with a higher occurrence in Argentina and Uruguay (Smit, 1987; Linardi and Guimarães, 2000; Lareschi and Linardi, 2009). For Patagonia, *P. (P.) platensis* was registered only for Río Negro and Santa Cruz (Lareschi and Linardi, 2009), thus, this finding represents the first mention for Chubut. In this study, the rodent species *A. iniscatus*, *R. auritus*, *A. olivacea* and *E. typus* are included as new hosts for this flea.

Polygenis (Polygenis) rimatus (Jordan, 1932)

Taxonomic summary

Type host and locality. *Didelphis* sp.; Sapucay, Paraguay.

Other known hosts. Rodents and marsupials (Linardi and Guimarães, 2000; Lareschi and Linardi, 2005).

Known geographical distribution. Paraguay, Peru, Brazil and Argentina (Smit, 1987; Linardi and Guimarães, 2000; Beaucournu and Castro, 2003).

Material examined. Chubut: ex *A. iniscatus*, Bahía Cracker (42°57'02" S; 64°28'40" W), 3 males (DUS461-1, 461-2, 464), 2 females (DUS461-1, 2); ex *A. iniscatus*, Bajo los Huesos (43°11'42" S; 64°51'52" W), 1 female (DUS509); ex *A. dolores*, Puerto Lobos (42°00'03" S; 65°04'19" W), 1 male (DUS451), 1 female (DUS451); ex *A. iniscatus*, 2 females (DUS439-2, 449); ex *G. griseoflavus*, 1 male (DUS443).

Remarks. *Polygenis (P.) rimatus* is distributed mostly in Brazil and Argentina (Linardi and Guimarães, 2000; Lareschi and Linardi, 2005). For Patagonia, *P. (P.) rimatus* had been mentioned only for Neuquén (Sánchez and Lareschi, 2013). This finding represents the first record for Chubut and extends its known geographical

distribution ca. 700 km from its southern most known record (Neuquén City, 38°54'42" S; 68°03'57" W). In this study, *A. iniscatus* and *G. griseoflavus* are included as new hosts for this flea.

Subfamily Parapsyllinae

Ectinorus (Ectinorus) ixanus (Jordan, 1942)

Taxonomic summary

Type host and locality. *Microcavia australis* (I. Geoffroy Saint-Hilaire and d'Orbigny, 1833); San Rafael, Mendoza, Argentina.

Other known hosts. Rodents and canids (Beaucournu and Kelt, 1990; Autino and Lareschi, 1998).

Known geographical distribution. Chile and Argentina (Beaucournu and Gallardo, 1991; Beaucournu and Castro, 2003).

Material examined. Chubut: ex *E. morgani*, Cabaña Arroyo Pescado, (43°01'31" S; 70°47'34" W), 1 male (DUS111); ex *A. olivacea*, Cañadón de la Madera, Sierra de Tepuel (43°52'33" S; 70°42'40" W), 1 female (PPA26); ex *E. typus*, Caolinería Dique Ameghino (43°40'48" S; 66°25'57" W), 1 male (DUS383); ex *E. morgani*, Establecimiento El Capricho, Cushamen (42°09'21" S; 70°40'51" W), 1 female (DUS200); ex *G. griseoflavus*, Establecimiento Gorro Frigio (43°02'26" S; 69°19'55" W), 1 female (DUS256), ex *A. longipilis*, 1 female (LTU156); ex *R. auritus*, Laguna de Aleusco (43°10'17" S; 70°26'20" W), 1 female (PPA112); ex *P. xanthopygus*, 1 female (PPA113). Santa Cruz: ex *A. olivacea*, Pali Aike, (50°06'30" S; 68°27'37" W), 3 females (LTU671, 676, 683); Puerto Santa Cruz (51°56'09" S; 69°34'26" W), 3 males (LTU650, 658-659), 3 females (LTU651, 656, 661).

Remarks. *Ectinorus* is represented by 39 species and subspecies distributed in Bolivia, Peru, Chile and Argentina, 10 with records for Patagonia (Beaucournu and Castro, 2003; Hastriter and Sage, 2009, 2011). The genus includes 3 subgenera: *Panallius*, *Ichyonus*, and *Ectinorus* (Hastriter and Sage, 2011). *Ectinorus (E.) ixanus* in Argentina has been registered in Mendoza and Chubut (Beaucournu and Castro, 2003), comprising the present findings for Santa Cruz as new geographical distribution records. Also, the locality Pali Aike (50°06'30" S; 68°27'37" W), close to the Magellanic Strait, is the southernmost limit of its geographical distribution. Rodent species, *E. morgani*, *E. typus*, *G. griseoflavus* and *P. xanthopygus* are new hosts for this flea species.

Ectinorus (Ectinorus) hapalus (Jordan, 1942)

Taxonomic summary

Type host and locality. *Graomys griseoflavus* Waterhouse, 1837; Santa Rosa, Mendoza, Argentina.

Other known host. *Akodon azarae* (Smit, 1987).

Known geographical distribution. Argentina (Beaucournu

and Castro, 2003).

Material examined. Chubut: ex *A. olivacea*, Estancia El Maitén, (42°03'34" S; 71°09'48" W), 1 female (DUS176); *A. longipilis*, 1 female (DUS135). Santa Cruz: ex *A. olivacea*, Pali Aike, (50°06'30" S; 68°27'37" W), 2 females (LTU671, 677); Puerto Santa Cruz (51°56'09" S; 69°34'26" W), 2 females (LTU643, 648), 2 males (LTU650, 661).

Remarks. *Ectinorus (E.) hapalus* is endemic to Argentina (Smit, 1987) and its distribution comprises Mendoza, San Luis, Buenos Aires and Neuquén (Beaucournu and Castro, 2003; Sánchez and Lareschi, 2013). In this work were identified specimens from Chubut and Santa Cruz, representing the first mention of the species for both provinces. This record from Puerto Santa Cruz, Santa Cruz (51°56'09" S; 69°34'26" W) extends the known geographical distribution ca. 1000 km from its southernmost known record (Domuyo, Neuquén; 36°40'54.0" S; 70°3'44.2" W). Furthermore, *A. olivacea* and *A. longipilis* are new hosts for this flea.

Discussion

For many species of Siphonaptera, the studies of the morphology of aedeagus have been careless for several reasons. In general, some characters cannot be easily observed, others were not considered appropriate for taxonomic purposes. Traub (1950) studied comparatively the morphology of the aedeagus in several genera and families of Siphonaptera from Central America and Mexico, describing new species and reallocating 2 genera into another family, demonstrating the importance of aedeagus in the taxonomic classification of species and higher taxa. In this study we describe for the first time the aedeagus of *A. boxi* and *T. argentina*, supplementing the description known for males of these fleas, and allowing future comparisons of this morphological structure among their congeners.

Present results contribute to the extension of the geographical and host distributional range of several flea species. Among them, *T. argentina* is mentioned for the first time for Patagonia. *Craneopsylla minerva*, *S. ares*, *P. (P.) platensis*, *P. (P.) rimatus* and *E. (E.) hapalus* are listed for the first time in Chubut. *Polygenis (P.) rimatus* and *E. (E.) hapalus* were cited previously for northern Patagonian (Sánchez and Lareschi, 2013), thus extending their distribution record to the south. Similarly, *A. boxi*, *E. (E.) ixanus* and *E. (E.) hapalus* are registered for the first time in Santa Cruz, expanding the southernmost limit of their geographical distribution. These new records extend the known list of Siphonaptera parasites of sigmodontine rodents for Chubut to 18 species and subspecies, 10 for

Santa Cruz, 57 for Argentinean Patagonia and 82 for Argentina. Besides, 19 parasite-host associations are reported for the first time. The new geographical and host records provided in this study contribute to the knowledge of the biodiversity in Patagonia. Moreover, considering the potential medical and veterinary significance of Siphonaptera and the value of sigmodontine rodents as hosts of these parasites in Patagonia, the results reported will be relevant in epidemiological studies.

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Literature cited

- Alarcón, M. E. 2003. Sifonapterofauna de tres especies de roedores de Concepción, VIII Región-Chile. *Gayana* 67:16-24.
- Autino, A. and M. Lareschi. 1998. Capítulo 27: Siphonaptera. In *Una perspectiva biotaxonomica* Morrone, J. J. and S. Coscarón (eds.). Biodiversidad de artrópodos argentinos. Ediciones Sur, La Plata. p. 279-290.
- Beaucournu, J. C. and J. A. Alcover. 1990. Pucés récoltées dans la province de Neuquén (Argentine); description de 4 nouveaux taxa (Insecta: Siphonaptera). *Annales de Parasitologie Humaine et Comparée* 64:489-505.
- Beaucournu, J. C. and D. Castro. 2003. Contribution á un inventaire des pucés d'Argentina. *Beiträge zur Entomologie* 53:449-479.
- Beaucournu, J. C. and M. H. Gallardo. 1991. Catalogue provisoire des pucés du Chili (Insecta: Siphonaptera) (1er partie). *Bulletin de la Société Française de Parasitologie* 9:237-270.
- Beaucournu, J. C. and D. A. Kelt. 1990. Contribution a la faune du Chili: Pucés nouvelles ou peu connues de la partie sud (Insecta, Siphonaptera). *Revue Suisse de Zoologie* 97:647-688.
- Hastriter, M. W., M. A. Alarcón and M. F. Whiting. 2001. A collection of fleas (Siphonaptera) from the San Martin reserve, Valdivia province, Chile. *Proceedings of the Entomological Society of Washington* 103:437-443.
- Hastriter, M. W. and R. D. Sage. 2009. A description of 2 new species of *Ectinorus* (Siphonaptera: Rhopalopsyllidae) from Laguna Blanca National Park, Neuquén Province, Argentina. *Proceedings of the Entomological Society of Washington* 11:581-597.
- Hastriter, M. W. and R. D. Sage. 2011. Description of a new species of *Ectinorus* (*E. spiculatus*) (Siphonaptera, Rhopalopsyllidae) from Argentina and a review of the subgenus *Ichyonus* Smit, 1987. *ZooKeys* 124:1-18.
- Hopkins, G. H. and M. Rothschild. 1953. An illustrated catalogue of Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural History). Vol. I. Tungidae and Pulicidae. British Museum (NH), London. 360 p.
- Hopkins, G. H. and M. Rothschild. 1956. An illustrated catalogue of Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural History). Vol. II. Cotopsyllidae, Vermipsyllidae, Stephanocircidae, Ischnopsyllidae, Hypsophthalmidae and Xiphopsyllidae. British Museum (NH), London. 445 p.
- Hopkins, G. H. and M. Rothschild. 1962. An illustrated catalogue of Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural History). Vol. III. Histricopsyllidae. British Museum (NH), London. 560 p.
- Hopkins, G. H. and M. Rothschild. 1966. An illustrated catalogue of the Rothschild Collection of fleas (Siphonaptera) in the British Museum (Natural History). Volume IV. Hystricopsyllidae. British Museum (NH), London. 449 p.
- Hopkins, G. H. and M. Rothschild. 1971. An illustrated catalogue of Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural History). Vol. V. Leptopsyllidae and Ancistropsyllidae. British Museum (NH), London. 530 p.
- Johnson, P. T. 1957. A classification of Siphonaptera of South America. *Memoirs of the Entomological Society of Washington*, Washington, D. C. 299 p.
- Jordan, K. and C. N. Rothschild. 1923. New American Siphonaptera. *Ectoparasites* 1:309-319.
- Krasnov, B. R. 2008. Functional and evolutionary ecology of fleas: A model for ecological parasitology. Cambridge University Press, Cambridge. 610 p.
- Lareschi, M. and P. M. Linardi. 2005. New data on the morphology of *Polygenis* (*Polygenis*) *rimatus* (Jordan) (Siphonaptera: Rhopalopsyllidae). *Neotropical Entomology* 34:121-125.
- Lareschi, M. and P. M. Linardi. 2009. Morphological variability in *Polygenis* (*Polygenis*) *platensis* (Jordan and Rothschild) (Siphonaptera: Rhopalopsyllidae: Rhopalopsyllinae) and taxonomic consequences. *Zootaxa* 2310:35-42.
- Lareschi, M., J. P. Sánchez, C. Ezquiaga, A. Autino, M. Diaz and R. Barquez. 2010. Fleas associated with mammals from northwestern Argentina, with new distributional reports. *Comparative Parasitology* 77:215-221.
- Linardi, P. M. and L. Rocha Guimarães. 2000. Sifonápteros do Brasil. *MZUSP* (Museu de Zoologia da Universidade de São Paulo), FAPESP (Fundação de Amparo a Pesquisa do Estado

- de São), Sao Paulo. 291 p.
- Marshall, A. G. 1981. The ecology of ectoparasitic insects. New York Academic Press, New York. 459 p.
- Morrone, J. J. 2006. Biogeographic areas and transition zones of Latin America and the Caribbean Islands, based on panbiogeographic and cladistic analyses of the entomofauna. *Annual Review of Entomology* 51:467-494.
- Oosterheld M., M. R. Aguiar and J. M. Paruelo. 1998. Ecosistemas patagónicos. *Ecología Austral* 8:75-308.
- Paruelo, J. M., E. G. Jobbágy, O. E. Sala, W. K. Lauenroth and I. C. Burke. 1998. Functional and structural convergence of temperate grassland and shrubland ecosystems. *Ecological Applications* 8:194-206.
- Rabassa, J. 2008. Late Cenozoic of Patagonia and Tierra del Fuego, 1st Edn. *In* The Late Cenozoic of Patagonia and Tierra del Fuego: developments in Quaternary Science Volume 11, J. Rabassa (ed.). Elsevier Science Publishers BV, Amsterdam. p. 151-204.
- Sánchez, J. P. and M. Lareschi. 2013. The fleas (Insecta: Siphonaptera) parasites of sigmodontine rodents (Cricetidae) from Northern Patagonia, Argentina. *Comparative Parasitology* 80:110-117.
- Sánchez, J. P., D. E. Udrizar-Sauthier and M. Lareschi. 2009. Nuevos registros de pulgas (Insecta, Siphonaptera) parásitas de roedores sigmodontinos (Cricetidae) de la Patagonia Austral, Argentina. *Mastozoología Neotropical* 16:243-246.
- Smit, F. G. A. M. 1987. An illustrated catalogue of the Rothschild collection of fleas, Vol. VII: Malacopsylloidea (Malacopsyllidae and Rhopalopsyllidae). Oxford University Press, The British Museum (Natural History), Oxford and London. 380 p.
- Soriano, A., W. Volkheimer, H. Walter, E. O. Box, A. A. Marcolin, J. A. Vallerini, C. P. Movia, R. J. C. León, J. M. Gallardo, M. Rumboll, M. Canevari, P. Canevari and W. G. Vasina. 1983. Desert and semidesert of Patagonia. *In* West, temperate desert and semi-deserts, N.E. (ed.). Elsevier Scientific Publishing Company, Amsterdam. p. 423-460.
- Traub, R. 1950. Siphonaptera from Central America and Mexico. A morphological study of the aedeagus with descriptions of new genera and species. *Fieldiana: Zoology Memoirs*, 252 p.
- Whiting, M. F., A. S. Whiting, M. W. Hastriter and K. Dittmar. 2008. A molecular phylogeny of fleas (Insecta: Siphonaptera): Origins and host associations. *Cladistics* 24:1-31.