Acarologia 51(2): 219–227 (2011)
DOI: 10.1051/acarologia/20112010

A NEW SPECIES OF LARVAL *CHARLETONIA* (PARASITENGONA: ERYTHRAEIDAE) AND NEW RECORDS OF LARVAL ERYTHRAEIDAE PARASITIZING ORTHOPTERA AND PHASMIDA FROM COSTA RICA

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(Received 08 February 2011; accepted 01 April 2011; published online 30 June 2011)

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ABSTRACT — A total of 36 larvae were captured parasitizing 4 species of Tettigoniidae (Orthoptera, Ensifera) and two phasmids (Phasmatodea) in the "Reserva Biológica Alberto Manuel Brenes" in Costa Rica. Here, we report the second capture of two species of mites since their original descriptions *Leptus nikanori* Haitlinger, 2000 (Erythraeidae) from Costa Rica and *Charletonia domawiti* Haitlinger, 2004 (Erythraeidae) from Brazil and each only known from a single specimen. We also describe and illustrate *Charletonia salazari* **sp. nov.** captured parasitizing *Scopiorinus mucronatus* (Saussure and Pictet, 1898) (Orthoptera, Tettigoniidae, Pseudophyllinae). A key for the species of the genus *Charletonia* from the New World is provided.

KEYWORDS — Acari; Erythraeidae; *Leptus nikanori*; *Charletonia domawiti*; *Charletonia salazari* **sp. nov.**; Central America

INTRODUCTION

We are presenting the data of mites parasitizing orthopteroids that were collected in a 15 days field trip in "Reserva Biológica Alberto Manuel Brenes (R.B.A.M.B.)" and the surrounding areas of the preserve. The preserve is located in Sierra de Tilarán, Cantón of San Ramón, Alajuela Province in Costa Rica. The specimens were captured under the auspices of the grant "Inventory of the arthropods of the Reserva Biológica Alberto Ml. Brenes" (INVARTRAB) and developed by the collaboration between the University of Costa Rica and I.N.I.A. (Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria) (Spain).

Several orders of arthropods were collected by different specialists. Approximately, five hundred orthopteroids were sampled, either manually from vegetation or using light traps. From over these orthopteroids sampled only six were parasitized. A total of 36 larvae were removed from 4 species of Tettigoniidae (Orthoptera, Ensifera) and two phasmids (Phasmatodea) (one *Planudes* sp. nymph and one *Brizoides* sp. adult): *Scopiorinus mucronatus* (Saussure and Pictet, 1898) (Tettigoniidae, Pseudophyllinae), *Lophaspis scabricula* Brunner von Wattenwyl, 1895 (Tettigoniidae, Pseudophyllinae) (Figure 1), *Idiarthron hammuliferum* (Saussure and Pictet, 1898) (Tettigoniidae, Pseudophyllinae), *Neoconocephalus triops* Linnaeus, 1758 (Tettigoniidae, Conocephallinae).

FIGURE 1: *Lophaspis scabricula* Brunner von Wattenwyl, 1895 (Tettigoniidae, Pseudophyllinae) parasitized by *Leptus nikanori* Haitlinger, 2000.

All the parasites captured belong to Erythraeidae Robineau-Desvoidy, 1828 and they are grouped into two genera, *Leptus* Latreille, 1796 and *Charletonia* Oudemans, 1910. These two genera are distributed world-wide but what is known for Central America is very scarce. Here, we report the second capture of two species since their original descriptions *Leptus nikanori* Haitlinger, 2000 from Costa Rica and *Charletonia domawiti* Haitliger 2004 from Brazil and both known from a single specimen; also, we describe a new species belonging to *Charletonia* and parasitizing *Scopiorinus mucronatus*.

MATERIALS AND METHODS

Mites were captured during a sampling field trip in Costa Rica while they were parasitizing different species of orthopterans. The complete list of Orthoptera identified has been published in two papers (Barranco, 2010a; Barranco, 2010b). Katydids were collected and identified, and the parasites were carefully removed in the laboratory under a stereomicroscope. Measurements and illustrations were made after clearing the specimens in 50% lactic acid and mounting them in PVA medium (Krantz and Walter, 2009) using a Nikon Optiphot-2 compound microscope with a drawing attachment. All the measurements are given in micrometers. Terminology and abbreviations for the description of the new species follow Saboori *et al*., (2009) and Sedghi *et al*., (2010).

FAMILY ERYTHRAEIDAE ROBINEAU-DESVOIDY, 1828

Subfamily Leptinae Southcott, 1957

Genus *Leptus* Latreille, 1796

Leptus nikanori Haitlinger, 2000

Material examined — Twelve larvae, Colonia Palmareña. San Ramón, Alajuela, Costa Rica. 21-IX-2006. P. Barranco leg. On *Scopiorinus mucronatus*. P. Barranco det. (R-249B-D, R-249G-I, R-249M-R); 3

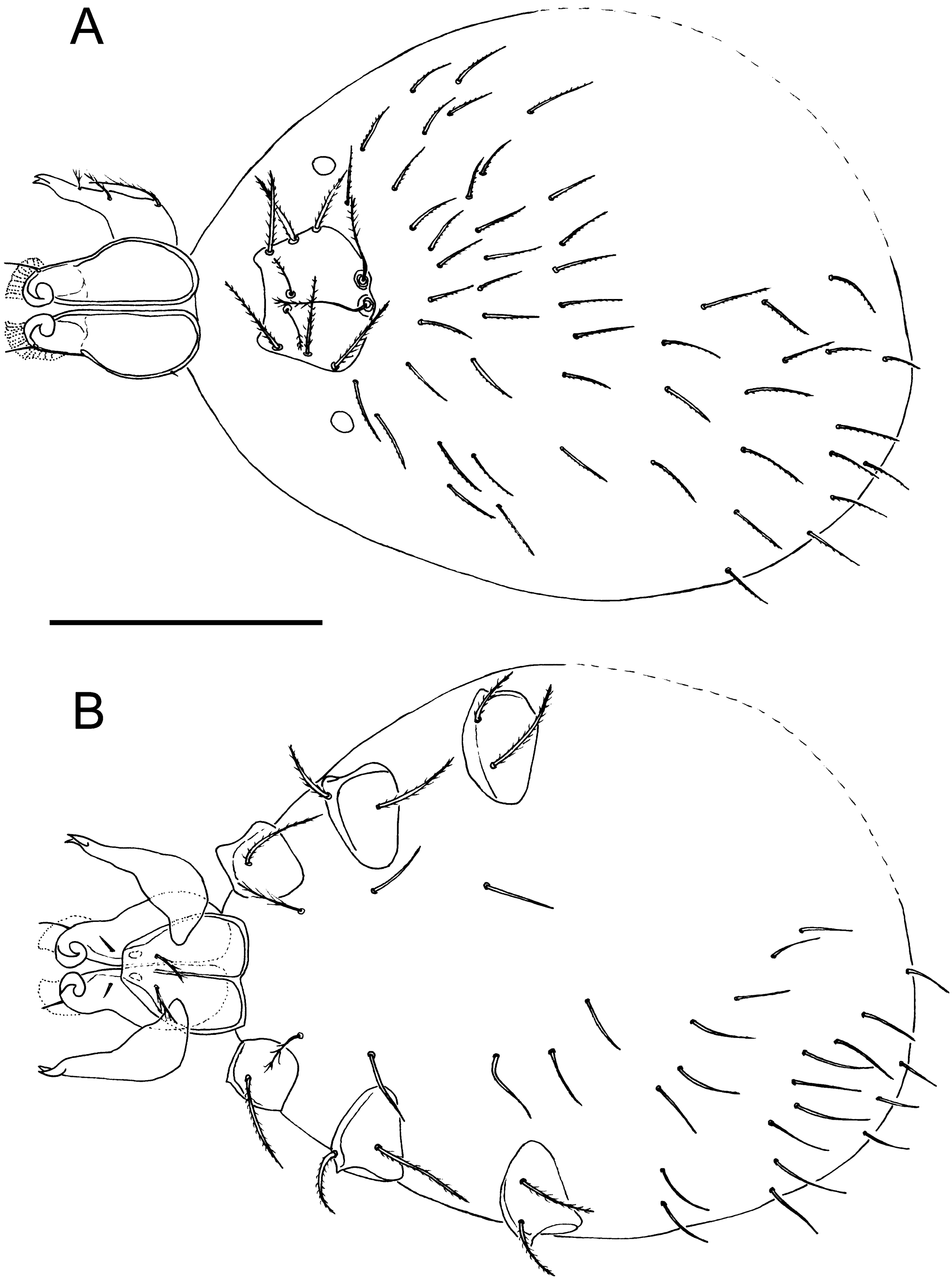

FIGURE 2: *Charletonia salazari* **sp. nov.** (larvae). A – idiosoma dorsal view; B – idiosoma ventral view. Scale bar 200 μm.

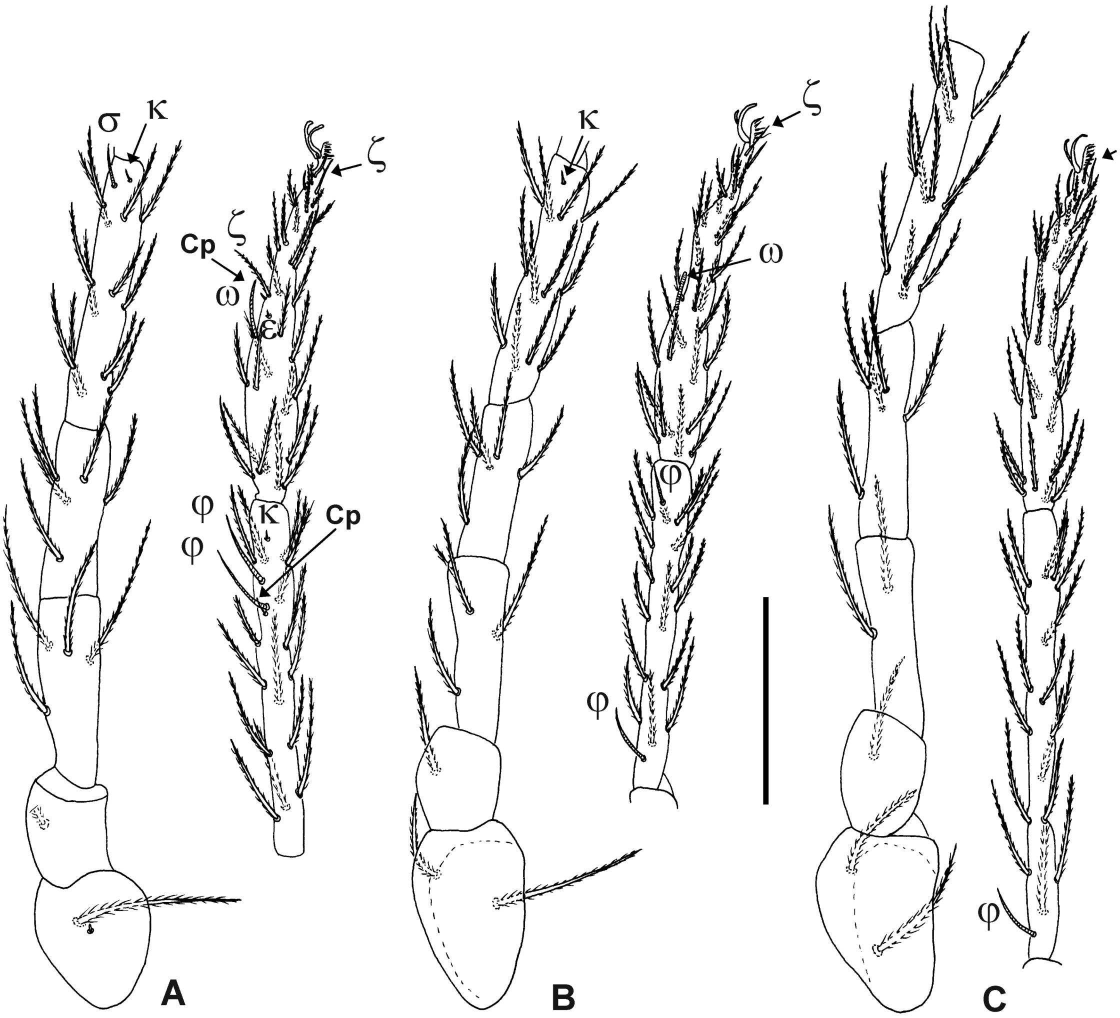

FIGURE 3: *Charletonia salazari* **sp. nov.** (larvae). A – Leg I; B – Leg II; C – Leg III. Scale bar 100 μm.

larvae, R.B.A.M.B. San Ramón, Alajuela, Costa Rica. 23-IX-2006. P. Barranco leg. On *Lophaspis scabricula*. P. Barranco det. (R-260A-C); 1 larva, R.B.A.M.B. San Ramón, Alajuela, Costa Rica. 23-IX-2006. P. Barranco leg. On *Idiarthron hammuliferum* Beier, 1960. P. Barranco det. (R-258); 1 larva, R.B.A.M.B. San Ramón, Alajuela, Costa Rica. 19-IX-2006. P. Barranco leg. On *Brizoides* sp. phasmid (R-261); 10 larvae, R.B.A.M.B. San Ramón, Alajuela, Costa Rica. 15-IX-2006. P. Barranco leg. On *Planudes* sp. phasmid nymph (R-259A-J).

Remarks — We found *L. nikanori* in two areas sampled, inside the R.B.A.M.B. and in the surrounding area of Colonia Palmareña. This species was relatively common inside of the preserve. These two areas differ in the type of vegetation and in the species of orthopterans present (Barranco, 2010a, 2010b). *Leptus nikanori* was found on the two different hosts Phasmida and Orthoptera. We captured a total of 16 larvae parasitizing 3 species of katydids and 11 larvae parasitizing 2 species of phasmids. This species was originally described from Irazú, Costa Rica on plants (Haitlinger, 2000) from a unique larva; since morphometric data is only known for the holotype, we are presenting the metric information for the 27 exemplars we captured from San Ramón, Alajuela, Costa Rica (Table 1). This is the second time that this species is captured and it is only known from Costa Rica.

TABLE 1: Metric data (in micrometers) for *Leptus nikanori* (larvae) from Costa Rica.

Character	*L. nikanori*	Character	*L. nikanori*
L	90-116	**TFe I**	99-148
W	108-135	**Ge I**	135-193
AW	85-99	**Ti I**	203-280
PW	99-121	**Ta I**	158-216
AA	14-18	**Cx II**	97-117
SB	14-18	**Tr II**	54-72
ISD	63-74	**BFe II**	99-135
AP	18-27	**TFe II**	90-135
AL	72-87	**Ge II**	117-166
PL	77-99	**Ti II**	176-256
AM	43-54	**Ta II**	144-175
S	54-77	**Cx III**	95-112
DS	45-70	**Tr III**	54-81
GL	216-256	**BFe III**	104-157
1b	90-108	**TFe III**	108-162
2b	32-52	**Ge III**	126-180
3b	45-67	**Ti III**	248-351
Cx I	72-99	**Ta III**	158-202
Tr I	50-67	**IP**	2558-3306
BFe I	108-162		

Subfamily Callidosomatinae Southcott, 1957

Genus *Charletonia* Oudemans, 1910

Charletonia domawiti Haitlinger, 2004

Material examined — Three larvae, R.B.A.M.B. San Ramón, Alajuela, Costa Rica. 16-IX-2006. P. Barranco leg. On *Neoconocephalus triops*. P. Barranco det. (R-247A-C).

Remarks — These exemplars captured from Costa Rica (247A–C) are identical to the specimen known of *C. domawiti* (Haitlinger, 2004). This species was described from a single specimen from plants and no further captures have been reported. Here, we provide metric data for the three specimens captured in Costa Rica (Table 2). The only differences found between the specimens from Costa Rica and Brazil are a slightly shorter BFe I (148-158 *vs.* 172) and BFe III (153-166 *vs.* 180). This is the second report of *C. domawiti*, the first out of Brazil. The host is also wide-spread from south of North America to Peru and Brazil (Barranco, 2010a).

Charletonia salazari sp. nov.
Figs. 2-4, Table 2

Material examined — Holotype, larva, Colonia Palmareña, San Ramón, Alajuela, Costa Rica. 21-IX-2006. P. Barranco leg. On *Scopiorinus mucronatus*. P. Barranco det. (R-249A); Paratypes, 5 larvae, same location, collector and host as holotype (R-249E, F, J, K, L). Holotype and one paratype are deposited in the Museum of Universidad de Costa Rica, two paratypes are deposited in "Museo Nacional de Ciencias Naturales de Madrid" (MNCN-CSIC) in Spain; two paratypes are deposited in the author's collection.

Description based on holotype — Color in life red. Idisoma ovoid, 560 μm long and 420 μm wide, total length of the animal from the tip of the chelicerae to posterior pole of idiosoma 682 μm.

Dorsum — Bears 52 idiosomalae, apically pointed, lightly barbed and arranged in transverse rows across idiosoma (Figure 2). One eye on each side of the idiosoma, cornea circular, 20 μm across. Dorsal scutum wider than long, with a concave anterior border, convex posterior border and antero- and posterolateral angles rounded. Three pairs of scutalae (AL > ML = PL) and two pairs of sensillae with fine setules in only distal half. Anterior pair of sensillae (AM) shorter than the posterior ones (S).

Venter — Idisoma with a pair of setae between coxae I, with long ciliations as figured; between coxae II a pair of pointed ciliate setae; in the area between coxae II and III four setae, tapering, pointed and ciliate (Figure 2). Measurements for these setae are included in Table 2. Behind coxae III, 20 setae, arranged approximately in three rows 8 (2+4+2), 8 (3+2+3), 4.

Gnathosoma — Galeala spiniform, nude, 31 μm long. Anterior hypostomala slender, nude, 16 μm long; posterior hypostomala with setules, 34 μm

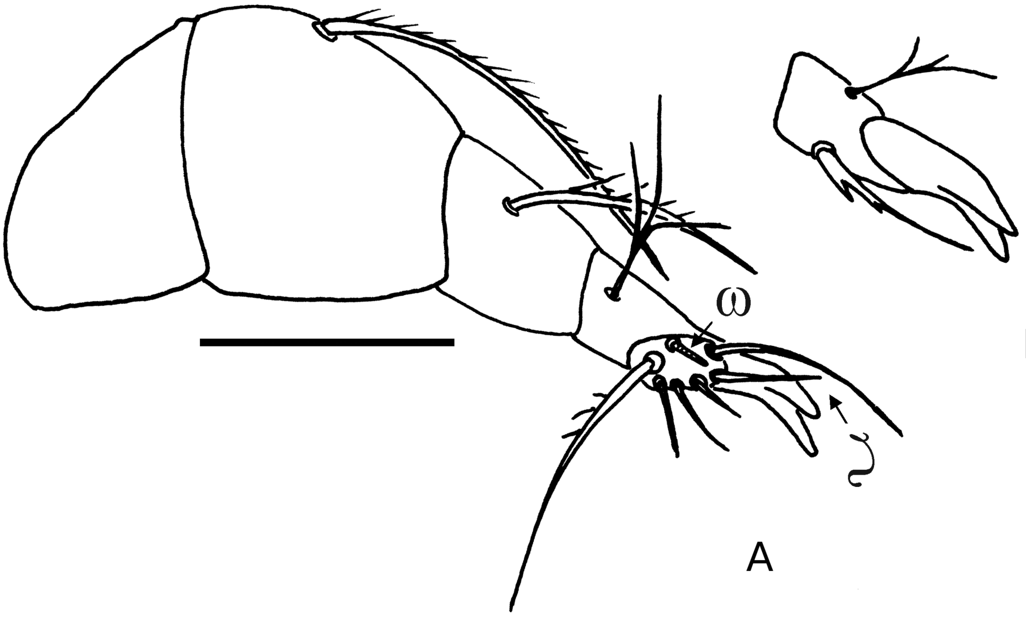

FIGURE 4: *Charletonia salazari* **sp. nov.** (larvae). A – palp dorsal view; B – palp tibia ventral view. Scale bar 15 μm.

long. Chelicerae bases rounded, chelicerae blades curved with a tiny secondary tooth at the apical end. Palpal supracoxala present, 9 μm long. Palpal setal formula: 0-B-B-BBB_2-4NB$\omega\zeta$ (Figure 4).

Leg setal formula — Leg I: Ta-1ω, 2ζ, 1ϵ , 1Cp, 25B, 2N; Ti-2φ, 1κ, 1 Cp, 15B; Ge-1σ, 1κ, 12B;TFe-5B; BFe-4B;Tr-1B, Cx-1B, Sx (Figure 3A). Leg II: Ta-1ω, 1ζ, 26B, 2N; Ti-2φ, 16B; Ge-1κ, 12B; TFe-5B; BFe-4B;Tr-1B, Cx-2B (Figure 3B). Leg III: Ta-, 1ζ, 28B,2N; Ti-1φ, 16B; Ge-12B; TFe-5B; BFe-2B; Tr-1B, Cx-2B (Figure 3C).

IP=775+721+854=2350

Measurements for the holotype and paratypes are given in Table 2.

Remarks — *Charletonia salazari* **sp. nov.** belongs to the group of species with four setae between coxae II-III. This group includes species described from Europe, Africa, Asia, Australia and America. The genus *Charletonia* is barely known from the New World and there are 7 species reported, one from Central America, two from South America and 4 from North America (Southcott, 1991; Haitlinger, 2000; Haitlinger, 2004; Treat and Flechtmann, 1979). All of them belong to the group with four setae between coxae II-III. The new species belongs to the species group with four setae between coxae II-III, two hypostomalae, solenidion placed distally on Ge I, fn Ge 12,12,12 and Ti III 200 – 255 μm. In this group the following species are included, *C. enhoffi* Southcott, 1991, *C. froggatti* Oudemans, 1910, *C. feideri* Southcott, 1966, *C. rageaui* Southcott 1966, *C. paolii* Southcott, 1966, *C. aerolata* (Tragardh 1908), *C. banksi* Southcott, 1966, *C. grandpopensis* Hailinger, 2007 and *C. hunanensis* Zheng, 1996 (Southcott, 1966; Southcott, 1991; Zheng, 1996; Haitlinger, 2007). It is possible to distinguish all these species from *C. salazari* **sp. nov.** because of its unique tibia setae formula (fn Ti). Also, they differ from the new species in the following characters.

It differs from *C. enhoffi* in the number of dorsal setae (52 *vs.* 76), ventral setae (28 *vs.* 40), the number of barbed seta on Ti I (15 *vs.* 17), Ti II (16 *vs.* 18) or Ti III (16 *vs.* 18) and posterior hypostomala with setules *vs.* nude; by shorter AW (72 – 81 *vs.* 86 – 91), ISD (54 – 63 *vs.* 73 – 77), L (86-97 *vs.* 105 – 110), AM (42 – 52 *vs.* 70 – 75), S (72 – 90 *vs.* 116 – 129), Ti I (162

TABLE 2: : Metric data (in micrometers) for *Charletonia salazari* **sp. nov.** (larvae) and *C. domawiti* (larvae). H: holotype, P1-P5: paratypes 1-5.

Character				*C. salazari* **sp. nov.**				*C. domawiti*
	H	**P1**	**P2**	**P3**	**P4**	**P5**	**Range**	**Range**
IL	560	-	-	-	-	-	560	822-910
IW	420	-	-	-	-	-	420	420-507
AW	77	81	77	77	77	72	72-81	81-95
MW	93	99	90	90	90	88	88-93	100-117
PW	112	117	112	108	112	106	106-117	117-135
AA	14	14	14	12	12	12	déc-14	16-18
SB	20	20	20	20	20	18	18-20	23-30
AAS	27	27	23	29	27	25	23-29	32-36
ISD	60	63	54	58	60	54	54-63	83-90
L	92	95	86	97	96	86	86-97	121-130
W	119	126	117	115	117	115	115-126	120-144
AP	48	49	45	49	45	45	45-49	59-72
AL	70	70	67	67	72	-	67-72	77-85
ML	59	59	59	60	60	54	54-60	63-72
PL	59	54	59	59	60	56	54-60	63-65
AM	50	50	-	45	50	52	45-52	68-70
S	74	90	-	76	72	78	72-90	99
DS	40-59	40-56	-	-	40-60	36-56	36/40-56/60	36/45-67/81
Oc	20	22	-	18	18	18	18-22	18-20
GL	148	148	148	148	148	148	148	176-184
1a	45	45	-	45	45	-	45	68-72
2a	65	63	-	67	63	-	63-67	85-90
1b	92	90	90	86	90	90	86-92	100-117
$2b_1$	81	85	81	77	85	77	77-85	85-94
$2b_2$	45	-	45	52	52	50	45-52	54-63
$3b_1$	72	70	-	-	68	63	63-72	81-90
$3b_2$	45	45	-	45	45	45	45	56-63
Cx I	81	85		77	72	78	72-85	86-95
Tr I	54	54	54	58	54	54	54-58	72
BFe I	99	112	95	104	99	90	90-112	148-158
TFe I	72	81	76	77	72	76	72-81	108-126
Ge I	140	135	135	133	135	126	126-140	194-211
Ti I	167	168	175	166	171	162	162-175	288-315
Ta I	162	162	162	158	162	158	158-162	202-207
Cx II	86	86	90	81	81	90	81-90	104-108
Tr II	54	58	58	54	58	58	54-58	77
BFe II	90	94	90	94	94	90	90-94	121-140
TFe II	68	76	-	72	68	68	68-76	99-113
Ge II	117	126	-	117	121	113	113-126	162-189
Ti II	153	157	-	149	153	140	140-157	243-275
Ta II	153	157	-	153	153	144	144-157	194-203
Cx III	85	94	-	94	94	81	81-94	112-117
Tr III	63	67	-	69	68	63	63-69	81-90
BFe III	103	95	-	99	95	99	98-103	153-166
TFe III	90	99	-	94	90	90	90-99	133-144
Ge III	140	144	-	140	144	135	135-144	185-211
Ti III	211	225	-	211	211	203	203-225	365-405
Ta III	162	162	-	166	162	150	150-162	203-207
IP	2350	2437		2366	2357	2268	2268-2437	3349-3604

– 175 *vs.* 200 – 216) and Ti II (140 – 157).

It differs from *C. froggati* in the number of dorsal setae (52 *vs.* 64), ventral setae (28 *vs.* 37), the number of barbed seta on Ti I (15 *vs.* 14), Ti II (16 *vs.* 14) or Ti III (16 *vs.* 18); by larger PW (106 – 117 *vs.* 99 – 100), AAS (23 – 29 *vs.* 16 – 17), W (115 – 126 *vs.* 107 – 109), ML (54 – 60 *vs.* 42 – 49), Ta I (158 – 162 *vs.* 129); by shorter ISD (54 – 63 *vs.* 61 – 71), short DS (36 – 40 *vs.* 54 – 60), long DS (56 – 60 *vs.* 73 – 77).

It differs from *C. feideri* in the number of dorsal setae (52 *vs.* 86), ventral setae (28 *vs.* 44), the number of barbed seta on Ti I (15 *vs.* 18), Ti II (16 *vs.* 18), Ti III (16 *vs.* 19) and the number of setae on palpal tarsus (8 *vs.* 7); by larger PW (106 – 117 *vs.* 98 – 99), W (115 – 126 *vs.* 104), AL (67 – 72 *vs.* 57 – 59), ML (54 – 60 *vs.* 48 – 54), Ge I (126 – 140 *vs.* 112 – 125), Ti I (162 – 175 *vs.* 138 – 159), Ta I (158 – 162 *vs.* 129 – 140) and Ge III (135 – 144 *vs.* 121)

It differs from *C. rageaui* in the number of dorsal setae (52 *vs.* 94), ventral setae (28 *vs.* 54), the number of barbed seta on Ti I (15 *vs.* 17), Ti II (16 *vs.* 17), Ti III (16 *vs.* 19) and the number of setae on palpal tarsus (8 *vs.* 7); by larger PW (106 – 117 *vs.* 97 – 102), W (115 – 126 *vs.* 103 – 107), PL (54 – 60 *vs.* 44 – 47) and Ta I (158 – 162 *vs.* 142 – 149).

It differs from *C. paolii* in the number of dorsal setae (52 *vs.* 98), ventral setae (28 *vs.* 62), the number of barbed seta on Ti I (15 *vs.* 18), Ti II (16 *vs.* 18) or Ti III (16 *vs.* 19), the number of setae on palpal tarsus (8 *vs.* 7), nude galeala *vs.* galeala with ciliations, posterior hypostomala with setules *vs.* nude; by larger PW (106 – 117 *vs.* 91), W (115 – 126 *vs.* 98), PL (54 – 60 *vs.* 36 – 43), Ta I (158 – 162 *vs.* 137) and Ta III (150 – 162 *vs.* 133).

It differs from *C. aerolata* in the number of dorsal setae (52 *vs.* 97), ventral setae (28 *vs.* 42), the number of barbed seta on Ti I (15 *vs.* 18), Ti II (16 *vs.* 18) or Ti III (16 *vs.* 19), the number of setae on palpal tarsus (8 *vs.* 7), nude galeala *vs.* galeala with several ciliations; AM (45 – 52 *vs.* 51 – 66), Ge I (126 – 140 *vs.* 157), Ti I (162 – 175 *vs.* 199), Ge III (135 – 144 *vs.* 167), Ti III (203 – 225 *vs.* 259), Ta III (150 – 162 *vs.* 173) and by longer AP (67 – 72 *vs.* 39 – 46).

It differs from *C. banksi* in the number of dorsal setae (52 *vs.* 97), ventral setae (28 *vs.* 46), the number of barbed seta on Ti I (15 *vs.* 18), Ti II (16 *vs.* 19) or Ti III (16 *vs.* 19), the number of setae on palpal tarsus (8 *vs.* 7), nude galeala *vs.* galeala moderately ciliated; by larger AL (67 – 72 *vs.* 52 – 60), PL (54 – 60 *vs.* 43 – 52), Ta I (158 – 162 *vs.* 146), Ge III (135 – 144 *vs.* 125), Ta III (150 – 162 *vs.* 142), Leg I (744 – 797 *vs.* 725), Leg II (703 – 754 *vs.* 660), Leg III (821 – 866 *vs.* 790) and by shorter S (72 – 90 *vs.* 90 – 95).

It differs from *C. grandpopensis* in the number of dorsal setae (52 *vs.* 60), ventral setae (28 *vs.* 43), the number of barbed seta on Ti I (15 *vs.* 18), Ti II (16 *vs.* 17) or Ti III (16 *vs.* 17), the number of setae on palpal tarsus (8 *vs.* 6) and AM with fine setules in distal half *vs.* nude; by larger W (115 – 126 *vs.* 100 – 104), GL (148 *vs.* 96 – 108), long DS (40 – 60 *vs.* 68 – 72), *2a* (63 – 67 nvs 52 – 56), *1b* (82 – 92 *vs.* 62 – 76), $2b_1$ (77 – 85 *vs.* 54 – 72), Cx I (72 – 85 *vs.* 58 – 68), Cx II (81 – 90 *vs.* 64 – 720, Cx III (81 – 94 (62 – 72), BFe I (90 – 112 *vs.* 76 – 86), BFe II (90 – 94 *vs.* 58 – 64), BFe III (98 – 103 *vs.* 82 – 88), Ta I (158 – 162 *vs.* 130 – 134), Ta II (144 – 157 *vs.* 118 – 126), Ta III (150 – 162 *vs.* 138), Tr III (63 – 69 *vs.* 48 – 54) and Ge III (135 – 144 *vs.* 112 – 122).

It differs from *C. hunanensis* in the number of dorsal setae (52 *vs.* 73), ventral setae (28 *vs.* 47), the number of barbed seta on TFe I (5 *vs.* 6), on Ti I (15 *vs.* 18), Ti II (16 *vs.* 21), Ti III (16 *vs.* 18), the presence of solenoidala on Ti II (2 *vs.* 0), the presence of solenoidala on Ti III (1 *vs.* 0), the number of vestigiala on genu I (1 *vs.* 2), the presence of vestigiala on tibia I (1 *vs.* 0), the presence of vestigiala on Ti I (1 *vs.* 0) and the absence of vestigiala on Ti II (0 *vs.* 1); by larger W (115 – 126 *vs.* 106), *2a* (63 – 67 *vs.* 59), $3b_1$ (63 – 72 *vs.* 54), Ge III (134 – 144 *vs.* 125) and by shorter $3b_2$ (45 *vs.* 52).

Key to the *Charletonia* species of the New World (Neotropic and Neartic)

1. Ti I with 15 normal setae 2
— Ti I with 17 normal setae . . . . . *C. cardinalis* (USA, Europe, Turkey, Malasia, Australia)
— Ti I with 18 normal setae 3

2. Ti II, III with 16, 16 normal setae. . . . . *C. salazari* **sp. nov.** (Costa Rica)
— Ti II, III with 18, 18 normal setae. . . . . *C. philometra* (USA)

3. Ti III with 18 normal setae 4
— Ti III with 19 normal setae 5

4. Ti I < 200 µm/ IP=1795 . . . . *C. rocciai* (Brazil)
— Ti I > 200 µm/ IP=3594 . *C. domawiti* (Costa Rica)

5. Ti II with 18 normal setae . . . . *C. alvedae* (Peru)
— Ti II with 19 normal setae 6

6. Ge I with 11 normal setae/ Ti I < 200 µm. . . . . *C. wrightii* (USA)
— Ge I with 12 normal setae/ Ti I > 200 µm. . . . . *C. nishidai* (USA)

Etymology — The new species is named after Mr. Alberto Hámer Salazar Rodríguez, director of the biological preserve in Costa Rica "Reserva Biológica Alberto Manuel Brenes" at the time that the captures were performed.

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