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Two new species of *Salina* MacGillivray (Collembola, Paronellidae) with rectangular mucro from South America

Fábio Gonçalves de Lima Oliveira [a,*], Nikolas Gioia Cipola [b]

[a] *Laboratory of Comparative Biology and Bees, Department of Biology, Faculdade de Filosofia Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP, Brazil*
[b] *Laboratory of Systematics and Soil Invertebrate Ecology, Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil*

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ABSTRACT

Two new species of *Salina*, *S. maculiflora* **sp. nov.** from Brazil and *S. colombiana* **sp. nov.** from Colombia are described and illustrated. The complete dorsal chaetotaxy, including the specialized chaetae (S-chaeta), is studied in these new species. Comparisons based on the chaetotaxy of the basomedian field, abdomen II, and mucro shape are made between species from groups *beta*, *celebensis*, and *borneensis*. This is the first record of *Salina* with rectangular mucro (*beta* group) in South America and a key to the seven Nearctic and Neotropical species is provided.

Introduction

Salina MacGillivray is a genus of paronellids with currently 71 nominal species widely distributed in America, Africa, and south Asia (Bellinger et al., 2015). *Salina* species resemble other genera of Cremastocephalini (sensu Mitra, 1993), such as *Akabosia* Kinoshita, 1919, by the absence of scales, dorsal chaetotaxy and dens with one spatulated and enlarged distal appendix (Szeptycki, 1979; Mitra, 1993). However, *Salina* is distinguished from other genera by the presence of an interocellar macrochaeta and dens not crenulate (Yoshii, 1983; Mitra, 1993; Soto-Adames, 2010).

Based on the shape of the mucro, dental appendage and tergal macrochaetotaxy, Mitra (1973, 1993) proposed two species groups within *Salina*: *celebensis* and *indica*. Posteriorly, Yoshii (1981, 1983) studied the chaetotaxy of the first two abdominal segments and included the groups *beta*, *borneensis* and *saikehi* alongside *celebensis*, while excluding the *indica* group.

Soto-Adames (2010) recently reviewed the *beta* group and proposed a new diagnosis, mainly characterized by the rectangular mucro with two main teeth and the second abdominal segment with one external and one central macrochaeta. So far, the *beta* group is exclusively found in the New World and contains five species: *Salina beta* Christiansen and Bellinger, 1980 from the United States, *S. ventricolor* Gruia, 1983 from Cuba, *S. wolcotti* Folsom, 1927 from Puerto Rico, and *S. bidentata* (Handschin, 1927) and *S. thibaudi* Soto-Adames, 2010 from Costa Rica. None of them is recorded from South America (Soto-Adames, 2010; Bellinger et al., 2015).

Herein, we describe two new species of *Salina* with rectangular mucro from South America, providing detailed information on dorsal chaetotaxy and an identification key for *Salina beta* species group.

Material and methods

Specimens were preserved in 80% ethanol, clarified with potassium dichromate ($K_2Cr_2O_7$) and hydrochloric acid (HCl) and mounted on glass slides with Hoyer liquid. We followed the procedures described by Arlé and Mendonça (1982) and Christiansen and Bellinger (1998), respectively. Specimens were photographed in ethanol gel using a stereomicroscope (M165C) attached to a DFC420 digital camera. Photographs were digitally corrected using Leica Application Suite V3.4.1. Type material is deposited at the Invertebrate Collection of Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil, and "Instituto de Ciencias Naturales" (ICN/UNAL), Universidad Nacional de Colombia, Bogotá, Colombia.

The system used in the descriptions of the species follows Soto-Adames (2010), except Mitra and Dallai (1980) for mucro description. The labial chaetotaxy follows Fjellberg (1999).

* Corresponding author.
E-mail: fabiogloliveira@gmail.com (F.G. de Lima Oliveira).

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Nomenclature of the head dorsal chaetotaxy follows the AMS system of genera *Entomobrya*, Rondani 1861, *Seira* Lubbock, 1870 and *Trogolaphysa* Mills, 1938 (Jordana and Baquero, 2005; Soto-Adames, 2008; Soto-Adames and Taylor, 2013), body follows Szeptycki (1979) based on the genus *Akabosia*, and tergal specialized chaetae (S-chaeta) of Entomobryidae according to Zhang and Deharveng (2015). Chaetae of uncertain homology are followed by a question mark (?). Abbreviations used in the text: Abd. = abdominal segment, Ant. = antennal segment, Th. = thoracic segment, mac. = macrochaeta(e), mes. = mesochaeta(e), mic. = microchaeta(e), sens. = sensilla(e).

Results

Salina maculiflora ***sp. nov.***

See Figs. 1–27.

Diagnosis. Distinguished by flower-shaped blue spots on Th. III to Abd. IV; dorsal head with chaeta **A5**; Ant. I dorsally with 4 mac.; basomedian field with two ciliated chaetae (**M2** and **E**); Th. II to Abd. II respectively with 1 (**p2**), 4 (**p1-3**, **p5**), 2 (**m3-4**) and 3 (**m3**, **m3e**, **m5**) central mac. per side; Abd. IV without **A4** mac.; collophore anterior side with 8 + 8 chaetae and posterior side with 3 + 3 chaetae (Figs. 1, 3, 5, 12, 14–17, 19, 24, 25).

Description. Total length of the holotype 1.7 mm. Habitus typical of paronellids of Cremastocephalini tribe (sensu Mitra, 1993) (Fig. 1). Specimens predominantly pale to light yellow aspect, with blue pigment covering the distal region of Ant. II-III, Ant. I base, anterior and lateral sides of head; lateral of Th. II to Abd. V; Th. III with 3 + 3 rosette-like blue spots, Abd. I, II and IV with 2 + 2, 4 + 4 and 6 + 6 flower-shaped spots, respectively; Abd. III and. IV with blue spots posteriorly. Femur I-III with one and tibiotarsi I-III with two light blue spots distally; eyepatch area black (Fig. 1).

Head. Eyepatches oval, with largest ocelli A and B and smallest G and H, with three interocular ciliated chaetae (Fig. 3). Head dorsal chaetotaxy as in Fig. 3; antennal series 'An' with 6 + 6 chaetae, **An1a**, **An1**, **An2**, **An3a** and **An3** as mac., **An2a** as spine-like mic.; anterior series 'A' with **A5** mes.; medio-ocellar series 'M' with 3 + 3 chaetae, **M4** as mac., **M0** and **M2** as mes.; sutural series 'S' with 3 + 3 chaetae, **S2** and **S3** as mac., **S7** as mes.; interocular series with 3 + 3 chaetae, **r** as mac., **p** and **t** as mic.; postoccipital anterior series 'Pa' with 3 + 3 chaetae, **Pa5** and one typical chaeta (**P5a**) as mac., **Pa6** as bothriotricum; postoccipital median series 'Pm' with 2 + 2 mac. (**Pm1** and **Pm3**); postoccipital posterior series 'Pp' with 1 + 1 mac. (**Pp1**); postoccipital external series 'Pe' with mac. **Pe3** present. Ant. IV with a simple apical bulb and smooth and ciliated chaetae. Ant. I with 4 + 4 dorsal mac.; dorsal base with 5 + 5 to 6 + 6 sensillae-like smooth mic. and ventral base with 12 + 12 (Figs. 5 and 6). Four prelabral ciliated chaetae and 14 labral smooth chaetae (4/5/5), four anterior (**a1-2**), **a1** spine-like; five median (**m0-2**), and five posterior (**p0-2**) (Figs. 7 and 8). Labial palp with five smooth proximal chaetae and six papillae (A-E and H), A and C simple, H with two smooth guard appendages (**h1-2**), B with five (**a1**, **b1-4**), D with three (**d1-2** and **d4**), and E with lateral process (**l.p.**) smaller than the papilla and two smooth guard appendages (**e1-2**) (Fig. 9). Maxillary outer lobe with apical appendage (**a.a.**) and basal chaeta (**b.c.**) of same length, both smooth, sublobal plate with three internal smooth appendages (Fig. 10). Right mandible (ventral view) with four incisive teeth, left mandible with five teeth; both mandibles with six stronger molar teeth (Fig. 11). Basolateral and basomedian field with chaetae **A1-5** smooth (A5 thickest), **M2**, **E**, **L1** and **L2** ciliated, **r** and **M1** absent (Fig. 12). Cephalic groove (CG) with 8 + 8 chaetae, 5 + 5 ciliated (**CG1-3**, **CG5** and **CG7**), 1 + 1 smooth (**CG8**), and 2 + 2 as spine-like mic. (**CG4** and **CG6**); medial postlabial (PLM) with 1 + 1 ciliated chaetae (**PLM1**); external postlabial (PLE) with 4 + 4 ciliated chaetae (**PLE1-4**). Head ventral chaetotaxy as in Fig. 13.

Thorax dorsal chaetotaxy. Th. II as in Fig. 14; anterior series 'a' with 10 + 10 unnamed mac. of anterior collar, one S-microchaeta (**ms**), and one anterolateral sens. (**al**); medial series 'm' with 3 + 3 chaetae, **m7** as mac., **m1** and **m2** as mes. present or absent, plus 1 + 1 unnamed mac. laterally; posterior series 'p' with 2 + 2 chaetae, **p2** as mac., **p1** as mes. present or absent. Th. III dorsal chaetotaxy as in Fig. 15; series 'p' with 6 + 6 mac. (**p1-3**, **p5** and 2 + 2 unnamed chaetae), and one anterolateral sens. (**al**).

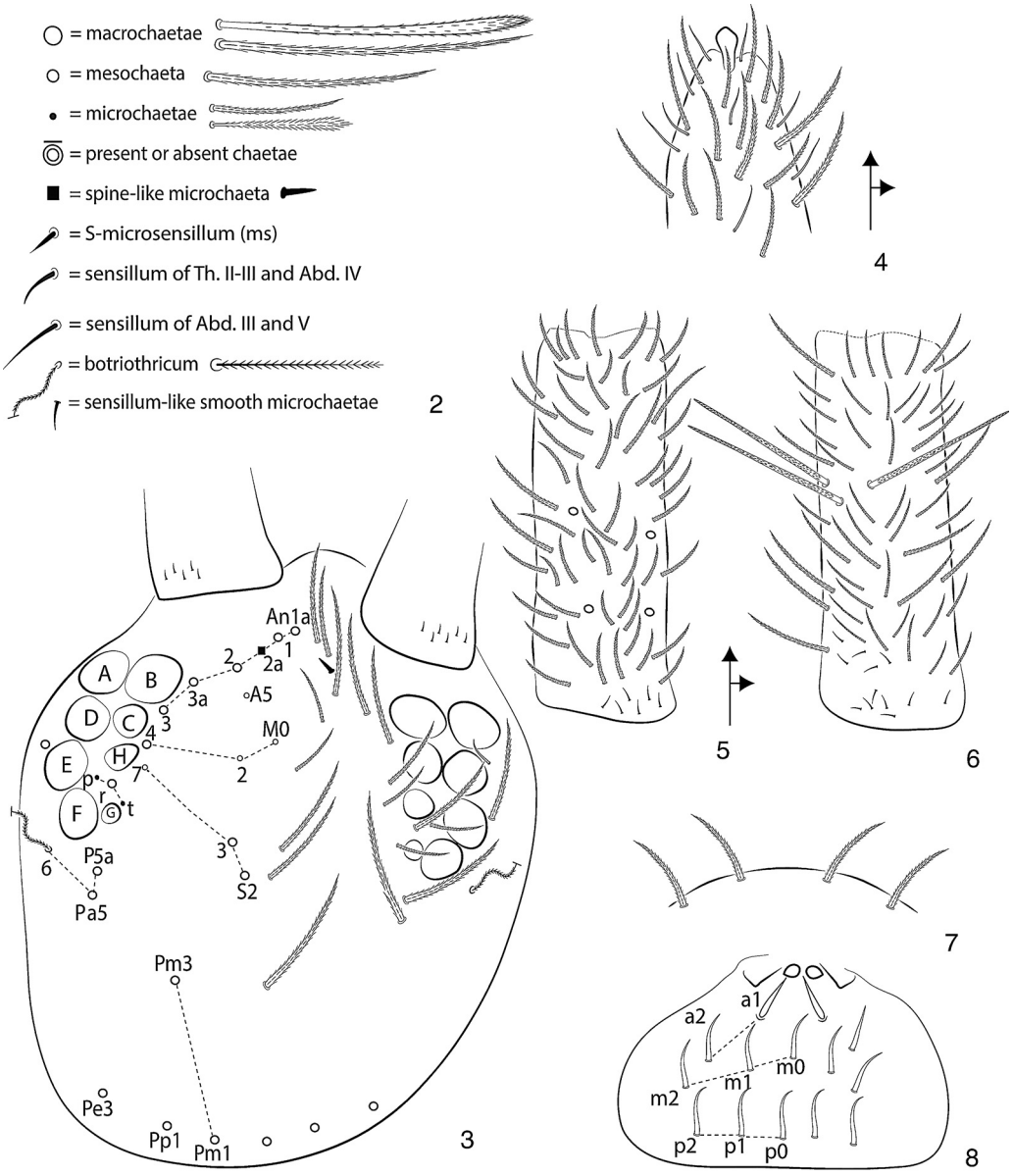
Abdomen dorsal chaetotaxy. Abd. I as in Fig. 16; series 'm' with 3 + 3 chaetae, **m3** and **m4** as mac., **m5** as mes., and one S-microchaeta (**ms**). Abd. II as Fig. 17; series 'a' with **a5** as bothriotricum; series 'm' with 4 + 4 chaetae, **m3**, **m3e** and **m5** as mac., **m2** as bothriotricum; series 'p' with 2 + 2 chaetae, **p6** as mac. present or absent, **p7** as mes. plus **el** mac. Abd. III as in Fig. 18; series 'a' with 3 + 3 chaetae, **a5** as bothriotricum, **a7** and **am6** as mes.; series 'm' with 2 + 2 bothriotricha (**m2** and **m5**); series 'p' with 3 + 3 chaetae, **p6** and **pm6** as mac., **p7i** as mes. One anterosubmedial sens. (**as**) present. Abd. IV as in Fig. 19; series 'A' with 3 + 3 chaetae, **A1** and **A6** as mac., **A3** as mes.; series 'Ae' with **Ae1** as mac.; series 'B' with 4 + 4 chaetae, **B3-5** as mac., **B6** as bothriotricum; series 'Be' with **Be1** as mac.; series 'C' with **C1** as mac.; series 'T' with 2 + 2 bothriotricha (**T2** and **T4**), and one S-microchaeta (**ms**); series 'E' with 2 + 2 mac. (**E1-2**); series 'F' with 4 + 4 mac. (**F1-3p**); series 'Fe' with 5 + 5 chaetae, **Fe1-3** as mac., **Fe4-5** as bothriotricha; posterior margin with 5 + 5 unnamed ciliated mes., and three sens. presents (**ps** and two unnamed). Abd. V as in Fig. 20; series 'a' with 3 + 3 chaetae, **a5** as mac., **a3** and **a6** as mes.; series 'm' with 4 + 4 or 5 + 5 mac. (**m2-5e**), **m5a** present or absent; series 'p' with 5 + 5 or 6 + 6 chaetae, **p1**, **p3-5** and **ap6** (present or absent) as mac., **pp6** as mes.; one anterosubmedial sens. (**as**) and two accessory sens. (**acc.p4** and **acc.p5**) present.

Tergal S-chaetae formula 1, 0| 1, 0, 0, 1, 0 (**ms**) and 1, 1| 0, 0, 1, 3, 3 (**sens**) of Th. II to Abd. V (Fig. 14–20).

Legs. Trochanteral organ with 14 spine-like chaetae (Fig. 21). Unguis I-II (same morphology) with three unpaired inner teeth, a basal, a median and one at the apex (Fig. 22). Unguis III with one unpaired inner tooth near the apex (Fig. 23). Unguiculi trilamelate, lamellae inner truncate, lamellae external acuminate, both smooth edges. Tenent hairs capitate, weakly ciliated, present on pretarsus. All tibiotarsi with one socket monocondyle at the apex (Figs. 22 and 23). Tibiotarsus III with a smooth distal chaeta, near unguiculus base (Fig. 23).

Collophore. Anterior side with 3 + 3 long ciliated mac. and 5 + 5 smooth mic.; posterior side with 2 + 2 smooth mic. and 1 + 1 ciliated; lateral side with 14 + 14 smooth mic. (Figs. 24 and 25).

Fig. 1. *Salina maculiflora* **sp. nov.**: habitus of a specimen in ethanol (Ant. III and IV missing).



Figs. 2–8. *Salina maculiflora* sp. nov.: (2) symbols used in detailed chaetotaxy schemes; (3) head dorsal chaetotaxy; (4) apical bulb of Ant. IV (dorsal view); (5) Ant. I dorsal chaetotaxy (right); (6) Ant. I ventral chaetotaxy; (7) prelabral chaetae; (8) labral chaetotaxy.

Furcula. Dens with rows of ciliated chaetae and mucro with two main teeth (**d1** and **v1**) and one reduced accessory teeth present or absent (**ap**) (1 out of 14 specimens) (Figs. 26 and 27).

Type material. Holotype female, on slide N° COLLE 040/INPA: Brazil, Amazonas, Rio Preto da Eva municipality, "Aprisco Pásargada" farm (02°42′26.6″S; 59°42′53.2″W), Amazon forest, 13.ix.2013, 45 m, Malaise trap, BG Oliveira coll. Paratypes on slide N° COLLE 040A-G/INPA: 3 males, 7 females in slides, and 4 specimens in ethanol, same data as holotype. 3 paratypes in ethanol, same data as holotype, except date: 13.xii.2013.

Other examined material. 1 immature on slide, Brazil, Amazonas, Presidente Figueiredo municipality, AM-270, Km 18 (02°02′48″S; 59°52′01″W), 30.viii.2014, 146 m, dish trap, NG Cipola and FGL Oliveira coll. 2 females on same slide, Manaus municipality, "Raifran" farm, entrance to "Brasileirinho" Km 7 (03°02′08″S; 59°52′16″W), 29.viii.2013, 38 m, BG-Malaria trap, LB Leal coll. 1 female on slide, Novo Airão municipality, "Mato Grosso" stream (02°49′00″S; 60°55′08″W), 28-31.iii.2013, dish trap, JT Câmara and AC Maldaner coll. All deposited in INPA.

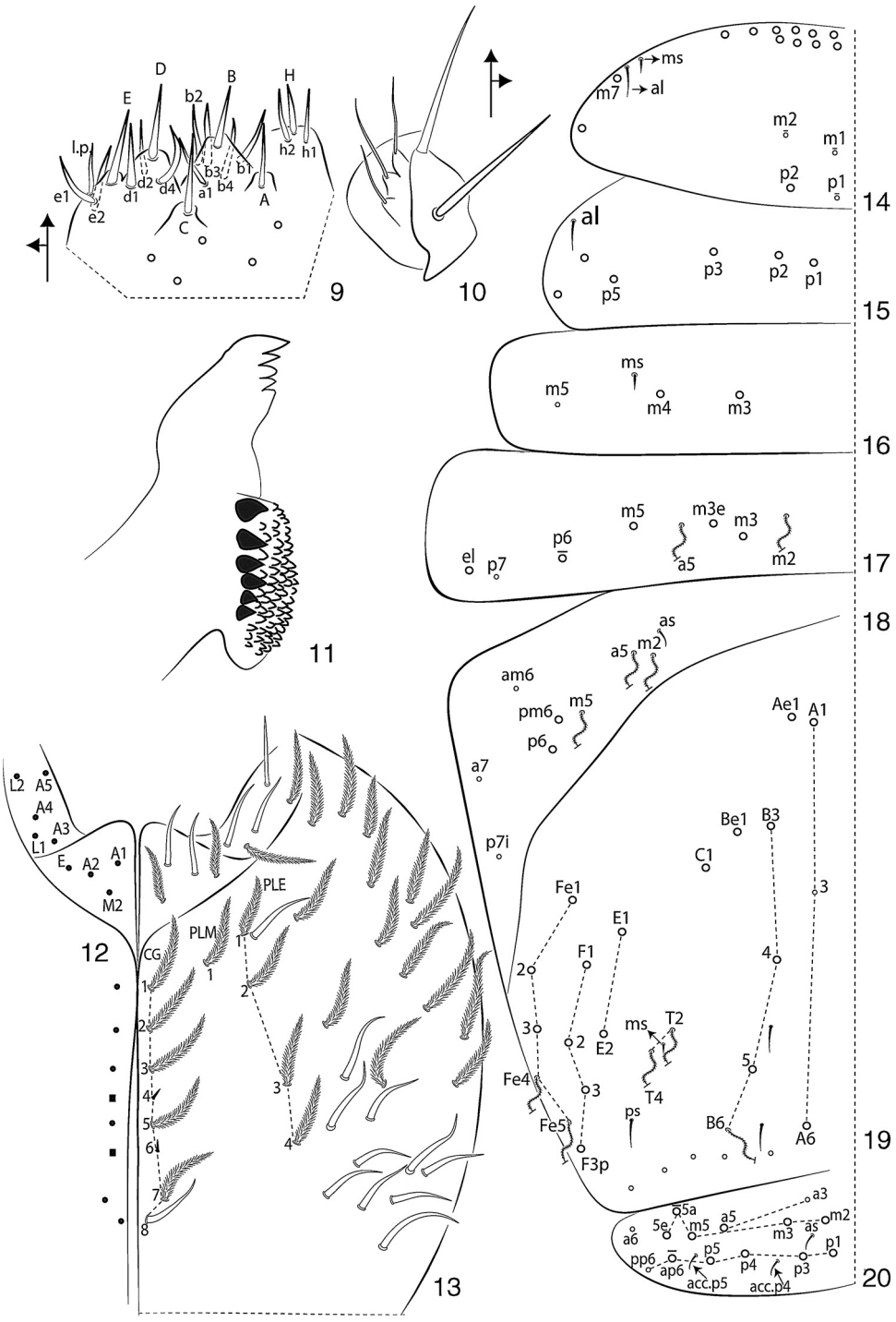
Etymology. Refers to its distinct color pattern resembling flowers (from Latin: *macula* = spot and *flos* = flower) (Fig. 1).

Distribution and habitat. This species was found only in the Amazon forest, Amazonas State, Brazil and in Good's biogeographic zone 26 of Neotropical region, Highlands of Eastern Brazil: North Brazilian (Good, 1974). The climate of the area is equatorial monsoonal (Am) (Kottek et al., 2006). This is the first species of *Salina* with rectangular mucro described from South America, and the first species of *Salina* described from Brazil.

Salina colombiana ***sp. nov.***

See Figs. 28–41.

Diagnosis. Distinguished by strong yellow color on body; dorsal head with **S6** mes. and without chaetae **An1a** and **M0**; Ant. I dorsally with 7 mac.; basomedian field with two ciliated chaetae (**M2** and **E**); Th. II to Abd. II respectively with 7 (**a5**, **m1-2**, **m4**, **p1-3**), 6 (**p1-5**), 3-4 (**m3-4**) and 3 (**m3**, **m3e**, **m5**,) central mac. per side; Abd. IV

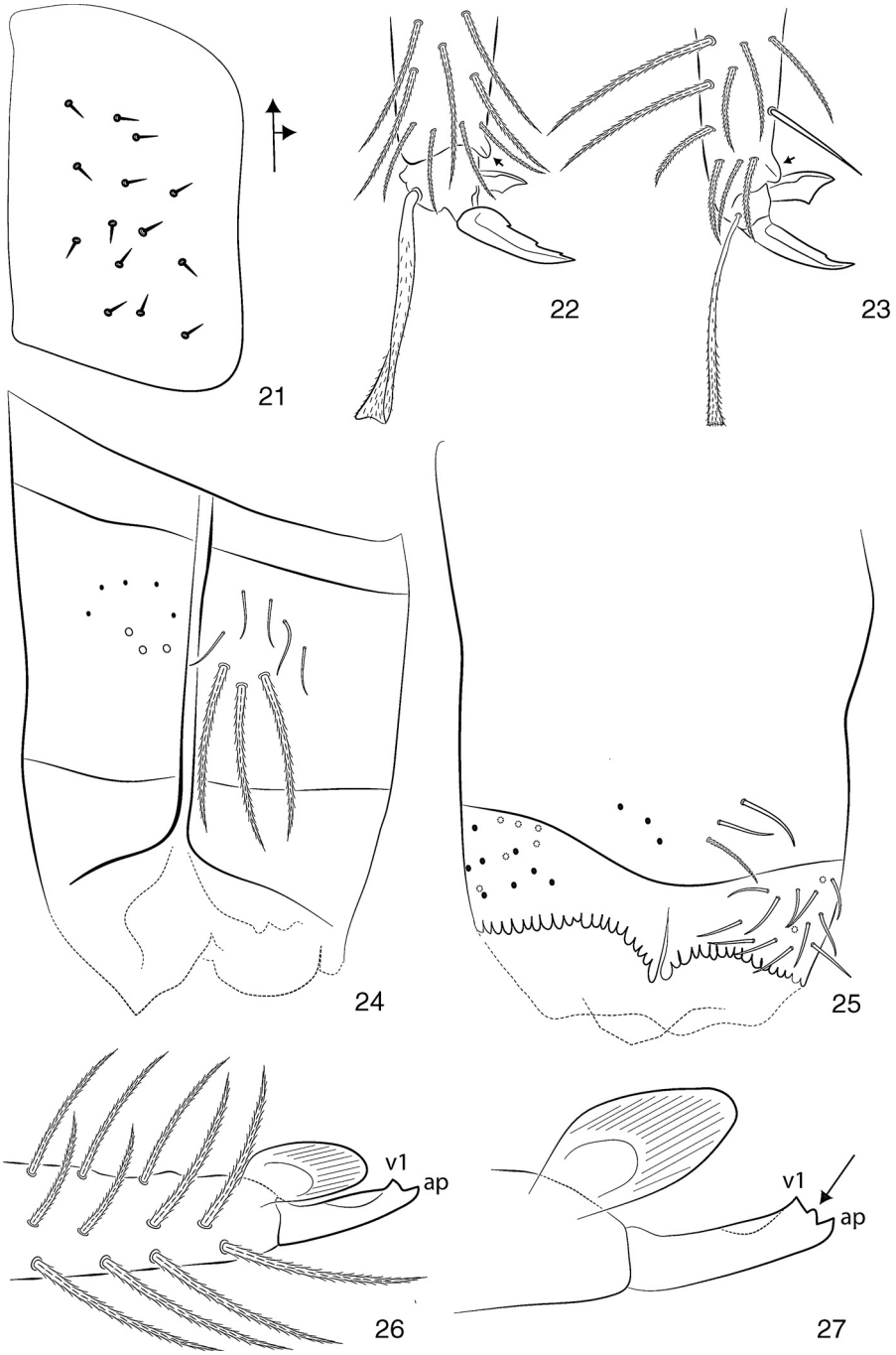


Figs. 9–20. *Salina maculiflora* sp. nov.: (9) labial palp; (10) maxillary outer lobe; (11) right and left mandibles (right molar plate omitted); (12) basomedian and basolateral field of labium; (13) head ventral chaetotaxy; trunk dorsal chaetotaxy: (14) Th. II, (15) Th. III, (16) Abd. I, (17) Abd. II, (18) Abd. III, (19) Abd. IV, (20) Abd. V.

with **A3** and **A4** mac.; collophore anterior side with 10 + 10 chaetae and posterior side with 5 + 5 chaetae (Figs. 28–31, 33–37, 40, 41).

Description. Total length of the holotype 2.25 mm. Habitus typically of paronellids of Cremastocephalini tribe (sensu Mitra, 1993) (Fig. 28). Specimens with strong yellow color covering the whole body; eyepatch area black (Fig. 28).

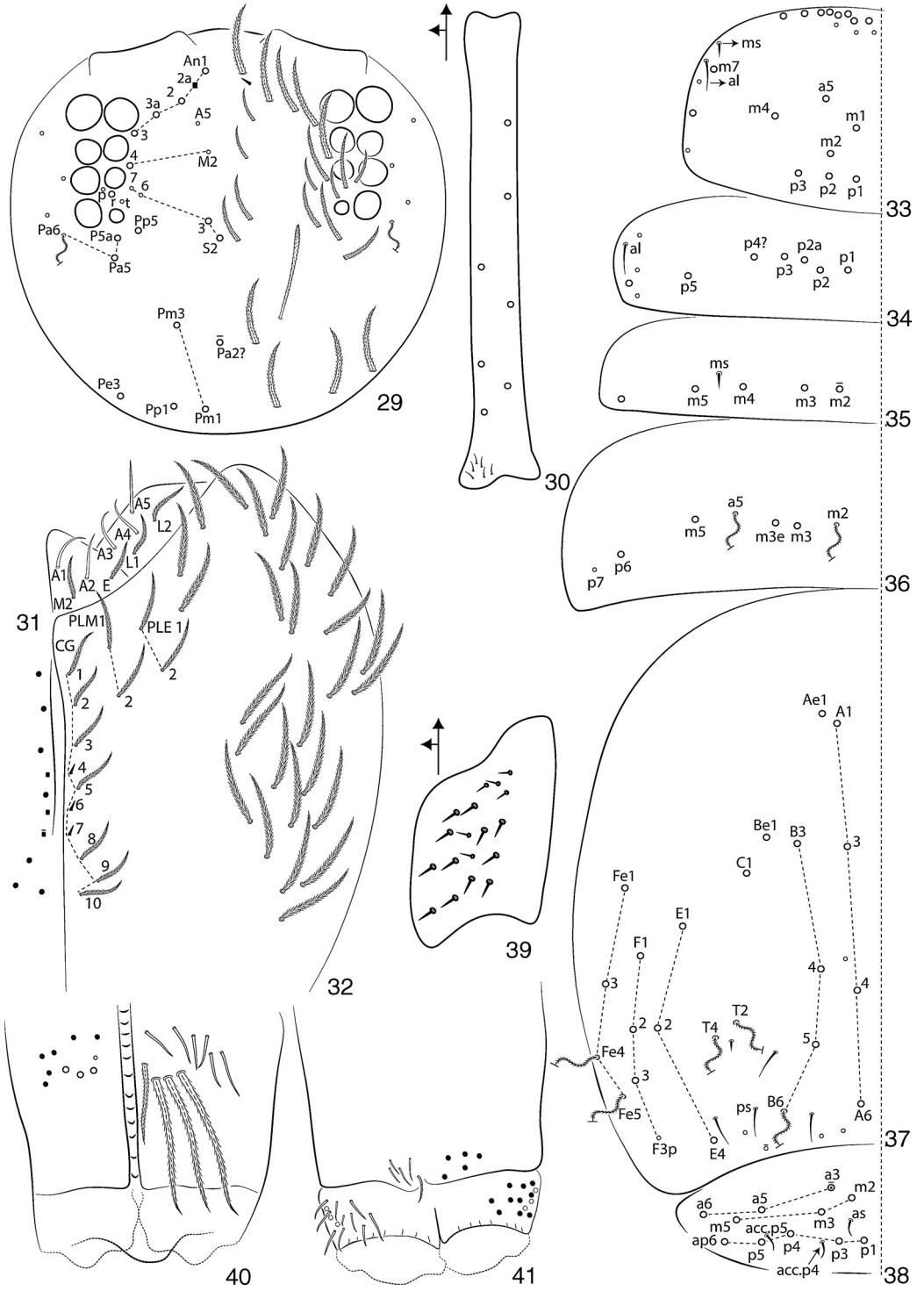
Head. Eyepatch oval, with largest ocelli A and B and smallest G and H, with three interocular ciliated chaetae (Fig. 29). Head dorsal chaetotaxy as in Fig. 29; antennal series 'An' with 5 + 5 chaetae, **An1**, **An2**, **An3a** and **An3** as mac., **An2a** as spine-like mic.; anterior series 'A' with **A5** mes.; medio-ocellar series 'M' with 2 + 2 chaetae, **M2** as mes. and **M4** as mac.; sutural series 'S' with 4 + 4 chaetae, **S2** and **S3** as mac., **S6** and **S7** as mes.; interocular series with 3 + 3 chaetae, **r** as mac., **p** and **t** as mes.; postoccipital anterior series 'Pa' with 3 + 3 or 4 + 4 chaetae, **Pa2?**, **Pa5** and one typical chaeta (**P5a**) as mac., **Pa6** as bothriotricum; postoccipital median series 'Pm' with 2 + 2 mac. (**Pm1** and **Pm3**); postoccipital posterior series 'Pp' with 1 + 1 mac. (**Pp1**); postoccipital external series 'Pe' with mac. **Pe3** present. Ant. IV with a simple apical bulb and smooth and ciliated chaetae (similar to *S. maculiflora* sp. nov., Fig. 4). Ant. I with 7 + 7 dorsal mac. and dorsal base with 6 + 6 sensillae-like smooth mic. (Fig. 30); Four prelabral ciliated chaetae and 14 labral smooth chaetae (4/5/5), four



Figs. 21–27. *Salina maculiflora* sp. nov.: (21) trochanteral organ; (22) distal tibiotarsus and foot I complex; (23) distal tibiotarsus and foot III complex; (24) collophore anterior side; (25) posterior and lateral side of collophore; (26) distal dens and mucro with two teeth; (27) distal dens and mucro with three teeth. 22-23, arrows indicate the monocondyle of the tibiotarsus.

Fig. 28. *Salina colombiana* **sp. nov.**: habitus of a specimen in ethanol.

anterior (**a1-2**), **a1** spine-like; five median (**m0-2**), and five posterior (**p0-2**) (similar to *S. maculiflora* sp. nov., Figs. 7 and 8). Labial palp with five smooth proximal chaetae and six papillae (A-E and H), A and C simple, H with two smooth guard appendages (**h1-2**), B with five (**a1**, **b1-4**), D with three (**d1-2** and **d4**), and E with lateral process (**l.p.**) smaller than the papilla and two smooth guard appendages (**e1-2**) (similar to *S. maculiflora* sp. nov., Fig. 9). Maxillary outer lobe with apical appendage (**a.a.**) and basal chaeta (**b.c.**) of same length, both smooth, sublobal plate with three internal smooth appendages (similar to *S. maculiflora* sp. nov., Fig. 10). Right mandible (ventral view) with four incisive teeth, left mandible with five teeth; both mandible with six molar teeth (Fig. 11). Basolateral



Figs. 29–41. *Salina colombiana* sp. nov.: (29) head dorsal chaetotaxy; (30) Ant. I dorsal chaetotaxy (left); (31) basomedian and basolateral field of labium; (32) head ventral chaetotaxy; trunk dorsal chaetotaxy: (33) Th. II, (34) Th. III, (35) Abd. I, (36) Abd. II, (37) Abd. IV, (38) Abd. V; (39) trochanteral organ; (40) collophore anterior side; (41) posterior and lateral side of collophore.

and basomedian field with chaetae **A1-5** smooth (A5 thickest), **M2**, **E**, **L1** and **L2** ciliated, **r** and **M1** absent (Fig. 31). Cephalic groove (CG) with 9 + 9 or 10 + 10 chaetae, 7 + 7 ciliated (**CG1-3**, **CG5**, **CG8-10**), **CG10** as ciliated or spine-like mic., **CG4**, **CG6** and **CG7** (present or absent) as spine-like mic.; medial postlabial (PLM) with 2 + 2 ciliated chaetae (**PLM1-2**); external postlabial (PLE) with 2 + 2 ciliated chaetae (**PLE1-2**). Head ventral chaetotaxy as in Fig. 32.

Thorax dorsal chaetotaxy. Th. II as in Fig. 33; series 'a' with 11 + 11unnamed chaetae of anterior collar, **a5** mac. present; S-microchaeta (**ms**), and one anterolateral sens. (**al**); medial series 'm' with 4 + 4 mac. (**m1**, **m2**, **m4** and **m7)** and 3 + 3 unnamed chaetae laterally; posterior series 'p' with 3 + 3 mac. (**p1-3**). Th. III as in Fig. 34; series 'p' with 7 + 7 mac. (**p1-5** and one unnamed); one anterolateral sens. (**al**), and three unnamed mes.

Abdomen dorsal chaetotaxy. Abd. I as in Fig. 35; series 'm' with 4 + 4 or 5 + 5 mac. (**m2-5** and one unnamed), **m2** present or absent, and one S-microchaeta (**ms**). Abd. II as Fig. 36; series 'a' with **a5** as bothriotricum; series 'm' with 4 + 4 chaetae, **m3**, **m3e** and **m5** as mac., **m2** as bothriotricum; series 'p' with 2 + 2 chaetae, **p6** as mac., **p7** as mes.; chaeta **el** absent. Abd. III as in Fig. 18 (the same to *S. maculiflora* sp. nov.); series 'a' with 3 + 3 chaetae, **a5** as bothriotricum, **a7** and **am6** as mes.; series 'm' with 2 + 2 bothriotricha (**m2** and **m5**); series 'p' with 3 + 3 chaetae, **p6** and **pm6** as mac., **p7i** as mes. One anterosubmedial sens. (**as**) present. Abd. IV as in Fig. 37; series 'A' with 4 + 4 mac. (**A1**, **A3**, **A4** and **A6**); series 'Ae' with **Ae1** as mac.; series 'B' with 4 + 4 chaetae, **B3-5** as mac., **B6** as bothriotricum; series 'Be' with **Be1** as mac.; series 'C' with **C1** as mac.; series 'T' with 2 + 2 bothriotricha (**T2** and **T4**), and one S-microchaeta (**ms**); series 'E' with 3 + 3 mac. (**E1-2** and **E4**); series 'F' with 4 + 4 chaeta, **F1-3** as mac., **F3p** as mes.; series 'Fe' with 4 + 4 chaetae, **Fe1** and **Fe3** as mac., **Fe4** and **Fe5** as bothriotricha; median region with one unnamed mes.; posterior margin with 3 + 3 to 5 + 5 unnamed mes., and four sens. present (**ps** and three unnamed). Abd. V as in Fig. 38; series 'a' with 2 + 2 or 3 + 3 chaetae, **a5-6** as mac., **a3** as mac. or mic. present or absent; series 'm' with 3 + 3 mac. (**m2-3** and **m5**); series 'p' with 5 + 5 mac. (**p1**, **p3-5** and **ap6**); one anterosubmedial sens. (**as**) and two accessory sens. (**acc.p4** and **acc.p5**) present.

Tergal S-chaetae formula 1, 0| 1, 0, 0, 1, 0 (**ms**) and 1, 1| 0, 0, 1, 4, 3 (**sens**) of Th. II to Abd. V (Figs. 33–38).

Legs. Trochanteral organ with 18 spine-like chaetae (Fig. 39). Unguis I-II (same morphology) with three unpaired inner teeth, a basal, a median and one at the apex (similar to *S. maculiflora* sp. nov., Fig. 22). Unguis III with one unpaired inner teeth near the apex (similar to *S. maculiflora* sp. nov., Fig. 23). Unguiculi trilamelate, lamellae inner truncate, lamellae external acuminate, both smooth edges. Tenent hairs capitate, weakly ciliated, present on pseudotarsus. All tibiotarsi with one socket monocondyle at the apex of tibiotarsus (Figs. 22 and 23). Tibiotarsus III with a smooth distal chaeta, near unguiculus base (Fig. 23).

Collophore. Anterior side with 3 + 3 long ciliated mac., 1 + 1 ciliated mes. and 6 + 6 smooth mic.; posterior side with 4 + 4 smooth mic. and 1 + 1 ciliated; lateral side with 13 + 13 smooth mic. (Figs. 40 and 41).

Furcula. Dens with rows of ciliated chaetae and mucro two teeth, **d1** and **v1** (4 out of 5 specimens) and sometimes with one reduced accessory teeth present (**ap**) (1 out of 5 specimens) (Figs. 26 and 27).

Type material. Holotype female, on slide deposited in ICN/UNAL: Colombia, Nariño, San Andres de Tumaco municipality, University campus (01°48′N; 78°452′W), Andean Region, 4-14.iii.2015, 3 m, Malaise trap, Animal Taxonomy students coll. Paratypes on slides deposited in ICN/UNAL: 1 male, 2 females and in alcohol 31 specimens in ethanol, same data as holotype. Paratypes on slide N° COLLE 041A-C/INPA: 3 females and in 10 specimens in ethanol, same data as holotype.

Other examined material. 1 female and 1 immature on slide, Colombia, Guaviare Department, San José del Guaviare municipality (02°34′06″N; 72°41′36″W), 18.iv.2013, 192 m, Malaise trap, Animal Taxonomy students coll. 1 male and 1 female on slide and 7 specimens in ethanol, Playa Guio, 14.iv.2013. All deposited in ICN/UNAL.

Etymology. Refers to its type locality, in Colombia.

Distribution and habitat. This species was found in areas of Amazon forest, Guaviare Department and low Andes Region, Tumaco municipality, both in equatorial area of Colombia. These locations are situated respectively in Good's biogeographic zone 26 and 28 of Neotropical region (Good, 1974). The climate of the area is "Af" tropical rain florest climate, characterized by high humidity (Kottek et al., 2006). The new species represents the first record of *Salina* with rectangular mucro from Colombia.

Discussion

Recently, Zhang et al. (2015) proposed a great change in Entomobryoidea taxonomy by supporting tergal specialized chaetae (S-chaeta) as the strongest morphological character for separating genera, what led to many classification changes within its families and subfamilies. *Salina* is also included in this context and its S-chaetae pattern of Th. II to Abd. V= 1, 1| 0, 0, 1, 3 (**sens**) (excluding Abd. IV, see Zhang et al. 2015), was corroborated in *S. maculiflora* sp. nov. and *S. colombiana* sp. nov. This character and other features, such as the S-microchaetae pattern of Th. II to Abd. V= 1, 0| 1, 0, 0, 1, 0 (**ms**), revealed here for the first time in *Salina*, have often been omitted in many species descriptions (Mitra, 1973, 1993; Yoshii, 1981, 1983; Soto-Adames, 2010). Therefore, we argue they should be further investigated in the genus, as they have been useful to separate other Entomobryoidea (Jantarit et al., 2013; Zhang and Deharveng, 2015).

In this sense, the species groups of *Salina* recently proposed by Soto-Adames (2010), must also be further phylogenetically analyzed, especially in a phylogenetic context, because morphological characteristics used in their diagnoses are unstable (Table 1). For example, in the *beta* group (species with rectangular mucro), the basomedian field has only smooth chaetae, but the two new species, which also present rectangular mucro, *S. maculiflora* sp. nov. and *S. colombiana* sp. nov. have two ciliated chaetae (**M2** and **E**) (typical *celebensis* group sensu Yoshii, 1981, 1983).

Another example is seen on Abd. II dorsal chaetotaxy, which was first proposed by Mitra (1973), modified and Yoshii (1981, 1983) and partly followed by Soto-Adames (2010) for the separation of *Salina* groups, was based on the following central mac. formulas: 1,1 (**m3** and **m5**); 2,1 (**m3**, **m3e** and **m5**) and 2,2 (**m3**, **m3e**, **m5**, **a6?**) for *beta*, *celebensis* and *borneensis* group, respectively (the last two have a square mucro). In *S. maculiflora* sp. nov. and *S. colombiana* sp. nov. the Abd. II has 2,1 central mac. (typical of *celebensis* group), while in *S. fasciata* (Handschin, 1928), from Indonesia, and with a rectangular mucro (after Yoshii, 1983: 23) the Abd. II has 2,2 central mac. (typical of *borneensis* group) (Table 1).

Thus, it is clear that the separation of species groups based on the presence or absence of two chaetae (**a6?**, **m3e**) on Abd. II is insufficient, since the remaining characteristics, such as basomedian field chaetae type, are variable within groups. Therefore, for instance, the only character able to separate *Salina* species groups may be the mucro: rectangular mucro with two main teeth (**d1** and **v1**) and one reduced or absent accessory tooth (**ap**) (*beta* group), or square mucro with three main teeth (**d1**, **ap** and **v1**) and a reduced or absent basal tooth (**v2**) (*celebensis* group).

Within the *beta* group and apart from Abd. II mac. formula, *S. maculiflora* sp. nov. resembles *S. wolcotti* Folsom, 1927 (see Soto-Adames, 2010) in the color pattern with flower-shaped spots, collophore anterior side with 3 + 3 long ciliated mac., dorsal chaetotaxy of Th. III, and Abd. I respectively with 4 + 4 and 2 + 2 central mac. (Table 1). However, *S. maculiflora* sp. nov. differs from this species by Ant. I dorsally with 4 mac. (3 in *S. wolcotti*) and 6 sensillae-like smooth mic. (4 in *S. wolcotti*), four prelabral chaetae (two in *S. wolcotti*), and collophore posterior side with 3 + 3 smooth chaetae (1 + 1 in *S. wolcotti*) (Table 1). In addition, *S. maculiflora* sp. nov. also differs in Th. II dorsal chaetotaxy with 1 + 1 (**p2**) central mac. (5 + 5 in *S. wolcotti*), and Th. III with 1 + 1 extranumerary mac. anterolaterally (none in *S. wolcotti*).

Salina colombiana sp. nov. resembles *S. thibaudi* Soto-Adames, 2010 by the chaetotaxy pattern of Th. II-III with 7 and 6 central mac., respectively, Abd. I with 3-4 central mac., and cephalic groove (CG) and post medial labial (PLM) chaetotaxy (Table 1). Conversely, *S. colombiana* lacks dark-colored patterns on the body (present in *S. thibaudi*), and Ant. I with 7 mac. (4 in *S. thibaudi*), Abd. I with 2 + 2 or 3 + 3 central mac. (**m2-4**) anterior to S-microchaeta (**ms**)

Table 1
Comparison of morphological characters among selected species of *Salina* and their species groups.

Species	Species group	Ant. I DM	Th. II CM	Th. III CM	Abd. I CM	Abd. II CM	Collophore posterior chaetae	Unguiculus shape	Mucro shape/No of teeth
S. maculiflora **sp. nov.** BR	*beta*	4	1	4	2	2, 1 [m3, m3e, m5]	3 + 3	Truncate	Rectangular 2–3 teeth
S. colombiana **sp. nov.** CO	*beta*	7	7	6	3 (4)	2, 1 [m3, m3e, m5]	5 + 5	Truncate	Rectangular 2–3 teeth
S. fasciata[b] ID	*beta?*	?	5	8	6	2, 2 [m3, m3e, m5, a6?]	?	Truncate	Rectangular 3 teeth
S. beta[e] USA	*beta*	2	4	5	4	1, 1 [m3, m5]	1	Truncate	Rectangular 3 teeth
S. thibaudi[e] CR	*beta*	4	7 (8)	6 (5–9)	4 (3–6)	1, 1 [m3, m5]	3 + 3 (3–6)	Truncate	Rectangular 2–3 teeth
S. wolcotti[e] PR	*beta*	2–3	3 (3–5)	4 (2–4)	2 (2–3)	1, 1 [m3, m5]	1 + 1	Truncate	Rectangular 2–3 teeth
S. celebensis[a,e] CR, PR	*celebensis*	?	1	2	2	2, 1 [m3, m3e, m5]	8 + 8	Truncate	Square 3 teeth
S. dedoris[c,e] CO	*celebensis*	4	6	8	3	2, 1 [m3, m3e, m5]	2 + 2 (0–2)	Truncate	Square 3–4 teeth
S. mulcahyae[d,e] USA	*borneensis*	?	?	?	13	2, 2 [m3, m3e, m5, a6?]	?	Lanceolate	Square 3 teeth
S. saikehi[b] ID	*borneensis*	?	0	2	4	2, 2 [m3, m3e, m5, a6?]	9 + 9	Truncate	Square 3 teeth

Abbreviations and symbols used to represent the morphological characteristics: DM, dorsal mac.; CM, central mac.; BR, Brazil; CO, Colombia; CR, Costa Rica; ID, Indonesia; PAN, Panama; PR, Puerto Rico; USA, United States;?, unknown; (), chaetal variation; [], chaetal nomenclature.

[a] Yoshii (1981).
[b] Yoshii (1983).
[c] Mari-Mutt (1987).
[d] Christiansen and Bellinger (1998).
[e] Soto-Adames (2010).

(4 + 4 in *S. thibaudi*), and Abd. IV with 8 + 8 lateral mac. (10 + 10 in *S. thibaudi*).

After the new species described here, *Salina* now has seven species of *beta* group from the New World, which can be identified in the following key.

Key to Nearctic and Neotropical species of *Salina* with rectangular mucro (in part, after Soto-Adames, 2010)

1. Abd. II with 2 + 2 central mac. (m3 and m3e) (Figs. 7 and 37) . . . 2
1′. Abd. II with 1 + 1 central mac. (m3) . . . 3
2. Th. II with 1 + 1 central mac. (p2); Th. III with 4 + 4 central mac. (p1, p2, p3 and p5) (Figs. 4 and 5); Brazil . . . *S. maculiflora* **sp. nov**.
2′. Th. II with 7 + 7 central mac. (a5, m1, m2, m4, p1, p2 and p3); Th. III with 6 + 6 central mac. (p1, p2, p2a, p3, p3e and p5) (Figs. 34 and 35); Colombia . . . *S. colombiana* **sp. nov.**
3. Abd. II and IV with dark and light blue transversal bands, respectively; Th. II with 4 + 4 central mac.; Th. III with 5 + 5 central mac.; USA . . . *S. beta* Christiansen and Bellinger, 1980
3′. Abd. II and IV without transversal bands; Th. II with 3 + 3 to 8 + 8 central mac., but if 4 + 4 then Th. III with 4 + 4 or less mac. . . . 4
4. Th. II to Abd. I with mac. formula 5, 5, 3; Cuba . . . *S. ventricolor* Gruia, 1983
4′. Th. II to Abd. I with mac. formula never 5, 5, 3 . . . 5
5. Th. II-III with 3 + 3 to 5 + 5 and 2 + 2 to 4 + 4 central mac., respectively, general formula 3, 4; collophore with 1 + 1 posterior chaetae; Puerto Rico . . . *S. wolcotti* Folsom, 1927
5′. Th. II-III with 5 + 5 or more central mac.; collophore with 2 + 2 to 6 + 6 posterior chaetae . . . 6
6. Prelabral chaetae two; Th. III with 5 + 5 to 6 + 6 central mac.; collophore with 2 + 2 posterior chaetae; Costa Rica and USA . . . *S. bidentata* (Handschin, 1927)
6′. Prelabral chaetae four; Th. III with 5 + 5 to 9 + 9 central mac.; collophore with 3 + 3 to 6 + 6 posterior chaetae; Costa Rica . . . *S. thibaudi* Soto-Adames, 2010

Conflicts of interest

The authors declare no conflicts of interest.

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