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VERSITA

A review of the genus *Listropsoralges* (Acari, Psoroptidae) with the descriptions of two new species

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Abstract

Mites of the genus *Listropsoralges* permanently parasitizing New World marsupials of the family Didelphidae are revised. An emended diagnosis of this genus, descriptions of the new species *L. caluromys* sp. nov. and *L. faini*, and a key to species based on males are provided. *Listropsoralges caluromys* differs from the morphologically similar *L. marmosae* by shorter setae *se* (35–37 µm long in males and 48–55 µm long in females), by female setae *h3* not being thickened and being subequal in the length to setae *ps2* and *ps3* (12–14 and 9–10 µm long, respectively) and by pretarsi III represented by only remnants of the pretarsal stalk in both sexes. *L. faini* sp. nov. (only males are known) differs from males of the morphologically similar *L. monodelphis* by having homogeneous ornamentation of the hysteronotal shield and by setae *h2* and *h3* not being positioned on distinct fleshy projections.

Keywords

Mites, Psoroptidae, parasites, Didelphidae, *Listropsoralges faini* sp. nov., *L. caluromys* sp. nov.

Introduction

The mite family Psoroptidae (Acari, Sarcoptoidea) is composed of permanent highly specialized ectoparasites associated with many orders of mammalian hosts distributed around the world. It currently includes 33 genera arranged into seven subfamilies (O'Connor 1982, 1984). Despite this large number of genera, only 64 species are described and 17 genera (51%) are still monobasic, with the remaining 16 genera including 2–5 species. Taking into consideration wide distribution of psoroptids on different host taxa along with their apparent high specificity, it should be expected that the actual number of psoroptid species is significantly greater and that the majority of taxa remain to be discovered. Unfortunately, the special methods necessary for collection of these small mites and their low occurrence in nature make surveying their diversity difficult.

Most psoroptid taxa were described in the 1960's and 1970's by the late Prof. Fain (see monographs Fain 1963, 1965). For this reason, homologies of many small structures with other Astigmata, especially setae (which are of paramount importance for phylogenetic study) are still not established, and these taxa are in need in modern revision. The first step in this direction was a review of the genus *Gaudalges* (Psoroptidae, Makialginae) whose representatives parasitize lemurs (Bochkov and O'Connor 2006). The present paper is a taxonomic review of the genus *Listropsoralges* (Psoroptidae, Listropsoralginae). Up to know, this genus had included only two species, *L. marmosae* Fain, 1965 and *L. monodelphis* Fain, 1965. Both of them are parasites of the New World marsupials of the family Didelphidae (Fain 1965; Fain and Lukoschus 1970, 1979). An emended diagnosis of this genus, descriptions of two new species of *Listropsoralges*, and a key to species based on males are provided.

Materials and methods

In the descriptions below, idiosomal chaetotaxy follows Griffiths *et al*. (1990) with modifications by Norton (1998) for coxal setae. Leg chaetotaxy follows Grandjean (1939). All measurements are in micrometers (µm) and were taken as follows: body length = the total length from the anterior extremity of the gnathosoma to the posterior extremity (extremities of opisthosomal lobes in males) of the body; body width = maximum width taken at whatever level it occurs; length of the opisthosomal lobes in male = length from the posterior margin of the interlobar membrane to the level of the lobar

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apices; distance between the opisthosomal lobes in male = maximum width taken at whatever level it occurs; length of the posterior legs = length from the most basal point of the trochanter to the apex of the tarsus, excluding pretarsal ambulacrum. Names of hosts follow Gardner (2005). Specimen depositories are cited using the following abbreviations: IRSNB – Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium; NHM – Natural History Museum, London, England; ZISP – Zoological Institute of the Russian Academy of Sciences, Saint-Petersburg, Russia; ZMH – Zoological Museum of Hamburg, Hamburg, Germany.

Systematics

Family Psoroptidae Canestrini, 1892
Subfamily Listropsoralginae Fain, 1965
Genus *Listropsoralges* Fain, 1965

Listropsoralges Fain 1965: 18; Fain and Lukoschus 1970: 50; Fain and Lukoschus 1979: 387.

Type species: *Listropsoralges marmosae* Fain, 1965 by original designation.

Hosts: New World marsupials of the family Didelphidae (Didelphimorphia).

Other species: *L. monodelphis* Fain, 1965, *L. caluromys* sp. nov., and *L. faini* sp. nov.

Distribution: Central and South America.

Diagnosis: Small sized strongly sclerotized mites with body length less than 200. Gnathosoma: Setation and structure of gnathosoma similar to other representatives of family. Subcapitulum ventrally with pair of small medially positioned retrorse spurs. Idiosoma: Propodonotal and hysteronotal shields covering almost all dorsal idiosomal surface, with or without ornamentation. Coxal organs absent, openings of podocephalic canals indiscernible. Openings of hysteronotal glands (*gl*) discernible. Anterior apodemes of coxal fields I (apodemes Ia) widely divergent from each other, not fused into sternum. Coxal apodemes Ib and IIb with short membranous projections. Coxal fields III with sclerotized spur-like projection. Idiosomal setation: *vi*, *si*, *se*, *c2*, *c3*, *cp*, *d2*, *e1*, *e2*, *f2*, *h1*, *h2*, *h3*, *1a*, *3a*, *4a*, *4b*, *g*, *ps1*, *ps2*, and *ps3*. Setae *h2* whip-like. Legs: Lyrifissures of tarsi I and II distinctly developed. Legs IV half as long and distinctly thinner than legs III. Pretarsi III and IV present or absent (in males, pretarsi III always absent). Legs I and II apophyses: trochanters with ventral spur; femora with small ventral tooth; genua with retrorse ventral process, tibia with ventral retrorse apophysis, tarsi with retrorse ventral spur and dorsal retrorse apically splintered apophysis. Leg setation: Leg I *pR*, *vF*, *mG*, *cG*, *gT*, *ra*, *s*, *e*, *f*, *d*, *σ*, *φ*, *ω1*, and *ω3*; Leg II *pR*, *vF*, *mG*, *cG*, *gT*, *ra*, *s*, *e*, *f*, *d*, *σ*, *φ*, and *ω1*; Leg III *sR*, *kT*, *w*, *r*, *e*, *f*, *d*, *σ*, and *φ*; Leg IV *kT*, *w*, *r*, *e*, *f*, *d*, and *φ* (in males setae *e* and *d* absent). Setae *d*III and IV whip-like. Solenidia *ω1*I and *ω1*II situated in median part of respective tarsi.

Male: Aedeagus small, situated between coxal fields III. Dorsal sclerite of aedeagus and postgenital shield weakly developed. Genital papillae absent. All coxal fields open. Adanal shields present, fused to each other. Para-anal suckers present, distinctly developed. Opisthosomal lobes moderately developed and widely separated from each other. Lobar membranes indistinct. Tibiae III with weakly sclerotized antaxial crest along the full length of segment. Tarsi III acute apically.

Female: Epigynum distinctly developed, located at level of posterior ends of apodemes Ia. Lateral parts lateral and median folds of vulva sclerotized. Coxal apodemes IVb with short membranous projection. Setae *4a* and *g* positioned at same longitudinal line. Two pairs of genital papillae present, very small and situated close to each other and to bases of setae *4a*. Opisthogastric shield present, distinctly developed. Spermaducts and bursa copulatrix indiscernible. Tibiae III with ventral retrorse projection; tarsi III with distinct ventral retrorse spur.

Tritonymph. Similar to female. Legs IV rudimentary.

Remarks: This genus differs from the closely allied genus *Listropsoralgoides* Fain et Lukoschus, 1970 by the presence of setae *h1* in males, by whip-like setae *h2*, by the absence of setae *s*III, and by the absence of strongly sclerotized spur-like projections of coxal fields II. In the genus *Listropsoralgoides*, setae *h1* are absent in males, setae *h2* are short, much shorter than legs IV, setae *s*III are present, coxal fields II each bear a strongly sclerotized spur-like projection.

Listropsoralges differs from *Petauralges* Fain et Lukoschus, 1979 in both sexes by the absence of setae *d1* and *s*III, in females, by location of the epigynum immediately behind the posterior ends of apodemes Ia and setae *g* positioned distinctly far from the vulvar opening, posterior to the level of coxal fields IV; in males, by the presence of the adanal shield and by the absence of genital papillae. In both sexes of *Petauralges*, setae *d1* and *s*III are present; in females, the epigynum is positioned between coxal fields II and setae *g* are located at the level of coxal fields IV; in males, the adanal shield is absent and the genital papillae are present.

1. ***Listropsoralges marmosae*** **Fain, 1965**

Listropsoralges marmosae Fain 1965: 20, figs 12, 13, 15 [Male holotype in NHM]; Fain and Lukoschus 1970: 50; Fain and Lukoschus 1979: 389.

This species was described from both sexes collected from *Marmosa* sp. (Didelphimorphia, Didelphidae) from Brazil (Fain 1965). A single female collected from *Marmosa murina* L., 1758 from French Guyana is lost (Fain 1965). This latter record most likely was of *L. faini* sp. nov.

Material examined: Four females and four males from *Marmosa robinsoni fulviventer* Bangs, 1901, **new host**, PANAMA: Perlas archipelago, San Miguel Island, 08°27′00″N, 78°51′00″W, 05.08.1970, coll. Ritte. Five males and 2 females from *Marmosa robinsoni isthmica* Goldman, 1912, **new host**, PANAMA: Panama Prov., Rodman United States Naval Reservation, 08°57′00″N, 79°35′00″W, 21.09.1972, coll. Guerrero [3 females and 3 males in IRSNB, one male and one female in ZISP]. One female and one male from *Caluromys derbianus*,

new host, PANAMA: Santa Rita, 24.11. 971. coll. Bowdre [IRSNB]. Two females from *Caluromys derbianus* Waterhouse, 1841 (Didelphidae), PANAMA: Panama Prov., Aguacate, Capira, 08°48´00˝N, 79°51´00˝W, 25. 01.1980, coll. Mendez [IRSNB].

Hosts and distribution: Species of the genera *Marmosa* and *Caluromys* from Central and South America.

2. ***Listropsoralges caluromys* sp. nov.** (Figs 1 and 2)

Male (holotype, Fig. 1). Body length, including gnathosoma, 210 (200 in one paratype), width 150 (145). Dorsal shields without ornamentation (Fig. 1A). Diameter of para-anal suckers 10. Adanal shield approximately wide as distance between centers of these suckers. Length of opisthosomal lobes 20.

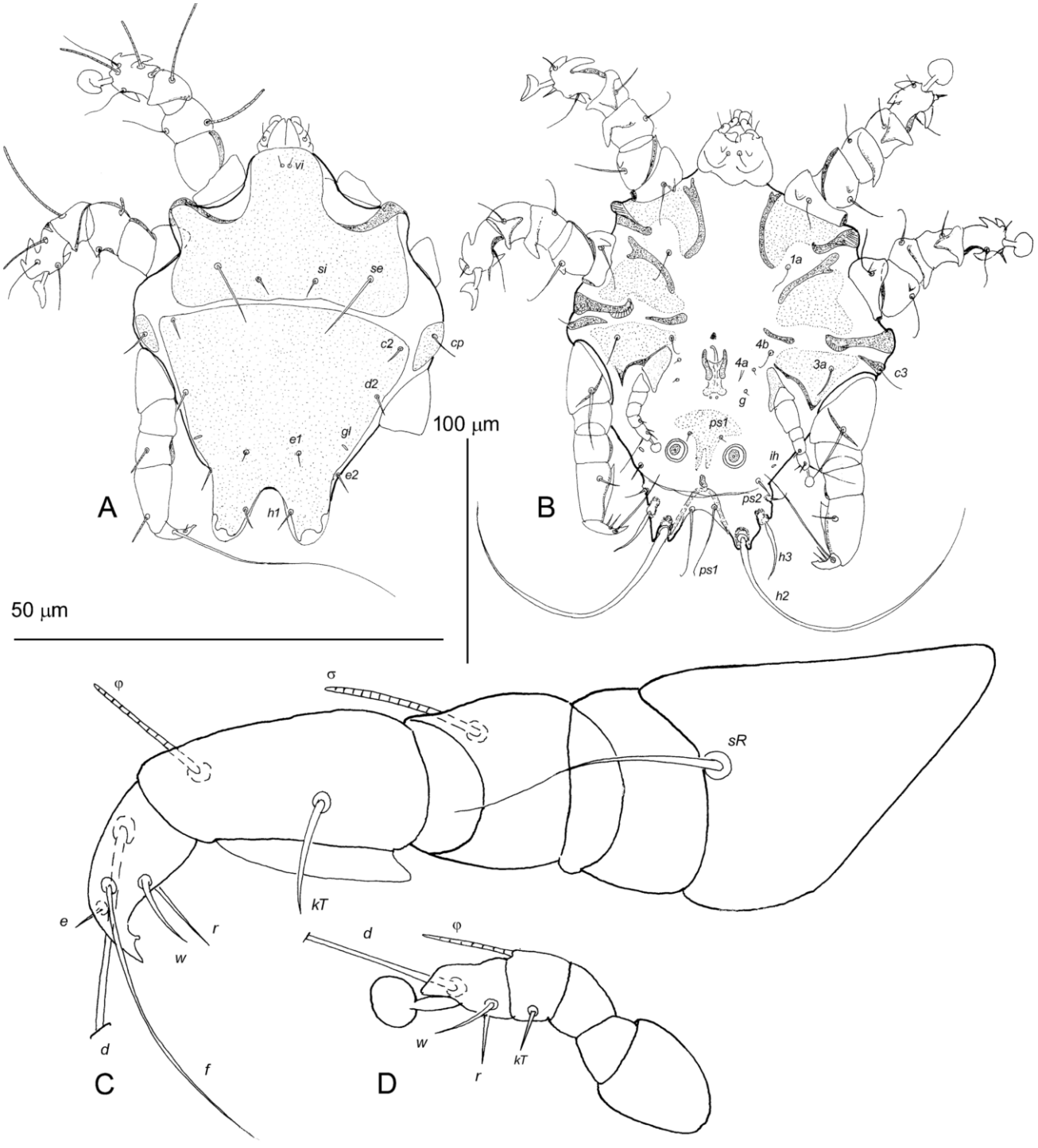

Fig. 1. *Listropsoralges caluromys* sp. nov., male: **A** – dorsal view; **B** – ventral view; **C** – leg III in ventral view; **D** – leg IV in ventral view. Scale bars = 100 μm (A and B); 50 μm (C and D)

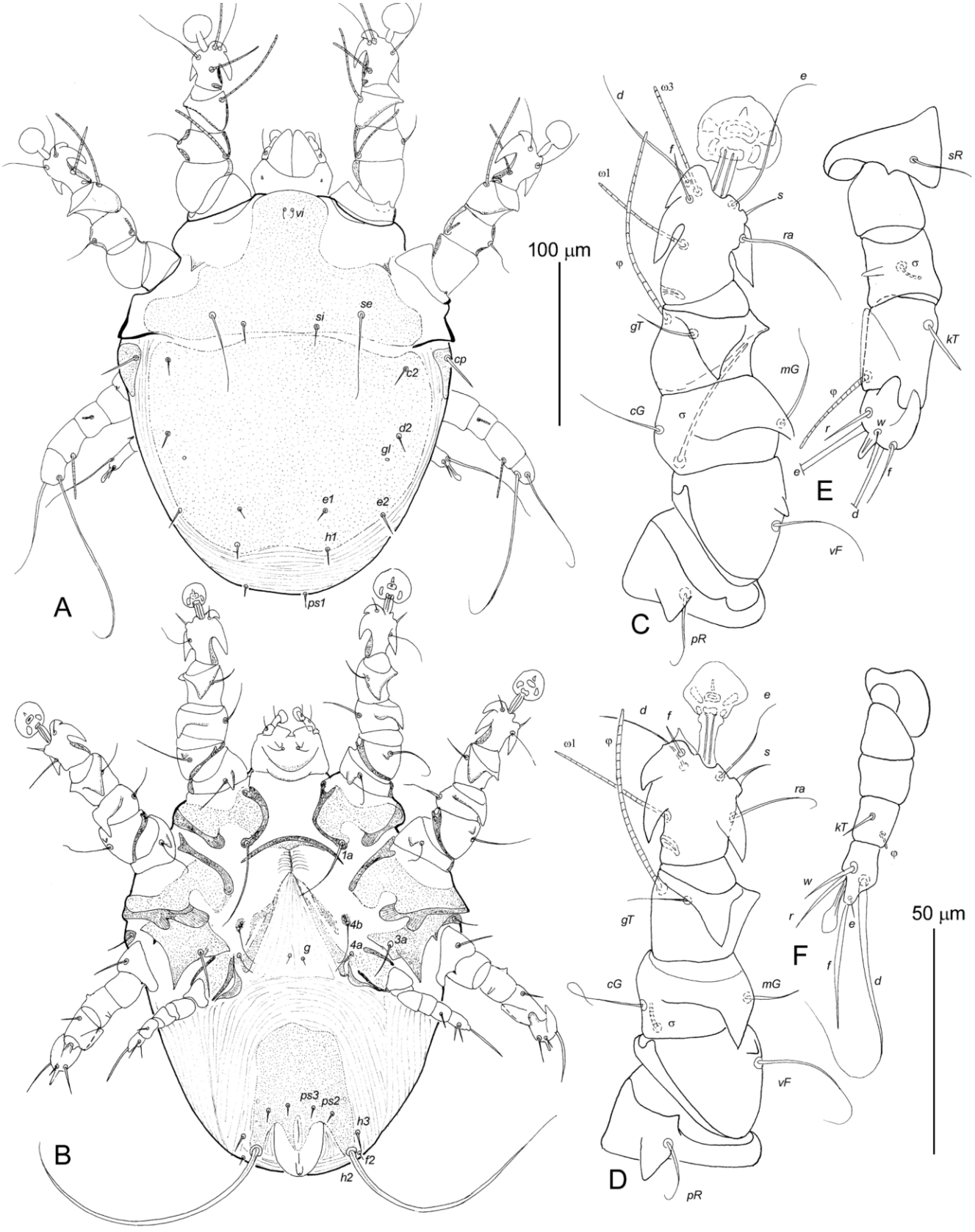

Fig. 2. *Listropsoralges caluromys* sp. nov., female: **A** – dorsal view; **B** – ventral view; **C-F** – legs I-IV in ventral view, respectively. Scale bars = 100 µm (A and B); 50 µm (C-F)

Maximum distance between opisthosomal lobes 30 (Fig. 1B). Legs III about 110 long (Fig. 1C), legs IV 35. Pretarsi IV present (Fig. 1D).

Length of setae: *se* 35 (37), *c2* 18 (19), *cp* 20 (22), *c3* 12 (14), *d2*, *e2*, and *f2* – all about 15, *e1*, *h1*, *ps2*, and *ps3* – all 8–9, *h2* 135 (140), *h3* 33 (35), *1a* 20 (19), *ps1* 27 (25), *σ*I 35

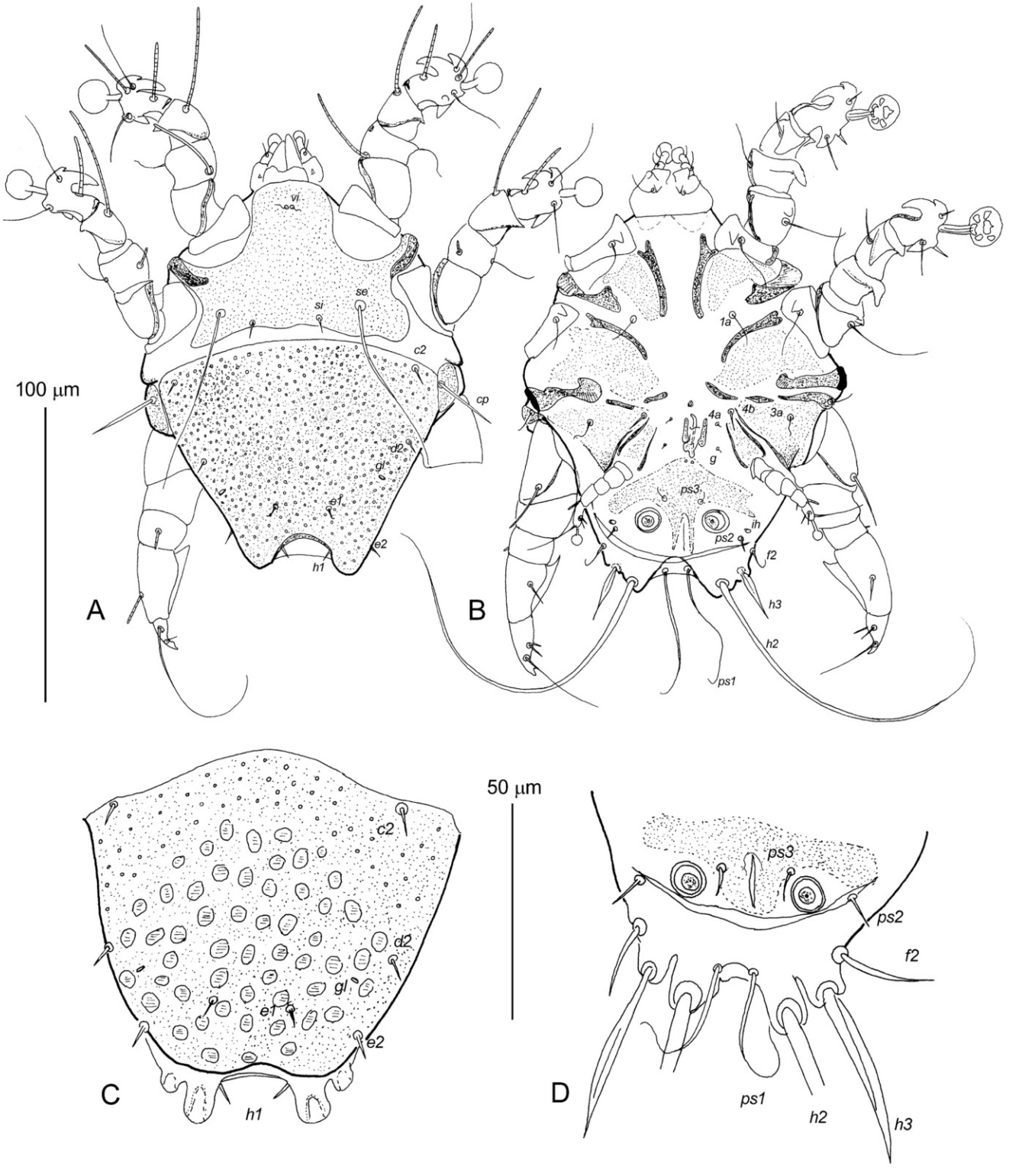

Fig. 3. *Listropsoralges* spp., males: *L. faini* sp. nov. (**A** and **B**); **A** – dorsal view, **B** – ventral view. *Listropsoralges monodelphis* Fain (**C** and **D**); **C** – opisthosoma in dorsal view, **D** – same in ventral view. Scale bars = 100 μm (A and B); 50 μm (C and D)

(37), φI-II about 50, *ω1*I-II 23–25, σII 10, σIII 7, φIII 15, φIV 10.

Female (3 paratypes, Fig. 2): Body length, including gnathosoma, 250–260, width 175–185. Dorsal shields without ornamentation (Fig. 2A). Epigynum 55–60 wide. Opisthogastric shield 65–70 long and 54–57 wide (Fig. 2B). Legs III about 85 long, legs IV 60 long. Pretarsi III strongly reduced and represented by only remnants of pretarsal stalk (Fig. 2E); pretarsi IV weakly developed with strongly reduced ambulacral disc (Fig. 2F).

Length of setae: *se* 48–55, *c2* 10–12, *cp* 15, *c3* 6–7, *d2*, *e1*, *e2*, *f2*, *h1* and *ps1* – all 6–12, *h2* 160–175, *ps2* and *ps3* – all 9–10, *h3* 12–14, *1a* 40–48, σI 34–37, φI-II about 50, *ω1*I-II 22–25, σII 11–12, σIII 6–7, φIII 25, φIV 7–8.

Type material: Male holotype, 1 male and 3 female paratypes from *Caluromys lanatus* Olfers, 1818 (Didelphidae), BRAZIL: Parana, ?Inkar, ?Lako, 21.07.1925, coll. F.S. Lukoschus. All type material is deposited in IRSNB.

Additional material: One female from *Caluromys philander* L., 1758, SURINAME: Welgedacht, 09.08.1971, coll. F.S. Lukoschus and N.J. Kok [IRSNB].

Etymology: The species name is derived from the generic name of the host and is a noun in apposition.

Host and distribution: This species parasitizes hosts of the genus *Caluromys* in Central and South America.

Differential diagnosis: This new species is close to *L. marmosae*. In both species, the dorsal shields are devoid of ornamentation, in males, the adanal shield is not wider than distance between the centres of the para-anal suckers, the ratio of seta *h3* and *f2* lengths is approximately 1:4.

Listropsoralges caluromys sp. nov. It differs from *L. marmosae* by the following features. In *L. caluromys* sp. nov., setae *se* are short, 35–37 in males and 48–55 in females, these setae are not reaching the level of seta *d2* bases; in females, setae *h3* are not thickened and are subequal in length to setae *ps2* and *ps3*, 12–14 and 9–10 long, respectively; pretarsi III are strongly reduced and are represented by only remnants of the pretarsal stalk, pretarsi IV are weakly developed with ambulacral discs strongly reduced. In *L. marmosae*, setae *se* are long, 65–70 in males and 90–95 in females, and reach the level of the hysteronotal gland openings; in females, setae *h3* are slightly thickened and longer than setae *ps2* and *ps3*, 25–30 and 8–10 long, respectively; pretarsi III and IV are weakly developed, but both have the pretarsal stalk and ambulacral disc.

3. ***Listropsoralges faini* sp. nov.** (Fig. 3A, B)

Male (holotype, Fig. 3). Body length, including gnathosoma, 155 (160 in one paratype), width 100 (110). Propodonotal shield without ornamentation, hysteronotal shield monotonously covered by small unsclerotized lacunae (Fig. 3A). Diameter of para-anal suckers 8. Adanal shield much wider than distance between outer margins of these suckers (Fig. 3B). Length of opisthosomal lobes 10. Maximum distance between opisthosomal lobes 14. Legs III about 80 long, legs IV 25–30. Pretarsi IV present.

Length of setae: *se* 60 (65), *cp* 27 (25), *c2*, *c3*, *d2*, *e1*, *e2*, *f2*, *h1*, *ps2*, and *ps3* – all 6–8, *h2* 85 (90), *h3* 19 (22), *1a* 15 (17), *ps1* 48 (50), σI 16, φI-II about 40, *ω1*I-II 20, σII 5, σIII 4, φIII 15, φIV 8.

Female: Unknown.

Type material: Male holotype and 1 male paratype from *Marmosa murina*, VENEZUELA: Monagas state, 05.08.1966, coll. unknown. All material is deposited in IRSNB.

Etymology: This species is dedicated to the late great Belgian acarologist Prof. Alex Fain.

Host and distribution: This species is known only from *Marmosa murina* from Venezuela and probably also from French Guinea (Fain 1965) (see remarks to *L. marmosae*).

Differential diagnosis: Males of this new species differ from *L. marmosae* and *L. caluromys* by the distinctly ornamented hysteronotal shield and the wide adanal shield, which is much wider than the distance between outer margins of the para-anal suckers. In males of both latter species, the dorsal shields are unornamented and the adanal shield is not wider than distance between the centres of the para-anal suckers.

It differs from *L. monodelphis* by the homogeneous ornamentation of the hysteronotal shield (Fig. 3A). Moreover, in this species, the bases of setae *h2* and *h3* are not positioned on distinct fleshy projections (Fig. 3B). In *L. monodelphis*, the anterior quarter of the hysteronotal shield is covered by small unsclerotized lacunae, whereas the other part of this shield is covered by the large unsclerotized lacunae of irregular shape (Fig. 3C), the bases of setae *h2* and *h3* are positioned on distinct fleshy projections (Fig. 3D).

4. ***Listropsoralges monodelphis* Fain, 1965** (Fig. 3C, D)

Listropsoralges monodelphis Fain 1965: 23, figs 14, 16 [Male holotype in NHM]; Fain and Lukoschus 1970: 50; Fain and Lukoschus 1979: 389.

This species was described from males and tritonymphs collected from *Monodelphis dimidiata* (Wagner, 1847) (Didelphidae) from Brazil (Fain 1965).

Material examined: One male and one tritonymph paratype from *Monodelphis dimidiata* (06.29.16.17 NHM), BRAZIL: Sul region, Parana state, Palmeira (estat de Parana), 25°28′00″N, 50°00′00″W, coll. Fain [IRSNB].

Host and distribution: This species is known only from the type host and locality.

Key to males of the genus *Listropsoralges*

1. Hysteronotal shield ornamented. Adanal shield wider than distance between outer margins of para-anal suckers ..... 2.
– Hysteronotal shield without ornamentation. Adanal shield not wider than distance between centres of para-anal suckers ..... 3.

2. Ornamentation of hysteronotal shield homogeneous. Bases of setae *h2* and *h3* not positioned on distinct fleshy projections ..... *L. faini* sp. nov. (Fig. 3A, B).

– Anterior quarter of hysteronotal shield covered by small unsclerotized lacunae, whereas other part of this shield covered by large unsclerotized lacunae of irregular shape. Bases of setae *h2* and *h3* positioned on distinct fleshy projections .....*L. monodelphis* Fain, 1965 (Fig. 4C, D).

3. Setae *se* 35–37 long, not reaching the level of seta *d2* bases ..... *L. caluromys* sp. nov. (Fig. 1).
– Setae *se* 65–70 long, reaching level of hysteronotal gland openings ..... *L. marmosae* Fain, 1965.

Discussion

The family Psoroptidae, is probably not a natural group, and its representatives cannot be characterized by common synapomorphies (O'Connor 1982). Most psoroptids are distinguished by such apomorphic but not unique features as the presence of a dorso-apical claw-like projection on tarsi I and II and the absence of setae *h1*. In mites of the subfamily Listropsoralginae, however, these characters have probably the plesiomorphic states. In species of this subfamily, the dorso-apical projections of tarsi I and II are absent. The dorsal and ventral retrorse spurs developed on anterior tarsi in these mites occupy the subapical position, and probably are not homologous to the dorso-apical projection of other psoroptids. Among representatives of the three genera known in this subfamily, *Listropsoralges*, *Listropsoralgoides*, and *Petauralges*, setae *h1* are absent only in males of the genus *Listropsoralgoides*. At the same time, mites of this subfamily possess some derived features: setae *ba*I-II, *s*I-II, *la*I-II, *wa*I-II, and *ε* are absent, openings of the podocephalic canals are absent or removed onto the anterior end of the idiosoma and therefore invisible with light microscopy, pretarsi III of males are absent, legs IV of nymphal stages are rudimentary. Thus, should the family Psoroptidae be separated into several natural groups (families) in the future, the subfamily Listropsoralginae is "the first candidate" for familial status.

The host-parasite associations of listropsoralgins have an unusual pattern. *Listropsoralges* (4 species) are associated with the New World marsupials of the family Didelphidae, *Listropsoralgoides* (1 species) are associated with South American rodents of the family Echimyidae (Rodentia) (Fain and Lukoschus 1970), and the two known species of *Petauralges* parasitize Australian marsupials of the family Petauridae (Phalangeriformes) (Fain and Lukoschus 1979, Domrow 1988). It should be mentioned that the genera *Listropsoralges* and *Listropsoralgoides* are presumably sister groups. In both of them, setae *d1*, the male genital papillae and setae *s*III are absent. We believe that the common ancestor of this subfamily parasitized marsupials. The parasitism of listropsoralgins on rodents of the family Echimyidae is the consequence of their probable switching from the New World marsupials to these rodents.

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Appendix: Comparative material

Listropsoralgoides surinamensis Fain et Lukoschus, 1970: 3 female and 2 tritonymph paratypes from *Proechimys guyannensis guyannensis* (E. Geoffroy, 1803) (Rodentia: Echimyidae), SURINAME: Uitkijk, 08.01.1970, coll. F.S. Lukoschus [IRSNB].

Petauralges rackae Fain et Lukoschus, 1979: male and tritonymph paratypes from *Petaurus breviceps* Waterhouse, 1838 (Phalangeridae: Petauridae) [ZMH T 663, ethanol preserved specimen], AUSTRALIA: 29.11.1913, coll. Vosseler [IRSNB].

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