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Two new species of *Listrocarpus* Fain (Acari: Atopomelidae) from *Cebus capucinus* Linnaeus and *Saimiri oerstedii* Reinhardt (Primates: Cebidae) in Costa Rica

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Abstract

Two new species of *Listrocarpus* Fain, 1967 (Acari: Atopomelidae): *L. capucinus* **sp. nov.** and *L. costaricensis* **sp. nov.**, are described from the hair of white faced capuchin (*Cebus capucinus* Linnaeus, 1758) and squirrel (*Saimiri oerstedii* Reinhardt, 1872) monkeys in the Central Pacific coast of Costa Rica.

Resumen. Se describen dos especies nuevas del género *Listrocarpus* Fain, 1967 (Acari: Atopomelidae): *L. capucinus* **sp. nov.** y *L. costaricensis* **sp. nov.**, presentes en el pelo de monos capuchinos (*Cebus capucinus* Linnaeus, 1758) y monos ardilla (*Saimiri oerstedii* Reinhardt, 1872) de la costa pacífica central de Costa Rica.

Key words: Atopomelidae, fur mite, *Listrocarpus capucinus*, *Listrocarpus costaricensis*, capuchin monkey, squirrel monkey

Introduction

The genus *Listrocarpus* was erected by Fain in 1967 with *L. lagothrix* as the type species. These fur mites are associated specifically with New World primates in the families Cebidae and Callitrichidae (Fain 1979). Members of this genus have a small prodorsal plate, wider than long, and a postdorsal plate, longer than wide; females generally have a tubular sperm duct and males have the fourth pair of legs enlarged, without aerolia and the tarsi are reduced (Fain 1967).

There are 9 species described to date: *L. lagothrix*, *L. saimirii*, *L. casgrovei*, and *L. hapalei*, by Fain in 1967; he also added *L. anurus*, *L. surinamensis*, *L. alouattae*, and *L. cebi* to the list in 1972, and *L. spinifer* in 1976. Later, in his review of the Atopomelidae of Neotropical America (1979), Fain included a more detailed description of all species, with line drawings and taxonomic keys.

The purpose of this paper is to describe two new species of *Listrocarpus* found on *Cebus capucinus* Linnaeus, 1758 (white faced capuchin) and *Saimiri oerstedii* Reinhardt, 1872 (squirrel monkey) from the Central Pacific coast of Costa Rica, Central America.

Materials and methods

Males, females, nymphs, larvae, and eggs were collected from hair samples of capuchin and squirrel monkeys as previously described (Troyo et al. 2002). The specimens were fixed in 70% ethyl

alcohol, cleared and softened in lactophenol for approximately one month. Whole mites and dissected sections were mounted in Hoyer's medium, dried in an incubator at 37ºC, and observations were conducted with a light microscope at 100x and 400x.

The species descriptions are based on 58 specimens (male holotype, allotype, 25 male paratypes and 31 female paratypes) from one *C. capucinus* and 11 specimens (male holotype, allotype, 8 male paratypes, and 1 female paratype) from 3 *S. oerstedii.*

Drawings were made with the aid of a *camera lucida*. Measurements are expressed in micrometers (values rounded up to the nearest whole number) and are reported as mean ± standard deviation followed by the range and number of measurements taken (n) in parenthesis unless otherwise indicated. All the data obtained were compared with those documented by Fain (1979) for the different *Listrocarpus* species.

***Listrocarpus capucinus* sp. nov. (Figs. 1–3)**

Diagnosis

Postdorsal plate longer than wide: 79-94 long and 40-52 wide in males (Fig. 1), 94-116 long and 49-64 wide in females. Male pregenital transversal band is 25-37 long and sclerotized, genital opening with 2 sharp non-divided triangular sclerites, coxal sclerites IV have a projection through at least half of the opisthosoma (Fig. 2). Female tubular sperm duct is conical, 59-67 long, and sclerotized at the base (Fig. 3), solenidia ω_1 of tibiotarsus III and IV are 16-21 and 12-16 long, respectively.

Description

Male

Total body length 523±14 (495-544, n=24), width 224±11 (198-238, n=20).

Gnathosoma: Triangular, ventrally concave and strongly sclerotized. Length 81±2 (79-86, n=22), width 94±2 (89-99, n=22). Anterior palpal segment with 3 setae; posterior palpal segment with one ventral seta.

Idiosoma: Dorsal length 483±11 (455-495, n=19). Prodorsal plate 10±1 (9-12, n=15) long, 42±3 (37-49, n=13) wide; postdorsal plate 87±4 (79-94, n=21) long, 46±4 (40-52, n=14) wide. Distances: *sci-sce* 35±2 (32-37, n=22), *sci-sci* 51±4 (42-57, n=17), *sce-sce* 78±7 (67-89, n=14). Setae length: *sci* 151±9 (143-165, n=7), *sce* 142±13 (121-156, n=6), d_2 54±3 (49-59, n=9), d_3 38±3 (32-42, n=7), d_4 62±7 (47-74, n=15), d_5 204±15 (173-232, n=19), l_1 55±7 (47-69, n=18), l_2 59±6 (47-67, n=16), l_3 117±8 (111-128, n=4), l_4 193±22 (158-227, n=9), l_5 305±29 (259-370, n=13), a_2 68±6 (54-82, n=20), a_3 50±4 (44-57, n=13), *h* 257±8 (247-272, n=14), *sh* 157±14 (136-173, n=11) (Fig. 1). Genital opening sclerotized with 2 anterior, sharp, non-divided triangular sclerites and a central, diffuse, genital sclerite 21±1 (20-22, n=21) long and 18±1 (16-21, n=22) wide. Strongly sclerotized pregenital transversal band 31±3 (25-37, n=24) long and 125±4 (119-136, n=20) wide (Fig. 2A). Pregenital sclerite ("Y" shaped projection anterior to pregenital band) 23±1 (22-25, n=22) long and 35±3 (27-40, n=23) wide. Lateral ends of pregenital band extend to coxas IV and fuse with sclerites which border legs IV. Coxal sclerites IV have a projection 58±4 (52-69, n=25) long through the opisthosoma (Fig. 2B).

Legs: Number of setae on segments of legs I-II: femora 1-1, genua 2-2, tibiae 1-2(ϕ), tarsi 6(ω_1, ω_3)-5(ω_3?); legs III-IV: trochanters 1-0, genua 1(σ)-0, tibiotarsi 8 (ω_1?, ω_2, ω_3)-5(ω_1, ω_3). Solenidion ω_1 of legs III and IV 36±2 (35-42, n=22) and 32±2 (30-35, n=21) long, respectively. Tibiotarsi III 77±1 (74-80, n=22) long and 29±1 (27-32, n=23) wide.

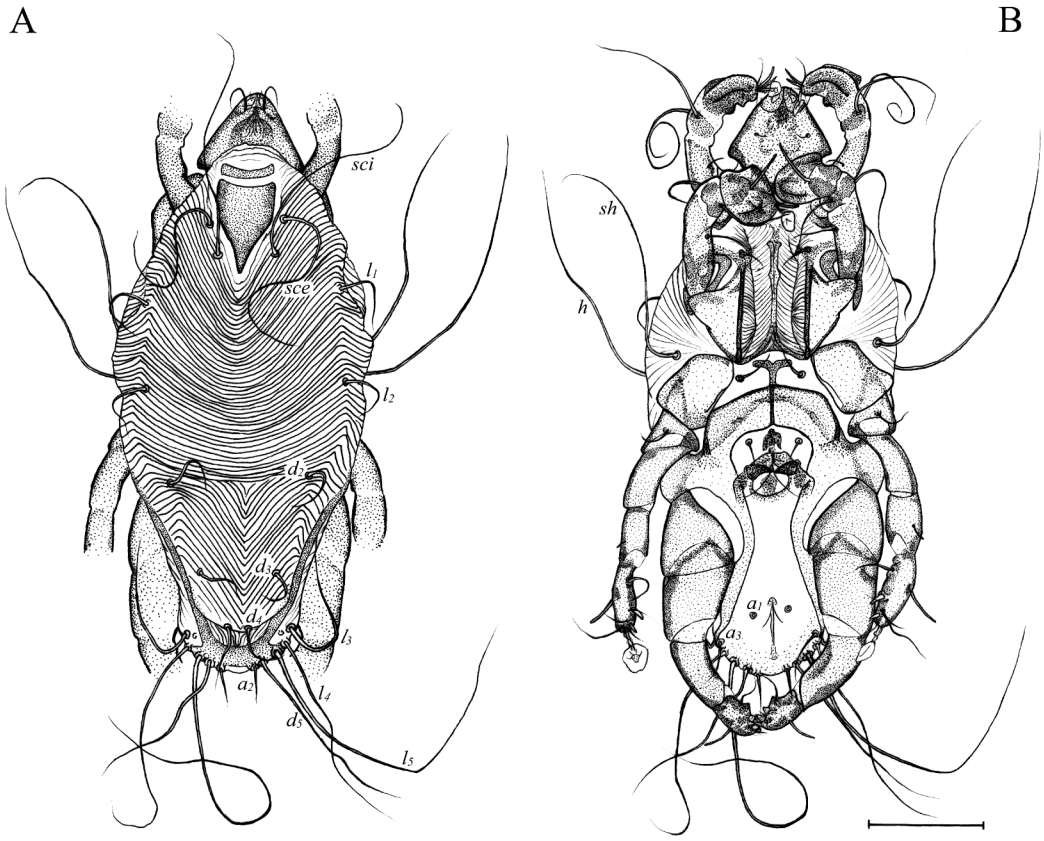

FIGURE 1. *Listrocarpus capucinus* **sp. nov.,** adult male. A, dorsal view; B, ventral view. Scale bar = 100µm.

Female

Total body length 593±28 (534-643, n=25), width 184±14 (168-208, n=8).

Gnathosoma: Similar to male, 92±3 (86-96, n=27) long and 105±4 (99-111, n=9) wide.

Idiosoma: Dorsal length 557±16 (524-584, n=19). Prodorsal plate 10±1 (7-12, n=29) long, 51±3 (47-57, n=10) wide; postdorsal plate 107±6 (94-116, n=28) long, 55±6 (49-64, n=10) wide. Distances: *sci-sce* 41±2 (37-44, n=25), *sci-sci* 59±5 (52-64, n=10), *sce-sce* 75±8 (64-84, n=6). Setae length: *sci* 138±12 (121-151, n=7), *sce* 130±7 (119-138, n=6), d_2 149±5 (143-161, n=15), d_3 91±6 (79-99, n=10), d_4 185±8 (178-198, n=5), d_5 138±4 (136-143, n=3), l_1 100±3 (96-106, n=18), l_2 107±7 (94-119, n=16), l_3 101±5 (91-106, n=7), l_4 299±19 (279-326, n=4), l_5 165±8 (158-175, n=5), a_1 44±4 (40-49, n=6), a_2 77±4 (72-82, n=7), a_3 133±6 (126-143, n=6), *h* 230±8 (217-242, n=13), *sh* 158±11 (131-173, n=12) (Fig. 3A). Tubular sperm duct conical, 61±2 (59-67, n=25) long and 31±3 (27-37, n=23) wide at base in lateral view; sclerotized basal section 42±3 (35-45, n=30) long (Fig. 3B). Oviporus striated with two postero-lateral sclerites 15±2 (12-17, n=22) long (Fig. 3C).

Legs: Number of setae in legs I-III similar to male; 7(ω_1, ω_3) setae in tibiotarsi IV. Solenidion ω_1 of legs III and IV 18±1 (16-21, n=21) and 14±1 (12-16, n=24) long, respectively. Tibiotarsi III 65±1 (62-67, n=26) long and 22±1 (20-25, n=26) wide, tibiotarsi IV 71±2 (68-77, n=27) long and 21±2 (17-22, n=27) wide.

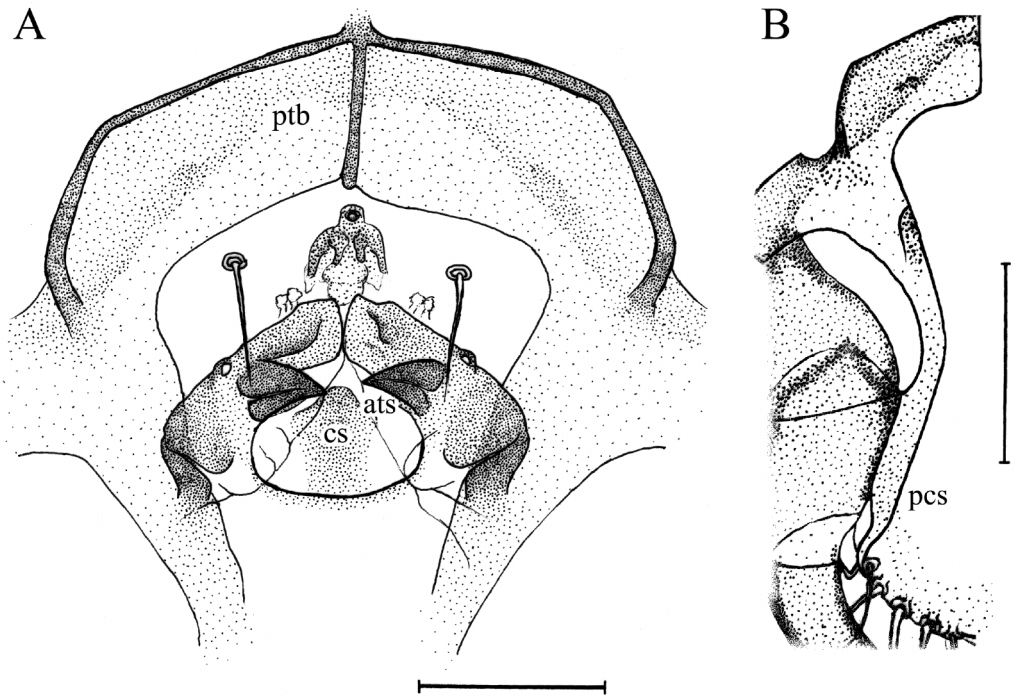

FIGURE 2. *Listrocarpus capucinus* **sp. nov.** A, male genital opening and associated structures, scale bar = 40µm; B, coxal sclerite, scale bar = 80µ. ats=anterior triangular sclerite, cs=central sclerite, pcs=projection of the coxal sclerite, ptb=pregenital transversal band.

Remarks

L. capucinus females resemble *L. saimirii* except that the former has a longer tubular sperm duct (59-67 vs 45-50) and a shorter postdorsal plate (94-116 vs 130); the males of both species differ in many characters of the genitalia, particularly in the sclerotized pregenital band, which is absent (or not sclerotized) in *L. saimirii*. *L. capucinus* females also have some similarities with *L. cebi*, but the postdorsal plate in the former is wider (49-64) than in the latter (40); however, the main difference is in the male specimens, where *L. capucinus* has a much longer pregenital band (25-37 vs 15) and a coxal sclerite projection that extends through more than half of the opisthosoma.

Taxonomic summary

Type host: *Cebus capucinus* Linnaeus, 1758

Type locality: Parque Nacional Manuel Antonio, Quepos, Costa Rica

Deposition of specimens: Holotype, allotype, and paratypes in the Departamento de Parasitología, Facultad de Microbiología, Universidad de Costa Rica; 8 paratypes in the Museo de Insectos, Universidad de Costa Rica.

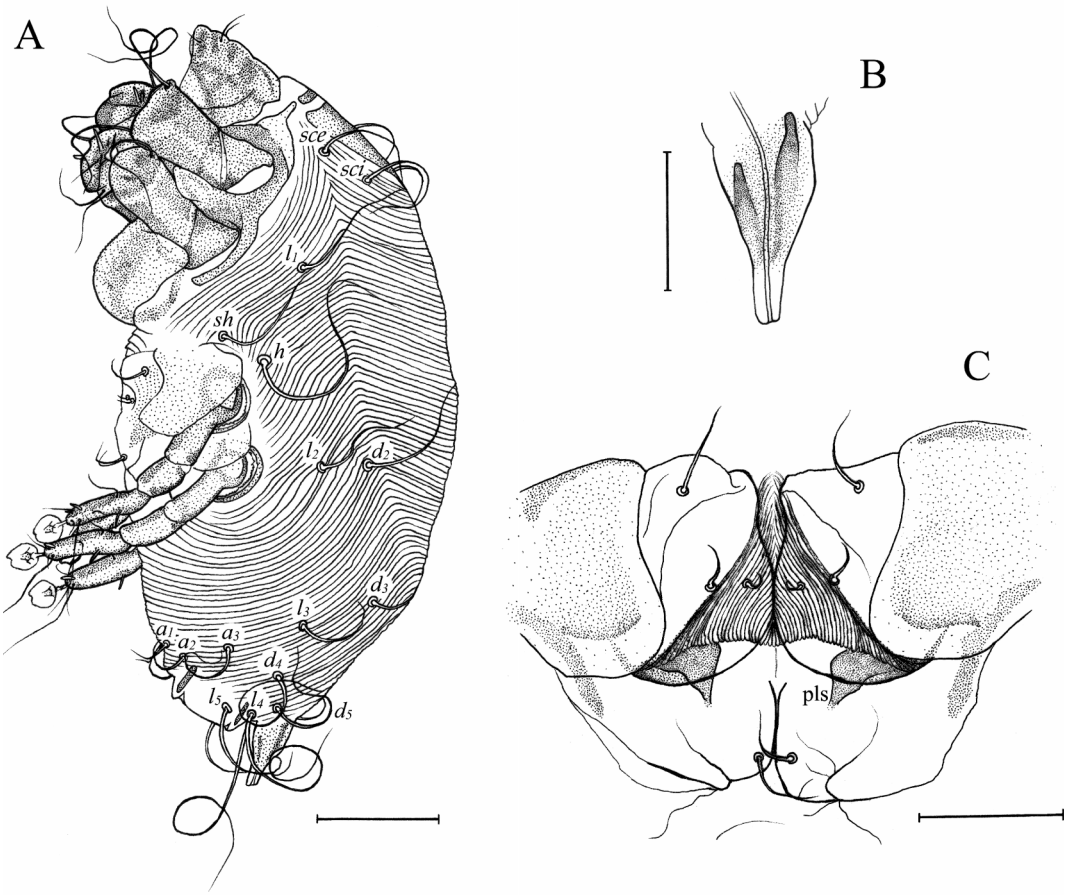

FIGURE 3. *Listrocarpus capucinus* **sp. nov.**, adult female. A, lateral view, scale bar = 100µm; B, tubular sperm duct, scale bar = 40µm; C, oviporus, scale bar = 40µm. pls=postero-lateral sclerites.

***Listrocarpus costaricensis* sp. nov. (Fig. 4)**

Diagnosis

Postdorsal plate longer than wide, 77-84 long and 30-37 wide in males, 99-106 long and 35 wide in females. Male pregenital transversal band is not sclerotized and inconspicuous, genital opening with 2 sharp non-divided triangular sclerites, coxal sclerites IV have a small triangular projection through less than half of the opisthosoma (Fig. 4A). Female tubular sperm duct is conical and 67-69 long (Fig. 4B), solenidia ω_1 of tibiotarsus III and IV are 17-19 and 15 long, respectively.

Description

General appearance and number of setae in leg segments as described for *Listrocarpus capucinus*.

Male

Total body length 424±17 (396-445, n=8), width 166±19 (139-188, n=5). Gnathosoma 65±4 (58-72, n=8) long, 72±2 (69-74,n=7) wide; idiosoma 383±14 (366-401, n=4) long in dorsal view. Prodorsal plate length 11±2 (10-14, n=5), width 36±3 (33-40, n=3); postdorsal plate 81±3 (77-84,

n=5) long, 33±3 (30-37, n=4) wide. Distances: *sci-sce* 36±2 (33-40, n=6), *sci-sci* 50±3 (47-54, n=5), *sce-sce* 58±1 (57-59, n=3). Setae length: *sci* 81±9 (74-91, n=3), *sce* 88±10 (79-99, n=3), d_2 53±6 (47-59, n=4), d_3 52±3 (49-57, n=4), d_4 61±6 (54-72, n=5), d_5 156±15 (136-178, n=6), l_1 56±4 (52-62, n=5), l_2 58±4 (54-64, n=5), l_3 89±5 (84-94, n=5), l_4 123±3 (119-126, n=4), l_5 180±11 (168-188, n=3), a_2 39±4 (32-43, n=6), a_3 35±4 (30-42, n=8), *h* 176±10 (165-188, n=5), *sh* 113±10 (101-121, n=3). Genital opening with 2 anterior, sharp, triangular sclerites and a central genital sclerite 13±2 (11-15, n=4) long and 8±1 (7-9, n=4) wide. Pregenital transversal band not sclerotized, 17±3 (12-20, n=4) long and 80±6 (74-86, n=4) wide with a pregenital "Y" shaped sclerite 18±3 (15-22, n=5) long and 41±7 (32-49, n=5) wide. Triangular projection of coxal sclerites that border legs IV 14±2 (12-17, n=7) long (Fig. 4A).

Solenidion ω_1 of legs III and IV 37±3 (32-40, n=7) and 31±1 (30-32, n=5) long, respectively. Tibiotarsi III 60±1 (59-62, n=7) long and 23±1 (22-25, n=8) wide.

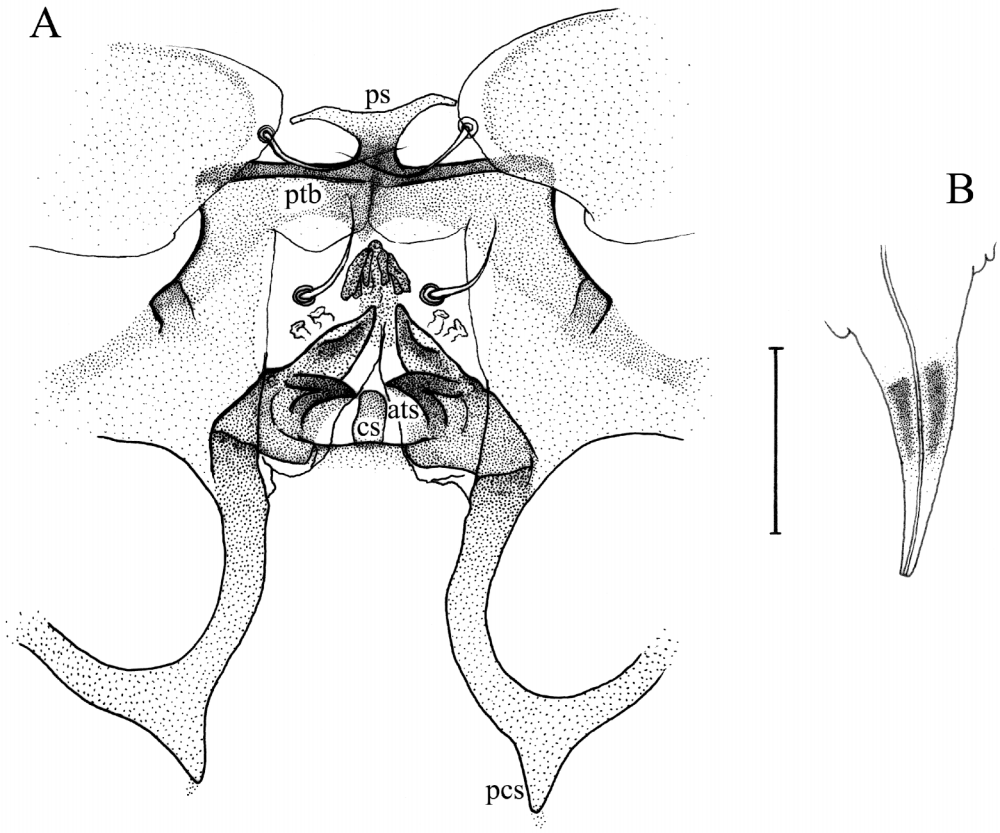

FIGURE 4. *Listrocarpus costaricensis* **sp. nov.** A, male genital opening and associated structures; B, female tubular sperm duct. ats=anterior triangular sclerite, cs=central sclerite, pcs=projection of the coxal sclerite, ps=pregenital sclerite, ptb=pregenital transversal band. Scale bar = 40µm

Female

Total body length 465 (n=1), width 168 (n=1). Gnathosoma 79-82 (n=2) long, 82 (n=1) wide; idiosoma 435 (n=1) long in dorsal view. Prodorsal plate length 12 (n=2), width 38 (n=1); postdorsal plate 99-106 (n=2) long, 35 (n=1) wide. Distances: *sci-sce* 45-46 (n=2), *sci-sci* 57 (n=1), *sce-sce* 62 (n=1). Setae length: *sci* 74-79 (n=2), *sce* 111-114 (n=2), d_2 86 (n=2), d_3 79-86 (n=2), d_4 163-168

(n=2), d_5 89-99 (n=2), l_1 74-82 (n=2), l_2 86-89 (n=2), l_3 74-79 (n=2), l_4 193-207 (n=2), l_5 131-148 (n=2), a_1 35-44 (n=2), a_2 57-62 (n=2), a_3 109-121 (n=2), *h* 153-156 (n=2), *sh* 101-111 (n=2). Tubular sperm duct conical 67-69 (n=2) long and 22-25 (n=2) wide at base in lateral view; length of sclerotized basal section 22 (n=2) (Fig. 4B). Postero-lateral oviporus sclerites 10 (n=1) long.

Solenidion ω_1 of legs III and IV 17-19 (n=2) and 15 (n=2) long respectively. Tibiotarsi III 54-57 (n=2) long and 20-21 (n=2) wide, tibiotarsi IV 54-57 (n=2) long and 17-19 (n=2) wide.

Remarks

Females of *L. costaricensis* resemble those of *L. cebi*, except for the total body length (465 and 610, respectively) and the length of the solenidia ω_1 of legs III (17-19 in *L. costaricensis* and 15 in *L. cebi*) and IV (15 and 10, respectively). However, the main differences are evident in the male specimens, where *L. costaricensis* does not have a sclerotized pregenital band as described for *L. cebi*. *L. costaricensis* females may also have some similarities with *L. saimirii*, except for the shorter body length (465 vs 630), shorter postdorsal plate (99-106 vs 130), and longer sperm duct (67-69 vs 45-50) of *L. costaricensis*; however, the main difference is in the male specimens, where, even though both lack a sclerotized pregenital band, *L. costaricensis* has a coxal sclerite projection that extends through less than half of the opisthosoma.

Taxonomic summary

Type host: *Saimiri oerstedii* Reinhardt, 1872

Type locality: Parque Nacional Manuel Antonio, Quepos, Costa Rica

Deposition of specimens: Holotype, allotype, and paratypes in the Departamento de Parasitología, Facultad de Microbiología, Universidad de Costa Rica; 4 paratypes in the Museo de Insectos, Universidad de Costa Rica.

Discussion

The characters that separate one species from another, in the genus *Listrocarpus*, are generally given by the length and width of the postdorsal plate, shape and length of the female tubular sperm duct, and different structures related to the male genital opening (Fain 1979). Although the qualitative differences between some of the species may be difficult to establish within females, the specific characters are much more evident in the males.

L. capucinus and *L. costaricensis* differ greatly from other *Listrocarpus* species, except for the females, which may initially resemble *L. cebi* or *L. saimirii*, although the males are readily distinguished (see remarks for each species). Some of the most evident reasons for their differentiation are: both have a postdorsal plate which is longer than wide (approximately as long as wide in *L. surinamensis* and the only known females of *L. hapalei*), but different in shape and much shorter than in *L. alouattae*; females have a conical sperm duct (not well developed or absent in *L. anurus*, sinusoidal in *L. casgrovei*, and evidently not conical in *L. lagothrix*) and lack the spines found in the only known females of *L. spinifer*.

L. capucinus and *L. costaricensis* differ from each other in quantitative and qualitative characters. In females, the main difference is in the shape of the sperm duct, which is conical in both species but shorter, wider, and more sclerotized in the former (Figs. 3B and 4B). In males, there are many different characters such as the sclerotized pregenital transversal band present in *L. capucinus*, the shape of the pregenital sclerite (Figs. 1B, 2A, and 4A), and the projection of the coxal sclerite which extends through more than half of the opisthosoma in *L. capucinus* (Figs. 2B and 4A).

The description of these two species from different hosts and geographical areas than those described by Fain suggests that this group may be diverse, and this diversity could be due to a strong specificity in the host-mite relationship.

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