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FIRST DESCRIPTION OF THE MALE OF *LINOTHELE LONGICAUDA* (AUSSERER, 1871) AND REDESCRIPTION OF THE MALE OF *LINOTHELE GAUJONI* (SIMON, 1889) (ARANEAE: DIPLURIDAE)

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Abstract: The male of *Linothele longicauda* (Ausserer, 1871) is described for the first time and the male of *Linothele gaujoni* (Simon, 1889) is redescribed, based in both cases on material held in the collections of the Natural History Museum, London.
Key words: Araneae, Dipluridae, curtain-web, taxonomy, morphology, museums, systematics, Ecuador.

Primera descripción del macho de *Linothele longicauda* (Ausserer, 1871) y redescripción del macho de *Linothele gaujoni* (Simon, 1889) (Araneae: Dipluridae)
Resumen: Se describe por primera vez el macho de *Linothele longicauda* (Ausserer, 1871) y se redescribe el de *Linothele gaujoni* (Simon, 1889), en ambos casos a partir de material conservado en las colecciones del Museo de Historia Natural de Londres.
Palabras clave: Araneae, Dipluridae, telaraña, taxonomía, morfología, museos, sistemática, Ecuador.

Introduction

The genus *Linothele* Karsch, 1879 currently contains 22 species (World Spider Catalog, 2022) of which eight are known from Ecuador: *Linothele cavicola* Goloboff, 1994, *L. gaujoni* (Simon, 1889), *L. longicauda* (Ausserer, 1871), *L. pukachumpi* Dupérré & Tapia, 2015, *L. quori* Dupérré & Tapia, 2015*, L. tsachilas* Dupérré & Tapia, 2015, *L. yanachanka* Dupérré & Tapia, 2015 and *L. zaia* Dupérré & Tapia, 2015. Only *L. gaujoni*, *L. quori* and *L. yanachanka* are known from both sexes, with the remaining five species known only from the female.

Ausserer (1871) described *Diplura longicauda* Ausserer, 1871 and *D. aequatorialis* Ausserer, 1871, the former from Quito and the latter simply with the locality "Cordilleren, Ecuador" (Ausserer, 1871: 179) both supposedly from the female. Simon (1889) described the genus *Uruchus* Simon, 1889 to house *Uruchus gaujoni* Simon, 1899 from Loja, Ecuador based on both sexes. In the same paper, Simon (1889) described *Diplura cousini* Simon, 1889 from Rumipamba, près [= near] Quito based on the female. Simon (1889) also comments on the species described by Ausserer (1871) stating he is not familiar with material of *D. aequatorialis* but that he was sent material of *D. longicauda* from Los Puentes, "près" [= near] Quito (Simon, 1889: 400).

Raven (1985: 160) synonymised *Uruchus* with *Linothele*, stating "*Uruchus* Simon (1889f) [*sic*] (type in MNHP, examined) is placed in the synonymy of *Linothele* Karsch (1879b) [*sic*] (type in ZMB, examined), from which it differs only in having slightly denser scopulae on tarsi I and II, insufficient in itself to warrant generic recognition. The previous synonymy of *Linothele* with *Diplura* by Raven (1980b) was based upon the assumption that the latter is alyrate, as indicated by Simon (1892a, 1903a).". Raven (1985: 75) states "male and female syntypes in MNHP, examined" indicating that both sexes still existed in the type series at this time. Drolshagen & Bäckstam (2021) partially revised *Linothele*, redescribing the females of *L. gaujoni* and *L. longicauda* and considering *D. aequatorialis* and *D. cousini* as junior synonyms of *L. longicauda*. The type specimen of *D. aequatorialis* was considered of indeterminate sex as the genital area was dissected but missing from the sample. The type material of *D. cousini* was found to consist of two females, and one immature male. Drolshagen & Bäckstam (2021) also stated that the vial of syntypic *U. gaujoni* sent to them from MNHN contained only females.

In this work, the male of *L. longicauda* is described for the first time and the male of *L. gaujoni* redescribed, based on specimens located by the author whilst undertaking recuration work of the Mygalomorphae collection at the Natural History Museum, London.

Material and methods

Specimens were examined under binocular microscopes. Photographs of the habitus and palpal bulbs were made using a Canon EOS 6D Mark II attached to a Leica MZ12.5 with images stacked using Helicon Focus software. Description style follows Sherwood *et al*. (2020), modified here for diplurids. Abbreviations, Institutes: BMNH = Natural History Museum, London. Structures: ALE = anterior lateral eyes, AME = anterior median eyes, D = ventral median depression; PLE = posterior lateral eyes, PLS = posterior lateral spinnerets, PME = posterior median eyes; PMS = posterior median spinnerets. Other: coll. = collector, d = dorsal, v = ventral, p = prolateral. Abbreviations for museum collections follow Evenhuis (2007). Leg formulae start with the longest leg to the shortest in order of decreasing size, e.g. 4,1,2,3. All measurements are in mm. Maps were made using SimpleMappr (Shorthouse, 2010). Author's emphases in [ ].

Table I: *Linothele gaujoni* non-type male (BMNH), podomere lengths.

	I	II	III	IV	Palp
Femur	10.0	10.1	9.3	10.5	6.5
Patella	6.0	5.0	4.1	5.0	3.4
Tibia	7.9	6.7	6.5	8.9	5.4
Metatarsus	8.6	8.2	9.4	12.8	–
Tarsus	5.7	6.6	6.7	7.4	2.0
Total	38.2	36.6	36.0	44.6	17.3

Taxonomy

***Linothele gaujoni* (Simon, 1889)**

Uruchus gaujoni Simon, 1889: 401.
Linothele gaujoni: Raven (1985): 74–75.
Linothele gaujoni: Drolshagen & Bäckstam (2021): 176, figs. 5C–D, 8A–D, 18D–E, 19G.

DIAGNOSIS: Males of *L. gaujoni* are differentiated from *L. sericata* by the absence of a keel on the palpal bulb and the rigid apical segment of the PLS (keel present and apical segment of PLS flexible in *L. sericata*), from *L. fallax* by the thinner embolus and shorter and stouter metatarsal protuberance (embolus thicker and metatarsal protuberance longer and thinner in *L. fallax*), from *L. curvitarsis* by the rigid apical segment of the PLS (apical segment of PLS flexible in *L. curvitarsis*), from *L. jelskii* by the 4,1,2,3 leg formula (1,4,2,3 leg formula in *L. jelskii*), from *L. yanachanka* by the presence of an opisthosomal chevron pattern (opisthosomal chevron pattern absent in *L. yanachanka*), from *L. spinosa* by the well-developed metatarsal protuberance (metatarsal protuberance weakly developed in *L. spinosa*), from *L. longicauda* by the presence of opisthosomal patterning, non-uniform black colouration and the comparatively more elongate embolus (opisthosomal patterning absent, colouration uniform black and embolus comparatively shorter in *L. longicauda*), from *L. quori* by the unicoloured appendages of the PLS (appendages of PLS bicoloured in *L. quori*), and from *L. mubii* by the comparatively elongate embolus (embolus comparatively shorter in *L. mubii*). For diagnosis of females, see Drolshagen & Bäckstam (2021).

MATERIAL EXAMINED: 1 ♂, 1 imm. (sex indeterminable) (BMNH), Ecuador, Loja, Zamora Huico in house at 2000m 1996-98, coll. P. Lewis & H. Klitgaard, *Linothele* sp. det. P. Hillyard, NHM, London; 4 ♂♂ (BMNH), Ecuador [apparently separated from other sample for an unknown reason]. [-4.00 -79.18]

DESCRIPTION OF NON-TYPE MALE (BMNH): Total length including chelicerae: 22.4. Carapace: length 12.0, width 9.6. Caput: slightly raised. Ocular tubercle: raised, length 1.2, width 1.8. Eyes: ALE > AME, AME > PLE, PLE > PME, anterior eye row procurved, posterior row slightly recurved (Fig. 4). Clypeus: narrow; clypeal fringe: long. Fovea: deep, slightly procurved. Chelicera: length 2.7, width 1.7. Abdomen: length 9.3, width 5.0. Maxilla with 36 cuspules covering approximately 25% of the proximal edge. Labium: length 1.3, width 1.5, with 2 cuspules separated by >2.0 × the width of a cuspule. Labio-sternal mounds: separate. Sternum: length 4.2, width 3.5, with three pairs of sigilla (Fig. 3). Tarsi and metatarsi I–IV with pseudoscopula. Tarsi flexible. Lengths of legs and palpal segments: see table I, legs 4,1,2,3. Spination: femur I d8, II d6, III d8, IV d12, palp d4, tibia I v3, II d1, v4, III v5, IV d6, v5, palp v2, p3, metatarsus I d1, v5, II v7, III d7, v6, IV d7, v14. Tibia I with single retrolateral megaspine (Figs. 5–6). Femur III: incrassate. Palpal tibia: slightly incrassate. Palpal cymbium: unmodified. Metatarsus I: metatarsal protuberance present (Figs. 5–6). PLS with three segments, basal 3.2, median 2.8, digitiform apical 3.8. PMS with one segment. Palpal bulb with embolus elongate, slightly curved retrolaterally at apex, D weakly developed (Figs. 7–10). Colour: overall alcohol preserved brown, opisthosomal markings indistinct (likely due to long-term preservation and abrasion), maculae absent (Figs. 1–2).

COLOURATION IN LIFE: Specimen records from the type locality on the citizen science platform iNaturalist confirm that in life, *L. gaujoni* have a dark bronze opisthosoma with slightly lighter bronze markings on the dorsal face, consisting of spots and line, forming chevrons, and maculae absent. The legs are overall black, with blue tinges to the lateral aspects of the femora, and the carapace is light bronze (Fig. 21).

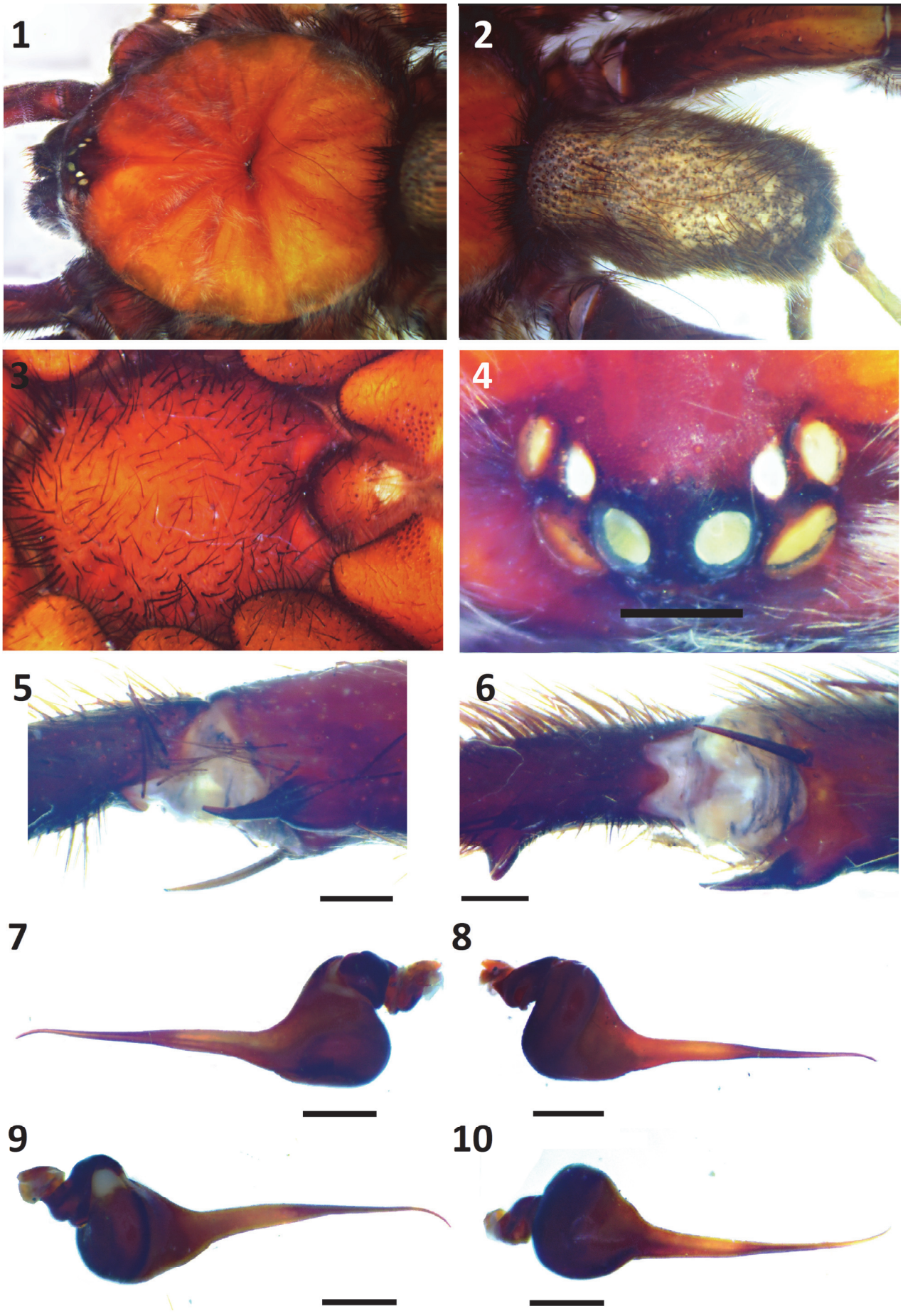
DISTRIBUTION: Loja (Fig. 23), and between Cuenca and Guamote, Ecuador

REMARKS: A tube with two specimens from Loja, Ecuador found in the collections of the Natural History Museum, London determined as *Linothele* sp. by the late Paul Hillyard (former Curator of Arachnida) consisted of an adult male and immature of indeterminate sex of *L. gaujoni*. The label indicated multiple males were determined (by inclusion of two male symbols on the print label) but they were not present in the tube and the immature was incorrectly determined as a female. However, another jar found during recuration by the author consisted of four males with matching palpal bulb, tibial megaspine and metatarsal protuberance morphology, along with congruent colouration and a printed label that simply stated "*Linothele* sp. Ecuador". It is apparent these specimens are the additional males mentioned by P. Hillyard, but it is unclear when and why they were previously separated.

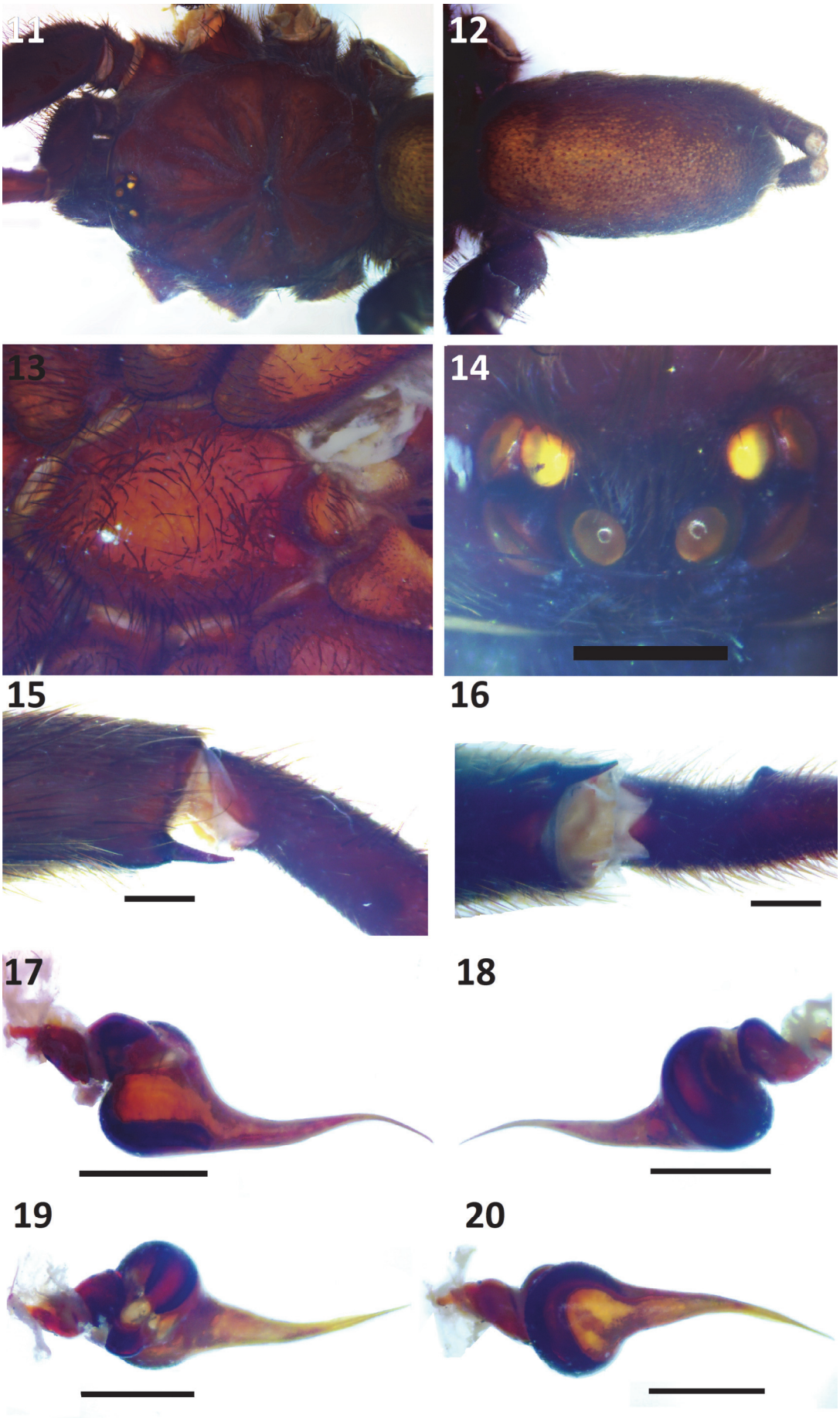
***Linothele longicauda* (Ausserer, 1871)**

Diplura aequatorialis Ausserer, 1871: 179.
Diplura longicauda Ausserer, 1871: 178.
Diplura cousini Simon, 1889: 400.
Linothele aequatorialis: Raven (1985): 74.
Linothele cousini: Raven (1985): 74.
Linothele longicauda: Raven (1985): 74.
Linothele longicauda: Drolshagen & Bäckstam (2021): 177, figs. 10A–C.

DIAGNOSIS: Males of *L. longicauda* are differentiated from *L. sericata* by the absence of a keel on the palpal bulb and the rigid apical segment of the PLS (keel present and apical segment of PLS flexible in *L. sericata*), from *L. fallax* by the thinner embolus and weakly developed metatarsal protuberance (embolus thicker and metatarsal protuberance well-developed in *L. fallax*), from *L. jelskii* by the 4,1,2,3 leg formula (1,4,2,3 leg formula in *L. jelskii*), from *L. quori* and *L. yanachanka* by the absence of middorsal opisthosomal markings (opisthosomal markings present in *L. quori* and *L. yanachanka*), and further from *L. quori* by the unicoloured appendages of the PLS (appendages of PLS bicoloured in *L. quori*), from *L. curvitarsis* by the rigid apical segment of the PLS (apical segment of PLS flexible in *L. curvitarsis*), from *L. gaujoni* by the absence of opisthosomal markings, uniform black colouration and comparatively shorter embolus (opisthosomal markings present, colouration not uniform black and embolus comparatively more elongate in *L. gaujoni*), and from *L. spinosa* and *L. mubii* by more pronounced curvature



Figs. 1–10: *Linothele gaujoni* non-type male (BMNH), **1** carapace dorsal view, **2** opisthosoma dorsal view, **3** sternum, maxilla, and labium dorsal view, **4** ocular tubercle dorsal view, **5** tibia and metatarsus I retrolateral view, **6** tibia and metatarsus I ventral view, **7–10** palpal bulb (right hand side), **7** prolateral view, **8** retrolateral view, **9** dorsal view, **10** ventral view. Scale bars = 1mm (4–10).



Figs. 11–20: *Linothele longicauda* non-type male (BMNH), **11** carapace dorsal view, **22** opisthosoma dorsal view, **13** sternum, maxilla, and labium dorsal view, **14** ocular tubercle dorsal view, **15** tibia and metatarsus I retrolateral view, **16** tibia and metatarsus I ventral view, **17–20** palpal bulb (right hand side), **17** prolateral view, **18** retrolateral view, **19** dorsal view, **20** ventral view. Scale bars = 1mm (14–20).

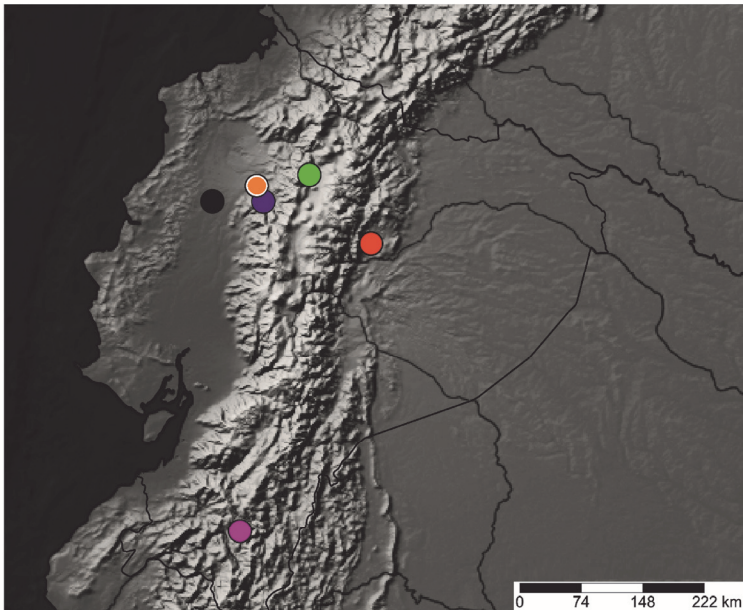
Fig. 21: *Linothele gaujoni* adult male habitus, in life, Loja, Ecuador. Photo credit: Dominik Hofer.



Fig. 22: *Linothele longicauda* adult male habitus, in life, Quito, Ecuador. Photo credit: Edison Ocaña.



Fig. 23: Type localities of Ecuadorian *Linothele* (all endemic, *L. zaia* and *L. tsachilas* occur in sympatry): red circle = *L. cavicola*, orange circle = *L. tsachilas*, pink circle = *L. gaujoni*, green circle = *L. longicauda*, blue circle = *L. yanachanka*, cyan circle = *L. zaia*, white circle = *L. quori*, black circle = *L. pukachumpi*.



at the apex of the embolus (embolus comparatively less curved at apex in *L. spinosa* and *L. mubii*), For diagnosis of females, see Drolshagen & Bäckstam (2021).

MATERIAL EXAMINED: 1 ♂ (BMNH), Quito, Ecuador, 24/3/1890, No. 1490, [collector unknown].

DESCRIPTION OF NON-TYPE MALE (BMNH): Total length including chelicerae: 22.1. Carapace: length 9.1, width 8.2. Caput: slightly raised. Ocular tubercle: raised, length 0.8, width 1.6. Eyes: ALE > AME, AME > PLE, PLE > PME, anterior eye row procurved, posterior row slightly recurved (Fig. 16). Clypeus: narrow; clypeal fringe: long. Fovea: deep, slightly procurved. Chelicera: length 3.0, width 1.4. Abdomen: length 10.0, width 5.3. Maxilla with 30–35 cuspules covering approximately 39% of the proximal edge. Labium: length 0.7, width 1.2, lacking cuspules. Labio-sternal mounds: separate. Sternum: (damaged) length 3.1, width 2.9, with three pairs of sigilla (Fig. 13). Tarsi and metatarsi I–IV with pseudoscopula. Tarsi flexible. Lengths of legs and palpal segments: see table II, legs 4,1,2,3. Spination: femur I d6, II d4, III d4, IV d6, palp d5, tibia I v5, II v7, III d3, v4, IV v6, palp p3, metatarsus I v3, II v8, III d5, v8, IV d7, v9. Tibia I with single retrolateral megaspine (Figs. 14–15). Femur III: incrassate. Palpal tibia: slightly incrassate. Palpal cymbium: unmodified. Metatarsus I: metatarsal protuberance present (Figs. 14–15). PLS (damaged) with three segments, basal 3.5, median 3.3, digitiform apical 3.9. PMS with one segment. Palpal bulb with embolus of moderate length, with developed retrolateral curve at apex, D absent (Figs. 17–20). Colour: alcohol preserved brown, opisthosomal patterning absent (Figs. 11–12).

COLOURATION IN LIFE: Specimen records from Quito on the citizen science platform iNaturalist show that *L. longicauda* lacks opisthosomal patterning in life (Fig. 22) and that it is uniformly black, unlike preserved specimens which are uniformly brown (pers. obs., see also Drolshagen & Bäckstam, 2021).

DISTRIBUTION: Quito, Ecuador (Fig. 23)

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Table II: *Linothele longicauda* non-type male (BMNH), podomere lengths.

	I	II	III	IV	Palp
Femur	8.1	7.2	6.4	8.9	5.3
Patella	4.5	3.6	3.2	3.5	2.9
Tibia	7.0	6.0	5.7	6.7	4.8
Metatarsus	7.7	6.4	7.1	10.4	–
Tarsus	5.7	4.8	4.7	5.0	1.9
Total	33.0	28.0	27.1	34.5	14.9

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