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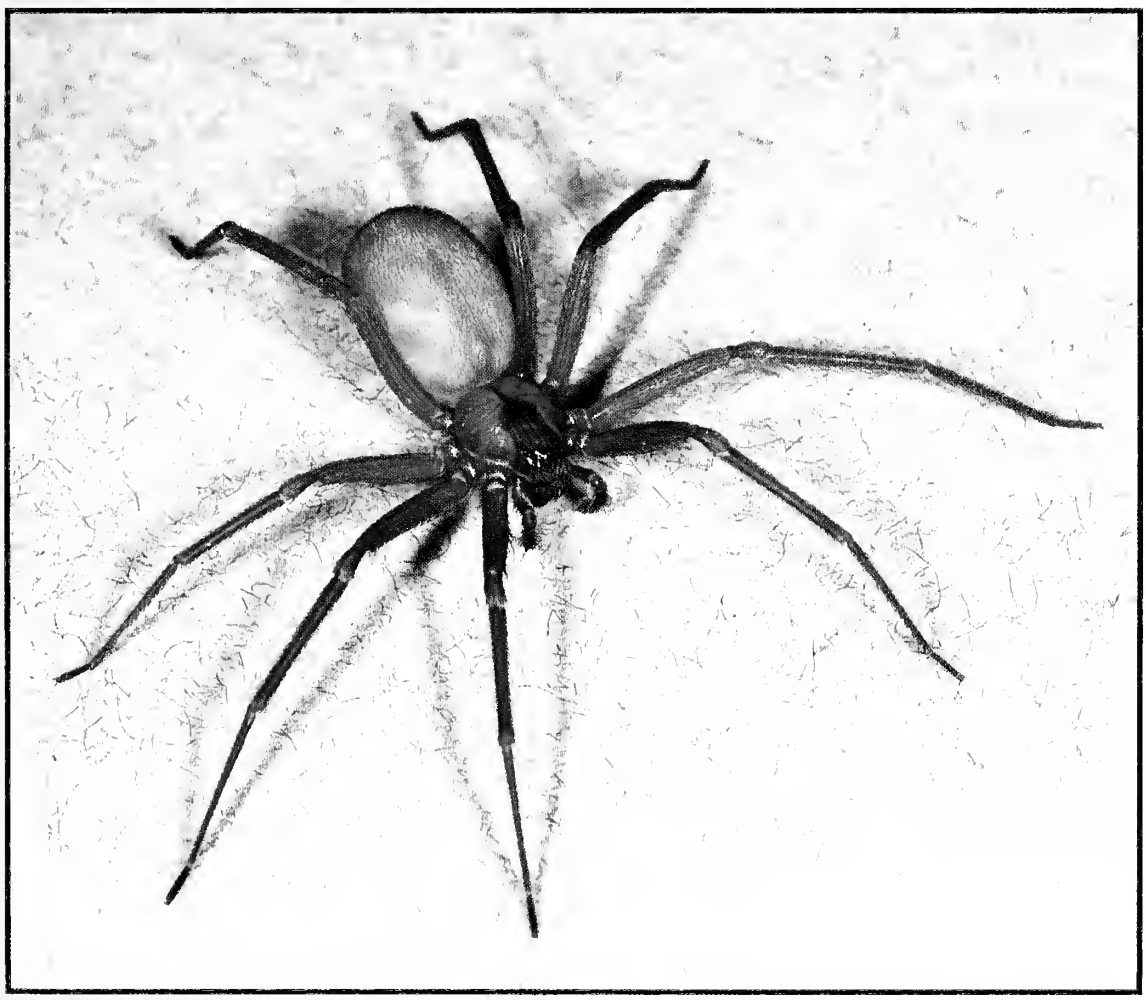

VOLUME 36 2008 NUMBER 1

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Cover photo: Brown recluse spider, *Loxosceles reclusa* Gertsch & Mulaik (Araneae, Sicariidae). Photo by Rick Vetter.

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The pholcid spiders of Micronesia and Polynesia (Araneae, Pholcidae)

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Abstract. Reeords of pholcid spiders from Micronesia and Polynesia are presented, along with records from Indonesia and parts of Melanesia. Nineteen species representing eleven genera are included. An illustrated key for Pacific pholcids is provided. Two species and one genus are not yet known from Micronesia or Polynesia, but are included in the key because they may occur there. Seven species are widespread synanthropic or anthropophilic species, two species are widespread native species, and nine species are endemics of one or several neighboring islands. Distribution maps include only specimens we have seen, not literature records.

Keywords: Pholcids, Pacific islands distribution, biogeography, taxonomy

Some synanthropic pholcid spiders are readily transported by human activity, with the result that a few species [e.g., *Pholcus phalangioides* (Fuesslin 1775)] have attained an almost world-wide distribution. The pholcid fauna of Micronesia and Polynesia consists largely of these domestic or semi-domestic species.

In some tropical areas the pholcids form a large part of the spider fauna, and many genera and species have recently been described (Huber 2000, 2001, 2003a, 2003b, 2003c, 2005a, 2005b). In the tropieal Pacific the smaller or more highly isolated islands seem not to have been eonducive to proliferation of pholcid species. This is in contrast to some other groups of spiders, e.g., in the Hawaiian Islands (Garb 1999; Gillespie 2004). A few new pholcid species, almost all small ground-dwelling spiders, have been found; but many of the Micronesian and Polynesian pholcids belong to cosmotropical or widespread Pacific species. The large continental islands (e.g., the Solomons and Indonesia) have been little investigated, and may harbor a much richer native pholcid fauna (Deeleman-Reinhold 1986; Huber 2005b, unpubl. data). Ten genera and 17 species make up the fauna so far known from the area considered here, Micronesia and Polynesia exclusive of New Zealand (Fig. 1). Eight of these species have very wide, if somewhat patchy, distributions. Six of them are also known from the continental New World and Old World.

METHODS

All pholcid specimens from the Pacific region that could be found in the collection of the Bernice P. Bishop Museum (BPBM) in Honolulu, Hawaii were examined. In addition, we were able to see those in the collection of the Hawaii Department of Agriculture (HDOA), the Entomology Department of the University of Hawaii (UH), the American Museum of Natural History, New York (AMNH), the Queensland Museum, Brisbane, Australia (QMB), the Senckenbergmuseum, Frankfurt, Germany (SMF), the California Academy of Sciences, San Francisco (CAS), and the Australian Museum, Sydney (AMS). Robert G. Holmberg and Don Buckle made available Holmberg's collection from Indonesia (RGH). The remaining records are from the collection of J. Beatty and J. Berry (BB). Holotypes from the "BB" collection, and eventually most of the collection, will be placed in the Bishop Museum.

The BB collection was made by J.W. Berry, E.R. Berry, and J.A. Beatty in a series of collecting trips: Marshall Islands (1968, 3 mo; 1969, 3 mo); Palau (1973, 6 mo); Guam, Yap, Truk (= Chuuk), Ponape (= Pohnpei), Taiwan (1973, 1–2 wk each); Yap (1980, 6 mo); Marquesas, Tuamotu, Society, Cook and Fiji Islands (1987, 2004, 6 mo total); Cook Islands (2002, 6 wk); and the Hawaiian Islands (1995, 1997, 1998, 3 mo). All measurements are in mm. Illustrations of male palps are of the left palp.

In most cases we have given locality data as they appear on the labels in the specimen vials. Where names of localities have changed the new name is given in parentheses, e.g., New Hebrides (= Vanuatu). On recent maps of Fiji, the spellings of some localities have been altered to match their pronunciations. We give the new spellings of these without presenting alternatives. For example, these changes include Nandi (Nadi), Mbau (Bau), Tholo-i-Suva (Colo-i-Suva), and Yanggona (Yaqona).

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Figure 1.—The islands of the Pacific Ocean, showing the regions of Micronesia and Polynesia. *Note:* Some authorities include the Fiji Islands in Polynesia, while others consider them to be part of Melanesia. New Zealand is part of Polynesia, as is Easter Island.

TAXONOMY

Family Pholcidae C.L. Koch 1851

KEY TO THE PHOLCID SPIDERS OF MICRONESIA AND POLYNESIA

(plus two other widespread species but excluding undescribed species)

1. With six eyes (AME absent) 2
   With eight eyes 8
2. Male chelicerae with long apophyses and male clypeus with sexual modifications (Fig. 2); procursus and bulb as in Fig. 3; epigynum as in Fig. 4; habitus, Fig. 41; known only on Fiji Islands ..... *Aetana fiji*
   Male chelicerae with much shorter apophyses; male clypeus unmodified; male and female genitalia different 3
3. Body size greater than 3 mm; abdomen elongate (Figs. 51, 52); genital bulb with three projections and proximal sclerite (Fig. 30); procursus as in Fig. 29; epigynum as in Fig. 31 ..... *Pholcus* (*Uthina*) spp.
   Body size less than 2 mm; abdomen globular; male and female genitalia different 4
4. All eyes close together on high median elevation (Figs. 32, 33); carapace with deep median groove; procursus and palpal femur as in Fig. 5; epigynum as in Fig. 6 ..... *Modisimus culicinus*
   Eyes in two triads, not elevated, carapace without median groove 5
5. Procursus with ventral flap and bulb with serrated and hooked apophysis (Fig. 10); epigynum with posterior pocket (Fig. 11); habitus Fig. 36 ..... *Spermophora palau*
   Procursus without ventral flap; bulb without serrated apophysis; epigynum without posterior pocket; habitus Figs. 37–40 ..... *Belisana* spp...6
6. Male palpal femur with strong ventral projection (Huber 2005b, fig. 626); eyes not ringed with black pigment (Fig. 37); known only from Fiji ..... *Belisana fiji*
   Male palpal femur without ventral projection; eyes ringed with black pigment; known only from Caroline Islands 7
7. Carapace with dark pattern (Fig. 39); abdomen globular; male clypeus with transverse row of thickened hairs (Huber 2005b, fig. 463), bulb without bulbal apophysis; epigynum without scape ..... *Belisana airai*
   Carapace pale and unmarked; abdomen slightly elongated; male clypeus with cone-shaped median projection, bulb with hooked bulbal apophysis (Huber 2005b, fig. 481); epigynum with seape (Huber 2005b, fig. 484) ..... *Belisana yap*

8. Carapace with median indentation 9
Carapace without median indentation 14
9. Body size less than 3 mm; male clypeus sexually modified (Fig. 7); procursus and epigynum as in Figs. 8, 9 . . . *Holocnemimus piritarsis*
Body size greater than 4 mm; male clypeus not sexually modified; procursus and epigynum different 10
10. Abdomen usually as high as or higher than long (Figs. 42–45); male chelicerae frontally with several dark cone-shaped projections 11
Abdomen usually longer than high (Figs. 46–49, 55); male chelicerae with one or two pairs of apophyses 12
11. Female carapace with posterior cone-shaped elevation (Fig. 12); cone-shaped elevations on male chelicerae are elevations of the cuticle; epigynum and procursus as in Figs. 13, 14 . . . . . *Physocyclus globosus*
Female carapace without posterior cone; cone-shaped elevations on male chelicerae are modified hairs; procursus and epigynum as in Figs. 15, 16 . . . . . *Artema atlanta*
12. Abdomen dorsally with characteristic pattern (Fig. 55); male and female chelicerae without stridulatory ridges; legs without small dark lines; male femur I without spines ventrally; epigynum as in Fig. 20 . . . . . *Smeringopus pallidus*
Abdomen without such pattern; male and female chelicerae with stridulatory ridges; legs with many small black lines (Figs. 47, 49); male femur I with spines ventrally 13
13. Abdomen pointed postero-dorsally (Fig. 47); male chelicerae with two characteristic pairs of apophyses (Fig. 17); female carapace with pair of small posterior projections; epigynum as in Fig. 18 . . . . . *Crossopriza lyoni*
Abdomen not pointed postero-dorsally (Fig. 49); male chelicerae with one pair of small apophyses; female prosoma without posterior pair of projections; epigynum as in Fig. 19 . . . . . *Holocnemus pluchei*
(This synanthropic species has not been taken in Micronesia or Polynesia, but is likely to occur there)
14. Body size less than 4 mm; abdomen oval (Figs. 56, 57); procursus with dorsal hinged sclerite (Fig. 21); epigynum with dark crescent-shaped internal structure frontally (Fig. 22) . . . . . *Microphiolcus fauroti*
Body size greater than 5 mm; abdomen elongate (Figs. 50, 54); proeursus without dorsal hinged sclerite; epigynum not as above 15
15. Abdomen with distinctive patterns dorsally and ventrally (Figs. 53, 54); ocular area in males with pair of horns; procursus strongly curved (Fig. 23); bulb and epigynum as in Figs. 24, 25 . . . . . *Pholcus ancoralis*
Abdomen without or with very indistinct (and different) pattern (Fig. 50); male ocular area without horns; procursus straight (Fig. 26); bulb and epigynum as in Figs. 27, 28 . . . . . *Pholcus phalangioides*

Genus *Aetana* Huber 2005

Aetana Huber 2005a:72.

Type species.—*Aetana omayan* Huber, 2005a, by original designation.

Remarks.—The three known species of this genus are medium sized (~3–4.5 mm total body length), six-eyed spiders with relatively long legs, as compared with *Spermophora*. The modifications on the male palpal femur are unique within pholcids and probably constitute a synapomorphy of the genus. A further synapomorphy might be the absence of sclerites on the genital bulb. One species occurs on the Fiji Islands, the other two in the Philippines and Borneo (Huber 2005a).

Aetana fiji Huber 2005
Figs. 2–4, 41, 58

Aetana fiji Huber 2005a:74.

Material examined.—FIJI: *Viti Levu*: Sawani [18°01′S, 178°28′E]: 2 ♂, 3 ♀, near Suva (18°01′S, 178°28′E), from epiphytes, 19 July 1956, R.R. Forster (BPBM); 1 ♀, Monasavu Watershed [17°45′S, 178°04′E], 1100 m, vegetation beating, 29–30 November 2002, D. Gruner (BPBM); 1 ♂, 1 juvenile, Suva [18°08′S, 178°25′E], "in wettest bush," 9 September 1958, Marples (BPBM); 1 ♀, Tholo-I-Suva, park near Nausori, in web on vegetation, wet forest, 6 May 1987, J.A. Beatty (BB); 1 ♂, 3 km E Monasavu Dam [17°46′S, 178°03′E], elev. 1000 m, 26 July 1987, G. Monteith, D. Cook, "pyrethrum, trees and logs" (QMB S50343); 1 ♀, Mt. Victoria (= Tomanivi) [17°37′S, 178°01′E], elev. 1100–1340 m, 25 July 1987, G. Monteith, D. Cook (QMB S50345). *Taveuni*: 1 ♀, 3 juveniles, Des Voeux Peak [16°51′S, 179°58′W], elev. 900 m, 16 July 1987, G. Monteith, D. Cook, "pyrethrum, tree trunks" (QMB S50349). *Vanua Levu*: 1 ♀, 1 juvenile, Mt. Delaikoro [16°33′S, 179°45′E], elev. 700 m, 21 July 1987, G. Monteith, D. Cook (QMB S 50350); 1 ♀, 4 juveniles, same locality, "pyrethrum, logs and trees" (QMB S50348). *Kandavu*: 1 ♀, Mt. Korongatule [17°41′S, 177°18′E], elev. 300 m, near Matasawalevu, 4 July 1987, G.B. Monteith (QMB S50353).

Natural history.—The collection data suggest that this species builds webs in shrubs and trees.

Distribution in the Pacific.—Viti Levu, Taveuni, Vanua Levu, and Kandavu Islands in the Fiji group.

Genus *Artema* Walckenaer 1837

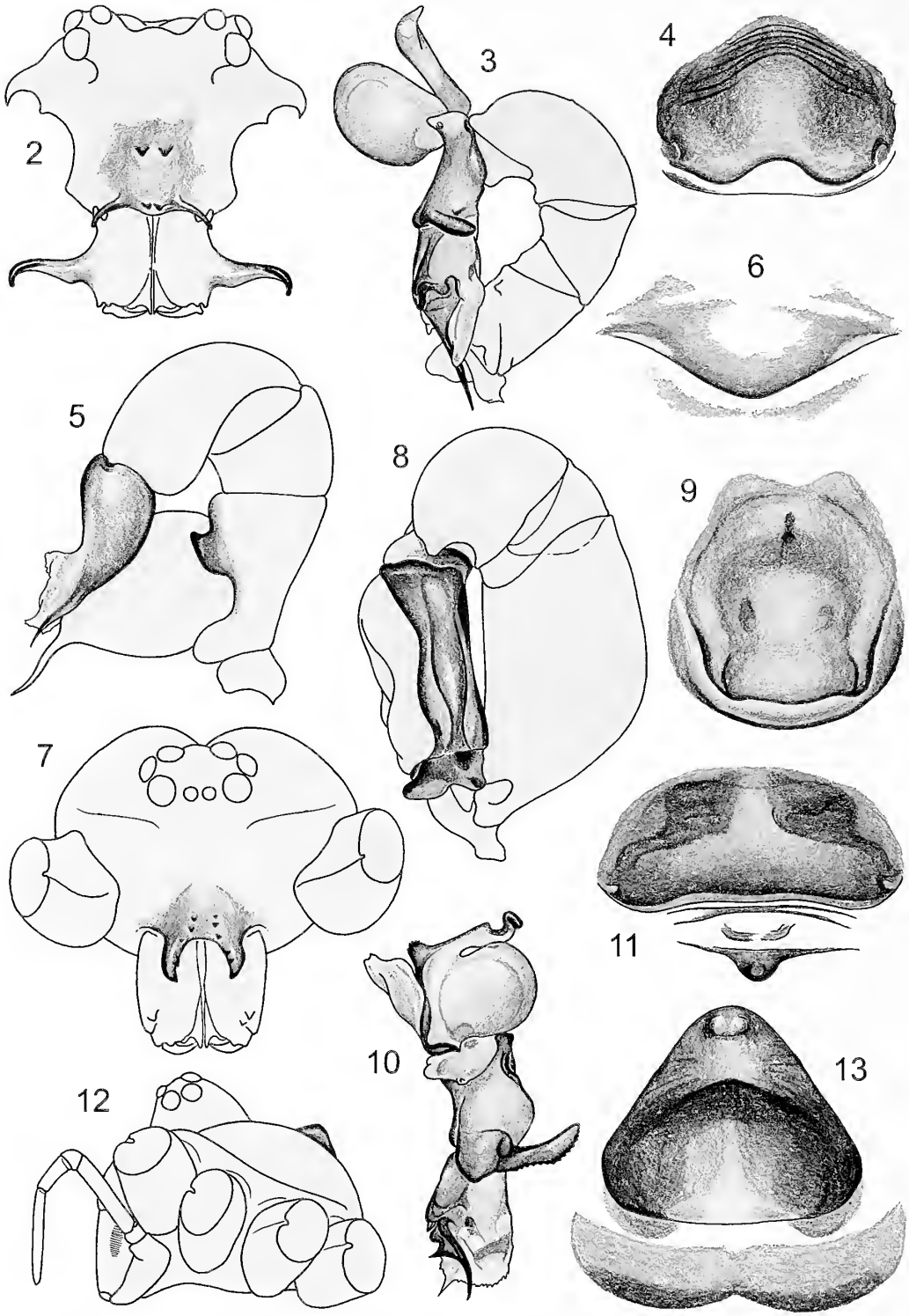
Artema Walckenaer 1837:438.

Type species.—*Artema atlanta* Walckenaer 1837, by monotypy.

Remarks.—This genus comprises one pantropical species, three poorly known and doubtful species in the Middle East and Central Asia.

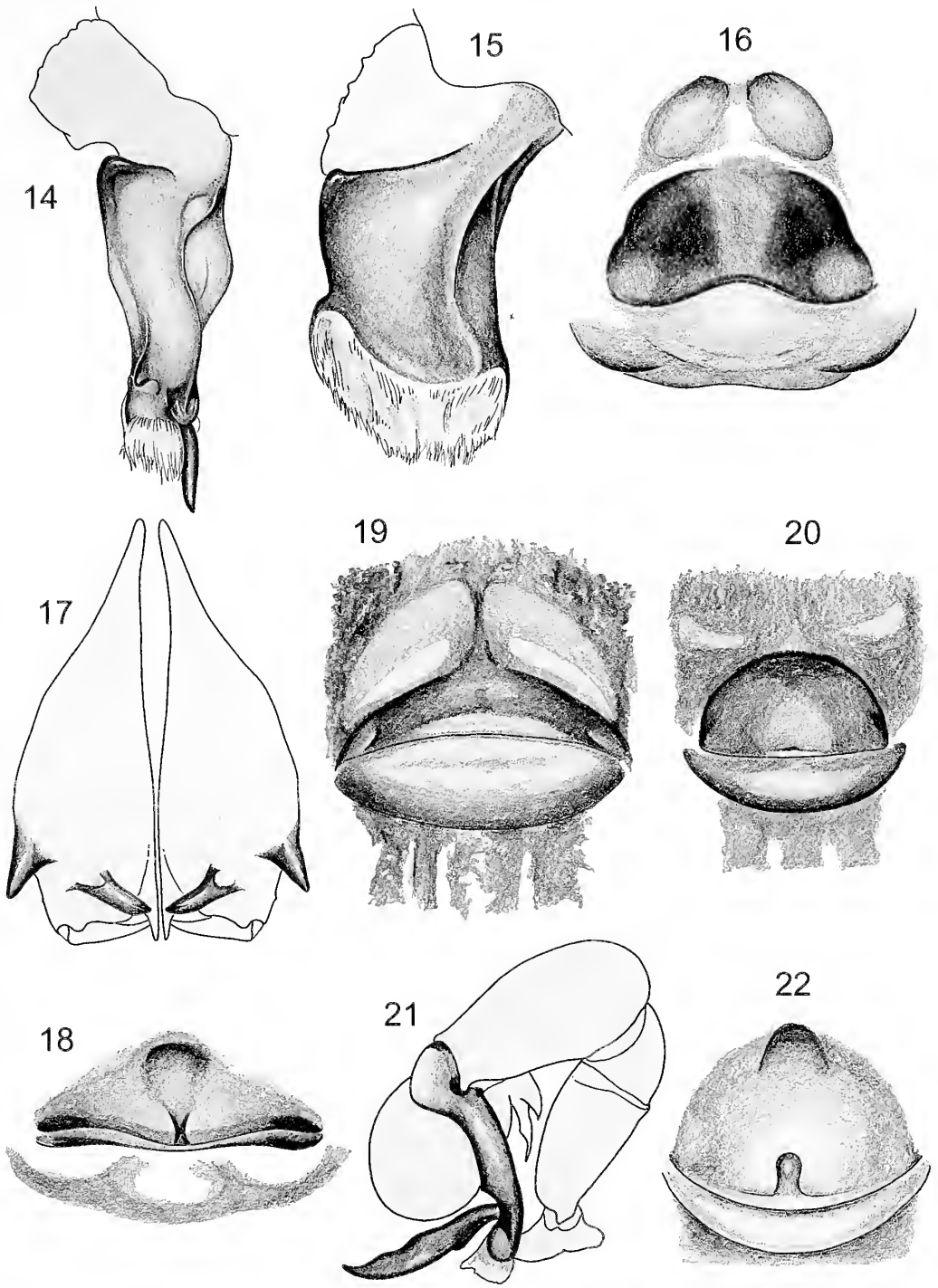
Artema atlanta Walckenaer 1837
Figs. 15, 16, 42, 43, 59

Artema atlanta Walckenaer 1837:656
Artema mauriciana Walckenaer 1837:657
Pholcus sisyphoides Doleschall 1857:408
Artema convexa Blackwall 1858:332
Pholcus borbonicus Vinson 1863:132
Artema mauricia Vinson 1863:141
Pholcus rotundatus Karsch 1879:106
Artema kochii Kulczynski 1901:3, 19



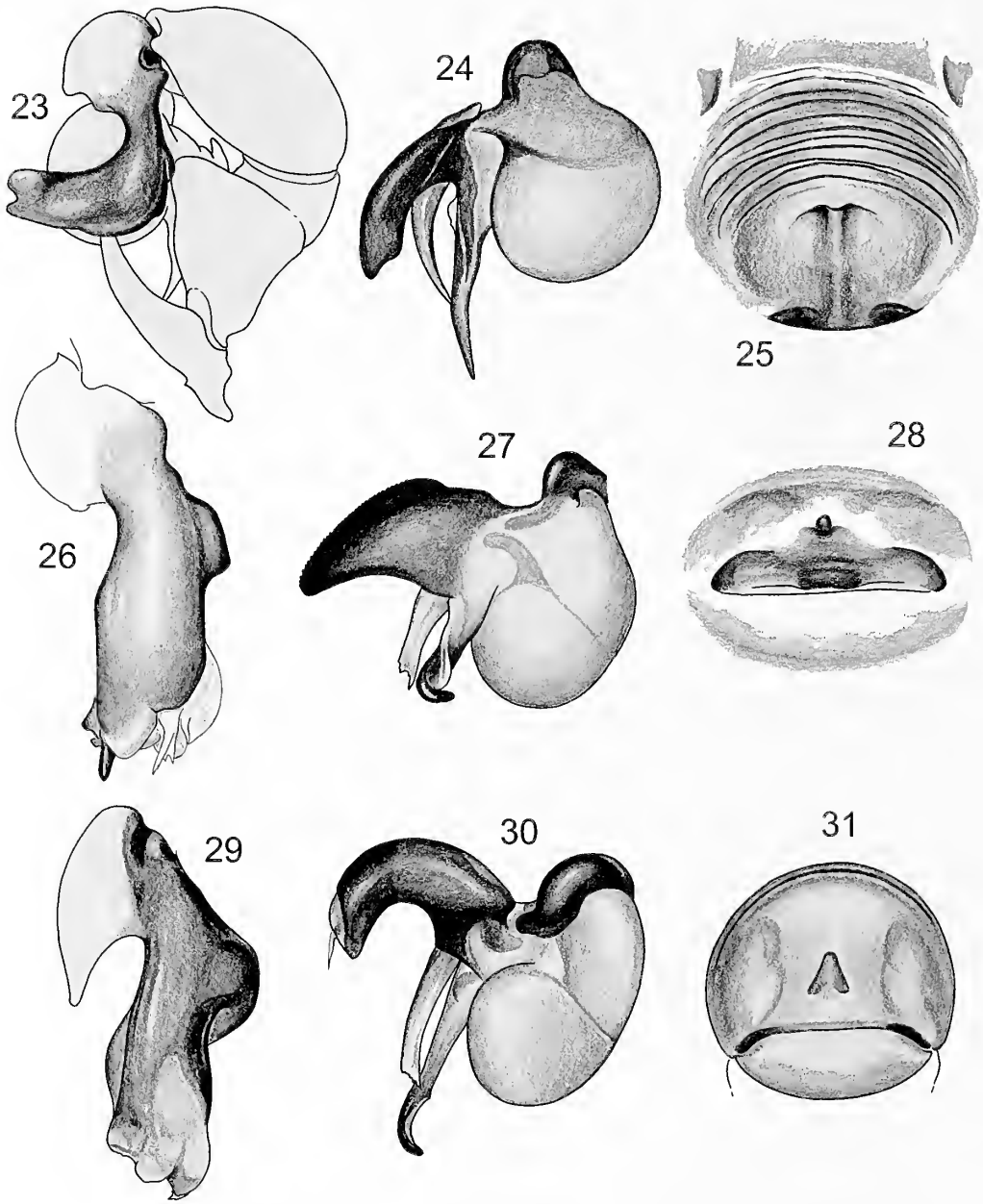
Figures 2–13.—Distinctive characters of Pacific Island pholcids. 2–4. *Aetana fiji*: 2. Male prosoma and chelicerae, frontal view; 3. Left male palp, retrolateral view; 4. Epigynum, ventral view. 5, 6. *Modisimus culicinus*: 5. Left male palp, retrolateral view; 6. Epigynum, ventral view. 7–9. *Holocnemimus piritarsis*: 7. Male prosoma and chelicerae, frontal view; 8. Left male palp, retrolateral view; 9. Epigynum, ventral view. 10, 11. *Spermophora palau*: 10. Left male procursus and bulb, retrolateral view; 11. Epigynum, ventral view. 12, 13. *Physocyclus globosus*: 12. Female prosoma, lateral view; 13. Epigynum, ventral view. Figures at various scales.

Material examined.—GILBERT ISLANDS (= Kiribati): *Tanaeang* [1°31′S, 175°05′E]: 2 ♀, N. Tabiteuea, 1972, 2 ♀, P.D. Manser (BPBM); *Tarawa* [1°25′S, 173°02′E]: 1 ♀, 1 juvenile, Belio, 14 August 1956 (BPBM); 1 ♀, Bairiki, in building, November 1957, N.L.H. Krauss (BPBM). HAWAIIAN ISLANDS: *Lanai* [20°49′N, 156°59′W]: 1 ♂, 1 ♀, 1 juvenile, Holopoe Bay, 7–9 February 1985, V. & B. Roth (BPBM); *Midway* [25°45′N, 171°43′W]: 2 ♀, Sand Island, Henderson



Figures 14–22.—Distinctive characters of Pacific Island pholcids. 14. *Physocyclus globosus*, left procursus, retrolateral view. 15, 16. *Artema atlanta*: 15. Left procursus, retrolateral view; 16. Epigynum, ventral view. 17, 18. *Crossopriza lyoni*: 17. Male chelicerae, frontal view; 18. Epigynum, ventral view. 19. *Holocnemus pluchei*, epigynum, ventral view. 20. *Smeringopus pallidus*, epigynum, ventral view. 21, 22. *Micropholcus fauroti*: 21. Left male palp, retrolateral view; 22. Epigynum, ventral view. Figures at various scales.

Ave, inside bunker, 20 December 1997, G.M. Nishida (BPBM); *Oahu* [21°19′N, 157°54′W]: 1 ♀, in Bishop Museum, no date, F.G. Howarth (BPBM); 1 ♂ (pinned), in basement, 23 January 1923, no collector (HDOA); 1 ♂, Bishop Museum, 31 January 1927 (no collector) (BPBM); 1 ♀, Bishop Museum, 15 October 1952, C. Hoyt (BPBM); 1 ♂ (pinned), Honolulu, August 1959, F.A. Bianchi (HDOA); 1 ♂, 1 ♀, 1 juvenile, Honolulu, Manoa, "a nuisance in house," 16 December 1960 (HDOA); 2 ♀, 1 juvenile, Honolulu, Manoa, in house, 12 December 1962, N.L.H. Krauss (HDOA); 1 ♀, Honolulu, Bishop Museum, August 1964, T. Suman (BPBM); 5 juveniles, Honolulu, elev. 50–100 m, 28 April 1976, N.L.H. Krauss; 1 ♀, Honolulu, 19 May 1972, no collector (BPBM); 1 ♀, 1 juvenile, Honolulu, elev. 0–100 m, April 1973, N.L.H. Krauss (BPBM);



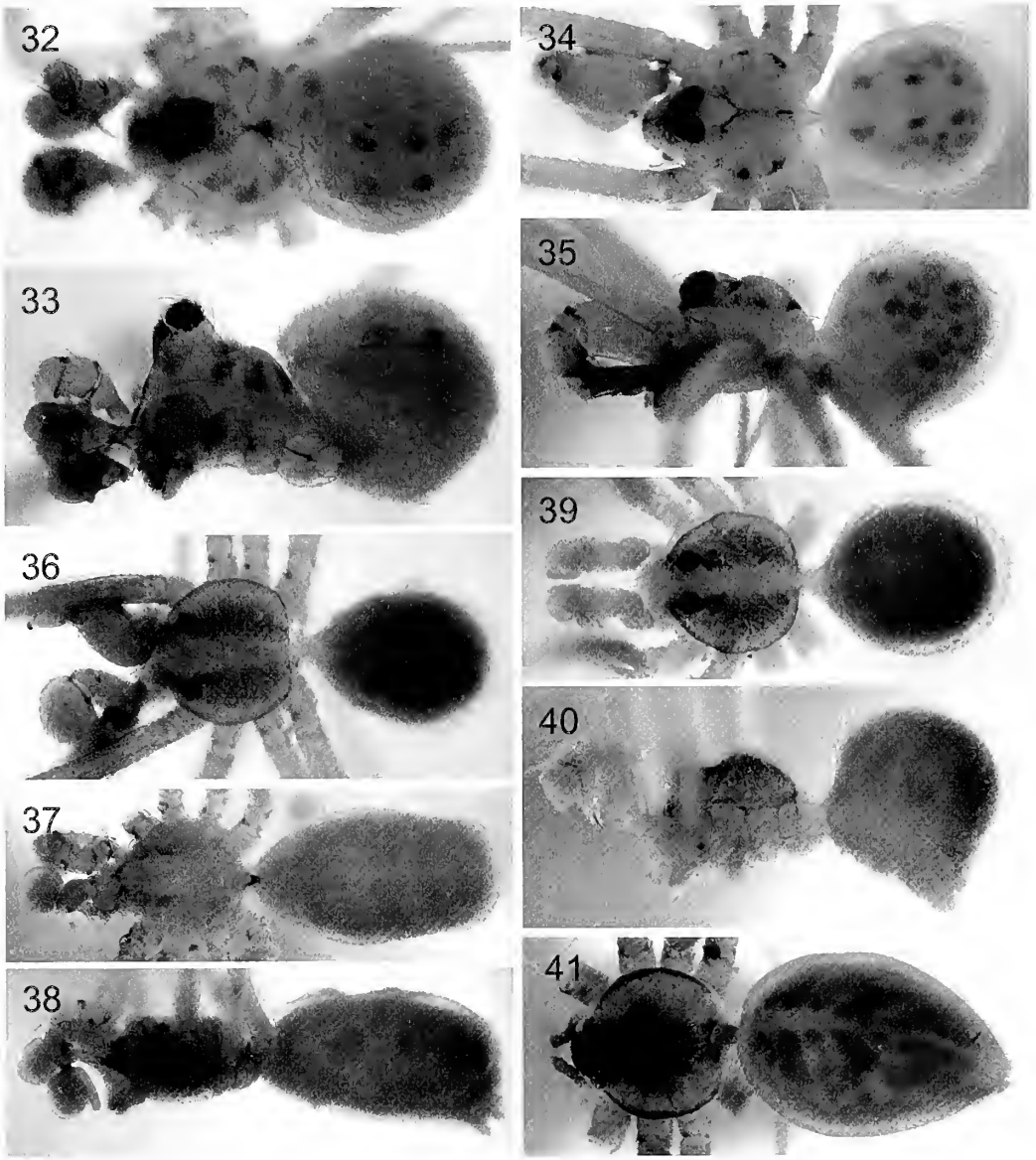
Figures 23–31.—Distinctive characters of Pacific Island pholcids. 23–25. *Pholcus ancoralis*: 23. Left male palp, retrolateral view; 24. Left genital bulb; 25. Epigynum, ventral view. 26–28. *Pholcus phalangioides*: 26. Left procursus, retrolateral view; 27. Left genital bulb; 28. Epigynum, ventral view. 29–31. *Pholcus* (*Uthina*) sp. B: 29. Left procursus, retrolateral view; 30. Left genital bulb; 31. Epigynum, ventral view. Figures at various scales.

1 ♀, Honolulu, Kalihi, in building, 30 January 1978, N. Evenhuis (BPBM); 1 ♂, Honolulu, Bishop Museum, Pauahi Hall, 17 July 1978, H. Megens (BPBM); 1 ♀, Honolulu, Pacific Heights, under house, November 1997, S. Swift (BPBM); 1 ♀, Honolulu, January 1958, D.E. Hardy (UH); 1 ♀, Lower Nuuanu, in office building, 17 January 1989, E. Leong (HDOA); 1 ♂, 6 June 1989, H. Shiroma (HDOA); 1 ♂, Pawaa, outside Entomology Laboratory, 27 February 1991, K. Murai (HDOA); 1 ♂ (pinned), Pawaa, HDOA office, under shelf, 26 November 1996, B. Kumashiro (HDOA); 1 ♂, 3 ♀, 2 juveniles, Kaluku, 27 September 1975, L. Pinter (UH); 1 ♂, 3 ♀, 3 juveniles, Waianukole, 17 October 1975, L. Pinter (UH).

Additional new records: INDONESIA: *Sulawesi* [3°36′S, 119°51′E]: 1 ♀, in house, April–May 1995, D. & F. Krill (RGH).

Remarks.—This species is among the largest of all pholcid spiders. Although it is reported from many Pacific Islands, a number of these records are old (Brignoli 1981); and the spider may now be absent from areas where it had previously occurred. Our collecting on many Pacific islands has not produced any specimens of the species, though we have seen specimens from Hawaii.

Description.—Large (to 12 mm body length), eight-eyed pholcid. Abdomen higher than long; legs long, femur I length about 1.9 times body length. Thoracic groove deep, running to



Figures 32–41.—Habitus photographs of Pacific Islands pholcids. 32, 33. *Modisimus culicinus*. 34, 35. *Holocneminus piritarsis*. 36. *Spermophora palau*. 37, 38. *Belisana fiji*. 39, 40. *Belisana airai*. 41. *Aetana fiji*. Photographs at various scales.

rear margin of carapace. Procursus and epigynum as in Figs. 15, 16.

Distribution in the Pacific.—Philippines, Indonesia, New Guinea, Australia, New Hebrides, Samoa, Cook Islands, and Hawaii.

Natural history.—All examined specimens with habitat data were collected in buildings, including bunkers in fortifications.

Genus *Belisana* Thorell 1898

Belisana Thorell 1898:278

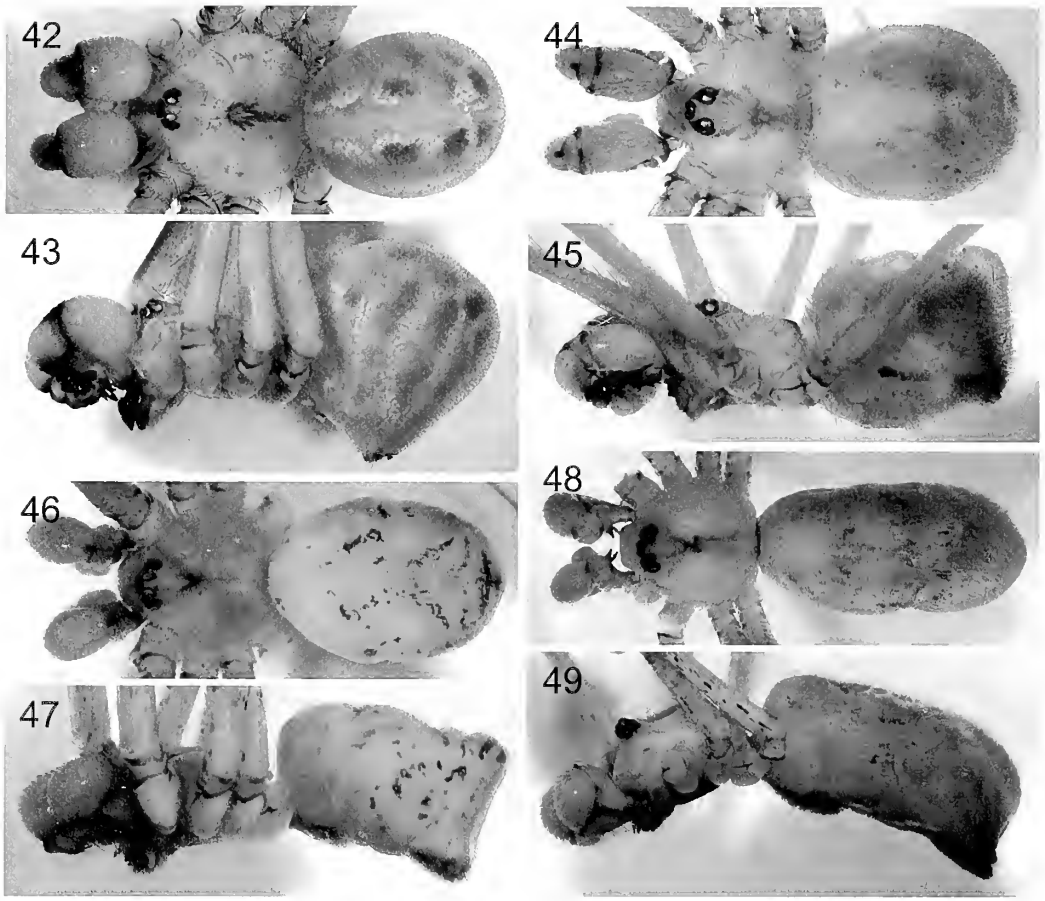
Type species.—*Belisana tauricornis* by original designation and monotypy.

Remarks.—The genus *Belisana* Thorell until recently included only two nominal species. A revision by Huber (2005b) resulted in over 50 new species, including three of the four species below.

Belisana airai Huber 2005
Figs. 39, 40, 60

Belisana airai Huber 2005b:78

Material examined.—CAROLINE ISLANDS: *Palau Islands* [ca. 7°10′N, 134°21′E]: 1 ♀, Arakabesan Island [7°10′N, 134°26′E]: mixed forest in litter, elev. 20 feet (6 m), 16 February 1973 (BB); 1 ♂, mixed forest, elev. 20 feet (6 m), 22 February 1973 (BB); 6 ♀, 3 juveniles, dry forest litter, elev. 374 feet (114 m), 1 March 1973 (BB); Babelthuap Island [7°20′N, 134°22′E]: 1 ♀, 1 juvenile, hill above Nekkin Forestry Headquarters, 3 February 1973 (BB); 1 ♂, 2 ♀, 2 juveniles, Airai [7°20′N, 134°33′E], dry forest, 10 March 1973 (BB); 2 ♂, 4 ♀, 3 juveniles, Airai, near airstrip, lowland forest, 27 March 1973 (BB); 3 ♂, 9 ♀, 3 juveniles, Airai, mango tree litter, 5 May 1973 (including holotype) (BB); Koror Island: 1 ♀, banana litter below Entomology Laboratory, 20 February 1973 (BB);



Figures 42–49.—Habitus photographs of Pacific Islands pholcids. 42, 43. *Artema Atlanta*. 44, 45. *Physocyclus globosus*. 46, 47. *Crossopriza lyoni*. 48, 49. *Holocnemus pluchei*. Photographs at various scales.

1 ♀, 9 March 1973 (BB); 2 ♂, 1 ♀, litter next to taro patch, 3 April 1973 (BB); 3 ♀, litter next to taro patch, 9 May 1973 (BB); *Malakal Island* [7°19′N, 134°27′E]: 2 ♂, 1 juvenile, dry forest litter, elev. 300 feet (91 m), 14 March 1973 (BB). All specimens collected by JWB, ERB and JAB.

Distribution in the Pacific.—Palau Islands.

Natural history.—All specimens for which microhabitat data are available were taken in ground litter.

Belisana yap Huber 2005
Fig. 60

Belisana yap Huber 2005b:81.

Material examined.—CAROLINE ISLANDS: *Palau* [7°22′N, 134°30′E]: Koror Island [7°20′N, 134°36′E]: 1 ♂, 3 ♀, lowland forest, 27 March 1973 (BB); Koror Island: 2 ♀, tree shaking in vacant lot, 13 March 1973 (BB); Kayangel Atoll [8°04′N, 134°43′E]: 1 ♂, 1 ♀, from banana tree, 21 May 1973 (BB); 1 ♀, tree shaking, 23 May 1973 (BB); *Yap* [9°28′N, 138°05′E]: 1 ♀, Gilman Point [9°26′N, 138°03′E], 29 May 1973 (BB); 1 ♀, Map [9°33′N, 138°09′E], tree shaking, 23 May 1973 (BB); *Yap* [9°28′N, 138°05′E]: 1 ♀, Gilman Point, shaking and sweeping, 30 May 1973 (BB); 2 ♀, 1 juvenile, road to Fanif, shaking banana leaves, 31 May 1973 (BB); 1 ♂, 1 ♀, 1 juvenile, Aringel village, tree shaking, 1 February 1980 (BB); 1 ♀, Fedor village [9°29′N, 138°04′E], near taro patch, 10 March 1980 (BB); 3 ♂, Wanyan, in litter, 17 April 1980 (including holotype) (BB); 1 ♂, Fedor village, banana leaves, 1 February 1980 (BB). All specimens collected by JWB, ERB and JAB.

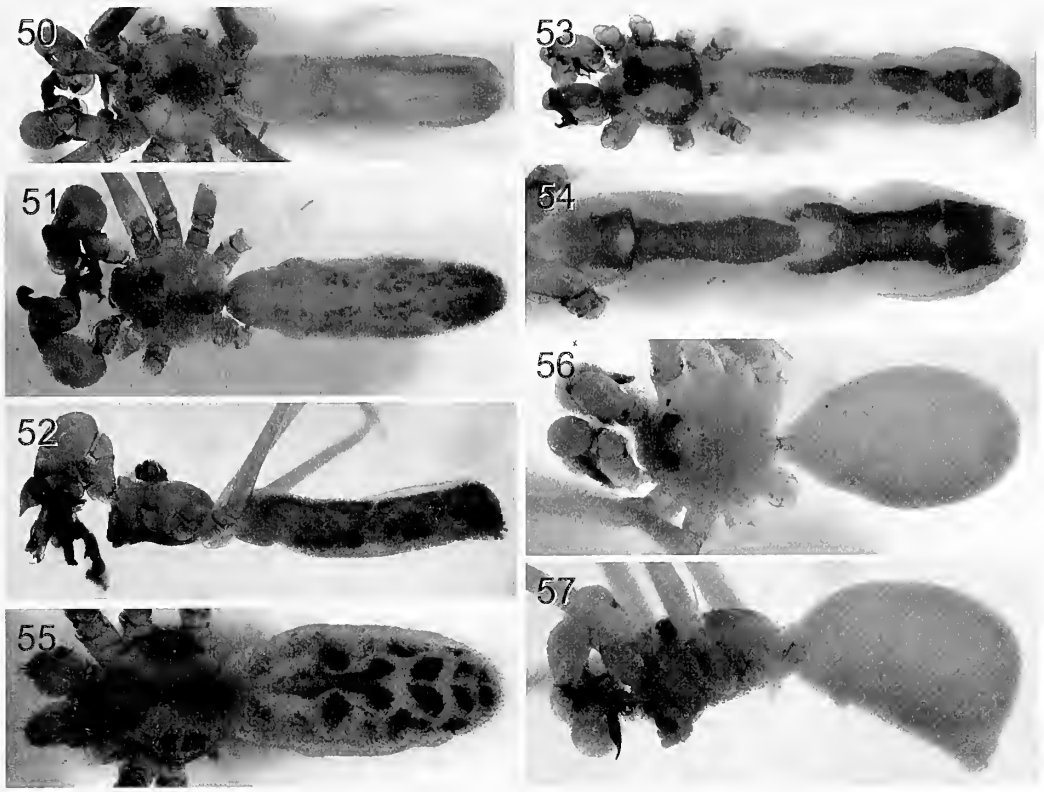
Remarks.—Similar to *B. airai* above, but paler, with longer legs and a slightly longer abdomen. The two species also differ in their mierohabitat.

Natural history and distribution in the Pacific.—A few specimens were taken from ground litter; but the majority were obtained by sweeping, or by shaking shrubs, small trees or dead lower leaves on banana plants. Collected in both Yap and the Palau Island group.

Belisana fiji Huber 2005
Figs. 37, 38, 60

Belisana fiji Huber 2005b:113.

Material examined.—FIJI: *Viti Levu*: 10 ♂, 2 ♀, 7 juveniles, 3 mi S. of Serea [17°53′S, 178°18′E], Lomaivuna District, picked from forest tree, 30 May 1987, J.W. & E.R. Berry (BB) (including holotype); 5 ♂, 7 ♀, 3 juveniles, Nausori [17°40′S, 178°25′E, Koronovia Research Station, shaken from trees, 18 May 1987, J.W. & E.R. Berry (BB); 1 ♀, Tholo-I-Suva Forest Reserve [17°55′S, 178°32′E], ~10 mi N. Nausori, dense ridgetop forest, 20 May 1980, J.A. Beatty (BB); 1 ♂, 2 ♀, Nausori Highlands, Leweitoko Block [17°46′S, 178°38′E], elev. ~1500 feet (457 m), "shaking," 27 May 1987, J.W. & E.R. Berry (BB); 2 ♀, Nausori Highlands, 600 m, "Pyrethrum, trees and logs," 13 July 1987, G. Monteith (QMB S50352); 1 ♂, 2 ♀, 1



Figures 50–57.—Habitus photographs of Pacific Islands pholcids. 50. *Pholcus phalangioides*. 51, 52. *Pholcus (Uthina)* sp. B. 53, 54. *Pholcus ancoralis*. 55. *Smeringopus pallidus*. 56, 57. *Micropholcus fauroti*. Photographs at various scales.

juvenile, Lomaivuna District, ~3 km N Nangali, tree shaking in pine woods, 30 May 1987, J.W. & E.R. Berry (BPBM); 1 ♂, Namosi Road [18°05′S, 178°14′E], 3 km N Queens Road, tree shaking in forest, 7 May 1987, J.W. & E.R. Berry, J.A. Beatty (BB); 5 ♀, 22.4 km W. of Suva [18°07′S, 178°15′E], sweeping and shaking in forest, 5 May 1987, J.W. & E.R. Berry (BB); 1 ♂, Sawani, near Suva [~18°10′S, 178°28′E], from epiphytes, 19 July 1956, R.R. Forster (BPBM); 1 ♀, sweeping mangrove near Namuka Harbor [18°20′S, 178°08′E], 2 May 1987, J.W. & E.R. Berry (BB); 1 ♂, Nanggelewal village [17°43′S, 178°05′E], elev. 260 m, vegetation beating, 28 November 2002, D. Gruner (BPBM); 1 ♂, 1 ♀, 3 km E. of Monasavu Dam [17°46′S, 178°03′E], elev. 1000 m, "Pyrethrum, trees and logs," 26 July 1987, Monteith, Cook (QMB); *Ovalau Island* [17°41′N, 178°50′E]: 1 ♂, Lovoni track behind Levuka [17°40′S, 178°47′E], 13 November 1988, R. Raven (QMB).

Remarks.—This is an unusual representative of the genus with a slightly elongate abdomen and distinctive male genitalia.

Natural history and distribution in the Pacific.—Most specimens were collected by sweeping, shaking, or beating of vegetation. Known only from Viti Levu and Ovalau Islands, Fiji.

Belisana n. sp. "A"
Fig. 60

Material examined.—CAROLINE ISLANDS: *Palau:* 1 ♂, 1 ♀, Angaur Island [6°54′N, 134°07′E]: banana-betel palm stand, 27 April 1973 (BB); Babelthuap Island [7°22′N, 134°33′E]: 1 ♂, 2 juveniles, Airai [7°22′N, 134°33′E], tree shaking in mixed forest, 11 March 1973 (BB). All specimens collected by JWB, ERB and JAB.

Remarks.—This is an undescribed species. Because of poor preservation and the limited number of specimens, this species was not described by Huber (2005b). The male specimen is very close to *B. yap*, both morphologically and geographically, but with different male cheliceral armature. Additional specimens in good condition are needed to permit description of this species. It is included only to call attention to its existence.

Genus *Crossopriza* Simon 1893

Crossopriza Simon 1893:460

Type species.—*Artema pristina* Simon 1890 by original designation.

Remarks.—This genus currently comprises six species in Africa and Middle East plus one pantropical species.

Crossopriza lyoni (Blackwall 1867)
Figs. 17, 18, 46, 47, 61

Pholcus lyoni Blackwall 1867:392.
Smeringopus lyoni (Blackwall): Thorell 1895:70.
Crossopriza lyoni (Blackwall): Simon 1893:475.
Crossopriza brasiliensis Mello-Leitão 1935:94.
Crossopriza mucronata Mello-Leitão 1942:389.
Crossopriza francoisi Millot 1946:154.
Crossopriza stridulans Millot 1946:156.

Material examined.—CAROLINE ISLANDS: *Palau* [7°20′N, 134°29′E]: 1 ♀, Koror [7°21′N, 134°36′E], in Entomology building, 30 January 1973, J.W. Berry (BB); 1 ♀, Koror, in Entomology building, 6 March 1973, J.A. Beatty

Figure 58.—Distribution of *Aetana fiji* in the Pacific is indicated by stars.

(BB); *Yap* [9°20′N, 138°07′E]: 3 ♀, Colonia, in buildings, 30 May 1973, J.W. Berry (BB); 5 ♀, Colonia, in building, 11 April 1980, 1 juvenile, J.W. Berry & J.A. Beatty (BB). MARSHALL ISLANDS: *Majuro* [7°04′N, 171°20′E]: 1 ♀, 2 juveniles, Uliga, in building, 6 August 1969, J.W. Berry (BB).

Additional new records: INDONESIA: *Ambon* [3°39′S, 128°09′E]: 1 ♂, 3 juveniles, no further data, 11 September 1994, R. Holmberg (RGH); 1 ♀, 1 juvenile, Poka, in building, 14 March 1994, R. Holmberg (RGH); 2 ♂, 2 ♀, Poka, Yette deKock's house, 15 April 1995, R. Holmberg (RGH); 4 ♀, 3 juveniles, Galala, 10–24 July 1997, Rut Pulungan (RGH); 2 ♀, 1 juvenile, Ambon City [3°39′S, 128°09′E], Dasilva village, 15 July 1997, Fenesa (RGH); 2 ♂, 2 ♀, 5 juveniles, R. Lateri, near Paso, 20 July 1997, Ronny, (RGH); 2 ♀, 1 juvenile, Wailela, near Poka, 25 July 1997, Eli Sangaji (RGH). *Java*: Yogyakarta [7°47′S, 110°22′E], 1 ♀ mid-February 1994, R. Holmberg (RGH). *Seram* [2°04′S, 128°10′E]: 2 ♂, 11 ♀, 4 juveniles, Western part, Pira, 16 November 1996, R. Pays, J. Mahurny, M. Rivi (RGH); 2 ♂, 16 ♀, 10 juveniles, Western part, Ety, 17 November 1996, J. Nikijuli, N. Sapulete (RGH). *Sulawesi* [5°02′S, 119°59′E]: 2 ♀, Ujung Pandang [5°09′S, 119°24′E], in museum, 30 June 1994, R. Holmberg (RGH); 3 ♀, 1 juvenile, Tenggara, in building, 1–8 July 1994, R. Holmberg (RGH); 1 ♀, Kemaraya, Kendari, in house, 11 March 1997, L. Kovinus et al. (RGH). MALAYSIA: *Kedah* [7°07′N, 99°49′E]: 1 ♂, 6 ♀, 2 juveniles, Kedah Peak (Gunung Gerai) [5°47′N, 100°18′E], on building at foot of peak, 6 January 1985, J.A. Beatty (BB).

Description.—Medium (to 6 mm body length), eight-eyed pholcid. Male chelicerae with two distinctive pairs of apophyses (Fig. 17). Legs long, femur I about 2½ times body length in female, longer in male. Abdomen trapezoidal in lateral view, high and abruptly truncate behind (Fig. 47). Legs yellowish, heavily marked with short dark lines. Femora white distally, patellae brown.

Remarks.—Originally described from India (Blackwall 1867), *Crossopriza lyoni* has become quite widespread in the tropics, but it appears to be missing or uncommon in the central and east Pacific islands. It is found almost exclusively in buildings, judging from data with the specimens we examined.

Distribution in the Pacific.—Indonesia, Australia, New Guinea, Caroline and Marshall Islands.

Natural history.—Found in or on buildings.

Genus *Holocnemimus* Berland 1942

Holocnemius Berland 1942:13

Type species.—*Holocnemius piritarsis* Berland 1942, by monotypy.

Figure 59.—Distribution of *Artema atlanta* in the Pacific is indicated by stars.

Remarks.—This genus comprises two nominal species, but the aetual number of species is uncertain. It occurs from Sri Lanka in the east to the Pitcairn Islands (Henderson Island).

Holocneminus piritarsis Berland 1942
Figs. 7–9, 34, 35, 62

Holocnemius piritarsis Berland 1942:14

Material examined.—MARSHALL ISLANDS: *Eniwetok* [11°21′N, 162°14′E]: 1 ♀, 2 juveniles, Buganegan [11°21′N, 162°11′E], 6 August 1968, J.W. Berry (BB); 2 ♀, 3 juveniles, Grinem Island [11°22′N, 162°09′E], coconut forest litter, 12 June 1969, J.W. Berry (BB); 2 ♀, 2 juveniles, Grinem Island, coconut litter in *Pisonia* forest, 21 June 1969, J.W. Berry (BB); 2 ♂, 1 ♀, 4 juveniles, Igurin Island [11°20′N, 162°13′E], coconut litter in *Pisonia* forest, 25 June 1968, J.W. Berry (BB); 2 ♀, 4 juveniles, Libiron Island [11°27′N, 162°10′E], *Pisonia* forest litter, 21 June 1969, J.W. Berry (BB); 6 ♂, 6 ♀, 9 juveniles, Rigili Island [11°27′N, 162°05′E], *Pisonia* forest litter, mostly coconut, 26 June 1968, J.W. Berry (BB); 5 ♀, 5 juveniles, Rigili Island, coconut litter in *Pisonia* forest, 2 July 1968, J.W. Berry (BB). *Kwajalein* [9°03′N, °34′E]: 2 juveniles, South Gugeegu [8°51′N, 167°45′E], *Scaevola-Pandanus* litter, 24 July 1969, J.W. Berry (BB). *Majuro Island* [7°06′N, 171°05′E]: 1 ♀, coconut-breadfruit forest, pitfall, 3 August 1969, J.W. Berry (BB); 4 ♀, 3 juveniles, Long Island [7°04′N, 171°22′E], 6 miles (9.6 km) from Laura, under coconut husks, 24 March 1980, J.A. Beatty (BB).

Description.—Small (body length to 3 mm) eight-eyed pholcid. Male clypeus modified (Fig. 7) and chelicerae with stridulating files. Abdomen higher than long, teardrop-shaped (Fig. 35). Legs medium length, femur I about equal to body length in female, 1¼ body length in male. Palp and epigynum as in Figs. 8, 9.

Remarks.—The odd inflated palpal tarsus of the female (a generic character) is consistently present in the 24 females examined. The holotype is a female from Rurutu in the Austral Islands (examined). Females in this genus are not reliably identifiable. Confirmation of the identity of our specimens requires comparison with males from Rurutu. *Holocneminus maculatus* Marples 1955 from Samoa has been synonymized with *H. piritarsis* by Benton & Lehtinen (1995), but a justification for the synonymy was not presented.

Distribution in the Pacific.—Definitely known only from Rurutu, Austral Islands, and possibly from Samoa (Marples 1955), Henderson Island (Benton & Lehtinen 1995) and the Marshall Islands (new records above).

Natural history.—Lives in ground litter.

Figure 60.—Distribution of the genus *Belisana* in the Pacific. *Belisana* sp. A is indicated by a circle with a cross, *Belisana yap* is indicated by a star, *Belisana airai* is indicated by an open box, and *Belisana fiji* is represented by a diamond shape.

Holocnemimus new species
Fig. 62

Material examined.—CAROLINE ISLANDS: *Yap* [9°29′N, 138°03′E]: 2 ♂, 3 ♀, 2 juveniles, Fedor [9°29′N, 138°04′E], in coconut litter, February 1980 (BB); Map [9°32′N, 138°10′E]: 1 ♂, 3 ♀, Chool, in pile of coconut husks, 12 April 1980 (BB); 2 ♂, 12 ♀, 5 juveniles, Mabuu [9°31′N, 134°06′E], in mouth of cave, 27 April 1980 (BB); 1 ♀, 1 juvenile, near Japanese tunnels, 29 April 1980 (BB). All collected by JWB, ERB and JAB.

Remarks.—Distinctly different from the described species of the genus. Several other undescribed species have been seen from the Indonesia-New Guinea region. Further study of this group is required.

Genus *Micropholcus* Deeleman-Reinhold & Prinsen 1987

Micropholcus Deeleman-Reinhold & Prinsen 1987:73.

Type species.—*Pholcus fauroti* Simon 1887, by original designation and monotypy.

Remarks.—This genus comprises two species, one of which is pantropical; the other is from Yemen.

Micropholcus fauroti (Simon 1887)
Figs. 21, 22, 56, 57, 63

Pholcus fauroti Simon 1887:453.
Pholcus infirmus Thorell 1895:72.
Pholcus unicolor Petrunckevitch 1929:147.
Leptopholcus occidentalis Mello-Leitão 1929:95.
Pholcus senegalensis Millot 1941:14.
Pholcus chavanei Millot 1946:130.
Micromerys occidentalis (Mello-Leitão 1946:75).
Micropholcus fauroti (Simon): Deeleman-Reinhold & Prinsen 1987:73.

Material examined.—GILBERT ISLANDS (= Kiribati): *Butaritari* [3°05′N, 172°49′E]: 2 ♂, Butaritari, December 1957, N.L.H. Krauss (BPBM). HAWAIIAN ISLANDS: *Oahu* [21°19′N, 157°56′W]: 1 ♂, St. Louis Heights, in house, 6 March 1986, B. Kumashiro (HDOA); *Hawaii* [19°21′N, 155°56′W]: 1 ♀, 20 miles (32 km) S of Kona, Manuka NARS, Mal Lua Cave #1, dark zone, 3 February 1991, F. Howarth, P. Stone, D. Tanaka (BPBM). MARSHALL ISLANDS: *Majuro* [7°04′N, 171°20′E]: 2 ♂, 2 ♀, Uliga Island [7°06′N, 171°22′E], on building, 6 August 1969, J.W. Berry (BB).

Figure 61.—Distribution of *Crossopriza lyoni* in the Pacific is indicated by stars.

Additional new records: INDONESIA: *Ambon* [3°39′S, 128°09′E]: 2 ♂, 1 ♀, no further location, December 1993, R. Holmberg (RGH); 1 ♀, no further location, 19 April 1994, R. Holmberg (RGH); 3 ♂, 3 ♀, in house, 17–18 May 1994, R. Holmberg (RGH); 1 ♀, no further location, 1994, R. Holmberg (RGH). 3 ♂, 2 ♀, Natsepa [3°39′S, 128°10′E], bathroom, 3 March 1994, R. Holmberg (RGH); (no further location), 1 ♂, 17 September 1994, R. Holmberg (RGH); 1 ♂, with ant prey, no further location, 30 December 1994, R. Holmberg (RGH); 2 ♂, 3 ♀, no further location, 15-26 April 1995, Audrey Leatimia (RGH); 1 ♂, Natsepa, in house, 1 December 1994, R. Holmberg (RGH); 1 ♂, 2 ♀, Natsepa, in garage, 10–24 January 1995, R. Holmberg (RGH); 5 ♂, 8 ♀, 9 juveniles, hatchlings, Natsepa, in garage, 28 January 1995, R. Holmberg (RGH); 18 ♂, 18 ♀, 9 juveniles, Natesepa, in garage, 2 March 1995, R. Holmberg (RGH); 1 ♂, 2 ♀, Natsepa Beach, house and garage, 19 March 1995, eats ants, R. Holmberg (RGH); 7 ♀, Natsepa Beach, in garage, 19 March 1995, R. Holmberg (RGH); 4 ♂, 6 ♀, Natsepa, in garage, 14 April 1995, R. Holmberg (RGH); 1 ♂, 3 ♀, 2 juveniles, Natsepa, in living room and bath, 16–17 April 1995, R. Holmberg (RGH); 7 ♂, 10 ♀, 8 juveniles, Natsepa, bedroom, 29 April 1995, R. Holmberg (RGH); 1 ♀, Natsepa, in garage, 16 June 1995, R. Holmberg (RGH); 4 ♀, Natsepa, in garage, 5 November 1995, R. Holmberg (RGH). *Bali* [8°30′S, 115°30′E]: 1 ♀, Ubud, June 1995, R. Holmberg (RGH). *Irian Jaya* [2°32′S, 140°42′E]: 1 ♀, Jayapura, from house, 24 July–13 August 1995, John Moore (RGH). *Java* [7°59′S, 110°36′E]: 1 ♀, Yogyakarta [7°47′S, 110°22′E], mid-February 1994, R. Holmberg (RGH); 1 ♂, Yogyakarta, November 1995, R. Holmberg (RGH). MALAYSIA: *Penang* [5°21′N, 100°18′E]: 2 ♀, Georgetown [5°21′S, 100°18′E], 3 Medan Tembaga, on building, 19 December 1984, J.A. Beatty (BB).

Description.—Small (body length about 2–3 mm), pale, eight-eyed pholcid. Thoracic groove shallow, inconspicuous. Male procursus with characteristic dorsal projection (Fig. 21), epigynum unsclerotized, with distinctive internal crescent-shaped structure visible through cuticle anteriorly (Fig. 22). Legs long, femur I about 1½ times body length in female, twice body length in male.

Remarks.—Rarely found in Micronesia and Polynesia, but common further to the west and in Australia. Unusual in lacking external sclerotizations of the epigynum. The female epigynal region usually projects markedly (Deeleman-Reinhold & Prinsen 1987).

Distribution in the Pacific.—Present but scarce in Hawaii, Gilbert Islands (= Kiribati), Marshall Islands and Australia. Common in Indonesia.

Natural history.—In or on buildings. According to notes on the collection labels, specimens taken in Indonesia eat ants (see data above).

Figure 62.—Distribution of *Holocneminus* n. sp. is indicated by an open box and *Holocneminus piritarsis* is indicated by stars.

Genus *Modisimus* Simon 1893

Modisimus Simon 1893:485.

Type species.—*Modisimus glaucus* Simon 1893, by original designation and monotypy.

Remarks.—Fifty-seven species are currently included in the genus, ranging from Mexico to northern South America and the West Indies, plus one introduced in the USA, Pacific Islands and Africa.

Modisimus culicinus (Simon 1893)
Figs. 5, 6, 32, 33, 64

Hedypsilus culicinus Simon 1893:322.
Hedypsilus lawrencei Lessert 1938:434.
Modisimus culicinus (Simon): Huber 1997:233.

Material examined.—COOK ISLANDS: *Aitutaki* [18°49′S, 159°46′W]: 1 ♀, near airstrip, beaten from *Pandanus*, 29 March 1987, J.A. Beatty, J.W. Berry (BB). HAWAIIAN ISLANDS: *Hawaii* [18°54′N, 155°40′W]: 1 ♀, Kau District, sand beach area, 5 February 1997, J.W. & E.R. Berry (BB); 1 ♀, Kau District at South Point [18°55′N, 155°40′W], on lava rock, 9 February 1997, J.W. & E.R. Berry (BB). *Oahu* [21°19′N, 157°36′W]: 1 ♀, Mt. Tantalus, elev. 1000 feet (305 m), xeric leaf mold, 22 October 1966, J.R. Vockeroth (BPBM); 1 ♀, Mt. Tantalus, elev. 1000 feet (305 m), pan trap among *Acacia* and *Cereus*, 8 November 1966, J.R. Vockeroth (BPBM); 4 ♂, 2 ♀, near Kaena Point, N. side, 25 January 1985, V. & B. Roth (BPBM); 1 ♂, 1 ♀, Koko Head, 31 January 1985, V. & B. Roth (BPBM); 1 ♀, TAMC , litter, August 1995, S. Swift (BPBM); 1 ♀, Lualualei, 29 May 1996, D. Preston (BPBM). MARSHALL ISLANDS: *Eniwetok* [11°21′N, 162°14′E]: 4 ♂, 1 ♀, Eniwetok Island [11°20′N, 162°19′E], under rocks, 1 August 1969, J.W. Berry (BB); 1 ♀, Eniwetok Island, rocky drift line, 16 July 1968, J.W. Berry (BB); 2 ♂, Eniwetok Island, in building, 23 June 1968, J.W. Berry (BB); 1 ♀, Engebi Island [11°39′N, 162°14′E], rocky drift line, 17 July 1968, J.W. Berry (BB); 2 ♀, Eniwetok Island, rubble in drift line, 2 August 1968, J.W. Berry (BB); 1 ♀, 1 juvenile, Eniwetok Island, *Scaevola* litter, 16 June 1969, J.W. Berry (BB). *Kwajalein*: 1 ♀, Kwajalein Island [8°43′N, 167°44′E], in building 15 June 1968, J.W. Berry (BB); 1 ♀, Kwajalein [8°43′S, 167°44′W], in garbage heap, 20 July 1969, J.W. Berry (BB). SOCIETY ISLANDS: *Moorea* [17°29′S, 149°48′W]: 1 juvenile, Paopao village, in building, 11 January 1987, J.W. Berry (BB). TUAMOTU ISLANDS: 1 ♂, 1 ♀, 1 juvenile, Manihi [14°26′S, 149°03′W]: Topihairi Island, 3 June 1987, E.R. Berry (BB); 1 ♀, Rangiroa, Avatoru Island [14°56′S, 147°42′W], 7 June 1987, E.R. Berry (BB).

Additional new records: INDONESIA: *Ambon* [3°39′S, 128°09′E]: 1 ♀, in egg cartons, 15 April 1995, R.

Figure 63.—Distribution of *Micropholcus fauroti* in the Pacific is indicated by stars.

Holmberg (RGH). NEW HEBRIDES (= Vanuatu) [15°06′S, 147°29′E]: 1 ♀, 15 January 1944, J.S. Haeger, W.R. Enns (AMNH).

Description.—Small (body length 1.2–1.5 mm) six-eyed pholcid, the eyes in two nearly contiguous triads on a distinctive elevated head region (Fig. 33). Male with short thorn-like spurs on anterior cheliceral face and a prominent inverted U-shaped mound in front of eyes. Epigynum very simple (Fig. 6).

Remarks.—This cosmopolitan species with New World origins has been previously reported in the Pacific only from Micronesia, New Guinea, and Australia (Huber 2001). Possibly its less synanthropic habit accounts for this. Of the 18 collections for whieh we have habitat data, only four were taken in buildings.

Distribution in the Pacific.—Marshall, Cook, Society, Tuamotu and Hawaiian Islands, New Guinea, Australia, Indonesia.

Natural history.—Mostly taken under rocks or in litter, occasionally in buildings.

Genus *Pholcus* Walckenaer 1805

Pholcus Walckenaer 1805:80.

Type species.—*Aranea phalangoides* Fuesslin 1775, by subsequent designation, but by whom is unknown. The authors have searched the literature for this citation without success.

Remarks.—This genus comprises over 100 species with worldwide distribution.

Pholcus ancoralis L. Koch 1865
Figs. 23–25, 53, 54, 65

Pholcus ancoralis L. Koch 1865:862

Material examined.—AMERICAN SAMOA: *Tutuila* [14°16′S, 170°42′W]: 1 ♀, Moloata, elev. 1000 feet (305 m), 27 July 1940, E.C. Zimmerman (BPBM); 1 ♀, Aunuu Island [14°17′S, 170°33′W], off Tutuila, 20 January 1952 (BPBM); 1 ♀, 3 juveniles, Fagatogo [14°17′S, 170°42′W], 13 July 1973, J.A. Beatty (BB); 4 ♀, Fagatogo, 14 July 1973, 9 juveniles, J.A. Beatty (BB). AUSTRAL ISLANDS: *Raivavae* [26°50′S, 147°20′W]: 1 ♂, 1 juvenile, slopes of Tavaia, elev. 500 feet (152 m), 28 November 2002, R. Englund (BPBM). CAROLINE ISLANDS: *Ponape* [6°52′N, 158°14′E]: 3 ♂, 1 ♀, Nett District [6°53′S, 158°13′W], cliff near hilltop near Nanpil, elev. 1500 feet (457 m), 6 June 1973, J.A. Beatty, J.W. Berry (BB). *Knsaie* (= Kosrae) [5°19′N, 163°01′E]: 2 ♂, 2 ♀, Lelu Island. *Yap* [9°28′N, 138°05′E] Tora, 4 November 1975, 3 ♂, 5 ♀, juveniles, M. Lundgren (CAS). COOK ISLANDS: *Atiu* [19°58′S, 158°07′W]: 1 ♂, 2 ♀, between buttresses on tree trunk, 23 January 2002, J.A. Beatty (BB). *Manke* [20°10′S, 157°07′W]: 1 ♀, on tree trunk, 1 February 2002, J.A. Beatty (BB). 1 ♀, 1 juvenile, webs in recesses on *Barringtonia* trunk, 2 February 2002. *Mitiaro* [19°52′S, 157°42′W]: 1 ♀, 1 juvenile, 29

Figure 64.—Distribution of *Modisimus culicinus* in the Pacific is indicated by stars.

January 2002, J.A. Beatty (BB); 1 ♂, 2 ♀, coral island (21°S, 158°W), 19–21 January 1996, J. Boutin (CAS). *Rarotonga* [21°14′S, 159°46′W]: 2 ♀, Arorangi [21°13′S, 159°49′W], roadside sweeping, elev. 50 m, 1 March 1987, J.W. & E.R. Berry (BB); 1 ♀, Te Rua Manga [21°14′S, 159°41′W], elev. 300 m, tree shaking, 5 March 1987, J.W. & E.R. Berry (BB); 1 ♂, 1 juvenile, Arorangi, roadside bank, 14 March 1987, J.W. & E.R. Berry, J.A. Beatty (BB); 3 ♂, 14 ♀, 2 juveniles, Turangi Valley [21°44′S, 159°44′W], webs on steep banks, 18 March 1987, J.W. & E.R. Berry, J.A. Beatty (BB); 2 ♂, near Raemaru [21°14′S, 159°48′W], elev. 25 m, tree shaking, 24 March 1987, J.W. & E.R. Berry, J.A. Beatty (BB); 1 ♀, Turangi Valley, elev. 20 m, tree shaking, 1 April 1987, J.W. & E.R. Berry, J.A. Beatty (BB); 2 ♀, 2 juveniles, Tupapa Valley [21°12′S, 159°44′W], elev. 150 m, 2 April 1987, J.W. & E.R. Berry, J.A. Beatty (BB); 3 ♂, Turangi Valley, in abandoned building, 12 January 2002, J.A. Beatty (BB); 1 ♀, 1 juvenile, Papua Valley [21°13′S, 159°49′W], near waterfall, 16 January 2002, J.A. Beatty (BB); 1 ♂, 1 ♀, Matavera [21°13′S, 159°44′W], Tom Douke's place, in green house, 17 January 2002, J.A. Beatty (BB). FIJI ISLANDS: [17°53′S, 177°58′E]: 1 ♂, 1 ♀, collection Roewer (1947) (SMF, RII/8904). *Fulanga* [19°7′S, 178°34′W]: 1 ♂, 1 juvenile (20°S, 178°W), 5 August 1924, E.H. Bryan (AMNH). *Kandavu* [19°01′S, 178°21′E]: 3 ♂, 1 ♀, 1 juvenile, 2 km SE Vunisea, elev. 20 m., 28 June 1987, G. Monteith (QMB, S50342, 50346); 1 juvenile, waterfall 2.5 km E of Vunisea, 29–30 June 1987, G. Monteith (QMB) (S50351); 1 juvenile, waterfall 2.5 km E of Vunisea, elev. 50 m, 29–30 June 1987, G.B. & S.R. Monteith (QMB, S50339); 1 ♂, 3 ♀, 1 juvenile, Langalevu, elev. 0–20 m, 2–7 July 1987, G.B. Monteith (QMB, S 50340, 50347). *Lau* [19°01′S, 177°03′E]: 2 ♀, 1 juvenile, Komo (19°S, 178°W), 20 August 1924, E.H. Bryan (AMNH). *Mango* [17°29′S, 179°10′E]: 2 ♀, 18 September 1924, E H. Bryan (AMNH). *Mothe* [18°40′S, 178°03′E]: 2 ♂, 2 ♀, 16 August 1924, E.H. Bryan (AMNH). *Ovalau* [17°41′S, 178°50′E]: 1 ♀, Lovoni track behind Levuka, 13 November 1988, R. Raven (QMB, S14318); 1 juvenile, Levuka, through dalo, yanggona plantations, creeks, some forest, 13 November 1988, T. Churchill (QMB, S14303). *Vanua Levu* [16°41′S, 179°10′E]: 2 ♂, 2 ♀, 19 km S Savu Savu, elev. 20 m, 19 July 1987, Monteith, Cook (QMB, S50341); 1 ♀, 82 km E of Lambasa on Wainikoro Rd. towards Odo Point, logged RF [16°17′S, 179°40′E], 21 November 1988, T.B. Churchill (QMB, S14230); 1 ♂, 1 ♀, along road between Lambasa and Savu Savu, 19 November 1988, T.B. Churchill (QMB, S14244). *Taveuni* [16°59′S, 179°53′E]: 1 ♂, L. Tagimauthia track, elev. 400 m, 17 July 1987, Monteith, Cook (QMB, S50344). *Viti Levu* [18°08′S, 178°26′E]: 1 ♂, Suva, Tholo-i-Suva [18°08′S, 178°26′E], 7 February 1969, J.E. Tobler (CAS); 1 ♀, Suva, Tholo-i-Suva Forest Park, mahogany "rain forest," no date, T. Churchill, R. Raven (QMB, S14264); 1 ♀, 1 juvenile, Fulton College near Suva [18°06′S, 178°28′E],

Figure 65.—Distribution of *Pholcus ancoralis* is indicated by stars, *Pholcus phalangoides* is indicated by a circle with a cross, *Pholcus* sp."A" is indicated by a circle with a dash, and *Pholcus* sp. "B" is indicated by a diamond shape.

on vegetation beside mangrove swamp, 5 January 1975, N. Poulter (AMS, KS 56210). HAWAIIAN ISLANDS: *Hawaii* [19°26′N, 154°51′W]: 1 ♀, Isaac Hale Beach Park, 25 February 1995, J.W. & E.R. Berry (BB); 1 ♀, Puna District, route 137, m.m. 17–18, on wooden building, 2 February 1997, J.W. & E.R. Berry (BB). MARQUESAS ISLANDS: *Fatu Hiva* [10°28′S, 138°38′W]: 1 ♀, Hanevave Valley, Teaotu, elev. 1000 feet (305 m), under dead bark, 9 September 1930, Pacific Entomol. Survey (BPBM). *Hiva Oa* [9°47′S, 139°00′W]: 1 ♀, 2 juveniles, sweeping and shaking vegetation, elev. 500 m, 12 February 1987, J.W. & E.R. Berry (BB). *Nuku Hiva* [8°54′S, 140°06′W]: 1 ♀, 2 juveniles, above Taiohae, elev. 800 m, sweeping, 23 January 1987 (BB). *Tahuata* [9°56′S, 139°05′W]: 2 ♀, 2 prosomata, Ananatuuna Valley, elev. 1300 feet (396 m), 18 July 1930, LeBronnec, Tauraa (BPBM). *Ua Huka* [8°54′S, 139°31′W]: 2 ♂, 3 ♀, 1 juvenile, Hanatekea, Hane Valley, elev. 900 feet (274 m), 24 February 1931, LeBronnec, H. Tauraa (BPBM). SAMOA: *Upolu:* Apia and Pago-Pago [14°28′S, 172°02′W]: 2 ♀, 17 July 1934, W.M. Karshner (CAS). *Savaii* [13°28′S, 172°21′W]: 1 ♂, 1 ♀, Mataatu Harbor, shore trail, 18 October 1938, C.E. Olsen (AMNH); Salailua: (14°S, 172°W) 1 ♀, 14 May 1924. E.H. Bryan (AMNH). SOCIETY ISLANDS: *Tahiti* [17°42′S, 149°25′W]: 1 ♂, no further data (BPBM); 2 ♀, Taravao, January 1960, N.L.H. Krauss (BPBM). *Hualtine* [16°42′S, 151°00′W]: 1 ♂, 1 ♀ (dried), valley W of Mt. Takatea, elev. 800 feet (244 m), 30 December 1934, E.C. Zimmerman (BPBM). *Moorea* [17°32′S, 149°49′W]: 2 ♂, 11 April 1961, R. Schick (AMNH); 2 ♀, 1 juvenile, Faatoa Valley, elev. 300 feet (91 m), 24 September 1934, E.C. Zimmerman (BPBM); 1 ♂, 2 ♀, Paopao [17°30′S, 149°49′W], tree shaking, mango forest, 11 January 1987, J.W. & E.R. Berry (BB); 2 ♂, 4 ♀, 4 juveniles,Paopao, in forested gorge, 12 January 1987, J.W. & E.R. Berry (BB); 2 ♂, 4 ♀, Tohivea [17°32′S, 149°49′W], elev. ~2000 feet (610 m), tree shaking in forest, 13 January 1987, J.W. & E.R. Berry (BB); 1 ♂, 1 ♀, near Paopao, in *Cyrtophora moluccensis* (Doleschall 1857) web, 5 May 1991, Heather Proctor (BB). *Rapa* [27°36′S, 144°19′W]: 1 ♀, Area, 1 July 1936, E.C. Zimmerman (BPBM). TONGA: *Vavau* [18°36′S, 173°57′E]: 1 juvenile, 28 June 1928, J.E. Hoffmeister (BPBM).

Additional new records: NEW CALEDONIA: *Yahoué* [22°11′S, 166°03′E]: 1 juvenile, elev. 0–100 m, November 1986, N.L.H. Krauss (AMNH). *Loyalty Islands* [20°35′S, 166°36′E]: 1 ♂, 1 ♀, Ovea Island, 15 June 1938, L. Macmillan (AMNH). *Prov. Sud*: 1 ♀, Port Boise [22°21′S, 166°58′E], coast, 8 February 1993, N.I. Platnick, R.J. Raven, M.S. Harvey (AMNH). NEW HEBRIDES (= Vanuatu): *Espiritu Santo* [15°24′S, 166°56′E]: 4 ♀, 1 juvenile (2 vials), August

Figure 66.—Distribution of *Physocyclus globosus* in the Pacific is indicated by stars.

1943–June 1944, J. S. Haeger (AMNH); 1 ♂, 4 ♀, juveniles, May 1944, G. Banner (AMNH). *Erromanga Island* [19°04′S, 169°13′E]: 1 ♀, March–April 1937, L. Macmillan (AMNH). SOLOMON ISLANDS: *Vella Lavella* [7°45′S, 156°38′E]: 1 ♀, 2 juveniles, Barakoma, elev. 0–50 m, November 1972, N.L.H. Krauss (AMNH).

Description.—Large (body length 5–8 mm) eight-eyed pholcid. Abdomen elongate, cylindrical, with distinctive dorsal and ventral marks (Figs. 53, 54). Legs long, femur I about twice body length in both sexes.

Remarks.—This very common species with southeast Asian affinities is apparently missing from Australia (Huber 2001). It is much less synanthropic than *Smeringopus pallidus*, which it resembles in size and shape. It appears to be a native Pacific Island spider, not an introduction from elsewhere, as many of the other large pholcids are.

Distribution in the Pacific.—Known from northeast New Guinea eastward to the Austral and Marquesas Islands and Hawaii.

Natural history.—Occasionally taken on or in buildings, but the specimens we examined (those that had any habitat data) were mostly from natural habitats – between buttresses on tree trunks, in webs among dense vegetation in damp shady areas, under bark, and, in one case, in the web of the araneid spider, *Cyrtophora moluccensis*.

Pholcus phalangioides (Fuesslin 1775)
Figs. 26–28, 50, 65

Aranea phalangioides Fuesslin 1775:61.
Aranea meticulosa Fourcroy 1785:537.
Pholcus phalangioides Walckenaer 1805:80.
Pholcus atlanticus Hentz 1850:284.
Pholcus nemastomoides L. Koch 1838:97.
Pholcus litoralis L. Koch 1867:193.

Material examined.—NEW CALEDONIA [21°43′S, 165°49′E]: 1 ♀, 7 miles (11 km) E of La Foa, 16–22 April 1945, C.L. Remington (AMNH). NEW HEBRIDES (= Vanuatu): 1 ♂, 1 ♀, Espiritu Santo [15°24′S, 166°56′E], May 1944, G. Banner (AMNH).

Remarks.—This widespread species has not been found in the Micronesian and Polynesian islands, but it has been found in nearby Melanesia (in New Caledonia and Vanuatu). Since it likely exists on other islands, it has been included here.

Pholcus spp. cf. *Uthina luzonica* Simon 1893

Remarks.—The two morphospecies below are close to *Uthina luzonica* Simon 1893, as well as to *Pholcus tagoman* Huber 2001 and *P. longiventris* (Simon 1893). *Uthina luzonica*

is known only from the female and, in this species group, separation of species on the basis of female specimens is very ambiguous. Revision of the whole group is required to determine the placement of these species. The two morphospecies below are very similar, differing only in the shapes of the uncus (Fig. 30 is from sp. B; in sp. A the uncus is wider distally) and appendix (the appendix of sp. A is more hooked at the tip than in Fig. 30). Because *Uthina* Simon is probably a synonym of *Pholcus*, the species are here listed as *Pholcus*.

Pholcus sp. A
Fig. 65

Material examined.—FIJI: *Viti Levu* [18°03′S, 178°27′E]: 1 ♀, 1 juvenile, Tholo-I-Suva Forest Park, 15 May 1980 (BB); 1 ♂, 4 ♀, Nanduruloulou Research Station, 15 May 1980; 1 ♀, 2 juveniles, hill forest 16 miles (26 km) W of Suva [18°03′S, 178°12′E], 16 May 1980 (BB); 2 ♂, 6 ♀, 4 juveniles, 8–10 miles (13–16 km) N of Nausori [17°48′S, 178°33′E], hill forest, on vegetation, 20 May 1980 (BB); 2 ♂, 4 juveniles, 8 miles (13 km) NE of Navua, soil bank, 2 May 1987 (BB); 3 ♂, 3 ♀, 1, 3 juveniles, 22.4 km W of Suva, forest, in litter and swept from vegetation, 5 May 1987 (BB); 1 ♀, 7 juveniles, Tholo-I-Suva Forest Park [18°03′S, 178°27′E], in litter, 6 May 1987 (BB); 1 ♂, 1 ♀, on vegetation, 6 May 1987 (BB); 2 ♀, Namosi Road 3 km N of Queen's Road [18°09′S, 178°14′E], tree shaking, 7 May 1987 (BB); 1 ♀, Nausori, Koronivia Research Station [18°01′S, 178°32′E], sweeping, 8 May 1987 (BB); 2 ♀, 2 juveniles, 1.7 km S of Naimborembore, sweeping, 8 May 1987 (BB); 2 ♂, 7 ♀, 5 juveniles, Nausori, Koronivia Research Station [18°01′S, 178°32′E], shaking banana leaves, 18 May 1987 (BB); 1 ♂, 9 km W of Suva, on soil bank, 23 May 1987 (BB); 1 ♀, Lomaivuna [17°50′S, 178°14′E], about 3 miles (5 km) S of Serea, on forest tree, 30 May 1987 (BB). All collected by JWB, ERB, and JAB.

Pholcus sp. B
Figs. 29–31, 50, 51, 65

Material examined.—CAROLINE ISLANDS: *Palau:* 1 ♀, Babelthuap Island [7°24′N, 134°28′E], mixed tropical forest, tree shaking, 11 March 1973; 1 ♂, 2 ♀, 2 juveniles, Airai, lowland forest, 27 March 1973; 1 ♀, Ngaremlengui, in beached boat, 21 April 1973; 1 ♀, 1 juvenile, same data, except in forest; Koror Island [7°22′N, 134°30′E], 5 ♂, 6 ♀, in cave, 17 March 1973; 1 ♂, in cave, 3 April 1973; 1 ♀, in banana litter, 20 March 1973; 1 ♂, 1 ♀, 6 juveniles, in compost pile at Entomology Laboratory, 24 March 1973; Malakal Island [7°14′N, 134°24′E]: 1 ♂, 2 ♀, 1 juvenile, roadside, 14 March 1973; 1 ♂, 1 ♀, in cave, 17 April 1973. All collected by JWB, ERB and JAB.

Genus *Physocyclus* Simon 1893

Physocylus Simon 1893:470.
Decetia O. Pickard-Cambridge 1898:234.
Decetica E. Strand 1929:18.

Type species.—*Physocylus*: *Pholcus globosus* Taczanowski 1874 by original designation.

Remarks.—This genus comprises 17 species in North and Central America, plus a single, *Physocyclus globosus*, cosmopolitan species.

Physocyclus globosus (Taczanowski 1874)
Figs. 12–14, 44, 45, 66

Pholcus gibbosus Keyserling 1877:208.
Physocyclus globosus Simon 1893:470.
Decetia incisa O. Pickard-Cambridge 1898:234.
Physocyclus dubius Mello-Leitão 1922:210.
Physocyclus nuricola Badcock 1932:7.
Physocyclus orientalis Zhu & Song 1999:63.

Material examined.—AMERICAN SAMOA: *Tutuila* [14°16′S, 170°42′W]: 2 ♀, Pago Pago, elev. 0–100 m, March 1972, N.L.H. Krauss (BPBM); 1 ♂, Fagatogo, 13 July 1973, J.A. Beatty (BB). CAROLINE ISLANDS: *Palau* [7°20′N, 134°28′E]: 2 ♂, 3 ♀, 4 juveniles, Angaur [6°54′N, 134°07′E], in house, 30 April 1973, J.A. Beatty, J.W. & E.R. Berry (BB); 1 ♀, Kayangel [8°04′N, 134°43′E], in building, 21 May 1973, J.W. Berry (BB); 1 ♀, Koror [7°20′N, 134°36′E], in Entomology building, 2 February 1973, J.W. Berry (BB); 8 ♂, 9 ♀, 6 juveniles, Koror, 6 March 1973, J.W. Berry, J.A. Beatty (BB); 1 ♀, Koror, in Entomology building, 18 April 1973, J.W. Berry (BB); 2 ♀, Peleliu, in house, 23 March 1973, J.W. & E.R. Berry (BB). *Ponape* [6°20′N, 158°12′E]: 1 ♀, Kolonia, 7 June 1973, J.W.Berry, J.A. Beatty (BB); 3 ♂, 1 juvenile, Kolonia, in and on buildings, 27 March 1980, J.A. Beatty (BB). *Yap* [9°29′N, 138°12′E]: 2 ♂, 2 ♀, 2 juveniles, Colonia [9°31′N, 138°07′E], in buildings, 30 May 1973, J.A. Beatty, J.W. Berry (BB); 1 ♀, Colonia, in house, 19 May 1980, J.W. Berry (BB); 1 ♀, 1 juvenile, Torá, 4 November 1975, M. Lundgren (CAS). *Ulithi Atoll* [10°00′N, 139°47′E]: 1 ♂, Falalop Island, 21 June 1971, M. Lundgren (CAS). COOK ISLANDS: *Aitutaki* [18°49′S, 159°46′W]: 1 ♂, 3 ♀, January 1960, N.L.H. Krauss (BPBM); 3 ♀, 1 juvenile, Amuri [18°51′S, 159°47′W], Josie's Lodge, in house, 26 March 1987, J.A. Beatty (BB); 1 ♂, 2 ♀, Ureia [18°49′S, 159°47′W], in abandoned house, 30 March 1987, J.W. Berry, J.A. Beatty (BB). *Atiu* [19°58′S, 158°07′W]: 1 ♀, in Humphreys' house, 22 January 2002, J.A. Beatty (BB). *Mangaia* [21°54′S, 157°55′W]: 1 ♀, 1 juvenile, in building, 11 February 2002, J.A. Beatty (BB). *Mauke* [20°10′S, 157°20′W]: 4 ♂, 3 ♀, 3 juveniles, in buildings, 31 January 2002, J.A. Beatty (BB). *Mitiaro* [19°52′S, 1157°30′W]: 1 ♂, 1 ♀, 1 juvenile, in building, 28 January 2002, J.A. Beatty (BB); 2 ♂, 5 ♀, 3 juveniles, in building, 31 January 2002, J.A. Beatty (BB). *Rarotonga* [21°14′S, 159°46′W]: 2 ♀, 1 juvenile, 15–18 January 1996, J. Boutin (CAS); 1 ♀, Arorangi [21°13′S, 159°49′W], in house, 1 March 1987, J.W. & E.R. Berry (BB); 1 ♀, Arorangi, in house, 11 March 1987, J.W. Berry (BB); 2 ♂, 2 ♀, Ngatangiia [21°14′S, 159°43′W], in house, 17 March 1987, J.W. Berry (BB); 1 ♂, 1 ♀, Kii Kii Motel, 11 January 2002, J.A. Beatty (BB). FIJI: *Viti Levu* [17°53′S, 177°58′E]: 1 ♀, Nandi [17°48′S, 177°23′E], in building, 14 May 1980, J.A. Beatty (BB); 1 ♂, Nandi, in building, 19 April 1987, J.A. Beatty, J.W. Berry (BB); 1 ♂, 2 ♀, 2 juveniles, Suva [18°06′S, 178°28′E], University of the South Pacific campus, on stone wall, 30 May 1987, J.W. Berry (BB). *Ongea* [19°08′S, 178°24′E]: 1 ♀, 30 July 1924, E.H. Bryan (AMNH). HAWAIIAN ISLANDS: *Oahu* [21°19′N, 157°54′W]: 2 ♀, Pearl City [21°23′N, 157°58′W], 28 March 1968, B. Chambers (BPBM); 1 ♂, 2 ♀, 2 juveniles, Manao [21°19′N, 157°48′W], in fruitfly laboratory, 9 August 1987, M. Wong (HDAO); 1 ♀, 3 juveniles, Niu Valley [21°17′N, 157°44′W], in corner of garage ceiling, 24 April 1995, B.

Figure 67.—Distribution of *Smeringopus pallidus* in the Pacific is indicated by stars.

Kumashiro (HDAO); 1 ♀, 3 juveniles, Liliha [21°19′N, 157°52′W], in house in pantry corners, 8 December 1997, S. Swift (BPBM). MARQUESAS ISLANDS: *Hiva Oa* [9°48′S, 139°01′W]: 2 ♂, 5 ♀, 3 juveniles, Entomology Survey (no further data) (BPBM); 4 ♀, 3 juveniles, Atuona Valley [9°47′S, 139°01′W], 7 July 1929, Mumford, Adamson (BPBM); 11 ♂, 16 ♀, 31 juvenile (2 vials), Atuona Valley, in house, 11 July 1929, Mumford, Adamson (BPBM); 1 ♂, 2 ♀, 2 juveniles, Atuona [9°48′S, 139°01′W], in house, 8 February 1987, J.W. & E.R. Berry (BB). *Nuku Hiva* [8°55′S, 140°06′W]: 1 ♀, Taiohae [8°55′S, 140°06′W], November 1929, Mumford, Adamson (BPBM); 1 ♂, 1 ♀, 1 juvenile, Taiohae, on building, 20 January 1987, J.W. & E.R. Berry (BB); 2 ♂, 3 ♀, 3 juveniles, Taiohae, on building 25 January 1987, J.W. & E.R. Berry (BB); 3 ♂, 1 ♀, 2 juveniles, Taiohae, on porch, 26 January 1987, J.W. & E.R. Berry (BB). *Ua Huka* [8°56′S, 139°33′W]: 1 ♂, 2 ♀, 1 juvenile, Tearamataikii, elev. 730 feet (222.5 m), 19 March 1931, LeBronnec, Tauraa (BPBM). MARSHALL ISLANDS: *Arno* [7°03′N, 171°34′E]: 2 ♀, Ina Island, 21 July 1950, I. LaRivers (BPBM). *Eniwetok* [11°22′N, 162°20′E]: 4 ♀, 5 juveniles, Eniwetok Marine Biology Lab (EMBL) [11°20′N, 162°20′E], in building, 12 June 1968, J.W. Berry (BB); 1 ♂, 1 ♀, 2 juveniles, in building, 23 June 1968, J.W. Berry (BB); 1 ♂, 1 ♀, 2 juveniles, in building, 29 June 1968, J.W. Berry (BB); 3 ♂, 1 ♀, 15 juveniles, EMBL, in building, 20 July 1968, J.W. Berry (BB); 9 ♂, 9 ♀, 3 juveniles, EMBL, in cabinets in building, 1 August 1968 (BB); 1 ♀, Parry Island [11°24′N, 162°22′E] , in building, 10 June 1969, J.W. Berry (BB). *Majuro* [7°05′N, 171°22′E]: 1 ♂, 1 ♀, 1 juvenile, Uliga [7°06′N, 171°22′E], in Mieco Hotel, 25 July 1968, J.W. Berry (BB); 1 ♀, Uliga, in building, 6 August 1969, J.W. Berry (BB); 1 ♀, 1 juvenile, main village, in building, 22 March 1980, J.A. Beatty (BB). SOCIETY ISLANDS: *Tahiti* [17°32′S, 149°33′W]: 4 ♀, Papeete, December 1907 (CAS). *Moorea:* 2 ♀, 3 juveniles, Paopao [17°30′S, 149°49′W] , in house, 13 June 1987, J.W. & E.R. Berry (BB). TOKELAU ISLANDS: *Nokunano* [9°08′S, 171°47′W]: 1 ♀, 5 September 1998, M. Laird (BPBM). TONGA: *Tongatabu* [21°09′S, 175°16′W]: 1 ♂, no further data (BPBM). TUAMOTU ISLANDS: *Manihi:* Topihairi [14°26′S, 146°03′W]: 2 ♂, 2 ♀, 2 juveniles, house and garden, 5 June 1987, E.R. Berry (BB).

Additional new records: INDONESIA: *Ambon* [3°39′S, 128°09′E]: 1 ♀, December 1993, R. Holmberg (RGH); 1 ♂, 25 March 1994, R. Holmberg (RGH); 1 ♀, Natsepa, in garage, 28 January 1995, R. Holmberg (RGH); 1 ♂, Natsepa, in garage, 2 March 1995, R. Holmberg (RGH); 1 ♀, Natsepa Beach [3°39′S, 128°10′E], in house 31 March 1995, R. Holmberg (RGH); 1 ♂, Natsepa, in house 6–9 April 1995, R. Holmberg (RGH); 11 ♀, 8 juveniles, Poka, Yette deKock's house, in egg carton, 15 April 1995, R. Holmberg (RGH); 4 ♂, 19 ♀, house and garage, 15–26 April 1995, R. Holmberg (RGH); 1 ♀, Natsepa, living room and bath, 16–17 April 1995, R. Holmberg (RGH); 1 ♀, 1 juvenile, Natsepa, bedroom, 29

April 1995, R. Holmberg (RGH); 2 ♀, Poka, in house, 1 May 1995, Yette deKock, R. Holmberg (RGH); 1 ♀ (no further data), student, August 1995; 1 ♀, January 1996, Yette deKock (RGH); 4 ♀, 4 juveniles, Galala, 10–24 July 1997, Rut Pulungan (RGH); 2 ♂, 2 ♀, 4 juveniles, Poka, 24 July 1997, Nanuru (RGH); *Irian Jaya* [2°32′S, 140°42′E]: 2 ♀, 3 juveniles, Abepuna, 10 km SW Jayapura [2°32′S, 140°42′E] , 21–23 July 1995, R. Holmberg (RGH); 2 ♂, 6 ♀, 11 juvenile, Jayapura, in house, 17 July–13 August 1995, J. Moore (RGH); 1 ♀, 4 juveniles, Jayapura, in house, 24 July–13 August 1995, J. Moore (RGH); 5 ♂, 2 ♀, 7 juveniles, Jayapura, in house, 13 August 1995, J. Moore (RGH); *Java* [17°59′S, 110°36′E]: 1 ♂, 1 ♀, 3 juveniles, Bogor, in guest house, 15–17 September 1995. *Seram* [2°52′S, 128°10′E]: 1 ♀, west part, from vegetation, 20 April 1996, Yette deKock (RGH). *Sulawesi* [5°20′S, 119°54′E]: 1 ♂, Andounohu, near Kendari [1°54′S, 121°06′E], 6 March 1997, Luisiana Korinus et al. (RGH). NEW CALEDONIA: 1 ♀, Bourail [21°34′S, 165°28′E], March 1959, N.L.H. Krauss (BPBM); 2 ♀, Thio [21°36′S, 166°12′E] , March 1959, N.L.H. Krauss (BPBM). *Loyalty Islands* [20°37′S, 166°33′E]: 1 ♀, Ovea Island, 14 June 1938, L. Macmillan (AMNH). SOLOMON ISLANDS: *Bougainville* [6°15′S, 155°14′E]: 2 ♀, Buin, elev. 0–100 m, October 1971, N.L.H. Krauss (BPBM). NEW HEBRIDES (= Vanuatu) [16°43′S, 168°17′E]: 1 ♂, 1 ♀, in building, 13 December 1943, W.R. Enns (AMNH).

Description.—Medium-sized (body length about 3.5–5.5 mm) eight-eyed pholcid. Male chelicerae with stridulatory files and several anterolateral tubercles. Abdomen globose (Figs. 44, 45). Thoracic groove deep. Legs moderately long, femur I a little longer than body length in female, about 1½ times body length in male. Female with distinctive cone on carapace (Fig. 12), epigynum and procursus as in Figs. 13, 14.

Remarks.—This species, along with *Smeringopus pallidus*, is the most widespread and abundant indoor pholcid in the Pacific Islands. The other synanthropic species have more restricted geographic distributions or occur less commonly in buildings.

Distribution in the Pacific.—Known from Indonesia and Australia east to Marquesas and Tuamotu Islands and Hawaii.

Natural history.—The material examined was taken almost exclusively in buildings.

Genus *Smeringopus* Simon 1890

Smeringopus Simon 1890:94

Type species.—*Pholcus pallidus* Blackwall 1858, by original designation and synonomy.

Remarks.—This genus comprises 21 species in Africa and Madagascar, plus one species which is virtually cosmopolitan.

Smeringopus pallidus (Blackwall 1858)
Figs. 20, 55, 67

Pholcus pallidus Blackwall 1858:433.
Pholcus elongatus Vinson 1863:307.
Pholcus distinctus O. Pickard-Cambridge 1869:390.
Pholcus tipuloides L. Koch 1872:281.
Pholcus tigrinus Taczanowski 1874:104.
Pholcus margarita Workman 1878:451.
Smeringopus elongatus (Vinson); Simon 1890:94.
Priscula tigrina (Taczanowski); Simon 1893:478.
Smeringopus purpureus Moenkhaus 1898:90.
Smeringopus todai Kishida 1913:827.
Smeringopus geniculatus Mello-Leitão 1918:121.
Smeringopus pallidus (Blackwall): Mello-Leitão 1918:119; Lee 1960:35.
Smeringopus kishidai Saito 1933:41.
Smeringopus katangae Giltay 1935:2.

Material examined.—AMERICAN SAMOA: *Tutuila* [14°16′S, 170°42′W]: 1 ♀, Fagatogo, 13 July 1973, J.A. Beatty (BB); 2 ♀, 4 juveniles, Fagatogo [14°17′S, 170°33′W], 14 July 1973, J.A. Beatty (BB). *Upolu* [13°50′S, 171°45′W]: 2 ♂, 1 ♀, 1 juvenile, Apia District, Marschall leg., April 1966. CAROLINE ISLANDS: *Palau* [6°54′N, 134°08′E]: 2 ♂, 9 ♀, Angaur [6°54′N, 134°07′E], in house, 30 April 1973, J.W. & E.R. Berry, J.A. Beatty (BB); 2 ♀, 1 juvenile, Angaur, in barrel outdoors, April 1973, J.W. & E.R. Berry, J.A. Beatty (BB); 1 ♂, 6 ♀, 1 juvenile, Babelthuap, Ngaremlengui [7°30′N, 134°22′E], in old Japanese bunker, 23 April 1973, J.W. & E.R. Berry, J.A. Beatty (BB); 1 ♂, 4 ♀, 4 juveniles, Malakal [7°19′N, 134°27′E], in cave, 17 April 1973, J.W. & E.R. Berry, J.A. Beatty (BB); *Truk* [7°27′N, 151°51′E]: 1 ♂, 2 ♀, 1 juvenile, Moen Island [7°26′N, 151°51′E], in building, 31 March 1980, J.A. Beatty (BB); *Yap* [9°31′N, 138°07′E]: 4 ♂, 6 ♀, Colonia [9°33′N, 138°09′E], in building, 30 May 1973, J.W. Berry, J.A. Beatty (BB); 1 ♀, 2 juveniles, Tora, 4 November 1975, M. Lundgren (CAS). COOK ISLANDS: *Mauke* [20°09′S, 157°20′W]: 1 ♀, in building, 31 January 2002, J.A. Beatty (BB). *Rarotonga* [21°14′S, 159°46′W]: 1 ♀ (no further data) (BPBM); 3 ♀, 2 juveniles, Arorangi [21°13′N, 159°49′E], in house, 11 March 1987, J.W. & E.R. Berry, J.A. Beatty (BB); 3 ♂, 2 ♀, 2 juveniles, Turangi Valley [21°44′N, 159°44′E], on fern-covered bank, 16 March 1987, J.A. Beatty, J.W. & E.R. Berry (BB); 1 ♀, Turangi Valley, in building, 12 January 2002, J.A. Beatty (BB). FIJI: *Viti Levu:* 4 ♂, 8 ♀, 1 juvenile, Nandarivatu [17°34′S, 177°57′E], in garage, 12 April 1987, J.A.Beatty, J.W. & E.R. Berry (BB); 3 ♂, 5 ♀, 1 juvenile, Nausori [18°01′S, 178°31′E], on tin building, 17 May 1980, J.A. Beatty (BB); 2 ♀, 1 juvenile, Suva (no further data) (BPBM). HAWAIIAN ISLANDS: *Midway* [25°45′N, 156°59′W]:1 ♂, 33 ♀, 4 juveniles, Eastern Island, no further data (BB); 1 ♂, 2 ♀, 4 juveniles, Eastern Island [28°12′N, 177°19′W], in storage shed, 14 May 1997, G.M. Nishida (BPBM); 1 ♂, 1 ♀, 2 juveniles, Sand Island [28°12′N, 177°22′W], inside bunker, 30 April 1998, G.M. Nishida (BPBM). *Kauai* [21°54′N, 159°28′W]:1 ♀, Koloa, cave #11, transition zone, 13 September 1978, F.G. Howarth (BPBM); 1 ♂, 4 ♀, Kapaa [22°05′N, 159°18′W], Kawai, around house, 13 January 1988, no collector (BB). *Lanai* [20°49′N, 156°59′W]:3 ♂, 3 ♀, 1 juvenile, Shipwreck Beach, 2–9 February 1985, V. & B. Roth (BPBM). *Oahu* [21°19′N, 157°56′W]:1 ♂, 5 ♀, 5 juveniles, Kepapa (no further data) (UH); 1 ♀, 1 juvenile, Honolulu, 1923, S.C. Ball (BPBM); 1 ♀, Kaimuki, in bath house, November 1952, Amy Suehiro (BPBM); 1 ♀, Ewa, July 1959, F.A. Bianchi (was pinned) (HDAO); 1 ♂, Honolulu, Bishop Hall annex, 5 August 1964, T. Suman (BPBM); 1 ♀, hillside behind Kailua Drive-in theater, on web, 8 November 1964, T.W. Suman (BPBM); 1 ♀, windward, near Sea Life park, litter on dry hillside, 15 November 1964, T.W. Suman

(BPBM); 1 ♂, Kailua, in house, July 1966, T. Suman (BPBM); 1 ♂, 1 juvenile, Manana Island, 12 September 1967, R.D. Spadoni (BPBM); 1 ♀, Honolulu, Bishop Museum grounds, 27 October 1967, P. Schaefer (BPBM); 2 ♀, 1 juvenile, Pearl City [21°23′N, 157°58′W], 28 March 1968, B. Chambers (BPBM); 1 ♂, Honolulu, 19 May 1972 (no collector) (BPBM); 1 ♀, 3 juveniles, Kahuka, 27 September 1975, L. Pinter (UH); 1 ♂, Honolulu, Nuuanu Pali Drive, Norfolk pine litter, 20 February 1985, V. & B. Roth (BPBM); 1 ♂, St. Louis, in house, 6 September 1985, B. Kumashiro (HDAO); 1 ♀, Kaimuki, under metal lid, 26 March 1990, D.J. Preston (BPBM); 1 ♂, 1 juvenile, Kailua, in bathroom, 1 November 1991, W. Fischer (HDAO); 1 ♂, Honolulu, Diamond Head [21°19′N, 157°47′W], under trash, 25 December 1997, J.A. Beatty (BB). *Maui* [20°48′N, 156°18′W]:1 ♂, Waianapanapa Cave, Makai pool, twilight zone, 24 January 1973, F.G. Howarth (BPBM); 1 ♀, Kanaio [20°05′N, 156°21′W], burial cave #1, twilight zone, 16 December 1992, F.G. Howarth (BPBM); 1 ♀, Kanaio, garbage pit, transition zone, 2 February 1993, F.G. Howarth et al. (BPBM). *Molokai* [21°09′N, 159°28′W]:3 ♂, 3 ♀, Kalaukol, elev. 10 feet (3 m), 24 May 1996, W. Perreira (BPBM); 1 ♂, Papu Str., 24 May 1996, W. Perreira (BPBM). *Hawaii* [19°21′N, 155°56′W]:1 ♀, Manuka NARS Mal Lua cave #1, dark zone, 3 February 1991, F. Howarth, F. Stone, D. Tanaka (BPBM); 1 ♂, 4 ♀, 1 juvenile, Waipio Valley [20°06′N, 155°35′W], along stream, 14 February 1995, J.W. & E.R. Berry (BB); 1 ♂, Hilo [19°43′N, 155°05′W], 22 February 1995, J.W. & E.R. Berry (BB); 1 ♂, 1 ♀, 1 juvenile, Route 137, m.m. 17–18, in building, 31 January 1997 (BB); 2 ♂, 2 ♀, 2 juveniles, Route 137, m.m. 17–18, in building, 2 February 1997, J.W. & E.R. Berry (BB); 1 ♀, Kau [18°52′N, 155°38′W], Green Sand Beach, 5 February 1997, J.W. & E.R. Berry (BB); 1 ♀, 2 juveniles, Kau at South Point, on lava rock, 9 February 1997, J.W. & E.R. Berry (BB). GILBERT ISLANDS (= Kiribati) [1°31′N, 175°05′E]:1 ♀, no further data. MARIANA ISLANDS: *Guam* [13°27′N, 144°45′E]:1 ♀, 1 juvenile, 1923, Hornbostel (no further data) (BPBM); 1 ♀, Tamuning [13°29′N, 144°47′E], on building, 3 March 1973, J.A. Beatty (BB); *Rota* [14°08′N, 145°12′E], 2 ♀, Talakaya, 60 m, 17 May 1958, W. Mitchell (BPBM). MARQUESAS ISLANDS: *Hiva Oa* [9°47′S, 139°00′W]: 1 ♀ (no further data) (BPBM); 1 ♂, 1 juvenile, Atuona Valley, 11 July 1929, Mumford, Adamson (BPBM); 3 ♂, 2 ♀, 1 juvenile, Hanamenu [9°45′S, 139°08′W], shaking ridgetop vegetation, 200 m, 5 February 1987, J.W. & E.R. Berry (BB); 1 ♂, Atuona, shaking low vegetation, 8 February 1987, J.W. & E.R. Berry (BB). *Nuku Hiva* [8°54′S, 140°06′W]: 2 ♀, 3 juveniles, Taiohae [8°55′S, 140°06′W], on stone cemetery wall, 20 January 1987, J.W. & E.R. Berry, 1 ♀, Taiohae in building, 25 January 1987, J.W. & E.R. Berry, 1 ♀ (BB); 1 ♀, 1 juvenile, Toovii [8°49′S, 140°12′W], on building, 29 January 1987, J.W. & E.R. Berry (BB). MARSHALL ISLANDS: *Arno Atoll* [7°03′N, 171°34′E], 1 ♂, 2 ♀, no further data; 1 ♂, 4 ♀, Ine Island, 21 July 1950, Ira LaRivers (BPBM). *Eniwetok* [11°21′N, 162°14′E], 6 ♀, 3 juveniles, Japtan [11°28′N, 162°23′E], on oil barrels, 22 July 1968, J.W. Berry (BB); 1 ♀, Parry [11°24′N, 162°22′E], in building, 10 June 1969, J.W. Berry (BB);2 ♀, Engebi [11°39′N, 162°14′E], in box, 19 September 1975, L. Cheng (BPBM); 2 ♂, 3 ♀, 2 juveniles (2 vials), Eniwetok hut, 21 September 1975 (BPBM). *Kwajalein* [9°03′N, 167°34′E], 1 ♀ (no further data), 20 May 1965 (BPBM); 3 ♀, 2 juveniles, Namur [9°23′N, 167°28′E], on wall of building, 23 July 1969, J.W. Berry (BB); 1 ♂, Namur, in building 27 July 1969, J.W. Berry (BB). *Majuro* [7°05′N, 171°22′E], 2 ♂, 4 ♀, 7 juveniles, Uliga village [7°06′N, 171°22′E], in building, 22 March 1980, J.A. Beatty (BB); 1 ♀, 10 juveniles, Uliga, Eastern Gateway Hotel, under giant clam shell on ground, 22 March 1980, J.A. Beatty (BB). NIUE: *Alofi* [19°03′S, 169°55′W], 1 ♀, 1 juvenile, elev. 0–60 m, December 1979, N.L.H. Krauss (BPBM). SOCIETY ISLANDS: *Moorea* [17°29′S, 149°48′W], 1 ♀, 1 juvenile, in house, 13 January 1987, J.W. & E.R. Berry (BB). TONGA: *Vavau* [18°36′S, 173°57′E], 1 ♀, Neiafu, elev. 0–100 m, January 1980, N.L.H. Krauss (BPBM).

Additional new records: AUSTRALIA: *Queensland* [16°49′S, 145°37′E], 1 ♀, Kuranda, 300 m, 16 May 1964 (no collector) (BPBM). INDONESIA: *Ambon* [3°39′S, 128°09′E], 2 ♀, 4 juveniles, 25 March 1994, R. Holmberg (RGH); 2 ♂, 3 ♀, in garage, 15–19 May 1994, R. Holmberg (RGH); 4 ♂, 5 ♀, in garage, 22 May 1994, R. Holmberg (RGH); 1 ♂, 1 ♀, Natsepa [3°39′S, 128°10′E], in garage, 11 June 1994, R. Holmberg (RGH); 1 ♀, Poka, in building, 22 July 1994, R. Holmberg (RGH); 3 ♂, 3 ♀, 4 juveniles, Natsepa, in garage, 5 November 1994, R. Holmberg (RGH); 1 ♀, 1995, R. Holmberg (RGH); 2 ♀, Natsepa, in garage, 24 January 1995; 4 ♂, 9 ♀, 16 juveniles, 28 January 1995; 1 ♂, 9 ♀, 6 juveniles, 2 March 1995, R. Holmberg (RGH); 1 ♂, Natsepa, in house, 13 March 1995, R. Holmberg (RGH); 1 ♂, 2 ♀, 1 juvenile, in house 15–24 April 1995, Audrey Leatemia (RGH); 1 ♀, Natsepa, in house, 29 April 1995, R. Holmberg (RGH); 1 ♀, in house, 30 April 1995, Audrey Leatemia (RGH); 1 ♀, 1 juvenile, 25 May 1995, Rudi Harfone (RGH); 1 ♂, 1 ♀, Poka, in office, 13 June 1995, R. Holmberg (RGH); 1 ♂, 3 ♀ and hatchlings, Natsepa, in garage,16 June 1995, R. Holmberg (RGH); 2 ♂, 2 ♀, 1 juvenile, Natsepa, 11–13 August 1995, R. Holmberg (RGH); 1 ♀, Natsepa, in garage, 13 August 1995, R. Holmberg (RGH); 1 ♂, 4 ♀, 3 juveniles, Waimena, 27 August 1995, Rina Budiman (RGH); 2 ♂, 4 ♀, 6 juveniles, Poka, in office, 1 September 1995, Ornie Sirabessy (RGH); 2 ♀, 2 juveniles, Galala, 1–24 July 1997, Rut Pulungan (RGH); 1 ♀, Ambon City [3°39′S, 128°09′E], Dasilna Village, 15 July 1997, Fenesa (RGH); 8 ♂, 18 ♀, 17 juveniles, Negen Lama, near Paso, 20–21 July 1997, Marsia (RGH); 1 ♀, Poka, across from Ambon City, 24 July 1997, Yette deKock et al. (RGH). *Bali*, 1 ♀, Ubud [8°31′S, 115°15′E], 11 June 1993, R. Holmberg (RGH). *Java* [7°41′S, 110°43′E], 1 ♂, Bogan, in guest house, 15–17 July 1995, R. Holmberg (RGH). *Seram* [2°52′S, 128°10′E], 6 ♂, 11 ♀, 4 juveniles, Kanikeh, in house, 30 November 1994, R. Holmberg (RGH); 2 ♀, 1 juvenile, Kanikeh, 24 August 1995, Kristen Leus et al. (RGH); 1 ♀, 1 juvenile, Melinani, 28 August 1995, Kristen Leus et al. (RGH); 5 ♀, 1 juvenile, Melinani, 29 August 1995 (RGH); 2 ♂, 8 ♀, 4 juveniles, western part, 1996–97 (no collector) (RGH); 3 ♂, 13 ♀, 2 juveniles, western part, in house, April 1996, Yette deKock; 1 ♀, 1 juvenile, Seriholu, 6 July 1996, Nico T. (RGH); 8 ♂, 22 ♀, 2 juveniles, Piru, 16 November 1996, Mia Rivi, Julai Mahumay, Rory Pays (RGH); 4 ♀, Ety, 17 November 1996, Io. Nikijulu (RGH); 4 ♂, 2 ♀, 1 juvenile, Nintari, near Pira, 12 July 1997 (RGH). *Sulawesi* [1°31′S, 124°50′E], 1 ♂, Manado, in house, May 1995, Charles Yonge (RGH). NEW CALEDONIA: *Voh* [21°32′S, 165°48′E], 1 ♀, elev. 0–50 m, 22–23 January 1969,

Figure 68.—Distribution of *Spermophora palau* in the Pacific is indicated by stars.

N.L.H. Krauss (BPBM); 1 ♂, 2 ♀, 1 juvenile, 7 mi E of La Foa [21°43′S, 165°49′E], 14 April 1945, C.L. Remington (AMNH). NEW HEBRIDES (= Vanuatu): *Banks Island:* 1 ♂, Vanua Lava [13°49′S, 167°29′E]: Sola, elev. 0–200 m, January 1974, N.L.H. Krauss (BPBM); 1 ♀, 1 juvenile, *Efate Island*, Vila Harbour, elev. 0–100 m, January 1987, N.L.H. Krauss (AMNH). PHILIPPINE ISLANDS: *Luzon*: 1 ♀, 2 juveniles, Ifugao, Banaue [17°03′N, 121°13′E], in house (no date), A. Bocek (BB). SOLOMON ISLANDS: *Russell Islands* [9°06′S, 159°11′E]: 4 ♀, 1 juvenile, December 1944, R.B. Eads (AMNH); *Guadalcanal* [9°30′S, 160°06′E]: 4 ♀, Lunga River region, no date, F.E. Samson (AMNH); 4 ♂, 6 ♀, 17 June 1944, Beck (AMNH).

Remarks.—This was the most common pholcid in the Pacific collections we examined. In shape and size it resembles *Pholcus ancoralis* but is readily distinguished by its abdominal pattern.

Description.—Medium-sized (body length 4–8 mm) eight-eyed pholcid. Male with small frontal tooth-like tubercle on chelicera near fang. Thoracic groove a more-or-less circular depression just behind cephalic region. Abdomen elongate, cylindrical, marked with two parallel rows of more-or-less rhomboidal purplish patches dorsally (Fig. 55), a few lateral patches the same color; and ventrally a median lengthwise band which divides into two parallel bands in front of spinnerets. Legs long, femur I almost twice body length in female, a little more than twice in males. Small simple epigynum as in Fig. 20.

Distribution in the Pacific.—Known from Philippines, Indonesia and Australia to New Caledonia, Marquesas and Hawaii.

Natural history.—Found mostly in buildings, but also in caves, under *Tridacna* shell on ground, and in webs on vegetation.

Genus *Spermophora* Hentz 1841

Spermophora Hentz 1841:117.
Oophora Hentz 1850:285.
Simonius Kishida 1913:1020.

Type species.—*Spermophora meridionalis* Hentz 1841, by monotypy.

Remarks.—This genus currently has 36 described species species from Africa, and Eurasia to western Pacific Islands. One introduced species almost worldwide.

Spermophora palau Huber 2005
Figs. 10, 11, 36, 68

Spermophora palau Huber 2005a:68.

Material examined.—CAROLINE ISLANDS: *Palau:* Babelthuap Island [7°22′N, 134°33′E]: male holotype. *Ponape*

Island: 1 ♂, 1 ♀, 1 juvenile, Kolonia [6°57′N, 158°12′E]: coffee leaf malt, Berlese funnel, 7 January 1953, J.L. Gressitt (BPBM); 1 ♂, same but not in coffee leaf malt (BPBM); 4 ♀, same locality, rotten stump, 17 January 1953, J.L. Gressitt (BPBM); 1 ♀, same locality, wet compost, 7 January 1953, J.L. Gressitt (BPBM); 3 ♀, 3 juveniles, east of Kolonia, elev. ~200 feet (61 m), in pile of coconut husks, 5 June 1973, J.A. Beatty, J.W. Berry (BB); 1 ♀, Ponape, wet forest litter, 8 June 1973, J.W. Berry, J.A. Beatty (BB); 1 ♀, Ponape, SW of Sekere School, shaken from bushes on bank, 10 June 1973, J.W. Berry, J.A. Beatty (BB); 1 ♀, Etscheit Property, near Kolonia, 7 June 1973, J.W. Berry, J.A. Beatty (BB); *Sokehs Island (= Deke Sokehs)* [6°59′N, 158°13′E): 1 ♂, 1 ♀, 1 juvenile, breadfruit and banana litter, 9 June 1973, J.W. Berry, J.A. Beatty (BB); 1 ♂, 3 ♀, 2 juveniles, same data but in pile of coconut husks (BB); *Truk*: Moen Island [7°26′N, 151°51′E]: 1 ♂, Mt. Terosken, 28 December 1952, J.L. Gressitt? (BPBM); 1 ♂, 1 ♀, 1 juvenile, forest litter, breadfruit and other trees, 12 June 1973, J.W. Berry, J.A. Beatty (BB); 5 ♀, same data but coconut litter (BB); 2 ♀, same data but tree shaking, mixed forest, hill above quarry (BB); *Tol Island* [7°21′N, 151°37′E]: 1 ♀, Mt. Unibot, 1 January 1953, J.L. Gressitt (BPBM).

Remarks.—Like most representatives of true *Spermophora*, this small six-eyed pholcid is provided with a median pocket on the female abdomen behind the epigynum (Fig. 11). Males have a distinctive ventral serrated flap on the procursus (Fig. 10).

Distribution in the Pacific.—This species has been found only on the Caroline Islands (Palau, Truk, and Ponape). The widespread *S. senoculata* differs from *S. palau* by the long bulbal apophysis, the bifid ventral procursus apophysis, the absence of pockets on the epigynum, and by the paired (instead of median unpaired) pockets posteriorly on the female abdomen. *Spermophora senoculata* has not been reported from the Pacific, but it may be found found there because of the frequency of importation of exotic species almost everywhere.

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Revision of the jumping spider genus *Sassacus* (Araneae, Salticidae, Dendryphantinae) in North America

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Abstract. The nine species of *Sassacus* Peckham & Peckham 1895 known from Canada, the United States, and Mexico are described. The genus as defined here includes: *Sassacus papenhoei* Peckham & Peckham 1895, *Sassacus paiutus* (Gertsch 1934), *Sassacus samalayucae* Richman (new species), *Sassacus cyaneus* (Hentz 1846), *Sassacus alboguttatus* (F.O. Pickard–Cambridge 1901), *Sassacus vitis* (Cockerell 1894), *Sassacus aztecus* Richman (new species), *Sassacus barbipes* Peckham & Peckham 1888, and *Sassacus lirios* Richman (new species). *Agassa* Simon 1901 is synonymized with *Sassacus*. "Typical" (beetle-like) and more "normal" (spider-like) *Sassacus* range from Southern British Columbia south into Central America. The *Sassacus arcuatus* group, which is much more extensive in South America, possibly belongs to its own genus and is not treated beyond one species described here from Mexico.

Keywords: Taxonomy, new species, *Agassa*, *Metaphidippus*

The salticid genus *Sassacus* Peckham & Peckham 1895, along with the spiders placed in the monotypic genus *Agassa* Simon 1901 (here made a junior synonym of *Sassacus*) and *Metaphidippus vitis* (Cockerell 1894) (described as a species of *Deudryphantes* and placed in *Sassacus* by Hill 1979) represent an evolutionarily interesting group. Members of *Sassacus* s.s., including the *Agassa* subgroup, appear to be beetle mimics, while the others are not beetle-like. The "*Agassa*" species appear to be mimics of chrysomelid beetles (Coleoptera, Chrysomelidae). Apparent beetle mimicry is also exhibited by at least two other salticid genera (Richman & Jackson 1992). The presence of such resemblances in some members of the highly diversified spider family Salticidae poses a number of important evolutionary questions.

The current paper centers on the revision and description of the species of *Sassacus* (including *Agassa* and the "*Metaphidippus*" *vitis* group) from Canada, the United States and Mexico to the Guatemalan border. The Neotropical species south of Mexico, mostly if not all in the *Sassacus arcuatus* group, are outside the scope of this paper. An unrelated salticid, *Sassacus aemulus* Gertsch 1934, was transferred first to *Bianor aemulus* (Gertsch): by Maddison (1978) and then to *Sibianor aemulus* (Gertsch): by Logunov (2001). It is not treated in the current paper.

METHODS

More than 1850 specimens were examined for this study. The specimens were loaned or data were provided by the following institutions and individuals (names followed by acronym used in the species descriptions): American Museum of Natural History, New York City (AMNH); British Museum of Natural History, London (BMNH* record of type from photographs- specimen not examined directly); Bruce Cutler Collection, Lawrence, Kansas (BCC); California Academy of Science, San Francisco (CAS); Canadian National Collection, Ottawa (CNC); Florida State Collection of Arthropods, Gainesville (FSCA); Illinois Natural History Survey, Chicago (INHS*- records from database- specimens not examined); Milwaukee Public Museum, Milwaukee, Wisconsin (MPM); Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (MCZ); New Mexico State University Arthropod Museum, Las Cruces (NMSUAM): Texas A&M University, College Station (TAM); United States National Museum of Natural History, Washington DC (USNMNH); University of California, Riverside (UCR); West Texas A&M University, Canyon (WTAM)

All measurements, given in mm, were made using an Olympus binocular dissecting microscope with an eyepiece scale calibrated with a slide micrometer. Total length was based on the standard anterior center edge of carapace to the tip of the abdomen, although on occasion it was difficult to discern exactly where the tip of the abdomen was located. Carapace length down the center and width at the widest points were also measured. Drawings were made using a grid in one ocular and a corresponding grid under tracing paper. Final drawings were made on coquille board using a black Prismacolor pencil (habitus drawings) and pen and ink on velum.

Latitude and longitude have been added to records from maps, internet web sites (e.g., United States Geological Survey site at http://geonames.usgs.gov/redirect.html) and gazetteers when practical. Some locations were not found on maps, websites, or in gazetteers, or there were two or more possibilities for the actual locations. For these no latitude or longitude is given. It should be noted that as almost none of the localities for the specimens were ever GPS recorded, these figures are only approximate. With *Sassacus papenhoei*, *S. cyaneus*, and *S. vitis* only county records are given for USA locations and latitude and longitude were not determinable. One North American species (*S. paiutus* Gertsch) is so little known that I have included exact locality records.

Specimens were compared to type specimens borrowed from the collections noted in the descriptions, photographs provided by the British Museum of Natural History and drawings in the literature cited and/or on the internet website of Prószyński (2003).

TAXONOMY

Family Salticidae Blackwall 1841
Sassacus Peckham & Peckham 1895

Sassacus Peckham & Peckham 1895:176; Peckham & Peckham 1909:591.
Agassa Simon 1901:643. **New synonymy.**
Metaphidippus F.O. Pickard-Cambridge 1901:258 (in part).
Homalattoides F.O. Pickard-Cambridge 1901:293 (in part – genus no longer recognized).
Ramboia Mello-Leitão 1943:229. (This synonomy is uncertain and may be altered in the future.)

Type species.—*Sassacus papenhoei* Peckham & Peckham 1895, by monotypy.

Agassa: *Attus cyaneus* Hentz 1846, by monotypy.

Metaphidippus: *Metaphidippus mandibulatus* F.O. Pickard-Cambridge 1901, by original designation.

Ramboia: *Ramboia helenica* Mello-Leitão 1943, by monotypy.

Etymology.—Apparently named for the Pequot chief Sassacus (born 1560), whose sub-chief, Uncas, rebelled founding the Mohegans. The name was also applied to the U.S.S. Sassacus, a Union gunboat, which earned some fame by ramming the Confederate ironclad C.S.S. Albemarle near the Outer Banks of North Carolina in 1864. As far as I know this is the only case of a genus of jumping spiders sharing the name of a warship!

Diagnosis.—Beetle-like to normal appearing dendryphantine jumping spiders with a short, curved or crooked terminal embolus and robust, usually unidentate, chelicerae in the males. Most species have metallic scales covering the body. The genus *Sassacus* is apparently restricted to North and Central America (if the *arcuatus* group is not this genus) and consists of only 8 species. A ninth species, *S. lirios*, from southern Mexico and Central America, is described here and placed in *Sassacus* until a new genus can be erected for the *arcuatus* group, if it so belongs. The type species is *Sassacus papenhoei,* which was described by Peckham & Peckham (1895, 1909). The genus *sensu stricto* is primarily beetle-like, as discussed earlier. *Sassacus sensu lato* as defined here, includes the genera *Sassacus s.s.* (including *Agassa*), *Sassacus barbipes* and the "*Metaphidippus*" *vitis* groups. The definition of *Agassa*, with the reduced spination on the ventral first tibia and more box-like cephalothorax is not distinctive enough to separate it from *Sassacus*. The spination on the ventral tibiae of the first legs is usually reduced to 3 in *Sassacus papenhoei.* "Normal" Dendryphantinae have 6 and this is the number found also in *S. samalayucae, S. vitis, S. aztecus*, and *S. lirios.* Since *S. papenhoei* itself can have anywhere from 1 to 4 ventral macrosetae, the spination of the first tibia cannot be depended on as a taxonomic character at the generic level for these spiders. This leaves *Agassa* with only a somewhat more extreme carapace shape and obviously different, but yet similar, genitalic characteristics, which in my view are only enough to make it a separate species group within *Sassacus.* The "*Metaphidippus*" *vitis* group was a little more difficult to place in relation to the *S. papenhoei* group until the discovery of *S. aztecus,* which resembles *S. vitis* with a more *S. papenhoei*-like embolus. Without this connection, while obviously a dendryphantine, *M. vitis* is not obviously a *Sassacus*, as defined by the type species, *S. papenhoei.* Hill (1979) placed *M. vitis* in *Sassacus*, based on body scale structure, and Hedin & Maddison (2001) agreed with this placement, based on molecular data. The genitalia of *S. vitis* are however somewhat different from those of *Sassacus s. s.*

The "*Sassacus arcuatus* group" (= *Ramboia*?) is mostly South American, with possibly only two species (one not described here) falling into the distribution range of the current work. These appear to belong to a separate genus. *Sassacus barbipes* is apparently (and surprisingly) a true *Sassacus.* (A second species presently placed in *Ashtabula*, *A. glauca* Simon, from Mexico, apparently is a junior synonym of *S. barbipes.*)

Behavior.—The genus *Sassacus* has been little studied in regard to behavior. Only two of the North American species, *S. paiutus* (misidentified as *S. papenhoei*) and *S. vitis* have had their courtship recorded (Richman 1982a, 1982b). Crane (1949a, 1949b) examined the courtship of two species of the *S. arcuatus* group that she described from Venezuela. As noted above *Sassacus paiutus* and *S. vitis* have some very similar elements in their courtships (Richman 1982a, 1982b), which led me to believe that they might be congeneric. Table 1 contains a summary checklist of the species known from North America, including Mexico.

KEY TO THE NORTH AMERICAN SPECIES OF *SASSACUS*

1. Front patellae-tibiae flattened in both sexes and with fringe of spatulate hairs on ventral edges (Fig. 43) ..... *Sassacus barbipes*
   With front legs normal and without fringes 2
2. Abdomen with inverted stylized lily-like marking (sometimes broken in middle) (Fig. 49); male with scythe-like embolus (Fig. 51); female epigynum generally smaller than in other species (Figs. 53, 54) ..... *Sassacus lirios*
   Abdomen usually without inverted stylized lily-like marking (exception some females of *S. aztecus* from southern Sonora); male embolus not scythe-like; body usually covered with metallic scales 3
3. Body elongated and covered with golden scales 4
   Body beetle-like (compact—not elongated) (Figs. 1–3, 9, 17, 23) and covered with metallic scales of various colors; male with kinked or curved embolus (Figs. 5, 11, 19, 25), but not buttonhook-like, or only female known 5
4. Male with buttonhook-like embolus (Figs. 31, 32 ..... *Sassacus vitis*
   Male with curved embolus (Fig. 38) ..... *Sassacus aztecus*
5. Body covered with metallic gold-silver scales (Fig. 9) 6
   Body covered with coppery, pink and green, brassy or blue scales (Figs. 1–3) 7
6. Three first ventral tibial macrosetae (as in *S. papenhoei*) ..... *Sassacus paiutus*
   Six first ventral tibial macrosetae; epigynum (Fig. 15) distinctive, quite unlike those of either *S. papenhoei* or *S. paiutus*. . . . . *Sassacus samalayucae*

7. Carapace more elongate (Fig. 3); males with broader slightly crooked embolus (Fig. 5); females with openings curved but not sinuate (Fig. 7) ..... *Sassacus papenhoei*
   Carapace nearly square (Figs. 17, 23) 8
8. Males with 0–2 promarginal teeth and single large curved retromarginal tooth (Fig. 18), and with narrow, slightly curved embolus (Fig. 19); females with epigynal plate wider than long and with sinuate epigynal openings (Figs. 21, 22) ..... *Sassacus cyaneus*
   Males with single large promarginal tooth and single large retromarginal tooth (Fig. 24), embolus curved toward tip (Fig. 25); females with epigynal plate longer (or at least as long as) than broad; epigynal openings not sinuate (Figs. 27, 28) ..... *Sassacus alboguttatus*

Sassacus papenhoei species-group

Sassacus papenhoei Peckham & Peckham 1895
Figs. 1–8, 55

Sassacus papenhoei Peckham & Peckham 1895:177, plate 16, fig. 11.
Sassacus smaragdinus Barrows 1919:359, plate 15, fig. 9.
Sassacus vanduzeei Chamberlin 1924:687, fig. 133; Roewer 1954:1228.
Sassacus uteanus Chamberlin & Gertsch 1929:111, plate 5, figs. 54, 56.

Material examined.—*Sassacus papenhoei:* male lectotype and 7 female paralectotypes, USA: *Kansas*: Wallace, Wallace County [38°54′41″N, 101°35′28″W], 1895 (MCZ, examined). Note: the type vial contained 1 male and 7 females from the same locality. As it is uncertain just which specimen the Peckhams intended to be the holotype, I designate the male as the lectotype and the females as the paralectotypic series.

Sassacus vanduzeei: holotype female, MEXICO: *Sonora*: San Pedro Martir Island, 28°20′N, 112°12′W, 18 April 1921 (CAS, examined).

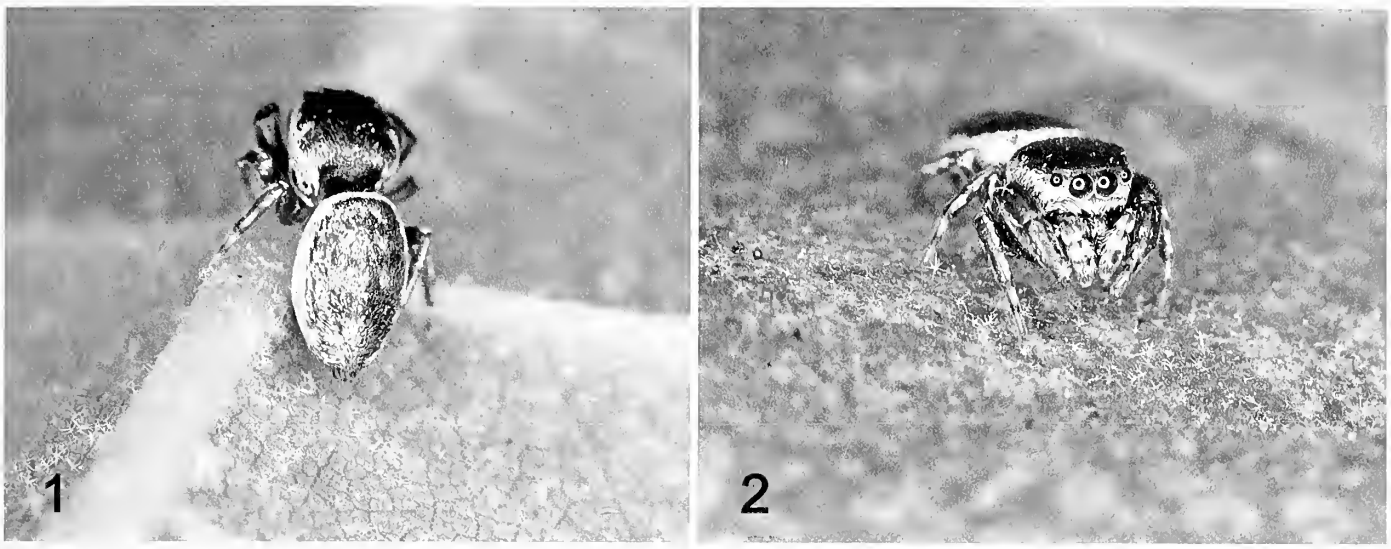
Sassacus uteanus: 1 paratype male (with female *S. vitis*), USA: *Wyoming*: Afton, Lincoln County [42°43′29″N, 110°55′54″W], 20 June 1927, W. J. Gertsch (AMNH, examined).

Other material: CANADA: *British Columbia:* 3.2 km E. of Lytton latter 50°14′N, 121°34′W (CNC); Osoyoos, 49°02′N, 119°28′W (CNC), Summerland 49°39′N, 119.33°W (CNC); Vernon 50°16′N, 119°16′W (AMNH), Victoria 48°26′N, 123°21′W (MCZ).

USA (counties only): *Alabama:* Cleburne (AMNH); Coosa (MCZ, AMNH); Madison (AMNH); Tallapoosa (MCZ); *Arizona*: Apache (AMNH, FSCA); Cochise (TAM, MCZ, CAS, UCR, AMNH, FSCA); Gila (AMNH); Pima (TAM, MCZ, AMNH, FSCA); Santa Cruz (MCZ, NMSUAM); Yavapai (MCZ, CAS); *Arkansas*: Benton (INHS*); Carroll (MCZ); Washington (MCZ, INHS*); *California*: Contra Costa (CAS, AMNH); Fresno (CAS); Inyo (AMNH); Lake (AMNH); Los Angeles (MCZ, AMNH); Marin (CAS); Mendocino (CAS); Monterey (MCZ, CAS, UCR, ANMH); Napa (CAS); Nevada (CAS); Riverside (CAS, UCR, AMNH); San Bernardino (UCR); San Diego (MCZ, AMNH, FSCA); San Joaquin (CAS); Santa Clara (CAS); Trinity (AMNH); Ventura (MCZ); *Colorado*: Boulder (CNC); Larimer (MCZ); Prowers (AMNH); *District of Columbia:* Washington (USNMNH); *Idaho*: Bannock (USNMNH); Boise (AMNH); Franklin (AMNH); Gem (AMNH); Minidoka (AMNH); Oneida (MCZ); Twin Falls (AMNH); *Illinois*: Bond (AMNH); Macoupin (AMNH); Mason (INHS*); *Iowa:* Woodbury (FSCA); *Kansas*: Barber (BCC); Cheyenne (BCC); Douglas (BCC); Geary (BCC); Gove (BCC); Riley (BCC, MCZ); Stafford (USNMNH); Wabaunsee (BCC); *Louisiana*: Caddo (MCZ); *Maryland*: Prince Georges (USNMNH); *Michigan*: Livingston (FSCA); *Minnesota*: Wabasha (BCC); Winona (BCC, CAS); *Mississippi*: Claiborne (MCZ); *Missouri*: Johnson (BCC, FSCA); Phelps (AMNH); St. Louis (MCZ); *Montana:* Sanders (AMNH); *Nebraska:* Keith (NMSUAM); *Nevada*: Washoe (MCZ); *New Mexico*: Bernalillo (TAM); Chaves (NMSUAM); Doña Ana (USNMNH, NMSU, MPM, NMSUAM, FSCA); Eddy (AMNH); Hidalgo (NMSUAM, FSCA); Luna (NMSU); Otero (FSCA); Roosevelt (AMNH); Sandoval (AMNH); *North Carolina*:(MCZ); Durham (MCZ); Macon (USNMNH, MCZ); Watauga (MCZ); *Oklahoma*: Delaware (AMNH); Dewey (NMSUAM); Marshall (FSCA); *Oregon*: Baker (AMNH); Benton (AMNH); Deschutes (AMNH); Grant (MCZ, AMNH); Harney (BCC, AMNH); Jackson (AMNH); Jefferson (AMNH); Josephine (AMNH); Klamath (AMNH); Lake (AMNH); Mulheur (AMNH); Wheeler (MCZ, AMNH); *South Carolina*: Darlington (FSCA); State record only (USNMNH); *Tennessee*: Hamilton (MCZ); Robertson (AMNH); *Texas*: Brazos (AMNH);

Table 1.—Check list of species of *Sassacus* from North America.

Species	Distribution
♂♀ *alboguttatus* (F.O. Pickard-Cambridge)	Mexico: Chiapas, Distrito Federal, Guerrero, Moreles, Nayarit, Sonora
♂♀ *aztecus* new species	Mexico: Nayarit, Sonora
♂♀ *barbipes* Peckham & Peckham	Mexico: Sonora south into Central America
♂♀ *cyaneus* (Hentz)	Eastern USA
♂♀ *lirios* new species	South-eastern Mexico, south to Costa Rica
♂♀ *paiutus* (Gertsch)	Mexico: Baja California Norte; USA: south-western Arizona, eastern California, southern Utah
♂♀ *papenhoei* Peckham & Peckham	South-western Canada; USA; Mexico
♀ *samalayucae* new species	Mexico: Chihuahua
♂♀ *vitis* (Cockerell)	South-western Canada; USA; Mexico south to Panama



Figures 1, 2.—*Sassacus papenhoei.* Female from New México, USA.

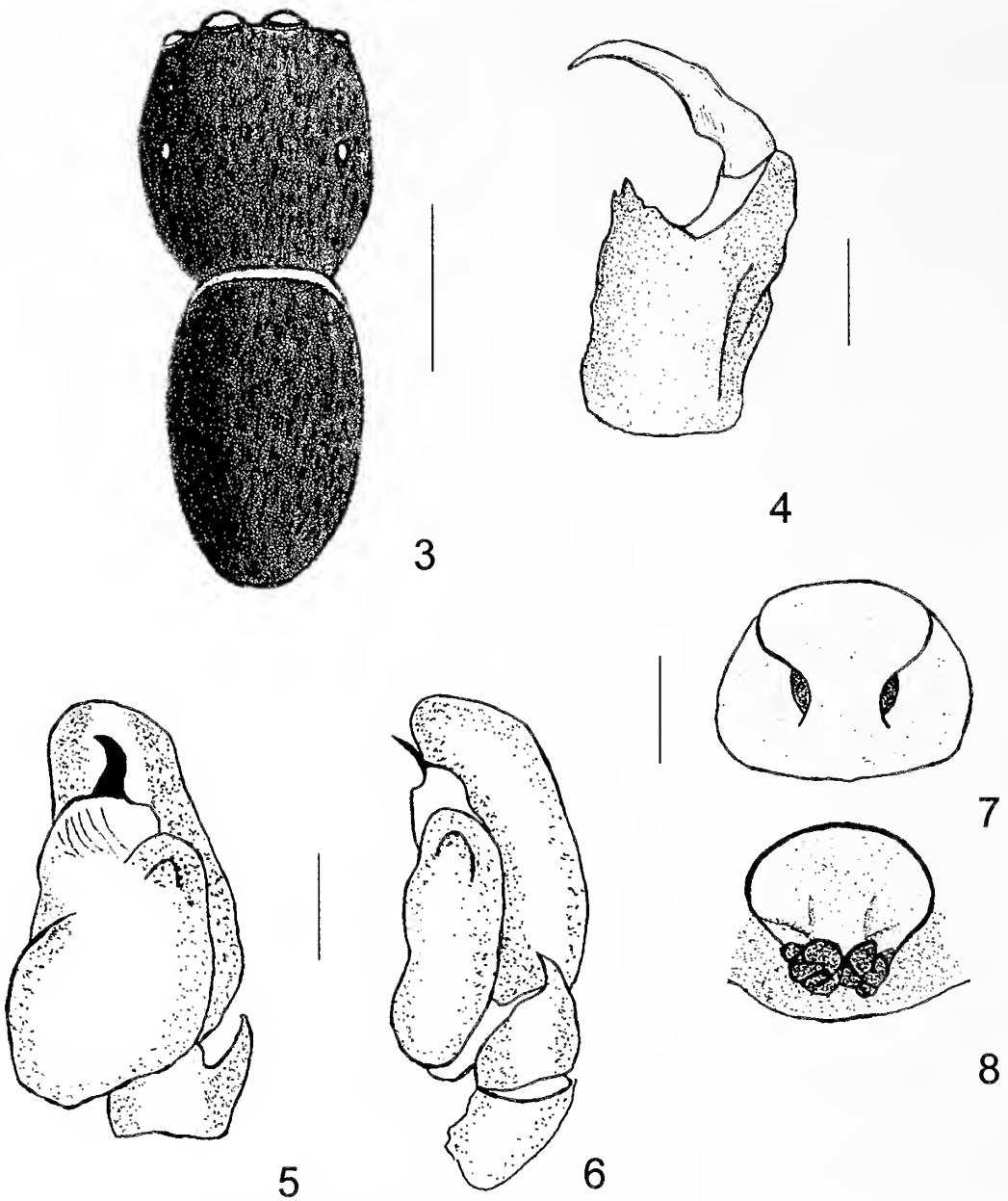
Brewster (BCC, CAS); Brown (FSCA); Burnet (FSCA); Calhoun (AMNH); Cameron (AMNH); Carson (WTAM); Collin (TAM); Comanche (TAM); Dallas (MCZ, AMNH); Denton (MCZ); Dickens (TAM); El Paso (AMNH); Erath (TAM); Floyd (TAM); Gaines (FSCA); Grayson (AMNH); Hale (TAM); Howard (TAM, NMSUAM); Jones (FSCA); Martin (TAM); Montague (AMNH); Nolen (FSCA); Randall (AMNH); Somervill (MCZ); Taylor (AMNH); Tom Greene (TAM); Travis (TAM, MCZ); Val Verde (TAM); Webb (TAM); Wichita (AMNH); Wilbarger (AMNH); Winkler (FSCA); Wise (AMNH); Yoakum (FSCA); *Utah*: Box Elder (MCZ, AMNH); Cache (MCZ, NMSUAM); Davis (USNMNH, AMNH); Duchesne (AMNH); Millard (MCZ); Morgan (AMNH); Salt Lake (AMNH); San Juan (MCZ); Summit (AMNH); Utah (AMNH); Wasatch (AMNH),Washington (MCZ); Weber (AMNH); *Virginia*: (USNMNH); Fairfax (MCZ); *Washington*: Benton (MCZ); Chelan (CNC); Franklin (MCZ); Grant (MCZ, AMNH); Okanagon (AMNH); Thurston (MCZ); Whitman (MCZ); Yakima (MCZ); *Wisconsin*: Walworth (MCZ) ; *Wyoming*: Goshen (MCZ); Lincoln (AMNH); Platte (MCZ).

MEXICO: *Baja California (Norte):* El Rosario, 28.38°N, 106.03°W (AMNH); San Jose (Meling Ranch) (coordinates not determined) (AMNH); Santo Tomas, 31.33°N, 116.24°W (AMNH); *Chihuahua:* 21 km N. Ciudad Camargo (MCZ); 40.2 km SW Carmargo (AMNH) 40 km W Carmargo (AMNH); Note: Carmargo is at 27.41°N, 105.10°, W Catarinas, 29.83°N, 107.7°W (AMNH); Cuevas Matamoros District 26°48′N, 105°35′W (AMNH); Huejotitlan 27°04′N, 106°12′W (AMNH); Las Delicias 28°12′N, 105°30′W (AMNH); La Cruz, 23.55°N, 106. 54°W (AMNH); Primavera (coordinates not determined) (AMNH); Santa Barbara, 26.48°N, 105.50°W (AMNH); 1.6 km E. La Sauceda (coordinates not determined) (AMNH); *Coahuila:* Gloria 25.50°N, 101.06°W (AMNH); Guadalupe, 32.05°N, 116.32°W (AMNH); 24 km N. Saltillo, 25.25°N, 101.0 W (AMNH); *Distrito Federal:* Tlalpan, 19°17′N, 99°09′W (AMNH); *Durango:* Encino 26.09°N, 105.20°W (AMNH); La Loma near 25.32°N, 103.32°W (AMNH); Palos Colorados (coordinates not determined) (ANMH) Nombre de Dios (coordinates not determined) (AMNH); Rodeo, 25.1°N, 104.39°W (AMNH); *Guanajuato:* San Miguel Allende 21°54′08″N, 101°06′06″W (AMNH); *Jalisco:* El Nolina (coordinates not determined) (MCZ); Ojuelos, 21°52′N, 101°40′W (AMNH); 3.2 km S. of Tlaquepaque near 20°39′N, 103°15′W (AMNH); Zapotlanejo 20°38′N, 103°04′W (AMNH); *Morelos*: N. of Cuernevaca, 18.55°N, 99.15°W (MCZ); *Nuevo Leon:* Villa de Santiago 25°26′N, 100°08′W (MCZ); *Oaxaca:* 5.6 km E. of Mitla near 16°55′N, 96°24′W (MCZ); Tlacolula 16°57′N, 96°28′W (AMNH); *Puebla:* Puebla, 6500′, 19.05°, 98.22°W (AMNH); *Sonora:* Isla San Pedro Martir 28°23′N, 112°20′W (CAS); Minas Nuevas 27°03′N, 109°00′W (AMNH); 13.8 km W. Tepoca near 30°16′N, 112°51′W (CAS); *Tlaxcala:* Huamantla 19°18′N, 97°55′W (AMNH); *Zacatecas*: Tropic of Cancer on Hwy. 23°27′N, 102°10′W (TAM).

Diagnosis.—This species differs from almost all other *Sassacus* (exception *S. paiutus*) in usually having only three ventral macrosetae on the first tibiae and in being covered with pink or coppery and green, blue or brassy metallic scales in life. These may all appear to be brassy or greenish under alcohol. The male palpi differ from all the other members of the genus (except for *S. paiutus*) in the characteristic kinked shape of the embolus (Fig. 5). Similarly the epigynum of the female differs from all but *S. paiutus* in the placement of openings and general structure (Figs. 7, 8). The species is easily separable from *S. paiutus* in that the body of the latter is covered with golden metallic scales. *Sassacus paiutus* is also confined almost totally to the lower Colorado River of Nevada, California, and Arizona, while *S. papenhoei* is widespread from British Columbia and Maryland south into southern Mexico.

Description.—Generally both sexes covered with metallic green and pink or coppery scales in life (Figs. 1–3). Usually the scales on the carapace are pink or coppery and on the abdomen are green or blue.

Male lectotype from Wallace County, Kansas: Total length 3.6, carapace length 1.7, carapace width 1.4. Ventral spines on first tibiae 1-2-0 (or 1-0, 1-1, 0-0) (typical spination). Leg



Figures 3–8.—*Sassacus papenhoei.* 3. Male from New Mexico, dorsal view. 4–6. Male from Utah: 4. Chelicera, ventral view; 5. Left palpus, ventral view; 6. Left palpus, retrolateral view. 7, 8. Female from Utah: 7. Epigynum, ventral view; 8. Vulva, dorsal view. Scale line 1 mm (Fig. 3), 0.25 mm (Fig. 4), 0.1 mm (Figs. 5–8).

formula 1423. Chelicerae excavate with 2 promarginal teeth and one large retromarginal tooth (Fig. 4), which may in some examples have a basal projection. Body covered with metallic scales, which appear greenish under alcohol, otherwise base color appears brown, darker around eyes. Palpi light brownish, chelicerae and clypeus orange brown. Sternum, endites, and labium brown; endites lighter on anterior 1/3. Legs brownish with metatarsi 2, 3, and 4 having proximal 1/3 yellow. Patellae slightly lighter ventrally. Ten males from Kansas (BCC) total body length 2.9–3.7, carapace length 1.4–1.8, carapace width 1.25–1.6.

Female paralectotype from Wallace County, Kansas: Total length 4.6, carapace length 1.8, carapace width 1.6. Leg formula 1423. Appearance as in male, but with metatarsi only dark at distal ends and legs 2, 3, and 4 lighter- nearly orange- and chelicerae not excavate. Ten females from Winona County, MN (BCC) total length 3.75–5.25, carapace length 1.75–2.0, carapace width 1.5–1.7.

Variation.—While *Sassacus papenhoei* is fairly stable in appearance throughout its distribution, it does vary somewhat in the number of ventral macrosetae on the first tibiae, as noted earlier. These are usually arranged as 1-0, 1-1, 0-0, but may be 1-0, 0-1, 0-0 or 1-0, 1-1, 0-1. One male from Gem County, Idaho, had 0-0, 0-1, 0-0 and a female from Utah County, Utah had 1-0,0-0,0-0 just the same as *S. cyaneus*! In both cases both front legs were examined closely for sockets, but none were found. Since loss of ventral macrosetae is fairly common in this species it is easy to see why "*Agassa*" has lost macrosetae to the point of only having one. The *arcuatus* and *vitis* groups of *Sassacus,* as well as the more typical *Sassacus*

samalayucae, have a more usual dendryphantine formula of 1-1, 1-1, 1-1, with the macrosetae occupying the distal 1/2 to 2/3 of the ventral tibia. This can be considered the "primitive" dendryphantine condition.

Some males from Utah County, Utah (AMNH) have emboli with the typical "crook" nearly or completely gone. The embolus in this case looks almost dagger-like. It is possible that this variation represents an incipient speciation event, but there do seem to be some intermediate forms. In females the spatial relationship of the epigynal openings seems to differ between being slightly slanted to being orientated parallel to the sides of the abdomen. This does not seem to be a stable difference, however, as females from several parts of the United States have the same variation.

Three males collected in Cochise County, Arizona, have a somewhat different color pattern, with white scales scattered on the abdomen forming a row of darker patches on each side (visible only when dry). The legs are less pigmented than the typical specimens. Comparison with a "typical" *S. papenhoei* from the Santa Catalina Mountains convinced me that these represent just a color variation and not a separate species. Color variations in this species are uncommon, but do exist. A few specimens from Cache County, Utah, have brassy scales but still have the darker leg segments on all legs except for the tarsi and metatarsi, which are yellow. Some individuals have lighter colored legs than usual, but these could possibly be recently molted. However, most variations are in the metallic colors rather than in having non-metallic scales replace metallic ones or in the base color.

Another interesting variation in *S. papenhoei* is found in some male specimens from Oregon, which almost resemble *S. vitis* in being apparently more elongated in body form than typical *S. papenhoei*. In at least one case specimens were consigned to a box marked "*vitis*." Such variation, while uncommon, points out the plasticity of body shape in this genus and I think implies that all of the included species are probably closely related enough to be within a single genus.

Distribution.—This species occurs from Maryland north to southern Minnesota, south to Mississippi, and west to California and British Columbia, south into Zacatecas, Oaxaca and Guerrero, Mexico

Natural history.—Often abundant in summer, especially on creosote, *Baccharis*, mesquite, and other desert shrubs in New Mexico or on shorter perennials, such as lupine in California. This species is often also swept from alfalfa or cotton. Two males and 21 females were collected from *Chrysothamnus* and *Artemisia* in Redmond, Deschutes County, Oregon (AMNH). Males and females were collected on *Acacia* near Jacumba, San Diego County, California (AMNH), 3 females from mesquite and acacia in Pima County, Arizona (FSCA), and a female from stream edge vegetation in Burnet County, Texas (FSCA). Three males and three females were collected on perennial *Gutierrezia* in Winkler County, Texas (FSCA). A male and female were collected by sweeping upland prairie in Woodbury County, Iowa (FSCA). Females have been collected on big sagebrush or "sagebrush" in Cache County, Utah. A male was collected in montane forest in the San Gabriel Mountains, Los Angeles County, California (AMNH). Others have been collected in meadows in Missouri and from bushes along creeks in Arizona. Males collected in May-September and November; females May- November. One female collected on the Jornada Experimental Range, Doña Ana County, New Mexico on 3 August 1990, had laid 5 large (1 mm) eggs in a small sac by the time it was preserved on October 23. Another female from Johnson County, Missouri was collected with an egg sac containing 7 spiderlings and 2 unhatched eggs. One female (AMNH) from Corvallis, Oregon, was collected in July from a mud dauber's nest (Hymenoptera: Sphecidae).

Sassacus paiutus (Gertsch)
Figs. 9–14, 56

Metaphidippus paiutus Gertsch 1934:18, fig. 22.
Sassacus paiutus (Gertsch): Maddison 1996:238.
Sassacus papenhoei Peckham & Peckham: Richman 1965:133; Richman & Roth 1976:201; Hill 1979:195, 208, fig. 10L (misidentification).

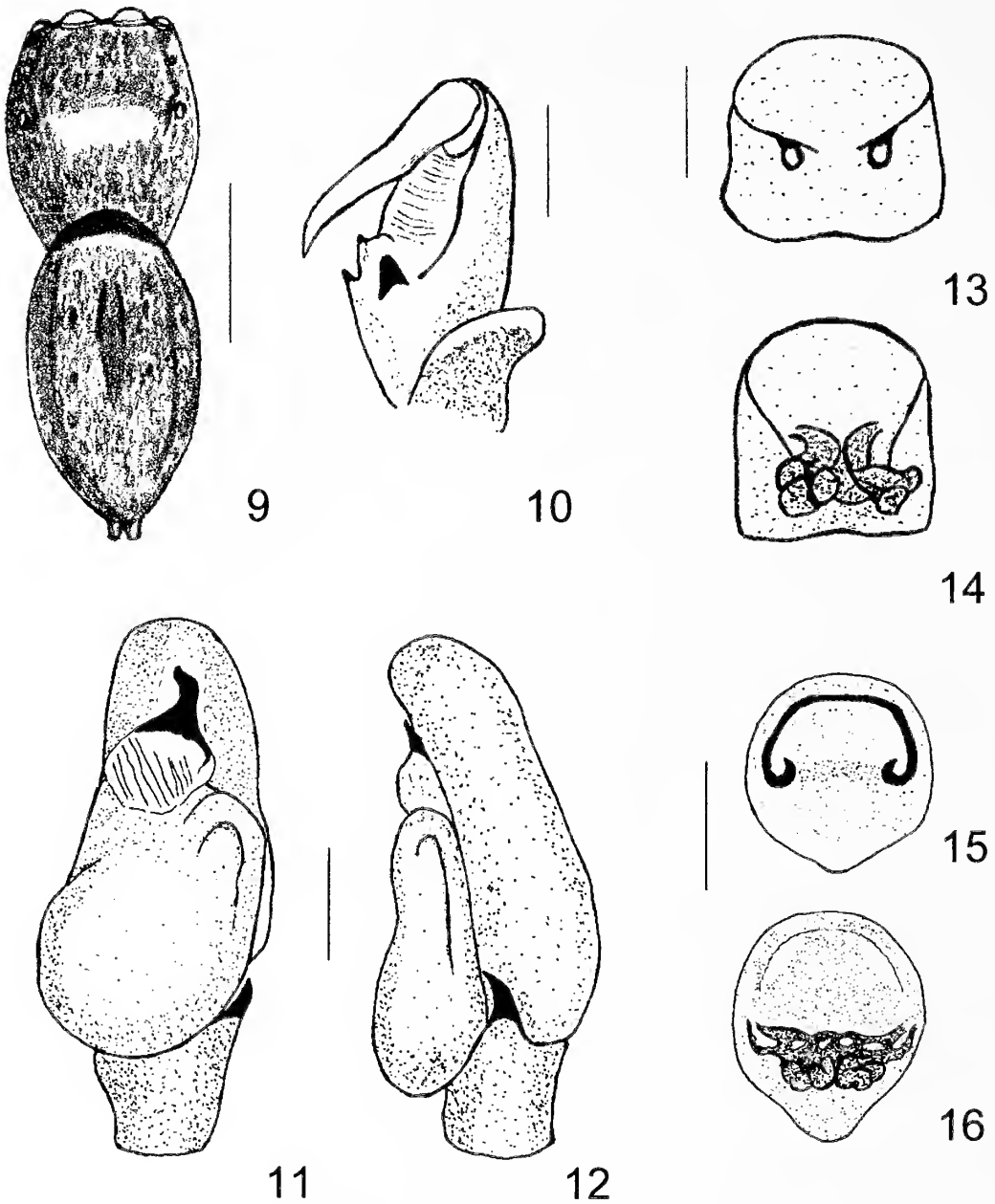
Material examined.—Male holotype, USA: *Utah*: Richfield, Sevier County, 38°46'21"N, 112°05'00"W, 4 July 1930, W.J. Gertsch (AMNH, examined).

Other material: USA: *Arizona:* Mojave County, Cottonia (coordinates not determined) (MCZ, AMNH); Yuma County, Gila Pumping Plant (coordinates not determined) (FSCA); Martinez Dam (coordinates not determined) (AMNH); McPhaul Bridge on the Gila River, 32°45'34"N, 114°25'16"W (FSCA); Mittry Lake, 32°49'07"N 114°29'18"W (CAS); Yuma, ca. 32°42'42"N 114°39'00"W (FSCA, AMNH). *California:* Imperial County, Salton City, 33°17'55"N, 115°57'22"W (AMNH); Inyo County, Laws, 37°24'02"N, 118°20'44"W (AMNH); Olancha, 36°16'54"N, 118°00'23"W (AMNH), Silver Canyon, 37°24'20"N, 118°18'58"W (AMNH); Mono County, Benton, 37°49'08"N, 118°28'35"W (AMNH); Riverside County, Blythe, ca. 33°36'37"N, 114°35'49"W (AMNH); north shore of Salton Sea, ca. 33°30'16"N, 115°54'52"W (UCR). *Utah:* Washington County, St. George, ca. 37°06'N, 113°33'W (MCZ).

MEXICO: *Baja California Norte:* San Felipe, 31.03°N, 114.52°W (FSCA).

Diagnosis.—This species is closest to *S. papenhoei* from which it differs in the curve of the embolus in males (Fig. 11) and the structure of the epigynum in females (Figs. 13, 14). This species also differs from *S. papenhoei* by the longer front legs with darkened femora. Otherwise the legs are not marked and in females are often completely yellow. When alive, *S. paiutus* differs from all other North American *Sassacus*, except for *S. samalayucae,* in having the entire dorsal surface of the body covered with golden-silver scales (Fig. 9), giving the impression of being cast from white gold. It differs from *S. samalayucae* by having only three ventral macrosetae on the first tibiae and in details of the female epigynum.

Description.—*Male holotype:* Total length 3.7, carapace length 1.8, carapace width 1.5. Leg formula 1423. Ventral tibial macrosetae on first legs appear to be 1-2-1, as reported by Gertsch, which differs from those of the paratypes and all other specimens examined, which are 1-2-0, as in average *S. papenhoei*. Badly rubbed, but showing remains of metallic electrum-colored scales on carapace (reported as white by Gertsch 1934). In life the spider is undoubtedly covered with such scales. Otherwise it appears as in original description



Figures 9–16.—*Sassacus paiutus*. 9, 10, 11, 12. Male from Arizona: 9. Dorsal view; 10. Chelicera, ventral view; 11. Left palpus, ventral view; 12. Left palpus, retrolateral view. 13, 14. Female from California: 13. Epigynum, ventral view; 14. Vulva, dorsal view. *Sassacus samalayucae*. 15, 16. Female from Chihuahua, Mexico: 15. Epigynum, ventral view; 16. Vulva, dorsal view. Scale line 1 mm (Fig. 9), 0.25 mm (Fig. 10), 0.1 mm (Figs. 11–16).

(Gertsch 1934). Chelicerae robust and excavate, with two promarginal and one large triangular retromarginal tooth (Fig. 10). Front legs distinctly longer than others.

Male from Imperial County, California: Total length 2.8, carapace length 1.3, carapace width 1.1. Leg formula 1423. Ventral first leg macrosetae 1-2-0. Chelicerae robust, excavate and appear to have only one large promarginal tooth and no retromarginal teeth. Carapace red-brown covered with white-gold scales. Palpus bulb and cymbium red brown, rest yellowish. Clypeus, chelicerae, labium and endites red-brown; endites with distal edge lighter. Clypeus with whitish hairs. Abdomen light brown above and darker below, covered with metallic white-gold scales over both surfaces. Area of book lungs anterior to epigastric furrow dark red-brown. Three other males from Yuma County, Arizona, ranged in total length from 3.2–3.5.

Female from Inyo County, California: Total length 4.7, carapace length 1.8, carapace width 1.5. Leg formula 4123, with leg 1 and leg 4 nearly equal in length, but with leg 4 having a slightly longer metatarsus-tarsus. Ventral tibial macrosetae 1-2-0. Carapace red-brown covered with white-golden metallic scales, clypeus and chelicerae red-brown, clypeus with white hairs. Sternum, labium and endites orange brown; endites with lighter anterior ¼. Palp yellow-brown. Front leg with femora, trochanters and coxae orange brown; rest of leg yellow-brown. Other legs uniform yellow-brown.

Abdomen yellowish dorsally covered with metallic white-gold scales. Venter darker with light widening center stripe and two rows of tiny light dots lateral on each side of stripe. Two other females from the same locality measured 4.7–4.8 in total length, earapace length 1.8 and carapace width 1.4 in both. Female from Salton City, Imperial County, California, in same vial with male described above, colored as females from Inyo County, but with less dark area on venter and with less dark brown on front legs; total length 4.0, carapace length 1.6, carapace width 1.2.

Distribution.—This species occurs in the Colorado River Drainage area from southwestern Utah and Mono County, California, south into Baja California and the Mexican border near Yuma, Arizona.

Natural history.—Common in summer (however Roth collected males and females in March at Mittry Lake) on *Pulchea* along watercourses. Specimens also have been collected on tamarisk and grass in similar habitats. Males collected in March and June. Females collected in March, May, June, and September. One female collected at McPhaul Bridge on 5 September 1965, laid 13 eggs on 11 September 1965. This is similar in number to the largest number (11) laid by *S. papenhoei.* The courtship (under *Sassacus papenhoei* in Richman 1982a, 1982b) is very similar to that of *Sassacus vitis*, with male crossing front pair of legs.

Remarks.—This species is very similar to *S. papenhoei* and may be derived from it. It was the species originally examined by Hill (1979) in his comparison of body scales of salticids that led him to conclude that *S. vitis* was a *Sassacus.*

Sassacus samalayucae new species
Figs. 15, 16, 57

Material examined.—Holotype female, MEXICO: *Chihuahua*: 57.9 km. S. of Juárez, ca. 31°20'N, 106°30'W, sand dunes, 13 June 1939, A.M. & L.I. Davis (AMNH).

Etymology.—This species is named for the sand dune field south of Juárez on which the type specimen was collected.

Diagnosis.—*Sassacus samalayucae* is most similar to *S. papenhoei* and *S. paiutus* from which it differs in the structure of the epigynum in females (Figs. 15, 16). The male is unknown. *Sassacus samalayucae* differs from all other North American *Sassacus*, except for *S. paiutus,* by having the entire dorsal surface of the body covered with golden-silver seales, giving the impression of being cast from electrum. It also differs from *S. paiutus* and *S. papenhoei* by having six ventral macrosetae on the first tibiae.

Description.—*Female holotype:* Total length 3.6. Carapace length 1.7, width 1.4. Leg formula 1423, cheliceral teeth two promarginal and one triangular retromarginal tooth, ventral tibial macrosetae 2-2-2. Ventral first metatarsi with four (2-2) very stout macrosetae. Carapace reddish-brown covered with metallic golden scales, as in *S. paiutus*. Chelicerae red-brown; endites lighter red-brown with pale distal portion. Sternum pale yellow. Legs and palpi pale yellow, except for ventral triangular dark marking at distal first femur at base of patella. Abdomen and venter covered with metallic golden scales.

Distribution.—Known only from the type locality in northern Chihuahua, Mexico.

Natural history.—The natural history of this species in unknown. The holotype female was collected in June.

***Sassacus cyaneus* (Hentz 1846)** new combination
Figs. 17–22, 57

? *Attus cerulea* Walckenaer 1837:448.
? *Attus quaternus* Walckenaer 1837:452.
Attus cyaneus Hentz 1846:365, plate 22, fig. 13.
Maevia chrysea C.L. Koch 1846:83, fig. 1337.
Homalattus septentrionalis Keyserling 1885:34, plate 13, fig. 19.
Homalattus cyaneus (Hentz): Peckham & Peckham 1888:86, plate 1, fig. 64, plate 6, fig. 64; Emerton 1909:232, plate 11, fig. 9.
Rhene cyaneus? (Hentz): Peckham & Peckham 1895:161, plate 15, fig. 3.
Agassa georgiana Simon 1901:643, fig. 752.
Agassa cyanea (Hentz): Peckham & Peckham 1909:590, plate 49, fig. 12, plate 51, fig. 9; Kaston 1948:471, plate 92, figs. 1721, 1722; Roewer 1954:1229.
Agassa cerulea (Walckenaer): Chamberlin & Ivie 1944:189.

Type specimens.—*Attus cerulea:* Type based on Abbot's (1792) drawing 82 of spider from "Burke County, Georgia" and resurrected by Chamberlin & Ivie (1944) now not thought to be identifiable to sex, genus, or species.

Attus quaternus: Type based on Abbot's (1792) drawing 442 of spider from "Effingham County, Georgia" and resurrected by Chamberlin & Ivie (1944) now not thought to be identifiable to sex, genus, or species.

Attus cyaneus: Listed by Hentz from North Carolina and Alabama, with no type designation. Not examined, as no Hentz specimens are known to have survived.

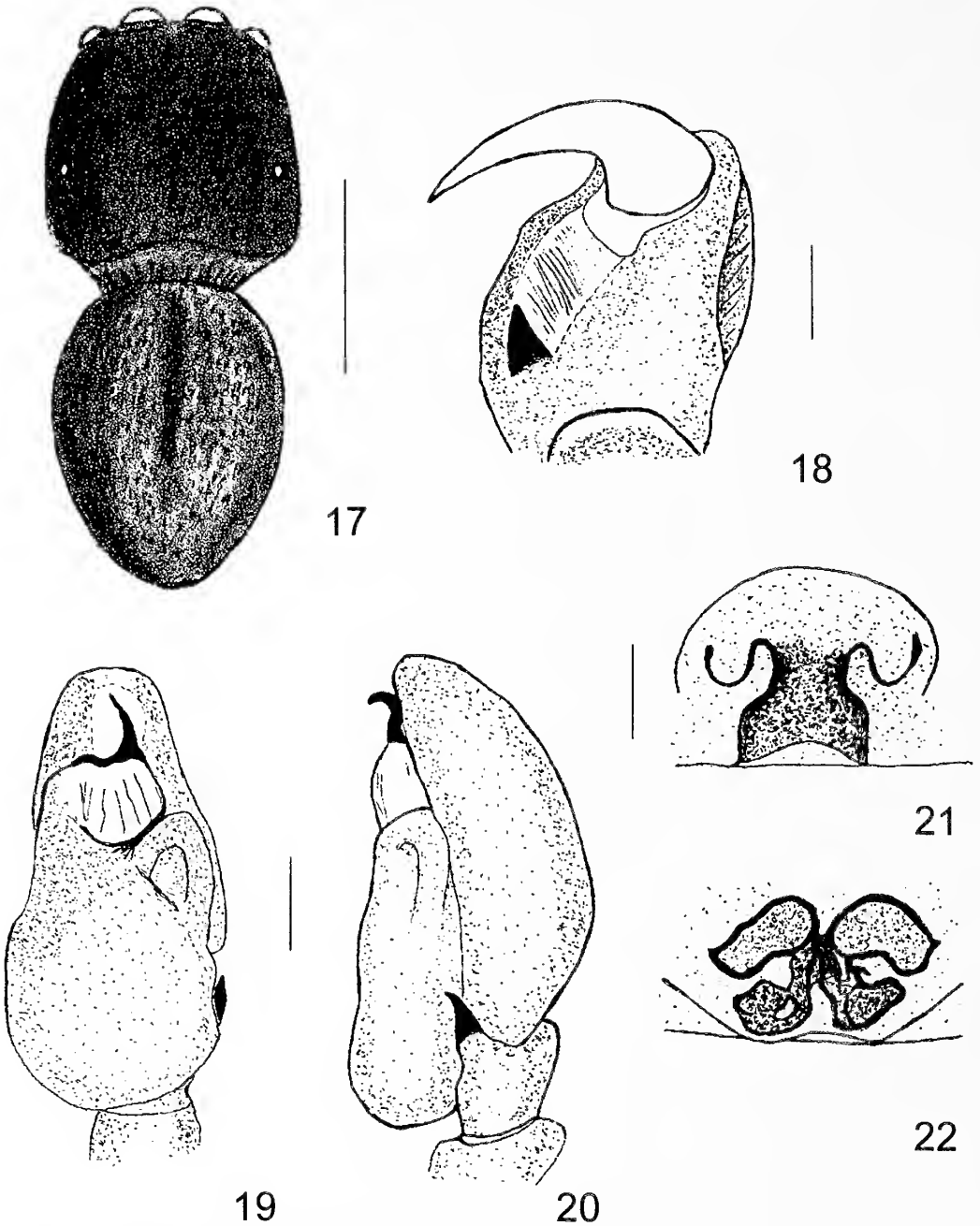
Maevia chrysea: Female holotype apparently from North America (Museum für Naturkunde, Berlin, not examined).

Homalattus septentrionalis: Female "holoype" apparently from "Nord-Amerika, Massachusetts" (MCZ, examined).

Agassa georgiana: No sex for holotype given; "type" apparently from Georgia (Museum National d'Histoire Naturelle, Paris, not examined).

Material examined.—USA (county records only): *Connecticut:* Fairfield (AMNH); Hartford (USNMNH); Litchfield (USNMNH); New Haven (MCZ, USNMNH, FSCA); Tolland (FSCA); *Florida:* Charlotte (MCZ); Gadsden (FSCA); *Georgia:* State Record Only (MCZ); Columbia (NMSUAM); *Illinois:* Effingham (INHS*); Mason (INHS*); *Massachusetts*: Barnstable (USNMNH); Middlesex (MCZ); Nantucket (MCZ); Norfolk (MCZ); Plymouth (MCZ); *Missouri:* Vernon (MCZ); *New Jersey:* Bergen (AMNH); Cape May (MCZ); Essex (FSCA); Middlesex (FSCA); Morris (FSCA); Ocean (AMNH); *New York:* Bronx (FSCA); Nassau (MCZ); Orange (MCZ); Rockland (AMNH, BCC); Tompkins (MCZ); Westchester (AMNH); *North Carolina:* Carteret (MCZ, AMNH); Durham (MCZ); New Hanover (MCZ); *Ohio:* Summit (BCC) *Pennsylvania*: Columbia (AMNH); *South Carolina:* Florence (FSCA), State record only (USNMNH); (USNMNH); *Texas*: San Patricio (TAM); *Virginia:* Fairfax (MCZ, USNMNH); *West Virginia*: Mercer (MCZ); *Wisconsin:* State Record Only (MCZ).

Diagnosis.—Very beetle-like. Most similar to *S. alboguttatus*, from which it differs in the following ways: male lacks a



Figures 17–22.—*Sassacus cyaneus*. 17, 18, 19, 20. Male from Georgia: 17. Dorsal view; 18. Chelicera, ventral view; 19. Left palpus, ventral view; 20. Left palpus, retrolateral view. 21, 22. Female from North Carolina: 21. Epigynum, ventral view; 22. Vulva, dorsal view. Scale line 1 mm (Fig. 17), 0.1 mm (Figs. 18–22).

curve (hook) at the embolus tip (Fig. 19), the female epigynal plate is broader than long, and the details of the epigynal structure differ (Figs. 21, 22). Both *S. cyaneus* and *S. alboguttatus* have a curious row of distinct setae on the anterior edge of the dorsal abdomen (Figs. 17, 23).

Description.—*Male from Columbia County, Georgia:* Leg formula 1423. Total length 3.4, carapace length 1.7, carapace width 1.6. (nearly square, but just slightly less so than in the males of *S. alboguttatus*). Ventral first tibial macrosetae 0-1-0. Posterior median eyes much closer to anterior median eyes than posterior laterals. Cheliceral teeth: two medium-sized prolaterals and one large and curved retromarginal tooth, or just one curved retromarginal tooth (Fig. 18). Carapace nearly black with dorsal and ventral fine metallic pink and green scales. Clypeus nearly black. Palpi with cymbium and bulb dark red brown; rest red-brown. Chelicerae red-brown with scattered metallic scales. Sternum, labium and endites red-brown with scattered metallic scales. Labium and endites with distal edges lighter. Legs generally red-brown except for metatarsi and tarsi II–IV, which are yellowish with the distal 1/3 of the metatarsi and proximal 1/5 of tarsi dark brown. Abdomen nearly black with metallic pink and green scales,

both ventrally and dorsally. Three males from Connecticut, Texas, and Virginia with total length 2.4–3.35, earapace length 1.25–1.6, and carapace width 1.25–1.5.

Female from Rockland County, New York: Leg formula 4123. Total length 4.1, carapace length 1.55, carapace width 1.5. Front tibial spination reduced as in male. Ventral first tibial macrosetae 0-1-0. Posterior median eyes much closer to anterior median eyes than posterior laterals. Cheliceral teeth: two promarginals and one simple retromarginal. Basic color overall (carapace and abdomen) dark reddish-brown, nearly black. Body covered with pink (in alcohol) metallic scales. Palpi, chelicerae, clypeus, sternum and endites reddish-brown, with endites yellowish anteriorly. Eyes arranged with PME much further from PLE than ALE; PLE set far back, closer to posterior declivity than to the PME. Carapace box-like, square to nearly square, enhancing the general beetle-like appearance. Legs reddish-brown except for yellow tarsi on first legs. Long hairs on anterior dorsal abdomen. Five females from Connecticut and South Carolina (USNMNH): Total length 3.75–4.8, carapace length 1.5–1.8, carapace width 1.5–1.6.

Distribution.—This species is found from New England south to Florida and west to Texas, Missouri, and Wisconsin.

Natural history.—This species is generally found on small shrubs, small oaks and scrub pines. Hentz (1846) noted that the species was collected in "April, May, June, etc." Males collected in May. Females have been found in June, July, August, and September. One female collected in Englishtown, Middlesex County, New Jersey on 12 July 1966 (FSCA) laid 5 eggs. A female collected near the junction of highways S-65 and S-65a in Gadsden County, Florida, on 8 August 1977 (FSCA), was found on a small bush with a large number of very similar leaf beetles in the genus *Graphops* (Chrysomelidae: Eumolpinae).

Remarks.—This and the following species would be placed in *Agassa*, a separate genus, by past convention. It differs from *Sassacus papenhoei* in having only one ventral macroseta on the first tibia, by the more box-like carapace and by the PME being placed much further posterior on the carapace. However, as noted in the description of *S. papenhoei*, the ventral macrosetae are easily lost and *S. papenhoei* itself can vary from having one to five, although the usual is three. The eye placement is a result of the more pronounced beetle-like structure of the earapace. The genitalia and other aspects of the general color and structure are so close to the other true *Sassacus* that these body shape differences do not seem to really matter, other than to relate *cyaneus* and *alboguttatus* on the same sub-clade of the *papenhoei* group. I can see no justification for retaining *Agassa* as a valid genus and have thus made it a junior synonym of *Sassacus*.

Sassacus alboguttatus (F.O. Pickard-Cambridge)
Figs. 23–28, 56

Homalattoides alboguttatus F.O. Pickard-Cambridge 1901:294, plate 28.

Sassacus alboguttatus (F.O. Pickard-Cambridge): Simon 1903:838.

Material examined.—Male holotype, MEXICO: *Guerrero*: Amula, ca. 17°38′N, 99°15′W, no date (BMNH, photographs of palpus, chelicerae and whole animal provided by the British Museum examined).

Other material: MEXICO: *Chiapas:* Tuxtla Gutierrez, 16°46′N, 93°21′W (AMNH); *Distrito Federal:* Pedregal, 19°20′N, 99°10′W (AMNH); *Guerrero:* 37 km S. of Chilpancingo near 17°33′N, 99°30′W (immature) (AMNH); *Morelos:* Cuernavaca 18°57′N, 99°15′W (AMNH); *Nayarit:* Tepic, 21°35′N, 104°54′W (AMNH); *Sonora:* 11 km SE of Alamos near 27°00′N, 108°58′W (FSCA).

Diagnosis.—Very beetle-like. Most similar to *S. cyaneus*, from which it differs in having one large promarginal tooth and one large uncurved retromarginal tooth in the male (Fig. 24), three ventral macrosetae on first tibiae in both sexes, the male with a curve (hook) at the embolus tip (Fig. 25), the female with the epigynal plate longer than broad, and in the details of the epigynal structure (Figs. 27, 28). Superficially this species looks almost exactly like *S. cyaneus*, except for being slightly more beetle-like.

Description.—*Male from Chiapas, Mexico:* Leg formula 1423. Total length 3.5, carapace 1.4 long and 1.6 mm wide and almost rectangular. Front tibial spination reduced, but more similar to *S. papenhoei* than *S. cyaneus*. Ventral first tibial macrosetae 1-2-0. Basic color over all dark brown, nearly black. The abdomen has a faint cardiac mark similar to that seen on many specimens of *S. cyaneus*. The name *alboguttatus* is derived from the white hairs on the clypeus and areas lateral to the clypeus, and the small clumps of white scales on the dorsal femur, patella and tibia. Body covered with metallic scales, as in *S. cyaneus*. Eyes arranged as in *S. cyaneus*, with a box-like shape to the carapace enhancing the general beetle-like appearance. Posterior lateral eyes set far back. Long hairs on anterior dorsal abdomen.

Female from Sonora, Mexico: Leg formula 4123. Total length 4.0, carapace length 1.7, carapace width 1.7. Color and structure as in male, except 2 promarginal cheliceral teeth and one apparent ridge-like retromarginal tooth (may be broken off base). Epigynal plate (Figs. 27, 28) distinctive, being longer than wide, exactly opposite to that of *S. cyaneus*. Leg formula 4123.

Distribution.—This species occurs from Southern Sonora south into Chiapas, Mexico.

Natural history.—Males were collected in August and September; the only female in November. Ecology and behavior unknown.

Remarks.—*Sassacus alboguttatus* is obviously close in structure to *S. cyaneus*. Unfortunately very little is known about this species. While I have only seen photographs of the holotype, the structure of the chelicerae and the palpus, and the general beetle-like appearance, together with the white patches of scales on the legs described by F.O. Pickard-Cambridge (1901) (observed on the male examined from Chiapas), and the general distribution are indicative that this is the right placement of these specimens.

***Sassacus vitis* species-group**

Sassacus vitis (Cockerell 1894)
Figs. 29–35, 58

Dendryphantes vitis Cockerell 1894:207.

Icius vitis (Cockerell): Peckham & Peckham 1909:501, plate 40, fig. 11, plate 41, fig. 7.

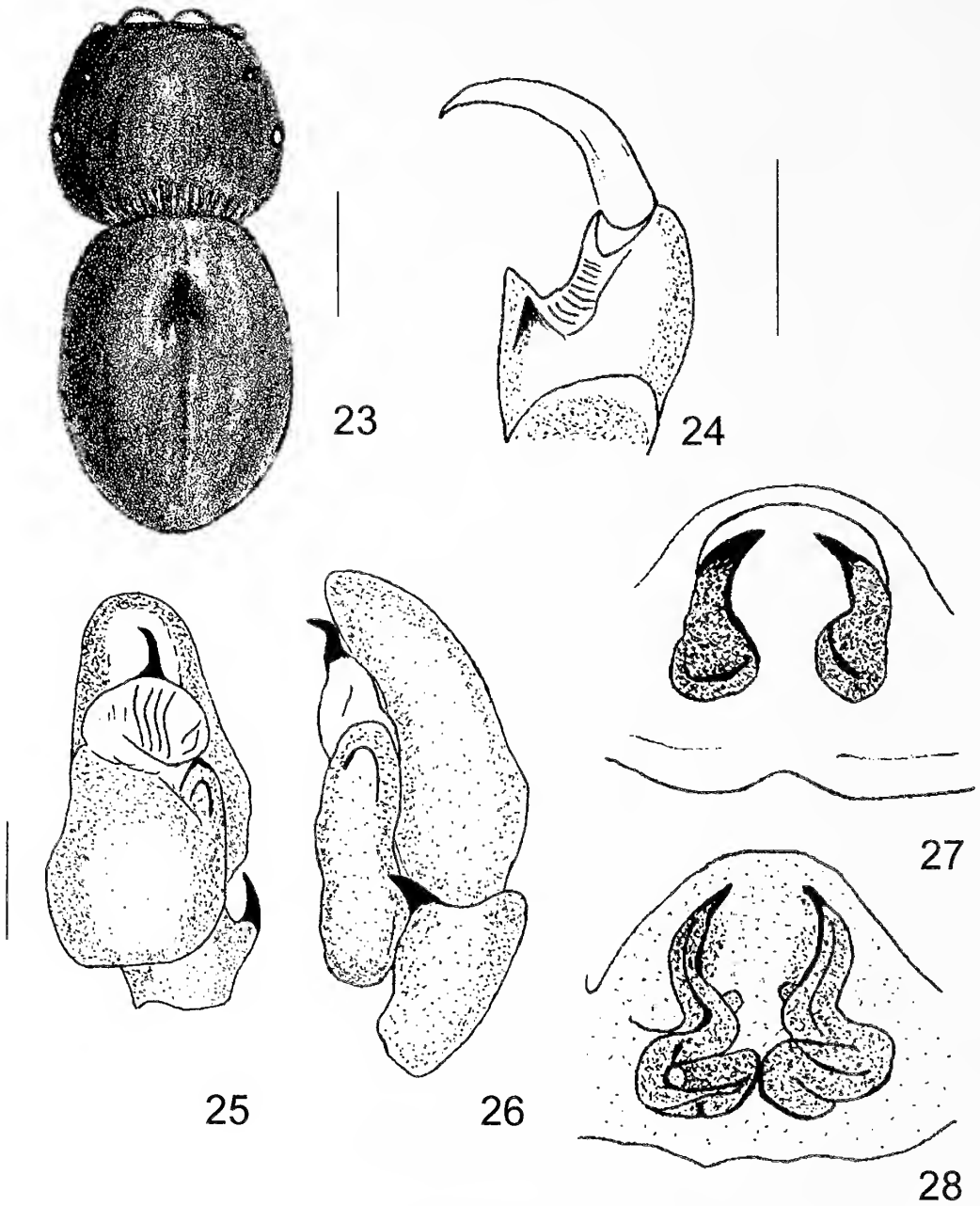


Figure 23–28.—*Sassacus alboguttatus*. 23. Female from Sonora, dorsal view. 24–26. Male from Nayarit: 24. Chelicera, ventral view; 25. Left palpus, ventral view; 26. Left palpus, retrolateral view. 27, 28. Female from Sonora: 27. Epigynum, ventral view; 28. Vulva, dorsal view. Scale line 1 mm (Fig. 23), 0.5 mm (Fig. 24), 0.1 mm (Figs. 25–28).

Dendryphantes melanomerus Chamberlin 1924:684, fig. 125–126; Jiménez-Jiménez 2007:64, figs. 1–7. **New synonymy.**

Dendryphantes apachecus Chamberlin 1925:136, figs. 55–56.

Dendryphantes mathetes Chamberlin 1925:138, figs. 59, 60. **New synonymy.**

Metaphidippus vitis (Cockerell): Gertsch 1934:19; Prószyński 1971:434.

Sassacus vitis (Cockerell): Hill 1979:215.

Metaphidippus vitis (Cockerell): Maddison 1996:237, figs. 27, 59.

Material examined.—*Dendryphantes vitis*: holotype male, USA: *New Mexico*: Las Cruces, Doña Ana County, 32°18′44″N, 106°46′40″W, no date or collector (presumably T.D.A. Cockerell) (MCZ, examined).

Dendryphantes melanomerus: holotype male, MEXICO: *Baja California del Sur*: Coyote Bay, Conception Bay (Bahia Concepcion), 26°43.24′N, 111°54.57′W, 18 June 1921, J.C. Chamberlin (CAS, examined). Paratypes: same data as holotype (MCZ, examined)

Dendryphantes apachecus: holotype male (thick embolus form), USA: *Arizona*: Thatcher, Graham County, 32°50′57″N, 109°45′33″W, 1913, R.V. Chamberlin (MCZ, examined).

Dendryphantes mathetes: Holotype male (thin embolus form), USA: *California*: Claremont, Los Angeles County, 34°05′48″N, 117°43′11″W, 1909, R.V. Chamberlin (MCZ, examined).

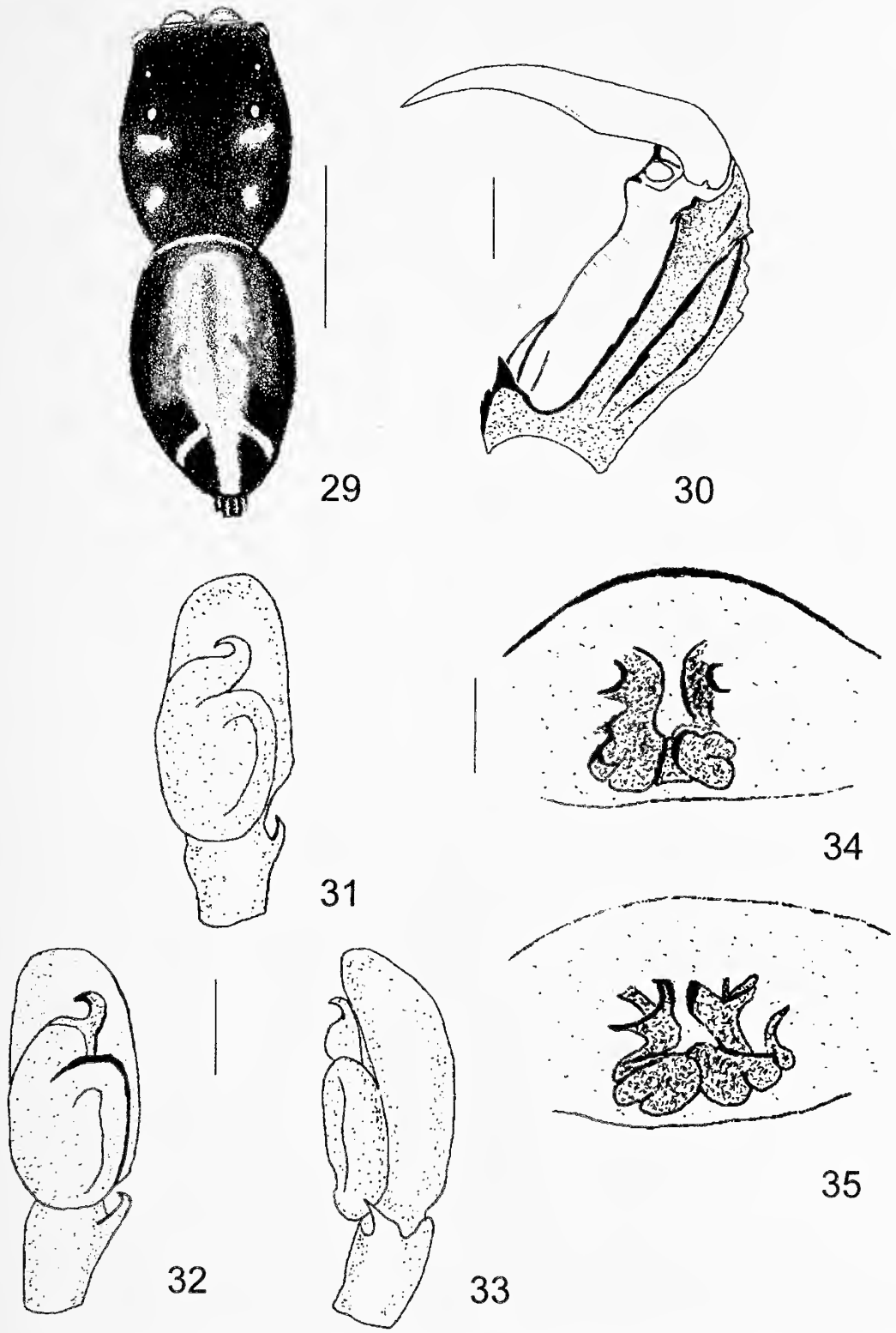


Figure 29–35.—*Sassacus vitis*. 29, 30, 31, 32, 33. Males from Arizona: 29. Dorsal view; 30. Chelicera, ventral view; 31. Left palpus, ventral view, specimen from Pima County; 32. Left palpus, ventral view, specimen from "Arizona," possibly Thatcher (holotype of *Dendryphantes apachecus* Chamberlin); 33. Left palpus, retrolateral view. 34, 35: Female from California: 34. Epigynum, ventral view; 35. Vulva, dorsal view. Scale line 1 mm (Fig. 29), 0.1 mm (Figs. 30–35).

Material examined.—CANADA: *Alberta:* Writing-on-Stone Province Park (CNC); *British Columbia:* N. end of Osayoos Lake (coordinates not determined) (CNC); Osayoos, 49°02′N, 119°28′W (CNC); Summerland, 49°39′N, 119.33°W (CNC).

USA (county records only): *Arizona:* Cochise (AMNH, FSCA); Coconino (FSCA); Graham (AMNH); Pima (MCZ, FSCA); Pinal (NMSUAM); Yuma (MCZ, FSCA, AMNH); *California:* Imperial (AMNH); Los Angeles (MCZ, AMNH, FSCA); Merced (AMNH); Monterey (AMNH); Mono (AMNH); Orange (MCZ, AMNH, NMSUAM); Riverside (USNMNH, MCZ, AMNH); San Diego (MCZ, MPM, BCC, AMNH); San Luis Obispo (AMNH); Santa Barbara (MCZ, AMNH); Santa Clara (MCZ); Tulare (USNMNH); Ventura (MCZ, AMNH, FSCA); Yolo (AMNH); *Florida:* Dade (FSCA); *Idaho:* Canyon (AMNH); Gooding (AMNH); Nez Pierce (AMNH); Payette (AMNH); *Kansas:* Decatur (MCZ); Meade (AMNH); *Montana*: Stillwater (AMNH); *New Mexico:* Doña Ana (MCZ, NMSUAM); *Oklahoma:* Tulsa (NMSUAM); *Oregon:* Grant (AMNH); Malheur (AMNH); *Tennessee:* Lake (AMNH); *Texas:* Bell (AMNH); Brewster (AMNH); Burnet (FSCA); Cameron (MCZ, AMNH); Denton (MCZ); Greyson (AMNH); Hidalgo (AMNH); Johnson (AMNH); Kerr (AMNH); Kimble (AMNH); Llano (FSCA); Presidio (MCZ); Runnals (FSCA); Travis (FSCA); *Utah:* Cache (MCZ); Salt Lake (AMNH); Utah (AMNH),Wayne (AMNH); *Washington:* Chelan (CNC); Columbia (MCZ); *Wyoming:* Lincoln (AMNH).

MEXICO: *Baja California (Norte):* El Rosario, 30°03.619′N, 115°43.567′W (AMNH); 67.6 km S. Ensenada (coordinates not determined) (AMNH); 11 km SE Mexicali (coordinates not determined) (AMNH); *Baja California del Snr:* Bahia Concepcion (no exact Lat/Long found) (MCZ); 16.4 km NW La Paz (coordinates not determined) (CAS); Mulege, 26.9°N 112.0°W (MCZ, FSCA); San Jose del Cabo near 22.9°N, 109.9°W (MCZ); *Chiapas:* Arriaga, 16.2°N, 93.9°W (AMNM); 77 km SE of Palenqueon road to Bonampak (coordinates not determined) (MCZ); Tonala, 16.1°N, 93.7°W (AMNH); *Chihuahua:* Catarinas, 29.83°N, 107.7°W (AMNH); Las Delicias, 28°12′N, 105°30′W (AMNH); *Hidalgo:* 3.2 km N. Chapulhuacan, 21°11′N, 98°57′W (AMNH); 4 km. NE Tlanchinol on highway 105 (no lat/long found) (MCZ); *Jalisco:* Guadalajara, 20°40′N, 103°20′W (MCZ, AMNH); *Morelos:* Cuernavaca, 18.55°N, 99.15°W (AMNH); *Nayarit:* SW of Acaponeta, 22°28′N, 105°24′W (AMNH); 32 km N. Tepic (No Lat/Long found) (AMNH); Tepic 21°31′N, 104°53′W (AMNH); San Blas, 21°31′N, 105°16′W (AMNH); *Nuevo Leon:* Monterrey, 25°40′N, 100°19′W (AMNH); *Oaxaca:* Rio Papaluapan at Papaluapan (coordinates not determined) (AMNH); Tehuantepec, 16°20′N, 95°14′W (AMNH); *Puebla:* Acatlan, 18°32′N, 96°36′W (AMNH); Huauchinango, 20°11′N, 98°03′W (AMNH); 2.4 km W. highway 130 bypass of Xicotepec de Juarez (coordinates not determined) (MCZ); *Quintana Roo:* Kohunlich ruins 9 km S. Francisco Villa, 18°26′N, 88°48′W (MCZ); Rancho Palmas, Carillo Puerto (coordinates not determined) (FSCA); 12.8 km west San Joaquin (21°45′N, 88°57′W) (AMNH); *San Luis Potosi:* Covadonga, south and WSW Valles 21°55′N, 98°58′W, and 21.57°N, 99.05°W (AMNH); Huichihuayan, 21°19′N, 98°50′W (AMNH),13 km E. Las Abritas on highway 80 (coordinates not determined) (MCZ); Pujal, 21°51′N, 98°55′W (AMNH); 10.4 km S. Valles, 21°55N, 98°57′W (AMNH); Valles (Taninul); 21°56 N, 98°53′W (AMNH); 16 km NE Xilitla, 21.27°N, 98.55°W (AMNH); *Sinaloa:* Burrion, 25.33°N, 08.25°W (AMNH); 24.1 km N. Mazatlan, 23°24′N, 106°27′W (AMNH); Piaxtla (River) 23°50′N,106°40′W (ANMH); *Sonora:* Hermosillo, 29°04′N, 110°58′W (AMNH); 37 km S. Hermosillo in foothills(coordinates not determined) (AMNH); Navojoa, 27°04′N, 109°25′W (AMNH); *Tabasco:* Ajijic (coordinates not determined) (AMNH); Pejelagatero 18.03°N, 93.10°W (AMNH); Villa Hermosa, 17°59′N, 92°55′W (AMNH); *Tamaulipas*: "72 km" Cd. Victoria (coordinates not determined) (FSCA); El Mante 22°45′N, 98°58′W (AMNH); Tampico, 22°18′N, 97°51′W (AMNH); *Veracruz:* Acayucan, 17°57′N, 94°55′W (MCZ); Estacion de Biologia Tropical Los Tuxtlas (coordinates not determined) (UNAM); near Lake Catemaco (coordinates not determined) (AMNH); Coatzacoalcos,18.09°N, 94.26°W (AMNH) near La Palma, 20°51′N, 97°43′W (MCZ); Martinez de la Torre, 20°04′N, 97°03W (AMNH); Plan del Rio (coordinates not determined) (AMNH); Riachuelos, 20°27′N, 96°57′W (AMNH); Tetolutla (coordinates not determined) (AMNH); Tuxpan Beach (no certain Lat/Long found) (MCZ); 12 km NW Alvarado on highway 180 (coordinates not determined) (MCZ); San Rafael (no certain Lat/Long) (AMNH).

HONDURAS: Tela Beach, 15°43′N, 87°29′W (MCZ).

PANAMA: Chiriqui, Puerto Armuelles, 08°20′N, 82°51″W (FSCA).

Diagnosis.—This is a distinctive, relatively slender species that is not beetle-like (Fig. 29). It differs from all North American *Sassacns* and *Metaphidippns* in the buttonhook shaped embolus of the male (Figs. 31, 32) and in the structure of the female epigynum (Figs. 34, 35). Most individuals also differ from other *Sassacns*, except *S. aztecus*, in having a pair of white bars, often with black slash or block-like mark on either side, just anterior to the spinnerets on the dorsal surface (Fig. 29). It is also similar to *S. aztecus* and *S. barbipes* in having an acute angle to the tibial apophysis of the male palpus (Fig. 33). When alive this species is covered with golden scales (may appear greenish), especially on the abdomen and usually (but not always) has a patch of light-colored scales posterior to each posterior lateral eye (these are often lost in badly rubbed specimens).

Description.—*Male holotype:* Leg formula 1423. Total length 3.5. Carapace length 1.7, width 1.3. Chelicerae slightly excavate with no apparent promarginal teeth and one large basal retromarginal tooth (in specimen from Pinal County, Arizona, with one large and two small cusps) (Fig. 30). Retromargin of fang with noticeable keel (Fig. 30), which also appears to be present in *S. aztecns* (Fig. 37). First tibia with 2-2-2 ventral macrosetae. Color overall orange brown. Carapace orange brown with metallic golden scales and with a white patch of scales posterior to each PLE. Clypeus dark with metallic scales. Chelicerae dark red-brown. Legs red-brown with lighter ventral distal patellae and whole tarsi. Palpi yellow. Abdomen dorsum orange with numerous metallic golden scales (in some may appear green in life); with posterior dark patch on each side, followed by paired light (probably white in life) bars, followed by smaller dark spot. Venter

yellow. Sternum, endites and labium orange. Ten males from Grayson County, Texas, range from 3.6–4.8 in total length. Carapace length 1.7–2.2; width 1.3–1.8. In many large males the retromarginal tooth is very large and the promarginal teeth may be lacking or nearly so (Fig. 30).

Female from Orange County, California: Leg formula 4123. Total length 4.1. Carapace length 1.6, width 1.2. Description as in male but with shorter and less robust chelicerae and with two small promarginal cheliceral teeth and one larger retromarginal tooth, and lighter in color, with scattered white lateral scales on carapace and white marginal band along carapace edge. Ten females from Grayson County, Texas, range from 4.0–4.9 in total length. Carapace length 1.6–1.9; width 1.3–1.4.

Variation.—The holotype male of *Dendryphantes apachecus* from Arizona, and males from Puebla, Tamaulpas, and San Luis Potosi in Mexico, Runnals County, Texas and Utah have a broader and flatter embolus (Fig. 32), but otherwise very closely resemble other specimens of this species. There seems to be some gradation in Mexico between broad and narrow embolic forms, however. Some populations (e.g., Chihuahua) seem to lack the white bar and dark marks found in most specimens. One female from Tamaulipas State in Mexico, is nearly black and lacks any markings except for the light anterior abdominal border. Some specimens from Chiapas and from a few other sites have the whitish bars on the dorsal posterior abdomen continue as a zigzag mark on each side. Oddly, there seems to be a faint reflection of this pattern on some specimens from Chihuahua. There seems to be no variation in the ventral maerosetae number on the first tibiae.

Distribution.—This species ranges from Alberta and British Columbia south through California, east to Tennessee, and Kansas south through Texas and Mexico to Honduras and Panama, with isolated, probably introduced, populations in Florida.

Natural history.—Males and females were collected on alfalfa, grasses, herbs, oaks, shrubs, and along riverbanks. A male and female were collected on seaside vegetation in Panama. Males have been collected in March, May, June, July, August, September, October, and November. Females have been collected in March, May, June, July, August, and September. A female collected in Yuma County, Arizona on 25 June 1972, laid 15 eggs on 20–21 August 1972. These all hatched 7 September 1972. Two other females from Yuma County, Arizona, laid 11 eggs on 29 July 1965 and 13 eggs on 23 August 1972, respectively. A female collected in Pima County, Arizona, on 28 May 1972 laid 10 eggs on 11–12 June 1972. A female eollected at Mexieo Highway 15 and the Rio del Fuerte on 27 October 1972 laid 13 eggs by 19 November 1972.

Remarks.—This species is rarely (if ever) variable in the number of ventral macrosetae on the first tibiae, there always being 2-2-2 (or 1-1, 1-1, 1-1), with the last posteroventral spine being offset proximally from the last anteroventral spine (based on 275 individuals - 109 males, 130 females, and 46 immatures from Arizona, California, Colorado, Idaho, Oregon, Texas, Utah, Washington, and Mexico.) As noted under variation there are some differences in the width of the embolus, some males from Puebla and San Luis Potosi (and other localities) in Mexico, Runnals County, Texas, and Utah Lake, Utah, among others, having wider emboli. This may yet prove to be a specific difference, but the males were structurally similar to most northern specimens and had similar patterns. The existence of males both with wide or narrow emboli in Utah and Texas argues against such specific distinctions and so far this appears to be one species, with mostly minor variation in color pattern, except for a few specimens as noted. Most fresh individuals have a patch of whitish scales posterior to the posterior lateral eyes, including the specimens from Puebla, Mexico, and a pair of acutely angled whitish bars (occasional two pairs) on the posterior abdomen. A few Mexican specimens and females from Dade County, Florida (the species was recently introduced to this state, probably from the east coast of Mexico), have a nearly complete zig-zag or nearly straight longitudinal band on each side of the dorsal abdomen, but this can be easily derived from the bar pattern seen on most specimens. A male from Dade County, Florida is nearly black in ground color, covered with metallic scales and with yellow tarsi on the front legs and yellow metatarsi and tarsi on the last three pairs of legs. A few specimens lack any pattern at all, as in a dark female from Tamaulipas, Mexico (FSCA). At present I conclude that these differences are part of the natural variation present in such a widespread species, but it is possible that *S. vitis* actually represents a complex of several species. If the thick embolus males are eventually shown to be distinct they would take on the name *Sassacus apachecus* (Chamberlin 1925). Recently Jiménez-Jiménez (2007) described and illustrated the female from Baja California Sur, Mexico, under the name *Dendryphantes melanomerus* Chamberlin.

Sassacus aztecus new species
Figs. 36–41, 57

Material examined.—Holotype male, MEXICO: *Nayarit*: San Juan Peyotan, ca. 22°20′N, 104°30′W, 1–3 August 1955, B. Malkin (AMNH). Allotype female, collected with holotype (AMNH). Paratypes: 1 male, 1 female, collected with holotype (AMNH).

Material examined.—MEXICO: *Morelos:* Cocoyoc (AMNH); *Nayarit:* San Juan Peyotan, ca. 22°20′N, 104°30′W, 1–3 August 1955, B. Malkin (AMNH); *Sonora:* Minas Nuevas, ca. 27°00′N, 108°58′W, 8 August 1952, P. & C. Vaurie (AMNH).

Etymology.—Named for the Aztec tribe of central Mexico.

Diagnosis.—This is a relatively slender species that is not beetle-like. It differs from the apparently closely related *S. vitis* in not having a buttonhook shaped embolus (Fig. 38). Instead the embolus is more similar to those of *S. papenhoei* and *S. paiutus.* However its general appearance is like *S. vitis* (Fig. 36). Also like *S. vitis* (and unlike either *S. papenhoei* or *S. paiutus*) this species has a full count of 2-2-2 ventral tibial macrosetae and has an acute-angled tibial apophysis (Fig. 39). The female genitalic structure (Figs. 40, 41) is also close to that of *S. vitis.*

Description.—*Male holotype:* Total length 3.8. Carapace length 1.8, width 1.4. Leg formula 1423. Chelicerae with no apparent promarginal teeth and one slanted retromarginal tooth with two (holotype) or three cusps (allotype males from same site and from Morelos) (Fig. 37). First tibia with 2-2-2 ventral macrosetae. Color overall red brown. Carapace dark

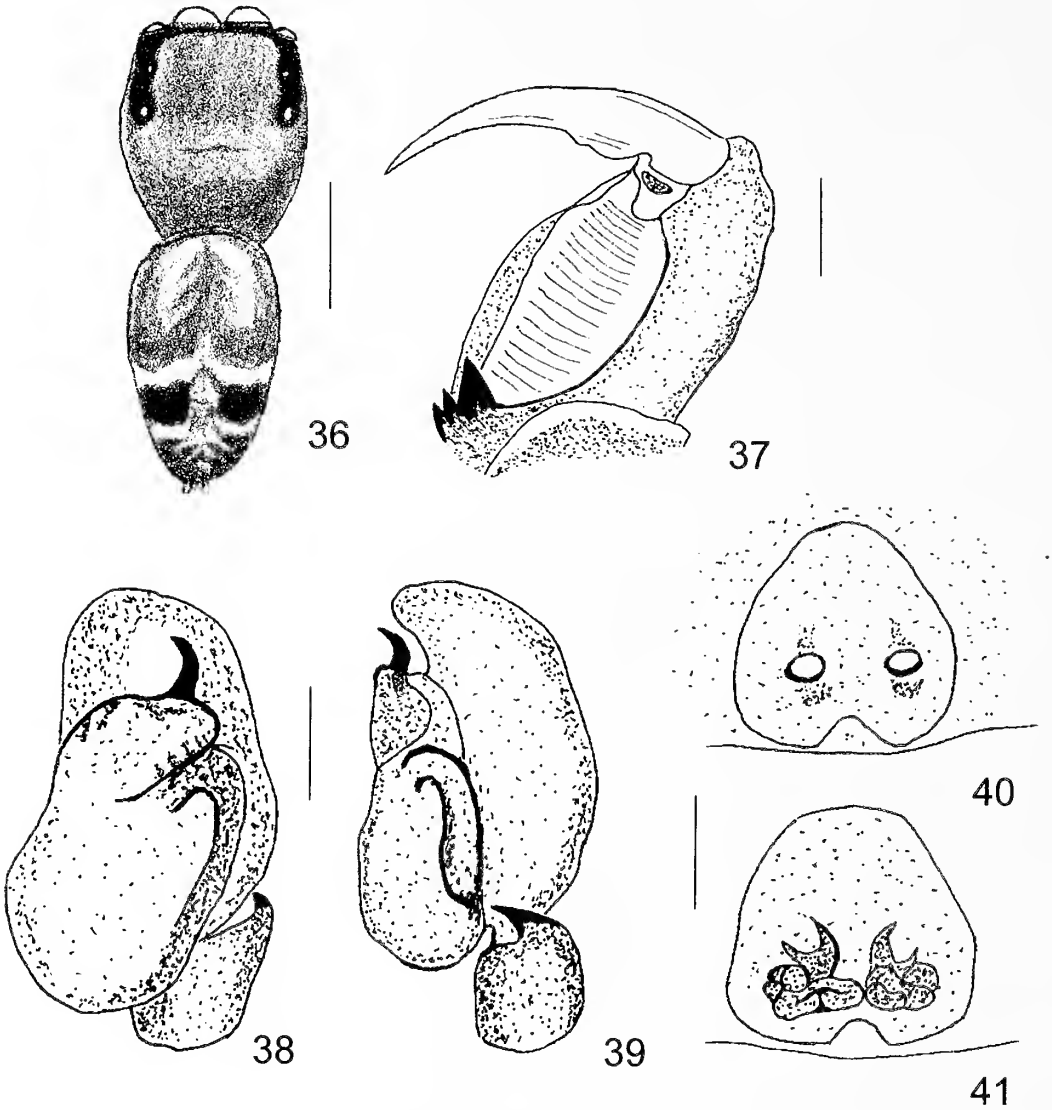


Figure 36–41.—*Sassacus aztecus*. 36, 37, 38, 39. Male from Nayarit: 36. Dorsal view; 37. Chelicera, ventral view; 38. Left palpus, ventral view; 39. Left palpus, retrolateral view. 40, 41. Female from Nayarit. 40. Epigynum, ventral view; 41. Vulva, dorsal view. Scale line 1 mm (Fig. 36), 0.1 mm (Figs. 37–41).

red brown with metallic scales, which were probably golden in life. Clypeus dark with metallic scales. Chelicerae dark red-brown. Legs red-brown with lighter ventral distal patellae and whole tarsi. Palpi reddish-brown. Abdomen dorsum red-brown with numerous metallic scales and with rim of white scales also extended as two white slashes posterior to the middle. A third slash is visible as a slight white projection on the lateral rim about one third of the way down the abdomen. Venter and sternum dark red-brown, as are endites and labium. Paratype male from same location with total length 3.6. Make dark red-brown, as are endites and labium. Paratype male from same location total length 3.6. Carapace length 1.7, width 1.3.

Female allotype: Leg formula 4123. Description as in male. Total length 5.4. Carapace length 2.1, width 1.5. Paratype female from same location: total length 4.5. Carapace length 1.6, width 1.4. One female from Sonora with complete inverted lily-like mark in center of dorsum as in *S. lirios*. In the other two females the lily-like mark is partly obscured, but traceable. The three females from Minas Nuevas (Alamos), Sonora have size ranges of 5.4–5.9 in total length, 2.0–2.1 in carapace length, and 1.5–1.7 in carapace width.

Distribution.—This species occurs in Southern Sonora to Nayarit in Mexico near border with Durango, Zacatecas and Jalisco and is probably found in all five states, south to Morelos.

Natural history.—The natural history of *S. aztecus* is unknown. The male and female type series and females from Sonora were collected in August, while a male and female from Morelos were collected in late July.

Remarks.—Very close in appearance to *Sassacus vitis*, but with very different embolus in the males (Fig. 38). Chelicerae (Fig. 37) very similar to that of *S. vitis*, although not as elongated. Also some individual females from Sonora with similar markings to *S. lirios*. The somewhat intermediate male palpal structure of this species between *S. papenhoei* and *S.*

vitis is further evidence of the closer relationship between those two species than might be supposed from the structure of the emboli and general appearances of each.

Sassacus barbipes species-group

Sassacus barbipes Peckham & Peckham 1888
Figs. 42–48, 59

Eris barbipes Peckham & Peckham 1888:55, plate 4, fig. 38; F.O.P.-Cambridge 1901:300, plate 29, fig. 11

Ashtabula nigricans F.O.P.-Cambridge 1901:257, plate 23, fig. 2.

Sassacus barbipes (Peckham & Peckham): Peckham & Peckham 1909:592, plate 50, fig. 6.

Material examined.—Lectotype female, MEXICO (MCZ). Paralectotype: 1 female, collected with lectotype (MCZ).

Other material: MEXICO: *Colima:* Colima, 19°13′N, 103°42′W (AMNH); *Guanajuato:* 8 km NW Yuriria, nr. 20°12′N, 101°06′W (AMNH); *Guerrero:* Iguala (no exact Lat/Long found) (AMNH); Taxco Viejo, 18°30′N, 99°34′W (AMNH); *Jalisco:* Guadalajara, 20°40′N, 103°20′W (MCZ); West side of Lake Sayula, 20°02′N 103°32′W (AMNH); 3.2 km, 16 km, and 32.2 km N. La Quemada (coordinates not determined) (AMNH); La Venta, 20°44′N, 103°33′W (AMNH); NW Magdalena, 20.59°N, 104.02°W (AMNH); Tlaquepaque, 20°39′N, 103°19′W (AMNH); *Mexico:* Malinalco, 18°57′N, 99°30′W (AMNH); *Morelos:* Cuernavaca, 18.55°N, 99.15°W (AMNH); Oaxtepec, 18°54′N, 98°58′W (AMNH); *Nayarit:* Arroyo Canavera (coordinates not determined)(AMNH); Tepic, 21°31′N, 104°53′W (AMNH); *Nuevo Leon:* Chipinque Mesa just S. Monterrey, 25.6°N, 100.4°W (MCZ); Santa Rosa Canyon, near 24.8°N, 99.8°W (MCZ); *Oaxaca:* 2 km S. of El Tule, ca. 17°02″N, 96°40′W (MCZ); Monte Alban ruins, ca. 17°02′N, 96°47′W (MCZ); Tlacolula 16.57°N, 96.27°W (AMNH); *Sonora:* 16 km W. Alamos, nr. 27°00′N, 108°58′W (AMNH).

Diagnosis.—This species differs from all other known North American *Sassacus* in having the front tibiae-patellae flattened and with a heavy brush of spatulate hairs in both sexes (Fig. 43). Although the palpi (Figs. 45, 46) are somewhat similar to those of *Sassacus aztecus,* especially in regard to the tibial apophysis, and the female spermathecae (Fig. 48) are also similar to this and other *Sassacus*, this larger species has been in dispute as a true *Sassacus*.

Description.—*Female lectotype from Mexico:* Leg formula 4123. Chelicerae with one or two promarginal teeth and one large retromarginal tooth (Fig. 44). First tibia with 2-2-2 ventral macrosetae. Color overall red to yellow-brown (reported as black by Peckham & Peckham 1888, 1909). Carapace dark red brown with scattered metallic scales (probably more widespread as in "syntype" (now paralectotype) from same locality (Fig. 42). Scales appear to be metallic pink under alcohol, although Peckham & Peckham (1888, 1909) reported the scales to be green. Clypeus, palpi, and chelicerae reddish brown. Sternum, endites and labium orange brown; latter two with lighter anterior 1/3. Legs yellow brown with front legs having darker brown on femora, patellae and tibiae. Tibia of front legs flattened with ventral fringe of yellowish spatulate hairs. Abdomen yellowish with scattered metallic scales (more complete in paralectotype) and with whitish basal band separating lighter dorsal from darker ventral surface (Fig. 42). Paralectotype very similar, but legs mostly missing. Lectotype with total length 7.1, carapace length 2.6, carapace width 1.9. Female from west side of Lake Sayula, Jalisco, Mexico, 3 August 1956, collected by W. Gertsch and V. Roth (AMNH) quite similar to lectotype. Total length 6.0, carapace length 2.2, carapace width 1.7. Peckham & Peckham (1909) give a total length range of 6.8–8.5 for females they measured.

Male from Jalisco, Mexico: Also quite similar to lectotype, but with smaller abdomen and with longer front legs (leg formula 1423). Total length 4.6, carapace length 2.2, carapace width 1.7. This fits well with the range of 4.5–5.5 published by Peckham & Peckham (1909).

Distribution.—This species occurs from southern Sonora to central America. F.O. Pickard-Cambridge (1901) reported it from Guatemala.

Natural history.—Males of *S. barbipes* have been collected in June and August, and females have been found from June to August.

Remarks.—Although reported from California by Peckham & Peckham (1909), I have yet to see a specimen from the USA. However, there is an apparently undescribed *Tutelina* from California (CAS) that has extensive fringes on the patella-tibia, which may have been misidentified as this species.

The type vial in MCZ contained two females from the same locality. As it is uncertain just which specimen the Peckhams intended to be the holotype, I designate one female as the lectotype.

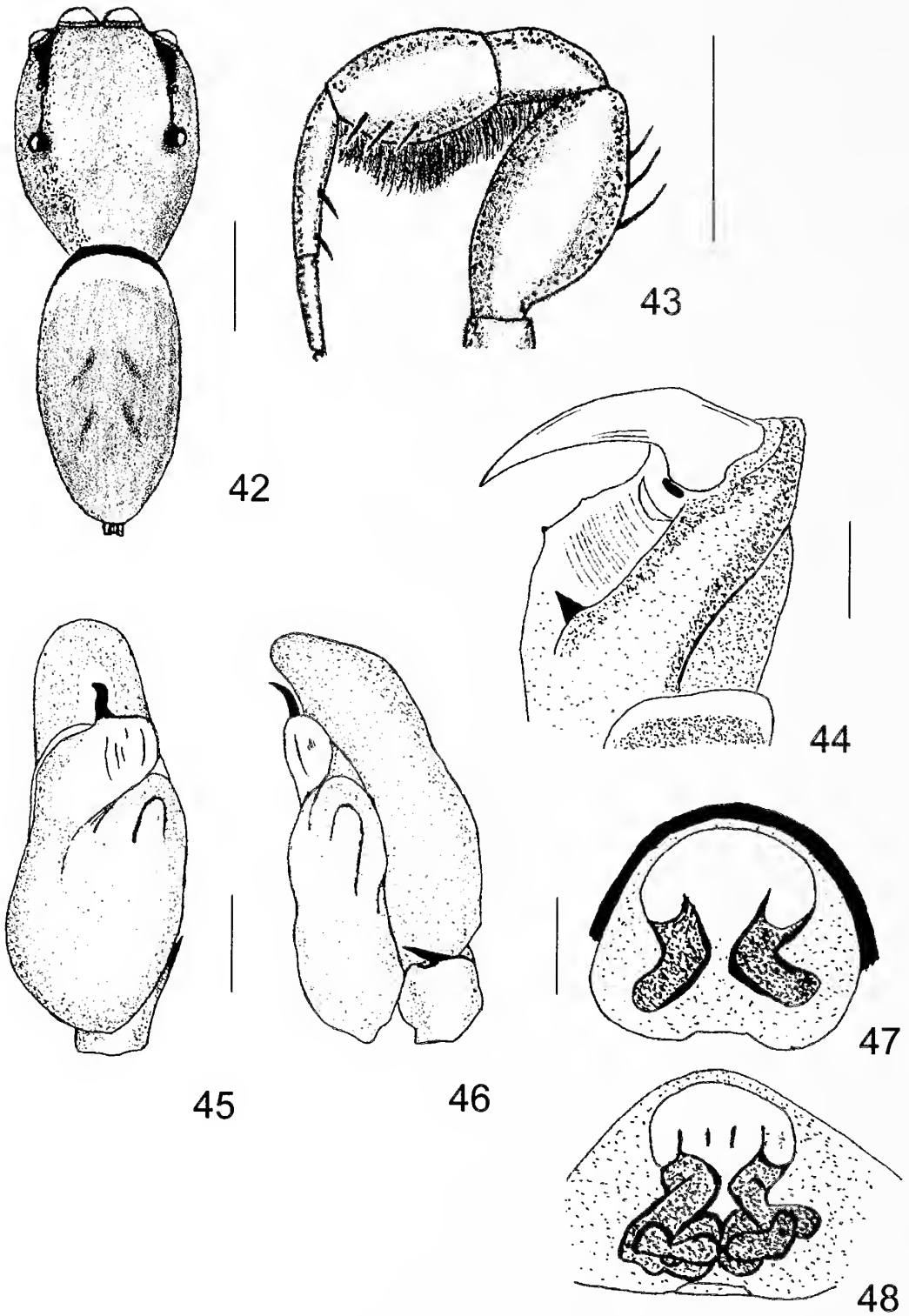
Sassacus arcuatus species-group

Sassacus lirios new species
Figs. 49–54, 57

Material examined.—Holotype male, MEXICO: *Quintano Roo:* Kohunlich Ruins, 9 km S. of Francisco Villa, ca. 18°26′N, 88°48′W, Cohune palm forest and clearings, 14–17 July 1983, W. Maddison, R.S. Anderson (83–109) (MCZ). Allotype female, collected with holotype (MCZ). Paratypes: 2 males, collected with holotype (MCZ).

Other material: MEXICO: *Hidalgo:* 1 ♂, Xilitla, 21°05′N, 98°49′W, 2000 feet, 24 July 1954, R. Dreisbach (MCZ); 1 ♀, Xilitla, 21°05′N, 98°49′W, 23 July 1954, R. Dreisbach (MCZ); 1 ♀, Xilitla, Cueva de Salitre, ca. 21°23′N, 98°59′W, ca. 2000 feet, 13 June 1983, W. Maddison (MCZ); *San Luis Potosi:* 1 ♀, near Taman, ca. 16 km SW of Tamazunchale on Highway 85, ca. 1000 feet, ca. 21°11′N, 98°53′W, 11 June 1983. W. Maddison & R.S. Anderson (MCZ); *Veracruz:* 1 ♂, no further data, N. Banks collection (with *Phidippus* labeled as *Dendryphantes dubitabilis* Peckham & Peckham) (MCZ); 3 ♂, no further data, G. & E. Peckham collection (identified as 282 *Akela* new.) (MCZ); 1 ♂, Estacion de Biologia Tropical Los Tuxtlas (UNAM), nr. La Palma, N. of Catemaco, ca. 18°36 N, 95°07′W, 29 June–1 July 1983, W. Maddison & R.S. Anderson (MCZ); 1 ♂, Tlapacoyan, 18°28′N, 95°24′W, 300 m, 7–8 July 1946, H. Wagner (AMNH); COSTA RICA: *Puntarenas:* 2 ♀, and ♂ palp, 6 km S. of San Vito, 08°42′N, 83°00′W, 13–18 March 1967, OTS Zoology course (MCZ); 3 ♂, 1 ♀, Turrialba, 9°54′N, 83°41′W, 25 July–15 August 1965, A.M. Chickering (MCZ).

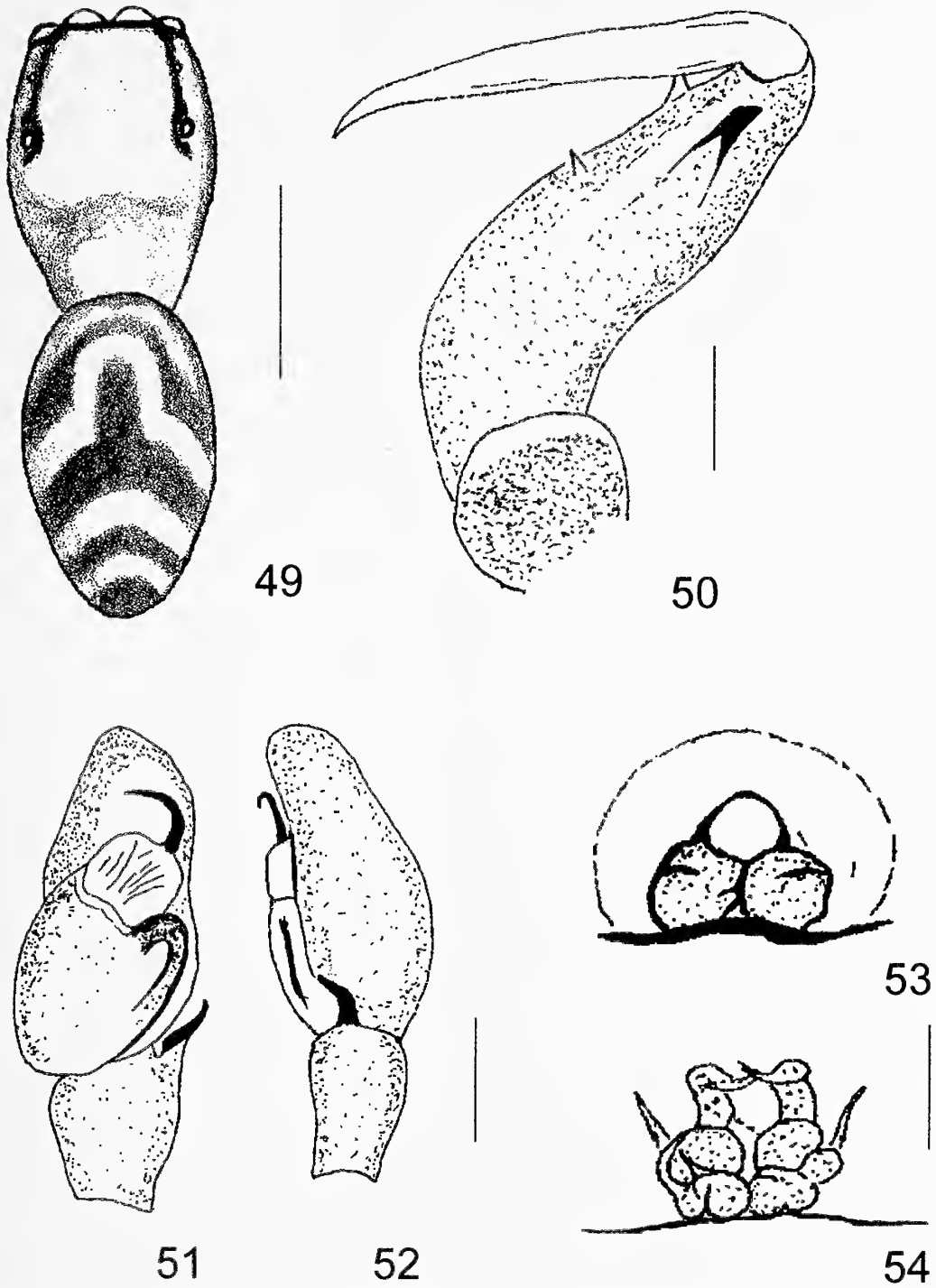
Etymology.—The specific epithet is Spanish for lilies or irises, the specific name reflects the stylized pattern on the



Figures 42–48.—*Sassacus barbipes*. 42. Male from Nayarit, dorsal view; 43. Female from Nayarit, leg I prolateral view, 44, 45, 46. Male from Nayarit: 44. Chelicera, ventral view; 45. Left palpus, ventral view; 46. Left palpus, retrolateral view. 47, 48. Female from Nayarit: 47. Epigynum, ventral view; 48. Vulva dorsal view. Scale line 1 mm (Figs. 42–43), 0.1 mm (Figs. 44–48).

abdomen and also is an allusion to a science fiction story set in Quintana Roo. To be treated as a noun in apposition.

Diagnosis.—This species differs from all other known North American *Sassacus* in having the embolus very long and curved (Fig. 51), in the structure of the male chelicerae (Fig. 50) and in the structure of the female epigynum (Fig. 53). It also differs from all other *Sassacus* except for many *S. vitis* and some females of *S. aztecus* from southern Sonora in having a contrasting pattern on the abdomen in most speeimens (Fig. 49). This pattern includes an anterior band in the rough shape of a stylized lily (sometimes incomplete, but angled), similar to the Brazilian species



Figures 49–54.—*Sassacus lirios*. 49. Male from San Luis Potosi, dorsal view; 50, 51, 52. Male from Quintana Roo: 50. Chelicera, ventral view; 51. Left palpus ventral view; 52. Left palpus, retrolateral view. 53, 54. Female from San Luis Potosi: 53. Epigynum, ventral view; Vulva, dorsal view. Scale line 1 mm (Fig. 49), 0.2 mm (Fig. 50), 0.1 mm (Figs. 51–54).

Sassacus helenicus (Mello-Leitão 1943). It also resembles *S. helenicus* in having a similar embolus (Fig. 51) and cheliceral structure (Fig. 50), and is obviously closely related to this species. However, based on illustrations from several noted sources published on the Internet by Prószyński (2004), the proximal promarginal tooth of the chelicerae is more basal in *S. helenicus* than in *S. lirios* and the epigynal structure is quite different (Figs. 53, 54). The abdominal pattern of the closely related *Sassacus flavicinctus* Crane 1949a from Venezuela includes an incomplete and straight anterior band. *Sassacus lirios* has a distinctive embolus showing close affinities to *S. flavicinctus*, but differing from this species in that the fleshy part of the bulb at the base of the embolus is nearly as high as wide, the base of the embolus is narrower, and the tibial

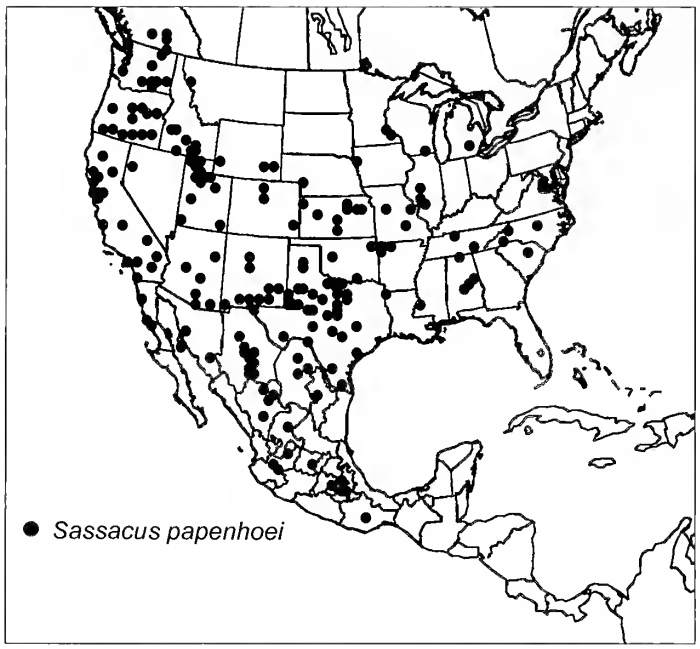


Figure 55.—Distribution of *Sassacus papenhoeii* in North America.

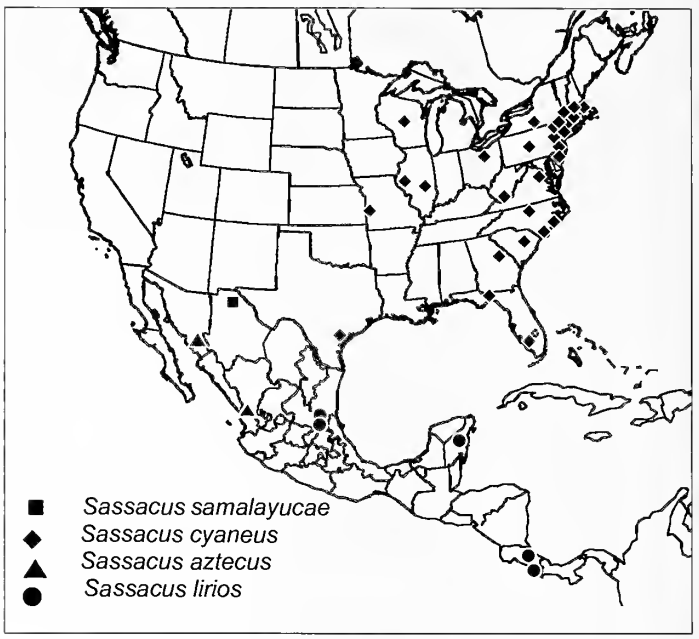


Figure 57.—Distribution of *Sassacus samalayucae*, *S. cyaneus S. aztecus* and *S. lirios* in North and Central America.

apophysis is narrower and more curved. The epigynum of *S. lirios* shows some similarities to that of S. *flaviciuctus*, but differs in the shape of the spermathecae.

Description.—*Male holotype:* Leg formula 1423. Chelicerae with two promarginal and one slanted retromarginal tooth (Fig. 50). First tibia usually with 2-2-1 ventral macrosetae. Color overall red to yellow-brown. Carapace dark red brown with metallic scales in eye region and with white scales forming sinuous bands (looking somewhat like the front coil and forward facing head of a snake with mouth engulfing the spider's posterior lateral eyes) beginning at anterior lateral eyes and extending to posterior edge of carapace on each side. Clypeus covered with white hairs. Chelicerae yellow brown. Legs yellow brown with lighter yellowish patellae and tarsi. Abdomen dorsum with light yellowish-cream inverted stylized lily pattern, followed with two light bands anterior to the spinnerets. Venter and sternum yellow-brown. Other males from same locality darker brown, with yellowish patellae and tarsi. Ten males from Quintana Roo, Vera Cruz and San Luis Potosi, Mexico, and Turrialba, Costa Rica, range from 2.7–3.8 (most about 3.1) in total length. Carapace length 1.3–2.0 and width 1.05–1.5.

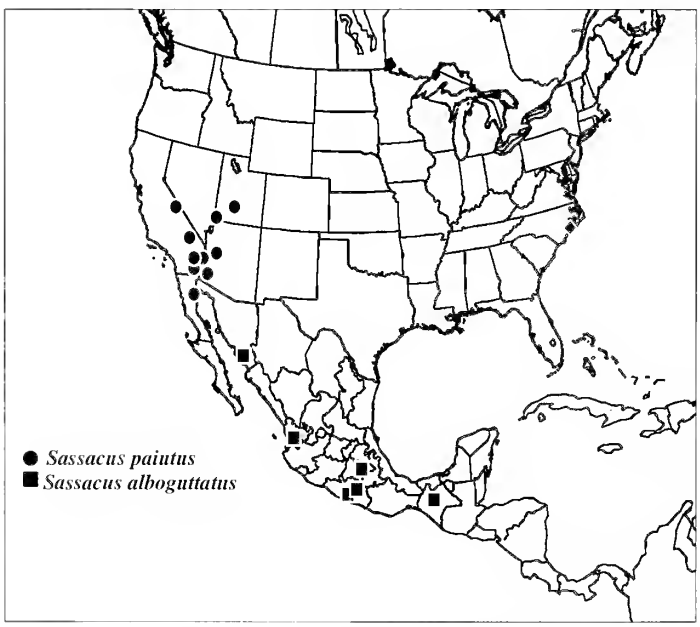


Figure 56.—Distribution of *Sassacus paiutus* and *S. alboguttatus* in North America.

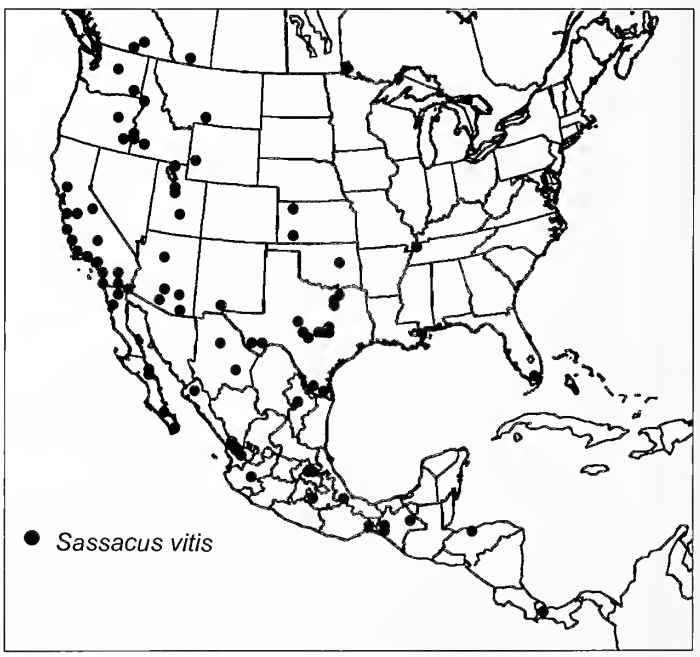


Figure 58.—Distribution of *Sassacus vitis* in North and Central America.

Figure 59.—Distribution of *Sassacus barbipes* in North America.

Female allotype: Leg formula, cheliceral teeth and ventral tibial macrosetae as in male, except cheliceral teeth much smaller and retromarginal tooth not slanted, but broad based and roughly triangular. Color pattern similar to male, but only femurs of legs dark, and dorsal carapace is some covered with light scales. Six females from Quintana Roo, San Luis Potosi and Costa Rica range from 3.0–3.7 mm in total length. Carapace length 1.4–1.6 mm, width 1.1–1.2 mm.

Distribution.—This species occurs in San Luis Potosi, Mexico, south to Quintana Roo and Costa Rica.

Natural history.—Males of this species are primarily known from July, but Costa Rican specimens may have been also collected in March and August. Females are known from March (Costa Rica) and June–July to possibly August.

Remarks.—This species appears to be a member of the mainly South American *arcuatus* species group. Whether these are actually *Sassacus* is open to debate. Their morphological structure, as exhibited in this species, is quite different, even from the most extreme members of the genus. Unfortunately the generic name *Ramboia* Mello-Leitão 1943, which might be used for this species group, is based on a species that appears to not be in the *arcuatus* group at all (Scioscia, personal correspondence). It remains for some other researcher to clear up this issue. It is my opinion that this "species group" will probably be placed into another genus, but at present it seems best to leave this species in *Sassacus* while noting the problem.

The female epigynum (Figs. 53, 54) does not match the figure provided by Peckham & Peckham (1896) for *Dendryphantes dubitabilis* (= *Metaphidippus dubitabilis*) and the dorsal pattern also does not match. It is thus thought that the identification label for Banks' specimen from Veracruz (see Material Examined) was the result of a misidentification. It does appear to be closely related to *Sassacus helenicus* (Mello-Leitão 1943), as noted in the diagnosis.

Another potential species of this species group, a female from Chiapas: Las Ruinas de Palenque, 17.31°N, 91.58°W, July 1948, C. & M. Goodnight (AMNH) was examined. The epigynum resembles that of *Sassacus aurantiacus* Simon 1901. Since placement of this specimen is uncertain (the pattern of *S. aurantiacus* is obscured in the type as noted by Galiano (1963) and I have not examined it) and only one specimen was found, it will be left for the future reviser of the whole *arcuatus* group

APPARENT CHRYSOMELID BEETLE MIMICRY IN THE SALTICIDAE

The well-known "ant mimicry" in various salticid, gnaphosid and corinnid genera is still not totally explained (Foelix 1996), although there is some solid evidence for Batesian mimicry in *Synageles* Simon 1876 (Engelhardt 1971; Cutler 1991) and *Myrmarachne* MacLeay 1839 (Nelson 1998). Indeed, most of the known ant mimics could not be aggressive mimics as they do not appear to feed on ants, although they may live with them, and Müllerian mimicry, although possible [see Nelson (1998), for a discussion of a distasteful non-mimic] so far seems unlikely. In addition to these, at least two genera of spiders (the salticids in the genus *Sarinda* Peckham & Peckham 1892 and possibly some *Castianeira* Keyserling 1879 in the family Corinnidae) may be generalist mimics of ponerine ants, while *Peckhamia* appears to mimic ants of the genus *Camponotus* or *Crematogaster,* and most *Synemosyna* Hentz 1846 seems to be obvious mimics of ants in the genus *Pseudomyrmex* [although in the north they resemble *Crematogaster* (B. Cutler, personal observation)]. Some other cases of apparent mimicry exist, including many species of *Phidippus* C.L. Koch 1846 (Edwards 2004) that apparently mimic velvet ants in the genus *Dasymutilla*, for example, *Phidippus apacheanus* Chamberlin & Gertsch 1929 (Edwards 1984), which itself has a painful bite (personal observation). This may, thus, be a case of Müllerian mimicry, as velvet ants have a painful sting.

With details lacking on documented ant and velvet ant mimicry, it is not strange that apparent beetle mimics in the genera *Sassacus*, *Coccorchestes* Thorell 1881, and possibly *Cylistella* Simon 1901, have been little studied. Are these really mimics of chrysomelid beetles or is the resemblance only incidental? The arguments for chrysomelid beetle mimicry are as follows:

1. Members of the three genera, *Sassacus*, *Cylistella* and *Coccorchestes* are so beetle-like that they can occasionally fool even a trained biologist. *Coccorchestes* from the Old World tropics is perhaps the most extreme of these and as far as is known all members of the genus are very closely beetle-like. After this genus come members of *Agassa* (*Sassacus cyaneus* and *S. albogutattus*). *Sassacus papenhoei* and closely related species (*S. paiutus* and *S. samalayucae*) are less beetle-like, but resemble a small flea beetle from a distance. *Cylistella* is much smaller and may be a beetle-mimic or may mimic a mite, or the resemblance may actually reflect the convergent development of an armored body to reduce water loss in a tiny animal (< 2 mm).
2. The members of these genera are generally metallic or shiny black, resembling the colors of various species of chrysomelid beetles in the Galerucinae and Eumolpinae.

3. At least one species, *Sassacus cyaneus*, has been collected on multiple occasions among groups of similarly colored chrysomelid beetles of similar size (G.B. Edwards and D.B. Richman, pers. observ.). Based on these observations, it would seem that chrysomelid beetle mimicry is a real phenomenon, although to make this concept more than a circumstantial hypothesis would require some exact experimentation.

If these are beetle mimics, what function does the resemblance serve for the mimic? It might be possible that this is indeed another example of Batesian mimicry because:

1. Some chrysomelid beetles are known to be distasteful and many produce toxins (Pasteels & Rowell-Rahier 1989; Pasteels et al. 1990; Pasteels 1993). *Galeruca tanaceti* (Chrysomelidae: Galerucinae) is known to produce anthraquinones in its hemolymph (Hilker & Schulz 1991). Furthermore, many chysomelid beetles, whether placed in the Alticinae or Galerucinae in the literature, are known to possess defense glands in the adult stage. Although some seem to lack them (Deroe & Pasteels 1982) and many leaf beetles, possibly including flea beetles and other leaf beetles that resemble flea beetles, may gain further defensive chemicals from the plants on which they feed (Blum 1981). The only chrysomelid beetle collected with *Sassacus* (*S. cyaneus*), to my knowledge, was a species of *Graphops* (Chrysomelidae: Eumolpinae) (current study - identified by Wills Flowers), not a galerucine. The defensive chemicals associated with this genus, if any, are unknown.
2. The apparent chrysomelid beetle-mimic jumping spiders are generally much less abundant than their beetle models, which would be a necessary prerequisite to effective mimicry, as otherwise the mimics would be more likely to be encountered and perhaps eaten.

From this it might also be suggested that metallic colors in small jumping spiders (that are not related to the male ornamentation) might be a general mimicry of metallic chrysomelids. This would make *Sassacus vitis, Tutelina* Simon 1901 and some *Salticus* Latreille 1804 possible general chrysomelid beetle mimics based on color. However, at least some *Tutelina* species, especially males, look and act much like ants in the field (personal observation of male *T. elegans* (Hentz 1846) on milkweed plants in Cook County, Illinois in 1998) and at least some (especially green) metallic jumping spiders (for example females of *T. elegans* (also based on observations in Cook County, Illinois, 1998) may really be "mimicking" (technically crypsis, not mimicry) water droplets (originally proposed by G.B. Edwards, pers. commun.; Edwards 2004). This might make them less visible in tropical or temperate forests or even in riparian habitats in the Southwestern United States. Thus metallic coloration alone is probably not a good criterion for general chrysomelid beetle mimicry.

What organisms are the likely targets of true beetle mimicry? Birds, other salticid spiders and possibly lizards may be the most important predators that could be fooled. This seems to be true for the ant mimics at least. Engelhardt (1971) showed that *Synageles* did fool birds into apparently perceiving them as ants. Cutler (1991) demonstrated the same for *Synageles* with immature *Phidippus* (jumping spiders) as predators. However, there are only sketchy data for beetle mimics. Preliminary experiments with the araneophage jumping spider *Portia fimbriata* (Doleschell 1859) indicated that this spider was not totally fooled by *Sassacus papenhoei*, which it usually attacked, although the attack was slower than it would have been for a normal-appearing salticid (R.R. Jackson, unpubl. data). Individuals of the jumping spider genus *Portia* Karsch 1878 may or may not encounter bad-tasting flea beetles in its normal habitat, however. Obviously, much needs to be done before we can be sure about the function of beetle mimicry, assuming it is a real phenomenon, but preliminary incidental observations seem to indicate that it may be another example of Batesian mimicry.

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Hemerotrecha banksi (Arachnida, Solifugae), a diurnal group of solifuges from North America

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Abstract. The *Hemerotrecha banksi* group is revised and the status of the genus *Hemerotrecha* is examined. The female of *H. truncata* Muma 1951 is described for the first time, and five new species are named: *H. hanfordana, H. kabooni, H. prenticei. H. pseudotruncata*, and *H. vetteri.*

Keywords: Solifuges, new species, distribution, systematics

Although solifuges are considered mainly nocturnal (Muma 1951, 1970; Cloudsley-Thompson 1958; Lawrence 1960, 1962; Punzo 1998), many species are primarily diurnal including species in the South African Solpugidae (Wharton 1981, 1987) and South American members of the Mummuciidae (Maury 1985; Xavier & Rocha 2001). The North American *banksi* group of the Eremobatidae genus *Hemerotrecha* also appears to be diurnal.

The Greek *Hemerous*, the sun, and *trechos*, to run, were used by Banks (1903) to erect the genus *Hemerotrecha*. He designated *Hemerotrecha californica* Banks 1903 as the type species. The collector, Dr. Harold Heath, said, "they run about in the blazing hot sunshine" (Banks 1903). The genus *Hemerotrecha* currently includes 31 species from western United States and northern Mexico (Harvey 2003). As defined by Muma (1951, 1970), the genus *Hemerotrecha* includes small to moderate-sized solifuges bearing a style-like fixed cheliceral finger with the ventral edge irregularly undulate or bearing one or more modified teeth. The mesoventral groove is absent or, at most, very faint. The flagellum complex consists of a dorsal row of striate bristles, the striae formed by very tiny setae, and a ventral row of plumose setae that are more plumose apically (Fig. 1).

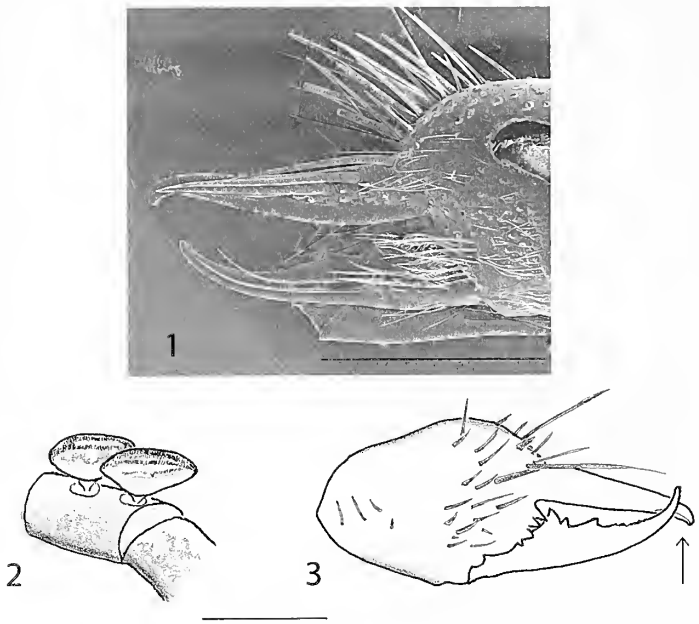
Muma (1951) established the *Hemerotrecha banksi* group for four species all with characters so similar that he thought that they might in fact be one species. The group includes: *H. banksi* Muma 1951, the new name for *H. californica* Banks 1903 (which is a junior secondary homonym of *Cleobis californica* Banks 1899); *H. californica* (Banks 1899); *H. marginata* (Kraepelin 1911); and *H. truncata* Muma 1951. All four species have eyes separated by 1.5–2 diameters, males with the ventral margin of the fixed cheliceral finger irregularly undulate, striate bristles of the flagellum complex indistinctly striate with apical and subapical bristles broad and flattened, and females with roughly triangular genital opercula, with parallel medial margins. Muma's 1970 publication emphasized the shape of the tip of the male fixed finger, length and type of ctenidia, and palpal coloration. In addition we found them to possess dark edges on the anterior of the malleoli in both males and females (Fig. 2), and a cup-like mesoventral groove at the tip of the male fixed finger (arrow, Fig. 3).

Females were described for *H. banksi* and *H. californica* but not for *H. truncata*. Muma did not examine Kraepelin's types of *Eremobates marginatus* Kraepelin 1911 but used Roewer's (1934) drawings. The type localities of each species were in the state of California and the meager material examined was all from that state except for a male and female from the state of Washington. Muma (1962, 1963, 1970) included specimens from these states as well as Idaho, Oregon, and several specimens that he identified as *Hemerotrecha californica* from the Nevada Test Site. After examining more extensive solifuge collections, particularly those of D. Giuliani (CAS, ESS) including specimens from wide ranging regions of Southern California and Arizona, a collection by Wendel Icenogle of Winchester, California, a collection from Tom Prentice (UCR) and a group sent to us by Richard Zack collected at the Hanford Nuclear Reactor Site, Hanford, Washington, we decided that a revision of the group was in order.

METHODS

Using the methods of Muma (1951), Brookhart & Muma (1981, 1987), Muma & Brookhart (1988), and Brookhart & Cushing (2004), we measured total body length, length of palpus, leg I, and leg IV of both males and females. Length and width of chelicera and propeltidium, width of base of fixed finger, and genital operculum were all measured using Spot Basic™ on an Olympus SZX12. All measurements are in millimeters. Ratios used previously by Muma (1951, 1970, 1989), Brookhart & Muma (1981, 1987), Muma & Brookhart (1988), and Brookhart & Cushing (2002, 2004) were computed. These ratios are as follows: A/CP: the sum of the lengths of palpus, leg I, and leg IV divided by the sum of length of chelicera and propeltidium indicating length of appendages in relation to body size. Long-legged species have larger A/CP ratios. Because there is no fondal notch, the chelicera width/fixed finger width ratio is used to indicate whether the fixed cheliceral finger is thin or robust in relation to the size of the chelicera. Genital operculum length/genital operculum width demonstrates the relative size of the female genital operculum in terms of length and width. No statistical analysis was attempted because of small sample sizes.

Species determinations were based on a combination of color comparisons, general shape of male fixed finger, particularly the tip; palpal setation; ctenidial size and shape. The difference (or similarity) in color pattern between the chelicerae and the propeltidium was noted as was the color pattern of the palpus and legs. The shape of the female chelicera and the female genital operculum margin were observed using the method of Brookhart & Cushing (2004). Due to strong similarities among members of this group, the description of *H. banksi* was used as the basis for all other species descriptions. Female morphology is consistent among the various species; differences are described when necessary.



Figures 1–3.—*Hemerotrecha vetteri* and *H. banksi*. 1. Ectal view of *H. hanfordana* chelicera showing flagellum complex. 2. Ventral view of malleoli of *Hemerotrecha vetteri*, new species showing dark edges. 3. Ectal view of the right chelicera of *Hemerotrecha banksi* holotype showing mesal ventral groove (arrow). Scale bars = 1 mm.

Specimens examined for this study are deposited in the American Museum of Natural History, New York (AMNH); Brigham Young University, Provo, Utah (BYU); California Academy of Sciences, San Francisco (CAS); Denver Museum of Nature & Science, Denver, Colorado (DMNS); Essig Museum, University of California at Berkeley, Berkeley (ESS); University of California at Riverside (UCR); California State University, Northridge (CSN); Florida State Collections of Arthropods, Gainesville (FSCA); Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ); San Diego Museum of Natural History, San Diego, California (SMNH); Washington State University, Pullman (WSU); and Zoologische Staatssammlung, Munich, Germany (ZSM).

SYSTEMATICS

Family Eremobatidae Kraepelin 1901
Subfamily Therobatinae Muma 1951
Genus *Hemerotrecha* Banks 1903

Type species.—*Hemerotrecha californica* Banks 1903 (junior secondary homonym of *Cleobis californica* Banks 1899, now *Hemerotrecha banksi* Muma 1951), by monotypy.

Remarks.—Muma (1951) placed the genus *Hemerotrecha* in the Therobatinae based on the style-like fixed cheliceral finger, undulate ventrally or with small modified denticles, none, or, at best, a very faint mesal ventral groove, and the female operculum variously developed. He later modified his description of the genus *Hemerotrecha* (Muma 1970) by describing the fixed cheliceral finger as weakly curved, undulate, or turned downward at the tip, and the dorsal flagellar setae as striate, spatulate, or hooked. Muma (1989) refined his description of the fixed finger as essentially straight but at times being denticulate, undulate, or serrate and completely lacking a mesal or mesoventral groove, the flagellar setae additionally to include "strong, enlarged, flattened, or hooked" setae, and the female opercula being variable but consistent within species groups.

KEY TO THE MALES OF THE *HEMEROTRECHA BANKSI* GROUP

1 Chelicerae and propeltidium of the same coloration . . 2
Chelicerae paler than propeltidium 5
2 Chelicera and propeltidium pale yellow; eye tubercle pale; cheliceral tip of fixed finger rounded (Fig. 28); palpus dusky on metatarsus and distal 20% of tarsus (Fig. 27); ctenidia short, thin, pointed . . . . *Hemerotrecha marginata*
Chelicera and propeltidium dark to dusky; eye tubercle dark; cheliceral tip hooked (Fig. 45); palpal tarsus either pale or completely dark; ctenidia thin or broad extending from one half to the entire length of the succeeding sternite (Fig. 19) 3
3 Entire body dark; entire palpus (Fig. 46) and appendages dark; chelicera slightly hooked with a distinct ridge on the distal dorsal edge of the fixed finger (arrow, Fig. 44) . . . . . *Hemerotrecha vetteri*
Chelicera and propeltidium blotchy gray or blotchy orange (Fig. 15); palpal metatarsus dark (Fig. 18) 4
4 Cheliceral fixed finger slightly hooked with tiny ridge on the distal dorsal edge of fixed finger, a short, deep concavity on the apical ventral edge of fixed finger (Fig. 16), ctenidia thin and of medium length . . . . . *Hemerotrecha hanfordana*
Cheliceral fixed finger slightly hooked without a distal dorsal ridge or an apical, ventral concavity (Fig. 51), ctenidia short and broad (Fig. 52) . . *Hemerotrecha prenticei*
5 Fixed cheliceral finger gently curved dorsally with rounded, attenuated tip (Fig. 12) 6
Fixed cheliceral finger gently curved dorsally with slightly to strongly hooked tip (Fig. 38) 7
6 Palpus dusky on metatarsus (Fig. 11); 2 long ctenidia extending length of sternal segment (Fig. 13); body pale; without spine-like setae on ventral tarsus and metatarsus of palp . . . . . *Hemerotrecha californica*
Palpus dusky on tarsus and metatarsus (Fig. 7); 2 shorter ctenidia (Fig. 6); body dark; with spine like setae on ventral tarsus and metatarsus of palp (Fig. 7) . . *Hemerotrecha banksi*
7 Fixed cheliceral finger with apical hook but with otherwise typical curved shape (Fig. 22); dusky orange chelicera; blotchy, dark propeltidium (Fig. 21); creamy yellow abdomen . . . . . *Hemerotrecha kaboomi*
Fixed cheliceral finger attenuated with a noticeable hook (Figs. 32, 38); dark to dusky orange chelicera and propeltidium, dusky to dark abdomen 8
8 Fixed cheliceral finger with sharply hooked (parrot beak) tip (Fig. 32); dusky chelicera, blotchy dark propeltidium (Fig. 31) and abdomen; dusky palpal tarsus, metatarsus, tibia and tip of femur . . . . . *Hemerotrecha truncata*
Fixed cheliceral finger with hooked tip but not nearly as deep or sharp as above (Fig. 38); dusky chelicera; blotchy propeltidium (Fig. 37); creamy yellow abdomen; dusky palpal metatarsus (Fig. 39) . . *Hemerotrecha pseudotruncata*

Hemerotrecha banksi Muma 1951
Figs. 3–9, 54

Hemerotrecha californica Banks 1903:79 (junior secondary homonym of *Cleobis californica* Banks 1899).

Hemerotrecha banksi Muma 1951:99–100, figs. 185–192 (replacement name for *Hemerotrecha californica* Banks 1903).

Material examined.—*Types:* USA: *California:* male holotype, Monterey County, Pacific Grove (36.62°N, 121.92°W), no date, H. Heath (MCZ). "Allotype" (designated by Muma 1951), 1 female, San Mateo County, Redwood City (37.49°N, 122.24°W), 18 May 1924, W. Meehan (AMNH).

Other material examined: USA: *California:* Calaveras County: 1 ♂, West Point (38.4°N, 120.53°W), 7 August 1970, S.C. Williams (CAS); Contra Costa County: 2 ♂, 1 ♀, Redwood (37.49°N, 122.29°W), 14 April 1995, J.G. Rozen, J.W. McSwain (ESS); 1 ♂, Walnut Creek (37.90°N, 122.06°W), 3 June 1961, J. Powell (CAS); Marin County: 1 ♂, Tiburon, Ring Mountain (37.92°N, 122.49°W), 13 July 1977, T.S. Briggs (ESS); Monterey County: 1 ♂, Pacific Grove (36.62°N, 121.92°W), no date, E.C. Starks (AMNH); 1 ♀, Redwood City (37.49°N, 122.24°W), 18 May 1962, W. Meehan (AMNH); San Benito County: 1 ♂, 9.7 km SE. of Idria (36.42°N, 120.63°W), 29 June 1954, S.G. Rozen (CAS); 1 ♂, Pinnacle National Monument (36.47°N, 121.17°W), 7 May 1977 C.E. Griswold (CAS); San Mateo County: 1 ♂, 19 April 1918, B.H. Van Duzen (CAS); Sonoma County: 1 ♂, Petaluma (38.26°N, 122.53°W), 4 July 1979, D.H. Kavanaugh (CAS); Santa Clara County: 1 ♀, Jasper Ridge (37.41°N, 122.27°W), 31 October 1952, F.S. Bartholomew (CAS); Santa Cruz County: 1 ♂, Scotts Valley (37.05°N, 122.01°W), 22 May 1990, running on trail, R. Morgan (CAS); 1 ♂, Santa Cruz Grasslands (coordinates not determined), 22 May 1990, R. Morgan (CAS); Santa Margarita County: 1 ♂, 9.7 km E. of San Luis Obispo (35.28°N, 120.66°W), 11 June 1958, J. W. McSwain (ESS).

Diagnosis.—Tip of male fixed cheliceral finger rounded, tapering anteriorally, palpal tarsus dark for at least the distal half, metatarsus dark 80% apically, dusky creamy orange chelicera, dark to dusky light orange propeltidium; ctenidia short (about half the sueceeding segment), pointed. Females with same coloration.

Description.—*Male*, Color: chelicera dusky yellow-orange, propeltidium dusky to dark orange but always darker than chelicera (Fig. 4), eye tuberele dark, abdomen blotchy, dusky to dark, palpal tarsus and apical 80% metatarsus dusky to dark; leg I dark on tarsi and metatarsi, legs II, III, IV dark ventrally.

Chelicera: fixed finger with a small basal rise and a rounded tip, ventral edge straight (although two specimens had a slight ventral concavity) with no apparent hooklike terminus; the mesal ventral groove a small, shallow apical cup; movable finger with large primary tooth, smaller anterior tooth, 1–2 intermediate teeth, the posterior being separated from primary tooth. Small crenulations anterior to anterior tooth. No mesal tooth (Fig. 5). Fondal notch obscure to absent, fondal teeth graded I, III, II, IV. Apical, subapical plumose flagellar bristles as well as dorsal apical cheliceral setae flattened (Fig. 5, arrow).

Propeltidium: eyes separated by 1.5 diameter of eye (Fig. 4).

Abdomen: 2 short, pointed ctenidia ventrally on fourth abdominal sternite (Fig. 6). Edges of malleoli darkly tinged.

Palp: scopula absent; a row of 2–3 spine-like setae on mesal ventral portion of metatarsus (Fig. 7).

Dimensions: male holotype: total length 11.0, cheliceral length 2.6, cheliceral width 1.2, propeltidium length 1.5, propeltidium width 2.0, palpus length 7.2, first leg length 5.0, fourth leg length 12.1. *Ratios*: A/CP 5.92, cheliceral width/fixed finger width 4.28.

Male (5): total length 8.5–11.0, cheliceral length 2.13–2.96, cheliceral width 0.93–1.28, propeltidium length 1.09–1.45, propeltidium width 1.71–2.23, palpus length 6.5–7.8, first leg length 4.6–7.6, fourth leg length 9.0–13.5. *Ratios*: A/CP 5.07–6.99, cheliceral width/fixed finger width 3.55–4.23.

Female: Color: same as males.

Chelicera: fixed finger with large primary tooth and medial tooth, smaller anterior tooth. Two intermediate teeth between primary tooth and medial tooth and medial tooth and anterior tooth. movable finger with medium sized primary tooth and anterior tooth. Two intermediate teeth between primary tooth and anterior tooth, the posterior intermediate tooth in the notch of the primary tooth. No mesal tooth (Fig. 8).

Genital region: genital operculum roughly triangular with parallel median margins, no wings, and a gently curved posterior margin. Genital opening behind the opercular plates (Fig. 9).

Dimensions: Female allotype: total length 11.0, cheliceral length 4.1, cheliceral width 1.6, propeltidium length 1.6, propeltidium width 2.7, palpus length 6.5, first leg length 5.5, fourth leg length 9.0. Ratios: A/CP 3.7, genital operculum length/genital operculum width 1.5.

Female measurements (n = 3): total length 9.0–12.0, cheliceral length 2.23–2.28, cheliceral width 1.12–1.22, propeltidium length 1.38–1.4, propeltidium width 1.82–2.0, palpus length 5.5–8.0, first leg length 4.3–5.5, fourth leg length 8.9–9.7. Ratios: A/CP 5.06–5.27, genital operculum length/genital operculum width 1.5–1.52.

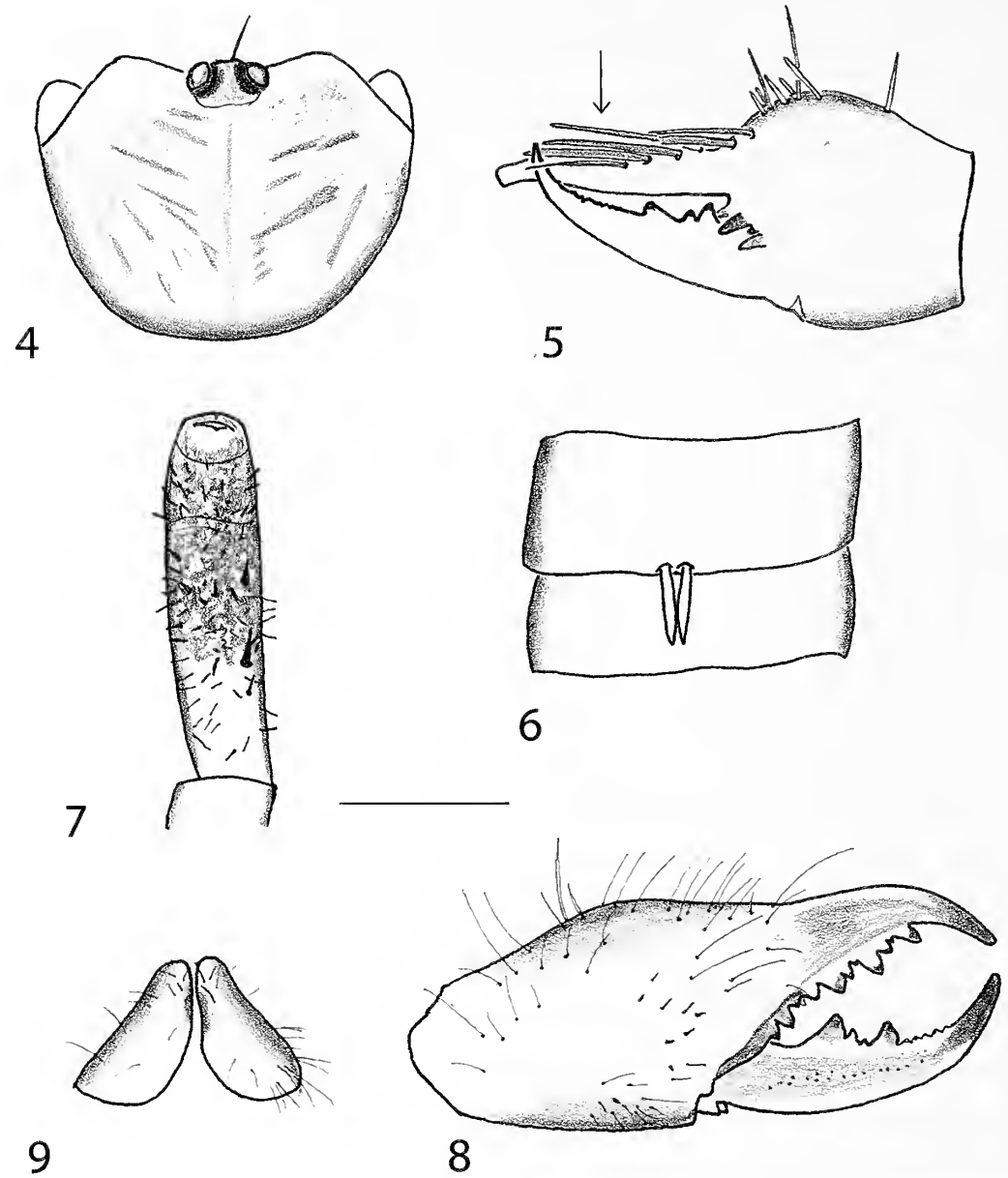
Remarks.—The distribution of this species roughly encompasses the northern area of California surrounding and including the Monterey Peninsula (Fig. 54). Muma (1951) lists female paratypes deposited at Cornell University and Utah State University (USU) but USU material is now at AMNH and the Cornell material is missing.

Hemerotrecha californica (Banks 1899)
Figs. 10–14, 54

Cleobis californica Banks 1899:314–315.
Anmotrecha californica (Banks): Banks 1900:427.
Hemerotrecha californica (Banks): Banks 1904:363.

Material examined.—*Type:* USA: *California*: female holotype, Los Angeles, Los Angeles County, A. Davidson (MCZ).

Other material: USA: *Arizona*: Mohave County: 7 ♂, 2 ♀, Virgin River Canyon, 11.3 km E. of Littlefield (36.52°N, 113.55°W), March-September 1983, D. Giuliani (ESS). *California*: Inyo County: 1 ♂, 30.6 km N. of Ridgecrest (35.62°N, 117.97°W), 5 April 1983–13 September 1983, D. Giuliani (ESS); 1 ♂, Saline Valley, Granite Canyon (35.82 °N, 116.62°W) 25 May 1981–15 April 1982, D. Giuliani (ESS); 2 ♂, White Mountains, Big Pine (37.09°N, 118.19°W), 1 November 1985–28 June 1986, D. Giuliani, (ESS); 8 ♂, 2 ♀, Sierra Nevada

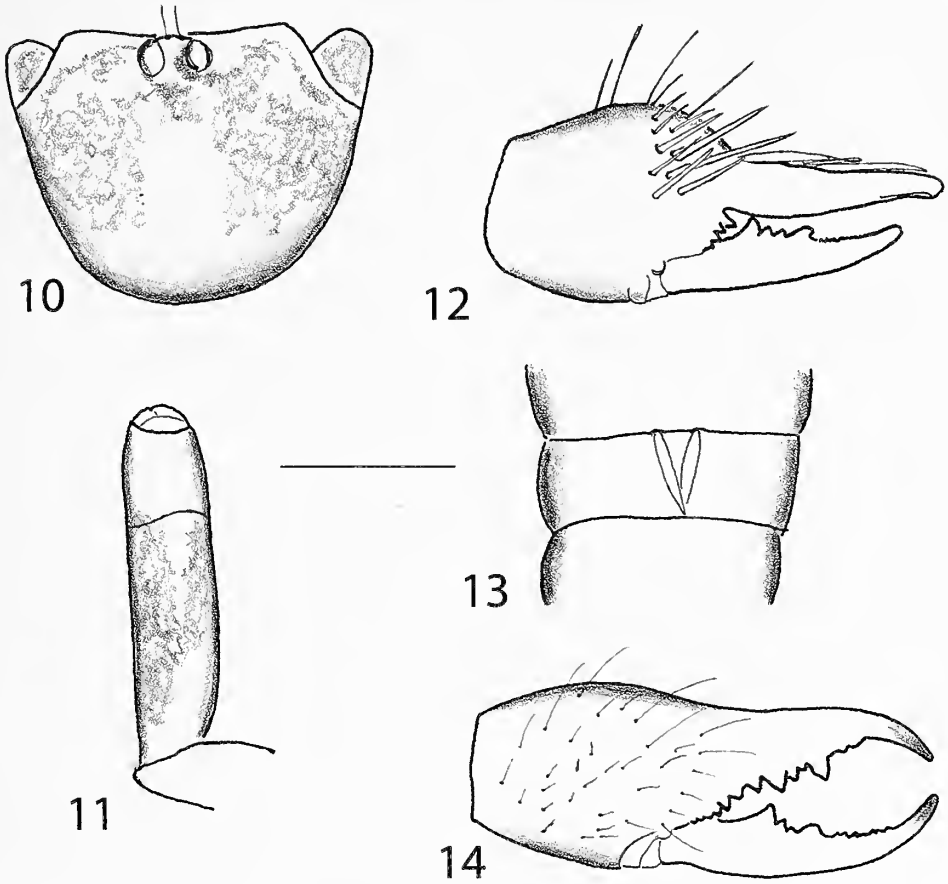


Figures 4–9.—*Hemerotrecha banksi* Muma. 4–7. Male holotype: 4. Dorsal view, propeltidium; 5. Mesal view, right chelicera showing flagella complex (arrow); 6. Ventral view, ctenidia; 7. Mesal ventral view, right palpus. 8–9. Female allotype: 8. Ectal view, chelicera; 9. Ventral view, genital operculum. Scale bar = 1 mm.

Range, 12.9 km NE. of Big Pine (37.09°N, 118.19°W), May–November 1983, D. Giuliani (ESS); 2 ♂, Bishop (37.21°N, 118.25°W), October 1985–November 1986, D. Giuliani (ESS); Los Angeles County: 1 ♂, Campo (34.14°N, 118.36°W), 23 October 1970, C. Mahrdt (CAS); 1 ♂, same data except 11 July 1971 (CAS); 1 ♂, same data except 31 July 1971 (CAS); 1 ♀, same data except 31 July 1971, H. Sunclar (CSN); 1 ♂, San Pedro (33.85°N, 118.31°W), (no date), Banks type label (MCZ #14855); 1 ♂, Chatsworth (34.26°N, 118.60°W), 1 July 1962, W.E. Icenogle (CSN); San Bernardino County: 2 ♂ Covington Flats (34.04°N, 116.31°W), June 2001, USGS, San Diego (DMNS), 1 ♂, Winchester (33.37°N, 17.15°W), 15 June 1967, W.R. Icenogle (DMNS); 3 ♂, same data except 29 June 1967 (DMNS); 1 ♀, same data except 5 May 1968 (DMNS); 1 ♂, same data except 6 June 1968 (DMNS); 1 ♂, same data except 21 May 1969 (DMNS); 1 ♂, same data except 10 May 1970 (DMNS). *Nevada*: Clark County: 2 ♂, 1 ♀, 14.5 km SW. of Overton (36.51°N, 114.32°W), March-September 1983, D. Giuliani (ESS); 3 ♂, 1 ♀, Spring Range Canyon (36.152°N, 115.88°W), March-September 1983, D. Giuliani (ESS). *New Mexico*: San Juan County: 4 ♂, 1 ♀, Shiprock (36.79°N, 108.69°W), March-September 1984, D. Giuliani (ESS).

Diagnosis.—Chelicera and propeltidium both dusky yellow-orange. Palpus dark on apical 80% of metatarsus. Fixed cheliceral finger slightly curved dorsally with a cupped mesoventral groove apically. Two long ctenidia extending length of succeeding sternite, palpus with no spine-like setae on ventral side.

Description.—*Male (from Winchester, California)*. Color: chelicera and propeltidium dusky yellow to dusky orange,



Figures 10–14.—*Hemerotrecha californica* (Banks). 10–13. Male from Winchester, California: 10. Dorsal view, propeltidium; 11. Mesal ventral view, right palpus; 12. Ectal view, right chelicera; 13. Ventral view, ctenidia. 14. Female holotype, ectal view, right chelicera. Scale bar = 1 mm.

propeltidium dusky orange to tan (Fig. 10), eye tubercle dark; abdomen lighter centrally with dusky tan blotches ectally, palpal metatarsus dark to dusky on apical 80% (Fig. 11); leg I pale, legs II, III, IV faintly tan dorsally.

Chelicera: fixed finger with a shallow cup-like mesal ventral groove apically but otherwise normally rounded at the tip; no dorsal ridge, movable finger with a more flattened, triangular shaped anterior tooth; 2 intermediate teeth, posterior intermediate tooth separated from primary tooth; a small but discernable fondal noteh (Fig. 12); flagellar complex typical of the group.

Abdomen: two ctenidia extending length of succeeding sternite (Fig. 13). Edges of malleoli darkly tinged.

Palp: many hair-like setae but no spines (Fig. 11).

Dimensions: (n=4): total length 8.0–9.0, cheliceral length 2.22–4.0, cheliceral width 0.95–1.9, propeltidium length 1.22–1.3, propeltidium width 1.76–2.1, palpus length 6.0–8.0, first leg length 4.8–7.0, fourth leg length 8.5–10.5. *Ratios*: A/CP 4.8–6.1, cheliceral width/fixed finger width 3.9–4.4.

Females.—Color: holotype lighter than male description but most other females the same coloration as males.

Chelicera: similar to *H. banksi* but posterior intermediate tooth is imperceptively to visibly separated from primary tooth (Fig. 14).

Genital region: typical, perhaps more flattened on the posterior margin.

Female allotype: total length 12, cheliceral length 3.8, cheliceral width 1.4, propeltidium length 1.6, propeltidium width 2.6, palpus length 6.5, first leg length 5.5, fourth leg length 9.5. *Ratios*: A/CP 4.4, 2.7, 0.62, genital operculum length/genital operculum width 1.6.

Female measurements (n=4): total length 8.0–14.0, cheliceral length 2.5–3.5, cheliceral width 0.92–1.4, propeltidium length 1.31, propeltidium width 1.6–1.91, palpus length 5.2–6.0, first leg length 4.5–5.5, fourth leg length 8.5–12.0. *Ratios*: A/CP 4.7–4.84, genital operculum length/genital operculum width 1.4–1.6.

Remarks.—Muma (1951) provides a description of a male *H. californica*. Based on the locality information he provides for examined specimens, this description was based upon a male collected from Starbucks, Washington. The color pattern of the propeltidium and chelicerae indicate that this male actually represents *H. hanfordana*, new species. Our identification for this group is based on the length and shape of the male ctenidia as well as the shape of the male fixed finger, particularly the tip. The distribution of *H. californica* includes the coastal region from Los Angeles to San Diego across southern California, into parts of Nevada and into northwestern New Mexico. This is in stark contrast to the patchy distribution of other members of this group. However, this wide distribution is not unusual among other solifuges, i.e., *Eremobates nodularis* Muma 1951, *Eremochelis bilobatus*

(Muma 1951), *Hemerotrecha fruitana* Muma 1951 (Brookhart & Brookhart 2006).

Hemerotrecha hanfordana new species
Figs. 15–20, 54

Material examined.—USA: *Washington*: male holotype, Hanford National Monument, Wahluke Wildlife Area, White Bluffs Ferry, Franklin County (46.41°N, 119.47°W) 5–12 July 2002, R.S. Zack (DMNS). Female allotype, 2 male and 2 female paratypes, collected with holotype (DMNS); 3 male, 1 female paratypes (WSU).

Other material: USA: *California:* Siskiyou County: 2 ♂, Macdoel (41.83°N, 122.35°W), 6 July 1968, J. Schuh (AMNH); *Nevada*: Washoe County: 1 ♂, Wadsworth (39.66°N, 119.29°W), 23 July 1965, B. Opler (ESS); *Utah*: Box Elder County: 1 ♂, Lucin (41.35°N, 113.90°W), 19 June 1952, D.E. Beck (BYU); 10 ♂, 5 ♀, Key Springs Rd. (41.601°N, 113.891°W, 2 June–2 July 2007, A. Spriggs & Joey Slowik (DMNS); Tooele County: 1 ♂, Dugway Proving Grounds (dunes) (44.48°N, 123.36°W), no name (BYU); *Washington*: Benton County: 8 ♂, 4 ♀, Hanford Nuclear Site (46.32°N, 119.31°W), Rattlesnake Mountain (46.40°N, 119.61°W), 21 June–13 Aug 2002, R.S. Zack (WSU); 1 ♂, Rattlesnake Spring (46.50°N, 119.71°W), 1–9 July 2002, R.S. Zack (WSU); Grant County: 6 ♂, 4 ♀, Saddle Mountain National Wildlife Refuge (46.68°N, 119.63°W), 14 June–23 July 2002, R.S. Zack (WSU).

Etymology.—The species name is an adjective referring to the type locality.

Diagnosis.—*Hemerotrecha hanfordana* has both darkly colored chelicera and propeltidium; palpus dark on metatarsus; two short, flat, pointed ctenidia separate it from both *Hemerotrecha kabooni*, new species and *Hemerotrecha californica*, which have longer, thinner ctenidia. *Hemerotrecha bauksi* also has darkly colored palpal tarsi.

Description.—*Male*, Color: base coloration a blotchy black, with lighter colored patches on the posterior median propeltidium, mesopeltidium, and metapeltidium. Chelicera and propeltidium both blotchy black (Figs. 15, 16); palpal metatarsus blotchy black (Fig. 18), leg I dusky on tibia and metatarsus, legs II, III, IV dark on the dorsal, ectal regions of coxa, femur, tibia, tarsus, and metatarsus.

Chelicera: fixed finger with small ridge basally on the dorsal edge, and a slightly hooked tip, ventral edge smooth with a short, deep mesal ventral groove apically (arrow, Fig. 16). Two specimens had very tiny denticles. Movable finger with large primary tooth, two intermediate teeth, and anterior tooth, posterior intermediate tooth is separate from primary tooth and fondal notch obscure to absent; fondal teeth graded I, III, II, IV (Figs. 16, 17).

Abdomen: two flat, pointed ctenidia extending across half of the succeeding abdominal segment (Fig. 19).

Palp: palpi with 2–4 thick spine-like setae ventrally (Fig. 18).

Dimensions: *Male holotype:* total length 11.5, cheliceral length 2.5, cheliceral width 1.1, propeltidium length 1.3, propeltidium width 2.0, palpus length 7.0, first leg length 6.0, fourth leg length 12.5. *Ratios*: A/CP 6.65, cheliceral width/fixed finger width 4.13.

Male paratypes (5): total length 11.5–13.0, cheliceral length 2.33–2.67, cheliceral width 1.05–1.1, propeltidium length 1.33–1.55, propeltidium width 1.77–2.0, palpus length 6.0–8.0, first leg length 5.0–6.5, fourth leg length 10.0–12.5. *Ratios*: A/CP 5.59–6.65, cheliceral width/fixed finger width 3.20–4.13.

Females: coloration as in males.

Chelicera: fixed finger with primary tooth, medial tooth, anterior tooth, with two intermediate teeth between each. Movable finger with primary tooth, anterior tooth, and two intermediate teeth. Posterior intermediate tooth in notch of primary tooth (Fig. 20).

Genital region: typical configuration for the group.

Dimensions: *Female allotype:* total length 11.0, cheliceral length 2.67, cheliceral width 0.85, propeltidium length 1.4, propeltidium width 1.85, palpus length 6.0, first leg length 5.0, fourth leg length 8.0. *Ratios*: A/CP 4.67, genital operculum length/genital operculum width 2.40. *Female paratypes (3)*: total length 11.0–13.0, cheliceral length 2.7–3.6, cheliceral width 0.85–1.46, propeltidium length 1.4–1.87, propeltidium width 1.85–2.6, palpus length 6.0–8.0, first leg length 5.0–7.0, fourth leg length 8.0–14.0. *Ratios*: A/CP 2.3–4.7, genital operculum length/genital operculum width 1.7–2.4.

Remarks.—The male of *H. californica* described by Muma (1951) was probably a member of this species. *Hemerotrecha hanfordana* is found in xeric regions of the Basin and Range system and extends into both northeastern California and northwestern Utah. This roughly corresponds with the distribution of *Eremochelis bidipressus* Muma 1951 and another *Hemerotrecha*, *H. denticulata* Muma 1951 (Brookhart & Brookhart 2006).

Hemerotrecha kaboomi new species
Figs. 21–26, 54

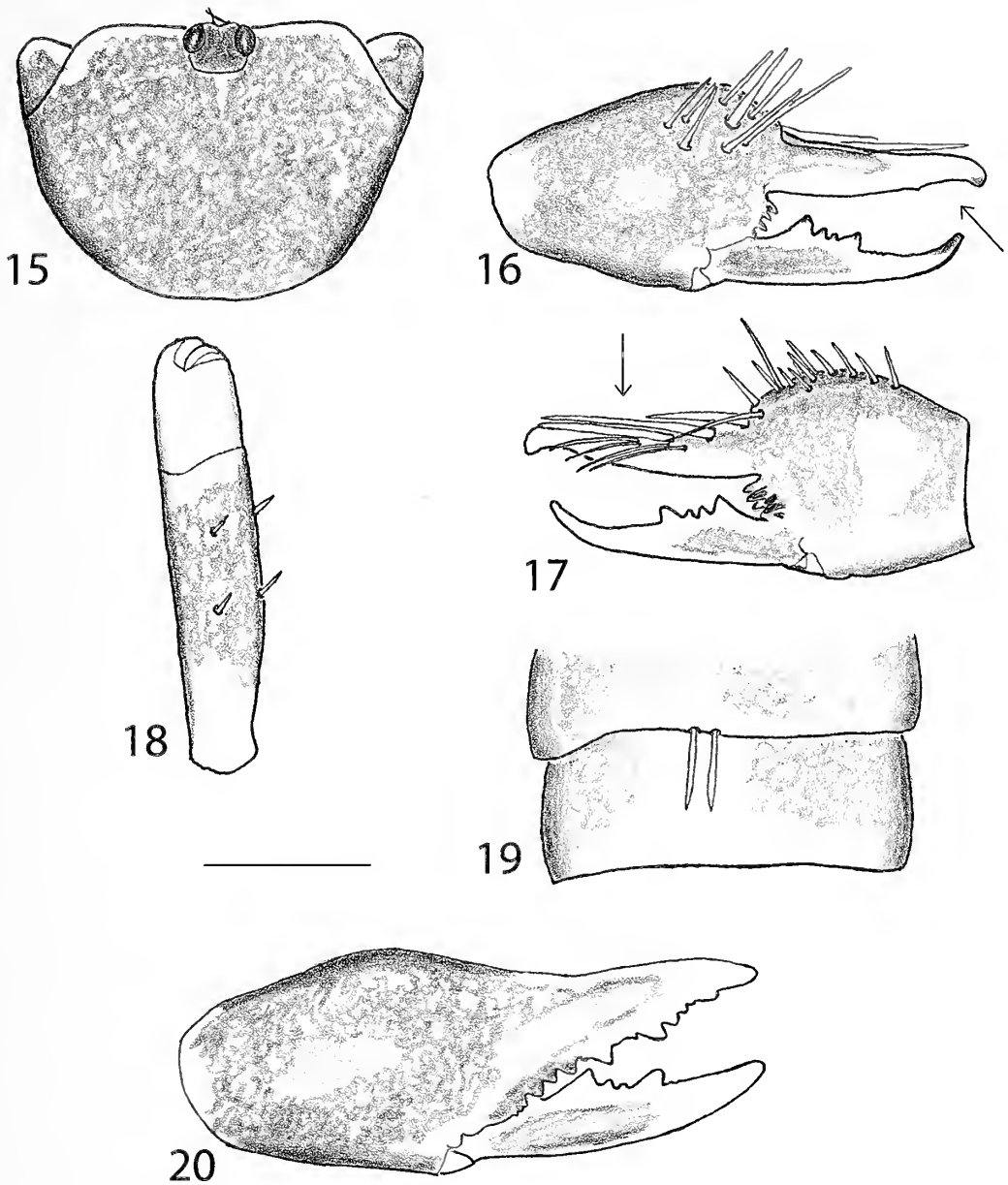
Material examined.—*Types:* USA: *Nevada*: Nye County: male holotype, Mercury, 25 July 1960, Atomic Energy Commission and Brigham Young University (AMNH). Female allotype, same data as holotype except 22 June 1960 (AMNH). Paratypes: 6 males, 6 females, same data as holotype except 6 June–20 July 1960 (AMNH).

Other material examined: USA: *Nevada*: Clark County: 1 ♀, Mercury, Nevada Test Site (36.94°N, 116.32°W), 6 June 1960, Atomic Energy Commission and Brigham Young University (AMNH); 1 ♀, same data except 11 June 1960 (AMNH); 1 ♂, same data except 20 June 1960 (AMNH); 1 ♀, same data except 30 June 1960 (AMNH); 1 ♀, 22 June 1960 (AMNH); 1 ♂, same data except 2 July 1960 (AMNH); 1 ♂, same data except 8 July 1960 (AMNH); 1 ♂, same data except 11 July 1960 (AMNH); 1 ♂, same data except 13 July 1960 (AMNH); ♂, same data except 25 July 1960 (AMNH).

Etymology.—The specific name refers to the explosion of the first nuclear device at the Nevada Test Site. It is to be treated as a noun in apposition.

Diagnosis.—This species is most similar to *H. hanfordana* and *H. bauksi*. It differs from *H. hanfordana* in the coloration of the chelicera with *H. hanfordana* dusky dark while *H. kabooni* is dusky orange and from *H. bauksi* in the shape of the cheliceral fixed finger. *Hemerotrecha kaboomi* has a ventral curvature and a small hook apically while *H. bauksi* has a rounded tip. The ctenidia are longer than either of the above species.

Description.—*Male:* chelicera dusky orange, dusky to dark mottled propeltidium (Fig. 21), and slightly lighter colored



Figures 15–20.—*Hemerotrecha hanfordana*, new species. 15–19. Male holotype: 15. Dorsal view, propeltidium; 16. Ectal view, right chelicera showing anterior concavity (arrow); 17. Mesal view, right chelicera showing flagellum complex (arrow); 18. Mesal ventral view, right palpus; 19. Ventral view, ctenidia. 20. Female holotype, ectal view, right chelicera. Scale bar = 1 mm.

abdomen, leg I dusky on metatarsus only; legs II, III, IV dusky ventrally.

Chelicera: fixed finger with a slight hook; the ventral apical concavity of the fixed finger shallow and extended, anterior tooth of movable finger triangular; posterior intermediate tooth separate from primary tooth; fondal notch obscure or absent (Fig. 22).

Abdomen: ctenidia extending entire length of succeeding sternite (Fig. 24).

Palp: with 2–3 spine-like setae ectal ventrally (Fig. 23).

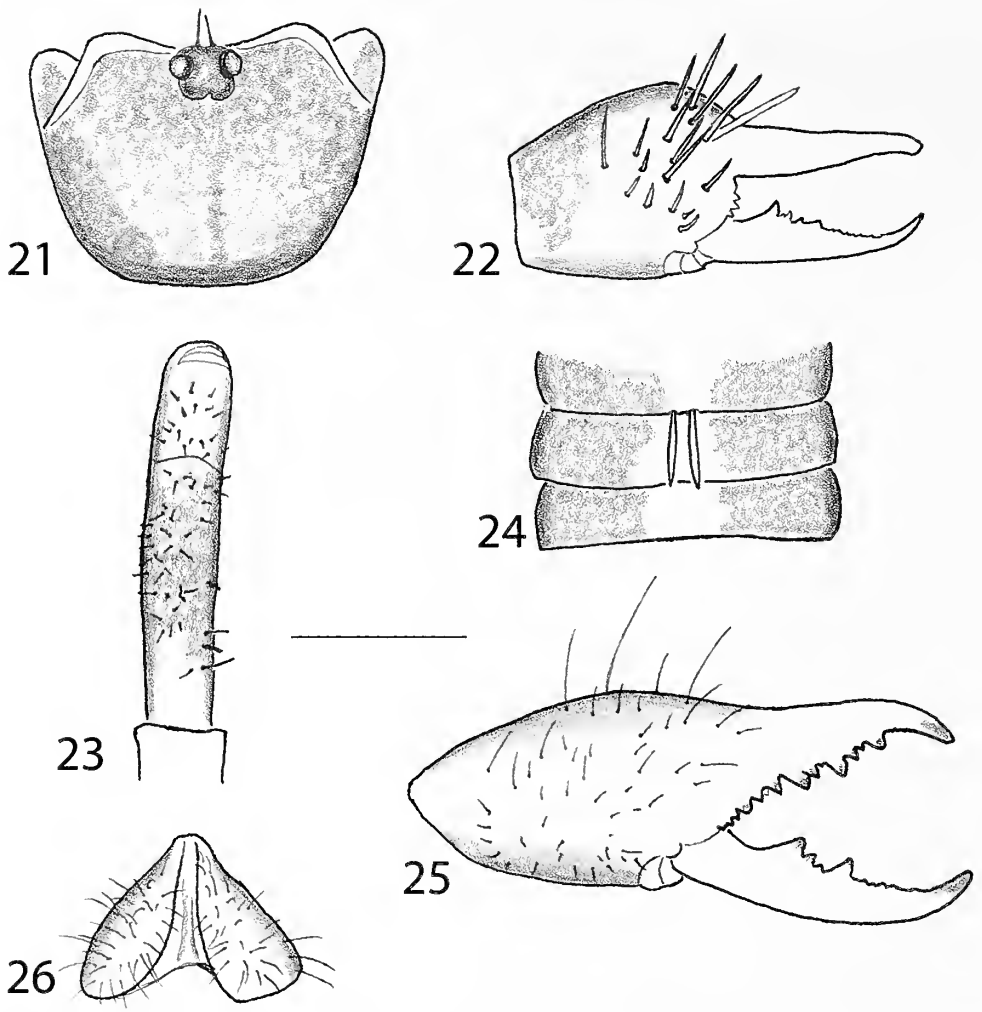
Male holotype: total length 10.5, cheliceral length 2.65, cheliceral width 1.12, propeltidium length 1.52, propeltidium width 1.9, palpus length 7.0, first leg length 6.0, fourth leg length 12.5. *Ratios*: A/CP 6.12, chelicera width/fixed finger width 4.48. *Male paratypes (6)*: total length 8.5–10.0, eheliceral length 2.16–2.40, cheliceral width 0.87–1.0, propeltidium length 1.07–1.33, propeltidium width 2.02–2.40, palpus length 4.0–6.5, first leg length 5.0–6.0, fourth leg length 8.5–9.5. *Ratios*: A/CP 5.18–5.97, cheliceral width/fixed finger width 3.25–3.75.

Females: coloration as in males.

Chelicera: typical for the females of this group (Figs. 7, 13, 24).

Genital region: typical of the group but with narrower arms and a more rounded posterior margin (Fig. 26).

Dimensions: Female allotype: total length 9.5, cheliceral length 3.0, cheliceral width 1.67, propeltidium length 1.18, propeltidium width 1.95, palpus length 5.0, first leg length 5.5, fourth leg length 6.5. *Ratios*: A/CP 4.07, genital operculum length/genital operculum width 1.67.



Figures 21–26.—*Hemerotrecha kaboomi*, new species. 21–24. Male holotype: 21. Dorsal view, propeltidium; 22. Ectal view, chelicera; 23. Mesal ventral view, palpus; 24. Ventral view, ctenidia. 25–26. Female allotype: 25. Ectal view, right chelicera; 26. Ventral view, genital operculum. Scale bar = 1 mm.

Female paratypes (6): total length 9.5–11.5, cheliceral length 2.7–3.2, cheliceral width 0.9–1.67, propeltidium length 1.18–1.45, propeltidium width 1.75–2.25, palpus length 5.0–5.5, first leg length 5.0–6.0, fourth leg length 6.5–7.5. *Ratios*: A/CP 4.0–4.4, genital operculum length/genital operculum width 1.4–2.0.

Remarks.—Females of *H. kaboomi* were collected early in June, males in July, all in dry pitfalls as part of the survey of the Nevada Test Site. Allred et al. (1963) considered this area as the boundary between the Mohave Desert and the Great Basin geographic provinces.

Hemerotrecha marginata (Kraepelin 1911)
Figs. 27–30, 54

Eremobates marginatus Kraepelin 1911:103–105, figs. 4a–b.
Eremognatha marginata (Kraepelin): Roewer 1934:569, figs. 116c, 128, 324p, 327c.
Hemerotrecha marginata (Kraepelin) Muma 1951:102, figs. 198–201; Muma 1970:38, figs. 32–35.

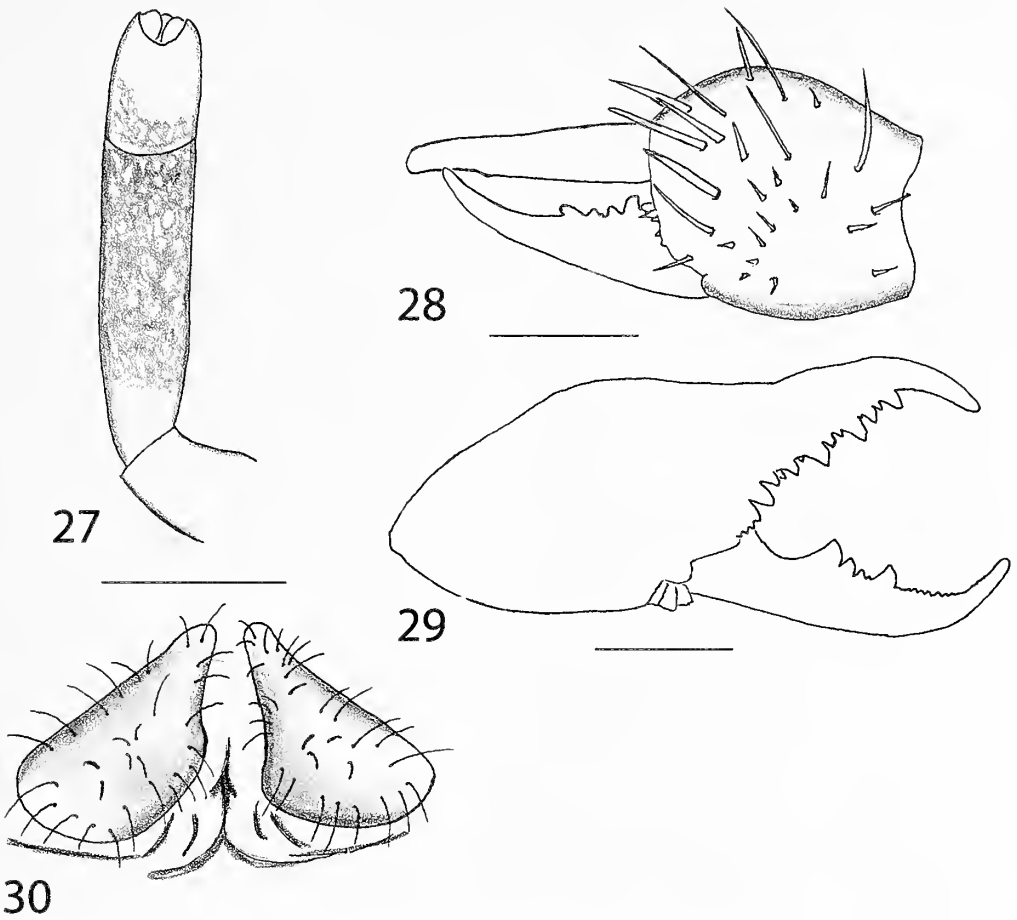
Material examined.—*Types:* USA: *California*: Los Angeles County: male holotype, San Pedro (33.74°N, 118.29°W), 5 June 1867 (ZSM, Roewer type #8376). Female allotype: same data as holotype (ZSM). Paratypes: 1 male, 1 female, same data as holotype (ZSM).

Other material.—USA: *California:* Inyo County: 1 ♂, Paxton Sand Dunes, 13 April–29 September 1982, E. Giuliani (ESS); Riverside County: 1 ♀, Banning (33.96°N, 116.89°W), April 1995, J.W. McSwain (ESS); San Bernardino County: 1 ♂, Granite Cove (34.78°N, 115.66°W), Interstate 40 & Kalbake Road, E. Fessler (UCR).

Diagnosis.—*Hemerotrecha marginata* is separated from *H. californica*, which it most closely resembles, by the coloration of chelicera, propeltidium, and eye tubercle, which are pale yellow. Palpus with metatarsus and distal 20% of tarsus dusky; ctenidia extend half way across succeeding sternite.

Description.—*Male:* Color: chelicera, propeltidium including eye tubercle, pale yellow. Palpus pale yellow with metatarsus and distal 60% of tarsus dusky (Fig. 27); legs mostly pale, slightly dusky on ventral side of femur of legs III, IV, abdomen mottled, ctenidia extend halfway across succeeding sternite.

Chelicera: typical for the group with only a slight apical hook. Fixed finger regularly curved without teeth, shallow cup like mesal ventral groove apically, movable finger with normal



Figures 27–30.—*Hemerotrecha marginata* (Kraepelin). 27–28. Male holotype: 27. Mesal ventral view, right palpus; 28. Ectal view, left chelicera. 29–30. Female allotype: 29. Ectal view, right chelicera; 30. Ventral view, genital operculum. Scale bars = 1 mm.

primary tooth, flat pointed anterior tooth, 1–2 intermediate teeth separated from primary tooth. Base of fixed finger as wide as the base of movable finger. Fond indistinct, fondal teeth graded I, III, II, IV ectally and mesally (Fig. 28).

Abdomen: two thin ctenidia extending halfway across succeeding sternite.

Palp: without spine-like setae (Fig. 27).

Dimensions: *Male holotype:* total length 10.0, cheliceral length 2.34, cheliceral width 1.21, propeltidium length 1.3, propeltidium width 1.7, palpus length 5.57, first leg length 5.5, fourth leg length 8.5. *Ratios*: A/CP 5.38, cheliceral width/fixed finger width 3.46.

Males (4): total length 8.0–11.0, cheliceral length 2.1–2.45, cheliceral width 1.05–1.3, propeltidium length 0.8–1.5, propeltidium width 1.3–1.8, palpus length 4.0–6.2, first leg length 4.5–6.1, fourth leg length 6.5–9.3. *Ratios*: A/CP 5.20–5.45, genital operculum length/genital operculum width 3.0–3.5.

Females: Coloration: same as in males.

Chelicera: typical for females of the group (Fig. 29).

Genital region: club shaped (Fig. 30).

Dimensions: *Female allotype:* total length 9.0, cheliceral length 2.3, cheliceral width 0.9, propeltidium length 1.2, propeltidium width 1.85, palpus length 5.0, first leg length 4.5, fourth leg length 7.0. *Ratios*: A/CP 4.70, genital operculum length/genital operculum width 1.70.

Females (2): length 8.5–9.0, cheliceral length 2.2–2.7, cheliceral width 0.86–1.0, propeltidium length 1.05–1.46. propeltidium width 1.73–1.9, palpus length 4.0–5.4, first leg length 3.7–4.5, fourth leg length 5.8–7.4. *Ratios:* A/CP 3.6–4.7, genital operculum length/genital operculum width 1.67–1.70.

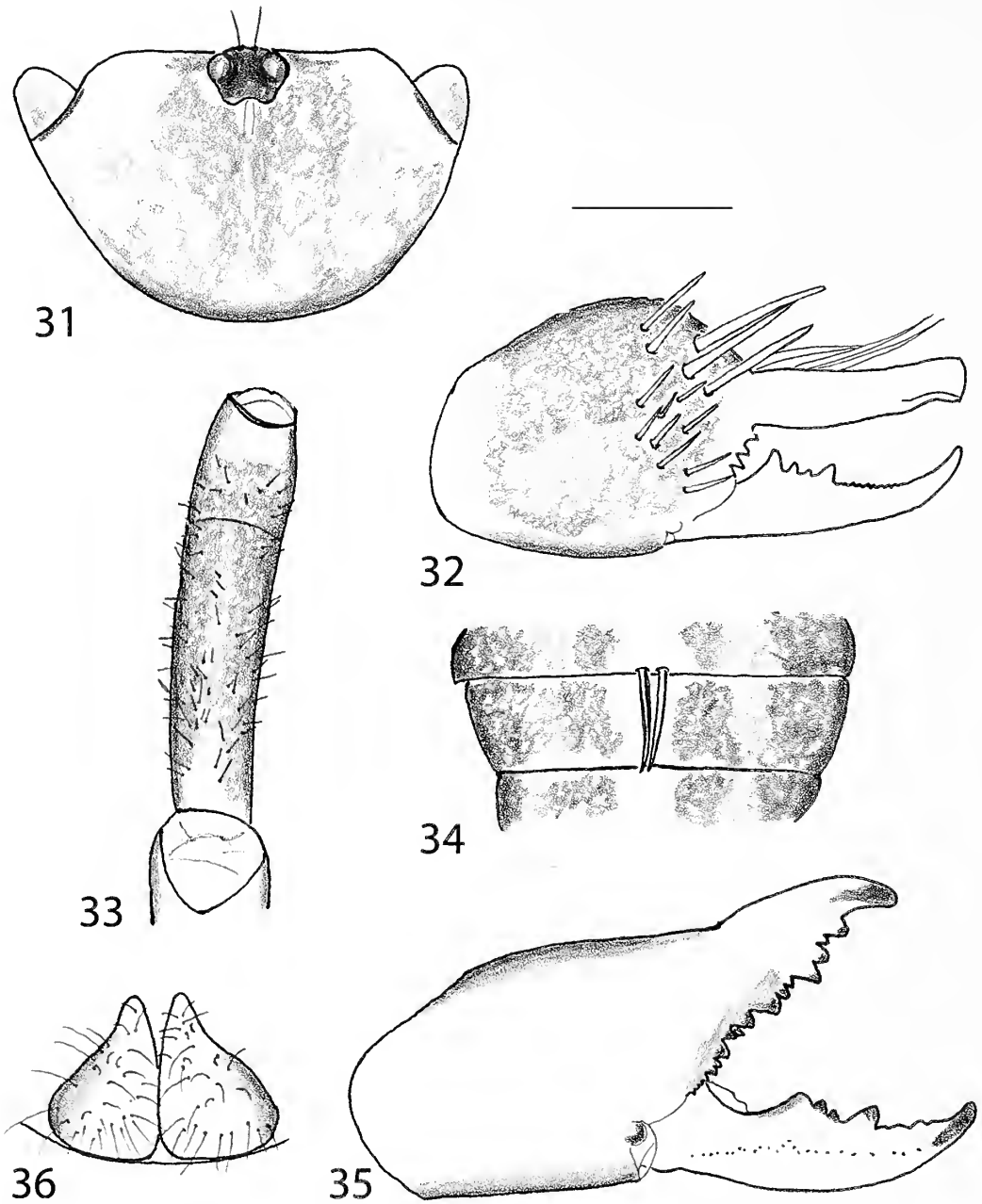
Remarks.—The illustration of the ctenidia provided by Muma (1951) was based on the drawing published by Kraepelin (1911). Muma (1970) re-drew the ctenidia based upon examination of the type specimen. In both the 1951 and the 1970 drawings, Muma illustrates three ctenidia found on the type specimen. However, in the 1970 publication, Muma assumed that it possessed four ctenidia, and that one had simply broken off. The males that we examined consistently had but two ctenidia as do all others of this group.

Hemerotrecha truncata Muma 1951
Figs. 31–36, 54

Hemerotrecha truncata Muma 1951:102, fig. 197; Muma 1970:41.

Material examined.—*Type:* USA: *California*: Tulare County: male holotype, Exeter (36.3°N, 119.14°W), 16 May 1909, C. L. Fox (AMNH).

Other material: USA: *California*: Inyo County: 1 ♂, Whippoorwill Canyon (37.00°N, 117.94°W), May 1983–June 1984, D.Giuliani (CA); Stanislaus County: 2 ♂, 1 ♀, Lagrange



Figures 31–36.—*Hemerotrecha truncata* Muma. 31–34. Male holotype: 31. Dorsal view, propeltidium; 32. Ectal view, right chelicera; 33. Mesal ventral view, right palpus; 34. Ventral view, ctenidia. 35–36. Female: 35. Ectal view, right chelicera; 36. Ventral view, genital operculum. Scale bar = 1 mm.

(37.67°N, 120.46°W), 27 May 1976, J. Collins (CAS); 2 ♂, 1 ♀, Turlock (37.5°N, 120.85°W), 2 June 1976, J. Collins (CAS); Tulare County: 1 ♂, 1 ♀, Kaweah (36.47°N, 118.92°W), 13 May 1963, J. Boswell (ESS).

Diagnosis.—This species is easily distinguished by the parrot-beak shaped hook on the tip of male fixed finger. Specimens are darkly colored.

Description.—*Males:* Color: chelicera dusky to dark yellow, propeltidium and abdomen chocolate brown (Fig. 31), palpal tarsus, metatarsus, tip of tibia darkly colored (Fig. 32); all legs dark to dusky brown; eye tubercle dark.

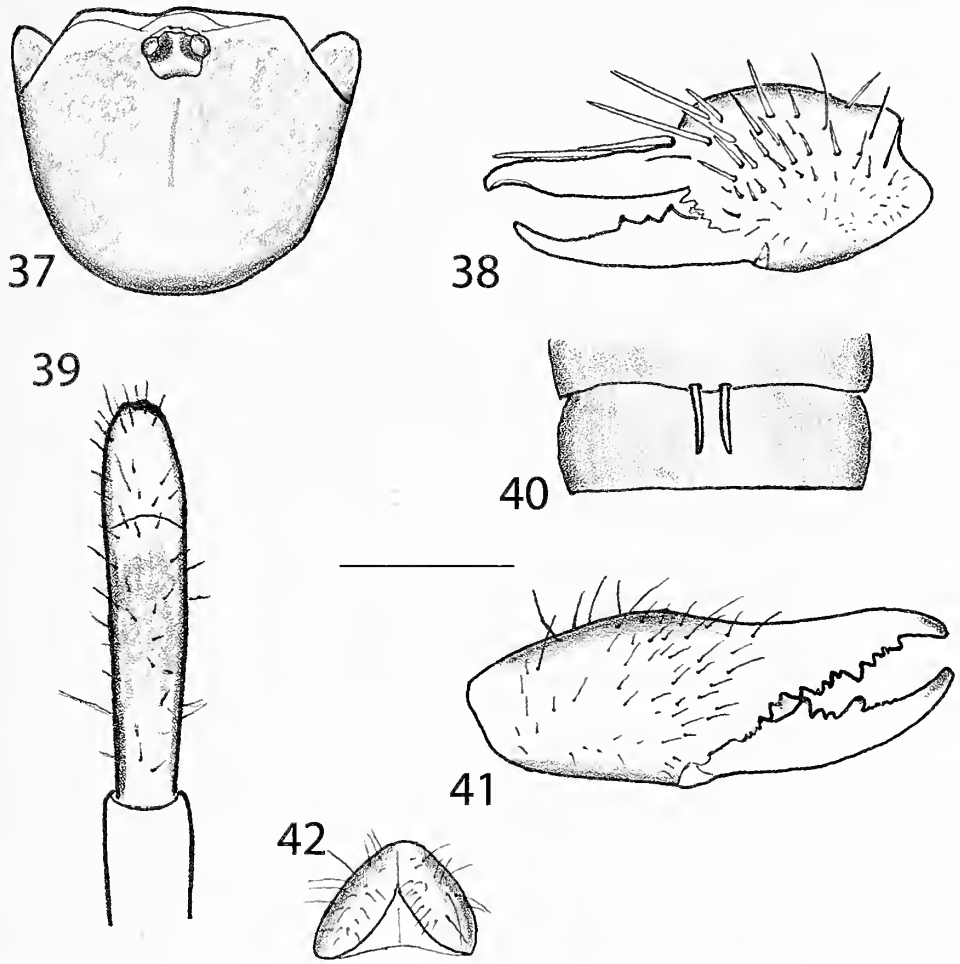
Chelicera: fixed finger sharply hooked (parrot beak) with deep cup-like mesal ventral groove apically, no dorsal trough/ridge. Dentition typical of the group with posterior intermediate tooth of movable finger separate from primary tooth (Fig. 32).

Abdomen: two long, thin ctenidia extending the length of the succeeding sternite (Fig 34).

Palp: as in Fig. 33.

Dimensions: *Male holotype:* total length 11.0, cheliceral length 3.1, cheliceral width 1.4, propeltidium length 2.01, propeltidium width 2.8, palpus length 9.0, first leg length 7.0, fourth leg length 13.5. *Ratios*: A/CP 5.77, cheliceral width/fixed finger 4.24.

Male paratypes (7): total length 7.5–11.0, cheliceral length 2.0–2.5, cheliceral width 0.8–1.5, propeltidium length 0.9–2.0,



Figures 37–42.—*Hemerotrecha pseudotruncata*, new species. 37–40. Male holotype: 37. Dorsal view, propeltidium; 38. Ectal view, left chelicera; 39. Dorsal view, right palpus; 40. Ventral view, ctenidia. 41–42. Female allotype: 41. Ectal view, right chelicera; 42. Dorsal view, genital operculum. Scale bar = 1 mm.

propeltidium width 1.5–2.8, palpus length 6.5–9.0, first leg length 4.5–7.0, fourth leg length 6.5–9.0. *Ratios*: A/CP 5.7–6.8, cheliceral width/fixed finger width 2.8–4.2.

Female: coloration as in the male.

Chelicera: typical of the group except posterior intermediate tooth of the movable finger is on the notch of the primary tooth (Fig. 35);

Palp: three pair of spine-like setae on ventral margin of metatarsus.

Genital region: typical of the group (Fig. 36).

Female measurements (2): total length 12.0–13.0, cheliceral length 3.3–3.6, chelieeral width 1.35–1.46, propeltidium length 1.44–1.86, propeltidium width 2.5–2.6, palpus length 7.0–8.0, first leg length 6.5–7.0, fourth leg length 12.5–14.5. *Ratios*: A/CP 5.0–5.7, genital operculum length/genital operculum width 1.7–1.8.

Remarks.—This very distinctive member of the *H. banksi* group inhabits the Mohave Desert Region of eastern California.

Hemerotrecha pseudotruncata new species
Figs. 37–42, 54

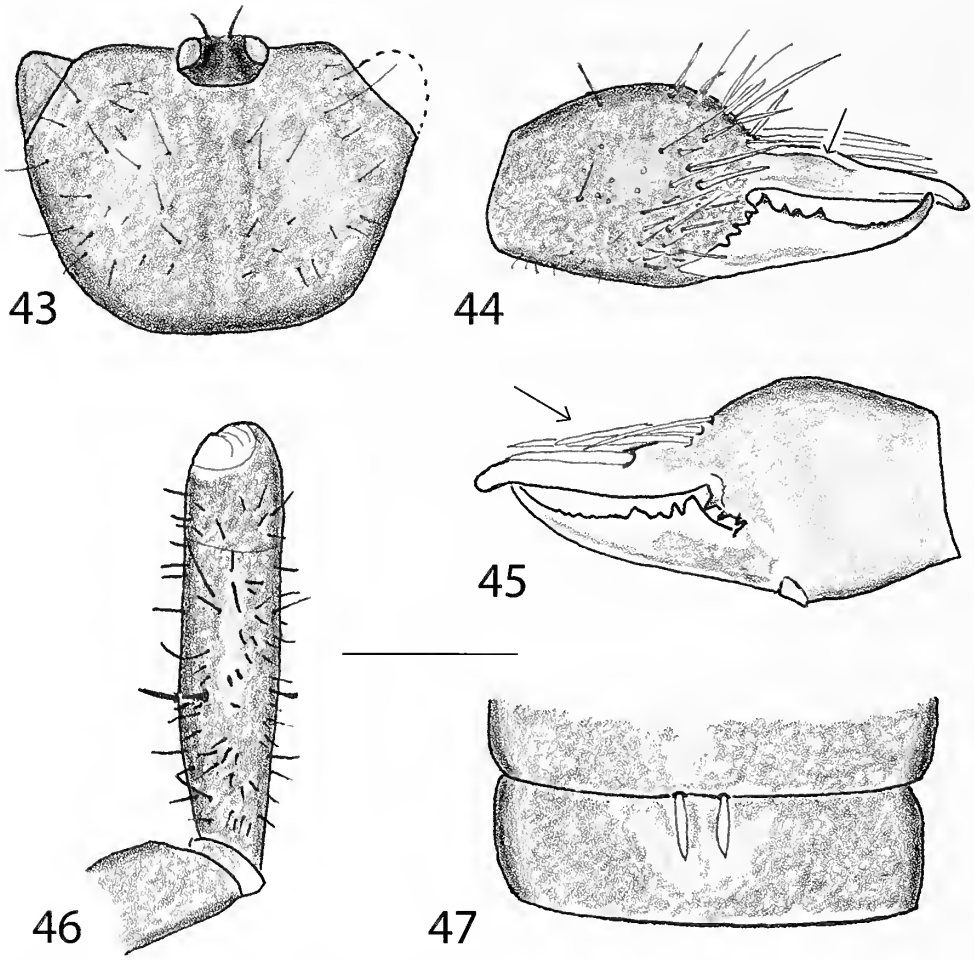
Material examined.—USA: *Nevada*: Nye County: male holotype Monitor Summit (38.8°N, 115.5°W), 27.3 km E. of Tonapah, October 1982–September 1983, D. Giuliani (ESS); female allotype: Currant Summit, 16.1 km E. of Currant, October 1982–September 1983, D. Giuliani (ESS).

Other material: USA: *California:* Inyo County: China Lake 3 ♂, 1 ♀, Death Valley Deep Springs (37.37°N, 117.98°W), May 1983–June 1984, D. Giuliani (CAS); 1 ♂, Fish Lake Valley, Waucoba Spring (36.7°N, 116.84°W), May–October 1983, D. Giuliani (CAS); 3 ♂, 1 ♀, Saline Range (coordinates not possible), March 1979–May 1983, D. Giuliani (CAS); *Nevada*: Esmeralda County 1 ♂, 8 km SW Lida (37.321°N, 117.8°W); Nye County: 1 ♂, 1 ♀, Grapevine Mountains, Phinney Canyon (36.99°N, 117.03°W), March–September 1983, D. Giuliani (CAS); 1 ♂, Monitor Summit (38.05°N, 117.22°W), October 1982–September 1983, D. Giuliani (CAS); 1 ♂, 1 ♀, Currant Summit (38.74°N, 115.47°W), March–September 1983, D. Giuliani (CAS).

Etymology.—The species name refers to the modified hook at the tip of male fixed finger, which is similar to *H. truncata* but not as radically modified.

Diagnosis.—This species differs from *H. truncata* by having less radical hook-like tip on the male fixed finger, slightly broader and shorter ctenidia, and slightly lighter coloration.

Description.—*Male:* chelicera dusky orange, propeltidium dusky (Fig. 37), palpi usually dark to dusky on apical 80% of



Figures 43–47.—*Hemerotrecha vetteri*, new species, male holotype: 43. Dorsal view, propeltidium; 44. Ectal view, right chelicera (arrow denotes dorsal ridge); 45. Mesal view, right chelicera (arrow denotes flagella complex); 46. Mesal ventral view, right palpus; 47. Ventral view, ctenidia. Scale bar = 1 mm.

metatarsus (Fig. 39), eye tubercle dark, legs dark to dusky ventrally.

Chelicera: with sharp hook apically but not nearly as prominent as in *H. truncata*, a short, deep concave cup-like mesal ventral groove apically, anterior ventral edge concave, movable finger with large primary tooth, smaller anterior tooth, single intermediate tooth separated from primary tooth, crenulations on the anterior dorsal edge; obscure to small fondal notch (Fig. 38).

Abdomen: two pointed ctenidia extending about one half the length of succeeding sternite (Fig. 40).

Palp: 2–3 spine-like setae on ventral metatarsus (Fig. 39).

Male holotype: total length 8.5, cheliceral length 2.1, cheliceral width 1.0, propeltidium length 1.1, propeltidium width 1.4, palpus length 8.6, first leg length 5.5, fourth leg length 7.0. *Ratios*: A/CP 6.6, cheliceral width/fixed finger width 3.78.

Male paratypes (n=8): total length 8.0–10.0, cheliceral length 1.9–2.7, cheliceral width 0.76–1.0, propeltidium length 1.0–1.36, propeltidium width 1.3–1.8, palpus length 8.0–10.5, first leg length 5.0–6.5, fourth leg length 6.0–7.0. *Ratios*: A/CP 6.4–6.5, cheliceral width/fixed finger width 3.33–4.1.

Female: coloration as in males.

Chelicera: typical for females of this group (Fig. 41).

Genital region: smaller and more oval than other members of this group (Fig. 42).

Dimensions: Female allotype: total length 8.0, cheliceral length 2.6, cheliceral width 0.9, propeltidium length 1.33, propeltidium width 1.76, palpus length 5.0, first leg length 5.0, fourth leg length 6.5. *Ratios*: A/CP 3.1, genital operculum length/genital operculum width 0.8.

Female (n=4)*:* total length 8.0–8.5, cheliceral length 2.8–3.0, cheliceral width 1.0, propeltidium length 1.4–1.55, propeltidium width 1.65–1.8, palpus length 5.5–5.8, first leg length 5.5–6.0, fourth leg length 6.5–7.0. A/CP 3.8–4.0, genital operculum length/genital operculum width 0.8–0.9.

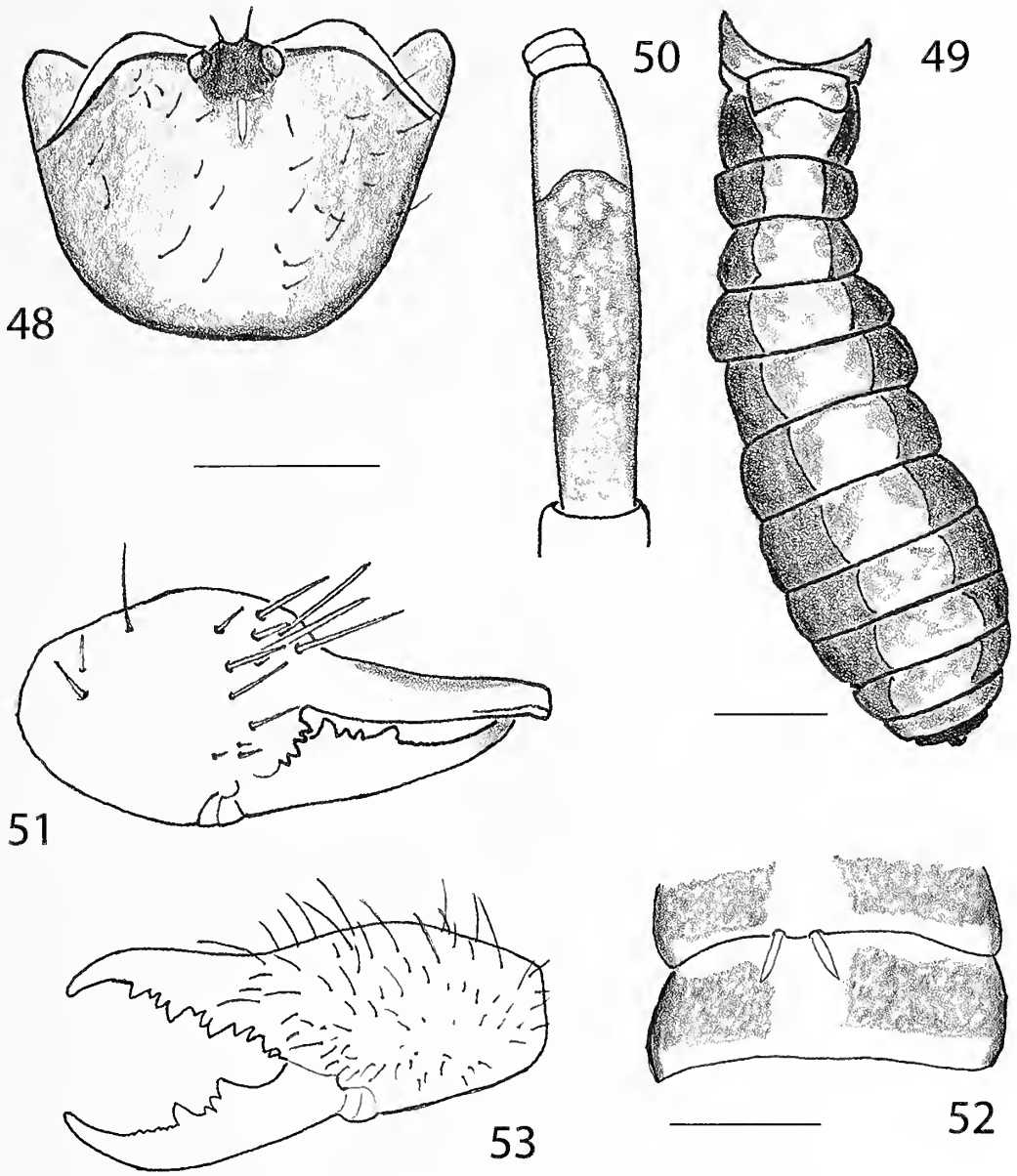
Remarks.—*Hemerotrecha pseudotruncata* seems closely related to *H. truncata.*

Hemerotrecha vetteri new species

Figs. 43–47, 54

Material examined.—*Type:* USA: *California*: Santa Barbara County: male holotype, Vandenburg Air Force Base (34.76°N, 120.46°W), 30 April 2004, Abela, Pierce, Pratt (DMNS).

Etymology.—This species is named for the inveterate invertebrate collector and arachnologist, Rick Vetter, who sent this and many other specimens for examination.



Figures 48–53.—*Hemerotrecha prenticei*, new species. 48–51. Male holotype: 48. Dorsal view, propeltidium; 49. Dorsal view, abdomen; 50. Dorsal view, right palpus; 51. Ectal view, right chelicera. 52. Ventral view, male ctenidia. 53. Ectal view, female chelicera. Scale bars = 1 mm.

Diagnosis.—This totally dark species is most similar to *H. banksi* except for its completely dark coloration. The presence of the dorsal, trough-like structure on the cheliceral fixed finger is unique to the group. Females unknown.

Description.—*Male:* Color: total body dark with no light patches (Fig. 43). Appendages dark over entire length.

Chelicera: similar to *H. banksi* with a short, small ventral concavity anteriorly. A highly visible ridge on the distal, ventral margin of fixed finger. Fondal notch absent or obscure, posterior intermediate tooth of movable finger separate from primary tooth (Figs. 44, 45).

Abdomen: ctenidia short, pointed, and extending about halfway across succeeding abdominal segment (Fig. 47).

Palp: several spine-like setae on mesal ventral side (Fig. 46).

Male holotype: total length 11.0, cheliceral length 2.7, cheliceral width 1.2, propeltidium length 1.4, propeltidium width 2.1, palpus length 7.0, first leg length 4.5, fourth leg length 10.0. *Ratios*: A/CP 6.14, cheliceral width/fixed finger width 3.2.

Remarks.—No females are known at present.

Hemerotrecha prenticei new species
Figs. 48–52, 54

Material examined.—USA: *California*: male holotype from Southwest Riverside County Multispecies Reserve (Lake Skinner), Riverside County (33.38°N, 117.00°W), 9–12 May 2000, Tom Prentice (DMNS). Female allotype: collected from same site, 15–18 May 2000 (DMNS). Paratypes: 4 males, 2 females, collected from same site, various dates (DMNS); 4 males, 1 female, collected from same site, various dates (UCR).

Other material: USA: *California:* Kern County, 1♂, 1♀, Dove Springs (35.42°N, 118.00°W) June 2003, collected by the United States Geological Survey, San Diego Office; 4 ♂, same

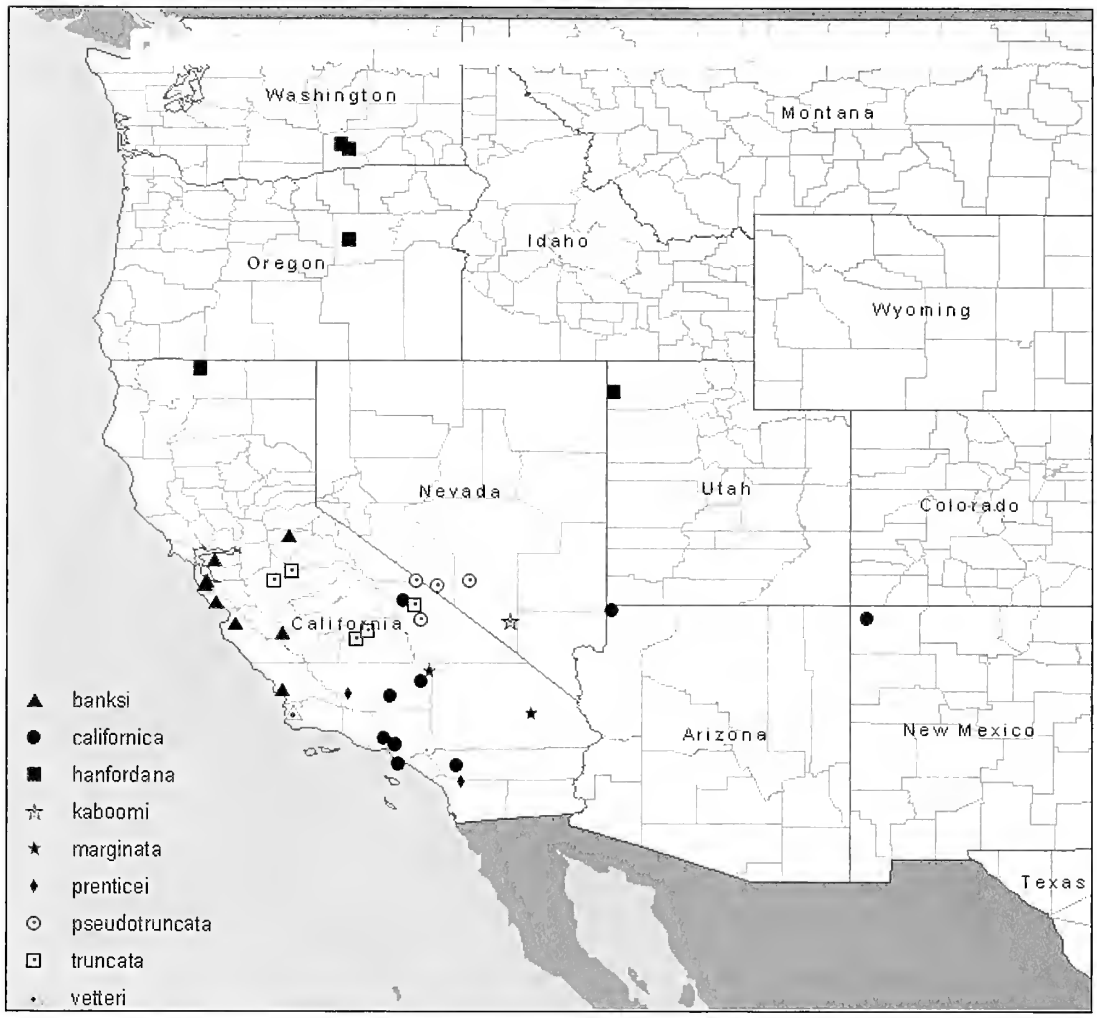


Figure 54.—Distribution map of *Hemerotrecha banksi* species group in the Western USA.

data except May 2004 (DMNS); 10 ♂, 4 ♀, Elk Hills (35.16°N, 119.31°W), T. Prentice (DMNS, UCR); 2 ♂, 3 ♀, El Paso Mountains (35.26°N, 117.49°W) August 1965, D. Gibo (UCN); 1 ♂, El Paso Mountains (35.26°N, 117.49°W) 24 June 1970, Wendel Icenogle (UCN).

Etymology.—Named for the collector, Tom Prentice, University of California, Riverside.

Diagnosis.—This species differs from the closely related *H. pseudotruncata* in its darker overall coloration and the broader, shorter ctenidia.

Description.—*Male:* Color: base coloration a creamy, dark orange, propeltidium with lateral dusky areas, eye tubercle dark, abdomen darker dorsally and ventrally with a median white stripe dorsally extending from propeltidium to sixth abdominal segment (Figs. 48, 49), palpal metatarsus dark over the entire length (Fig. 50), all legs dusky to dark on tarsus, metatarsus, tibia, and femur, coxa lighter. Leg I lighter ventrally. Malleoli edges dark.

Chelicera: fixed finger with rounded tip and typical cup like mesal ventral groove apically. No recurved area apically. Movable finger with primary tooth, two intermediate teeth, and an anterior tooth, Posterior intermediate tooth separate from the primary tooth. Fondal teeth graded I, III, II, IV ectally and I, III, II mesally. No apparent fondal notch (Fig. 51). Flagella typical of the group.

Abdomen: 2 short, broad, pointed ctenidia (Fig. 52). These are the shortest of any in this species group.

Palp: entire palp covered with setae but no spine-like setae present (Fig. 50).

Dimensions: *Male holotype*: total length 10.5, cheliceral length 2.2, cheliceral width 0.82, propeltidium length 1.35, propeltidium width 1.84, palpus length 6, first leg length 4.5, fourth leg length 8. Ratios: A/CP 5.25, cheliceral width/fixed finger width 3.0.

Male paratypes (n=5): total length 9.0–11.0, cheliceral length 2.0–2.4, cheliceral width 0.8–1.0, propeltidium length 1.2–1.4, propeltidium width 1.6–1.9, palpus length 9.0–11.0, first leg length 4.5–5.5, fourth leg length 7.0–9.5. Ratios: A/CP 5.0–5.9, cheliceral width/fixed finger width 3.0–4.3.

Female allotype: color, same as the male.

Chelicera: fixed finger typical of the group but on the movable finger the posterior intermediate tooth is closely oppressed to the posterior tooth which differs from other females of this group (Fig. 53).

Palp: same as the male with 1–2 spine-like setae ventrally.

Genital operculum: typical for the group.

Dimensions: *Female allotype*: total length 10.5, cheliceral length 2.25, cheliceral width 1.05, propeltidium length 1.2, propeltidium width 1.75, palpal length 7.0, first leg length 5.0, fourth leg length 7.5. *Ratios:* A/CP 5.27, genital length/genital width 2.0.

Female paratypes (n=5)*:* total length 10.5–11.5, cheliceral length 2.3–3.1, cheliceral width 0.9–1.0, propeltidium length 1.2–1.3, propeltidium width 1.7–2.2, palpus length 5.0–7.0, first leg length 4.0–5.0, fourth leg length 6.5–7.0. Ratios: A/CP 4.3–5.7, genital operculum length/ genital operculum width 2.3–3.1.

DISCUSSION

Adult members of the *Hemerotrecha banksi* group have been collected as early as the first week in May and as late as the middle of October. A total of 82 males and 27 females were examined in this study, indicating a greater vagility among the males. Several vials contained information suggesting that the collected specimens were active during the daytime. We suggest that all of the species of this group are diurnal. For such diurnal species, color ornamentation, particularly of the palps, could be important during courtship and mating. Although mating patterns of solifuges remain largely unknown (Punzo 1998), the few descriptions available (Muma 1966; Wharton 1981; Punzo 1998) involve the presentation of palps by both sexes.

Most North American Solifugae have white to pale malleoli. The presence of the dark edged malleoli in the *H. banski* group was not noted by Muma (1951, 1970) although he did identify them in other species (Muma 1951, 1962); i.e., *Eremochelis rothi* (Muma 1962), *Eremochelis larreae* (Muma 1962), *Hemerotrecha bidepressus* (Muma 1951), and (*Eremochelis arcellus* Muma 1962). Examination of the types of these species showed at most a very tiny edge of black. He also did not describe the cup-like cavity on the tip of the male fixed finger as a mesal ventral groove, which is surprising since he did so in the *Eremochelis branchi* group (Muma 1970). *Eremochelis striodorsalis* (Muma 1962) has an obvious ridge which Muma (1962) called a mesal dorsal groove. Examination of the type of *E. striodorsalis* reveals a faint mesal ventral groove. The dorsal ventral ridge of *E. striodorsalis* and *H. vetteri* are very similar.

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Trochosa sepulchralis, a senior synonym of *Trochosa acompa*, and the restoration of *Trochosa abdita* (Araneae, Lycosidae)

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Abstract. *Trochosa sepulchralis* (Montgomery 1902) is recognized as the senior synonym of *Trochosa acompa* (Chamberlin 1924) based upon careful examination of critical morphological characteristics. In addition, *Trochosa abdita* (Gertsch 1934), once considered a junior synonym of *T. acompa*, is now recognized as a valid species. *Trochosa sepulchralais* and *T. abdita* are fully illustrated and described, and essential information regarding species identification, morphological dimensions, and geographic distribution is included.

Keywords: Wolf spiders, Florida spiders, Texas spiders, synonomy

Spiders of the lycosid genus *Trochosa* are small to medium sized wolf spiders (5.8–13.0 mm) that are largely Holarctic in distribution. They are often found at the edge of woods and in woodland habitats. In this paper, we clarify the relationship of two Nearctic species in this genus: *Trochosa sepulchralis* (Montgomery 1902) and *T. abdita* (Gertsch 1934). Previously *T. sepulchralis* and *T. acompa* (Chamberlin 1924) were recognized as separate species (Platnick 2007), but are in fact one with *T. sepulchralis* as the senior synonym. Roewer (1955) plaeed *T. sepulchralis* in *Geolycosa*, despite the fact that it lacks characteristic features of this genus, such as a very high cephalothorax, darkened forelegs, and obligate burrowing behavior. *Trochosa abdita* was considered a junior synonym of *T. acompa* by Wallace (1947), but it is a distinct species. Both species have genitalic and morphological characters consistent with those of *Trochosa*.

Lycosa sepulchralis was first described by Montgomery (1902) from Philadelphia, Pennsylvania and has received little attention since that time. When *Lycosa acompa* was described by Chamberlin (1924) from a single female individual collected from New Orleans, he apparently was unaware of the great similarities between these two populations. As a result, they have been recognized as two separate species up to this point. This research began as an investigation into the relationship between *T. abdita* and *T. acompa*. We discovered drawings by Brady during the 1970's of the *L. sepulchralis* holotype that bore a striking similarity to *T. acompa*. The holotypes were then compared and it was concluded that they represent the same species, and hence the new synonymy.

Gertsch (1934) described *L. abdita* based upon a single female specimen. For reasons that were not made clear, Wallace (1947) synonomized it with *L. acompa*. The two species were grouped together and locality records for these two species from Florida, Texas, and Georgia were consolidated. Barnes (1953) did not recognize Wallace's synonymy when he included *T. abdita* in a list of spiders from North Carolina, nor did Roewer (1955). *Trochosa abdita* and *T. acompa*, both originally described in *Lycosa*, were not included in Brady's revision of the genus *Trochosa* (Brady 1979), but their placement in this group is now considered valid.

A thorough examination of the holotypes and many additional specimens of both species collected during the past 50 years have allowed us to clarify the distribution of and relationship between *T. abdita* and *T. sepulchralis*. Differences in size, geographic distribution, and the morphology of somatic and reproductive structures in these two species became readily apparent, and the existence of two distinct species is now recognized.

Trochosa abdita occurs in peninsular Florida and north along the eastern seaboard to North Carolina, while *T. sepulchralis* is found from the Florida panhandle east throughout Texas. Specimens from Pennsylvania and New York extend the range of the latter species into New England (Fig. 21).

Little is known of the natural history of these two species other than that inferred through collection methods and locations, and the scant information found with the original descriptions. Wallace (1947) reported *T. abdita* collected from "leaf mould of mesophytic hammocks in northcentral Florida." He also noted that *T. abdita* "is usually found close to its retreat which is most often a shallow burrow in the ground beneath the leaf mould." Whether or not *T. sepulchralis* shares these specific behavioral characteristics needs to be ascertained. It is hoped that this paper will stimulate further investigations of these interesting woodland wolf spiders.

METHODS

Specimens from the collections of the American Museum of Natural History, New York (AMNH); the Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ); the Florida State Collection of Arthropods, Gainesville (FSCA); and Hope College, Holland, Michigan (HCC) were utilized in this study. For localities indicated by county only, we used the geographic coordinates of the county seat. Descriptions are based on multiple specimens preserved in 70–75% ethyl alcohol. Internal female genitalia were prepared by submersion in clove oil at room temperature overnight, and were drawn in the same medium. Expanded male genitalia were prepared in submersion in 10% potassium hydroxide at room temperature overnight, followed by a brief submersion

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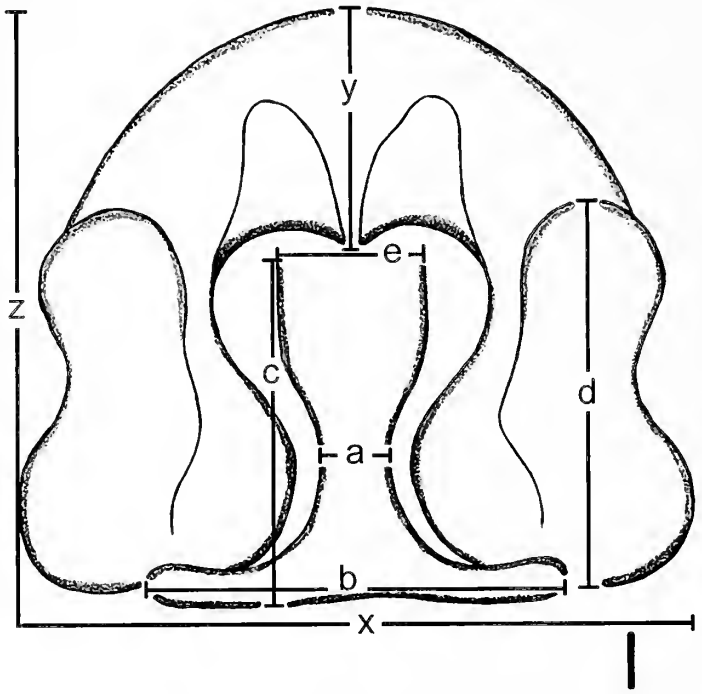


Figure 1.—Diagnostic measurements of the epigynum in *Trochosa*.

in 1% hydrochloric acid before being drawn in 75% ethyl alcohol. All other drawings were made in 75% ethyl alcohol. Drawings of male and female external genitalia omit setae for simplification.

Measurements were made following the protocol as deserибed by Brady (1979). In each case, an optical grid was used to take each measurement at the optimum magnification, this being defined as the greatest magnification that allowed the entire structure to be seen within the field of view. A conversion factor for the optical grid under each magnification allowed the measurements to be converted into millimeters. All reported figures are in millimeters and are shown to no more than two significant figures, the greatest number possible based upon the use of the grid. The measurements are also reported here in tables as a mean ± standard deviation and maximum to minimum values indicating the variability among species. The specimens measured were chosen on the basis of the proximity of their locality to that of the type specimen. The measurement of the Posterior Ocular Quadrangle (POQ) follows that of Brady (1962), while that of the dimensions of the epigynum and its associated structures follows a modified version to the one described by Locket & Millidge (1951). The dimensions of the epigynum as defined here are outlined below in Fig. 1, while the structures of the female epigynum and male palp are identified in Figs. 11–15. The palpal macrosetae are those on the most distal tip of the palp, and specifically identify those that are more pronounced than the fine hairs which cover this structure.

Abbreviations.—Body: anterior eye row (AER), anterior median eyes (AME), posterior eye row (PER), posterior median eyes (PME), posterior median eye width (PMEW), posterior lateral eyes (PLE), posterior lateral eye width (PLEW), Posterior Ocular Quadrangle (POQ), carapace width at the posterior lateral eyes (CWPLE), anterior cheliceral teeth (Ant. CT), posterior cheliceral teeth (Post. CT), patella-tibia (PT), metatarsus (Meta). Measurements: carapace width (CW), carapace width at posterior lateral eyes (CWPL), carapace length (CL), length overall (LOA).

Male palpal structures: basal haematodocha (BH), conductor (CON), cymbium (CYM), distal haematodocha (DH), embolus (EMB), lunar plate of the subtegulum (LPS), median apophysis (MA), palea region (PR), tegulum (TEG), terminal apophysis (TA). Female epigynum structures: fertilization ducts (FD), middle field (MF), transverse piece (TP), spermathecae (SP), vulval chambers (VC).

TAXONOMY

Family Lycosidae Sundevall 1833
Genus *Trochosa* C.L. Koch 1847

Trochosa C.L. Koch 1848:95; C.L. Koch 1851:33; Keyserling 1877:610; Scudder 1882:328; Marx 1890:564; McCook 1894:90, 100, 107, 112, 118; Montgomery 1904:300; Banks 1905:319; Petrunkevitch 1928:250.
Trochosa (Trochosina) Simon 1885:10.
Trochosa (*Varacosa*) Chamberlin and Ivie 1942:36; Roewer 1955:304.
Allohogna Roewer 1955:212 (in part).
Trochosina Simon: Roewer 1955:302.
Trochosomma Roewer 1955:304.
Varacosa Chamberlin & Ivie: Roewer 1955:304.

Type species.—*Trochosa: Arenea ruricola* DeGeer 1778, by original designation.

Trochosa (Trochosina): Trochosa terricola Thorell 1856, by original designation.

Trochosa (Varacosa): Trochosa avara Keyserling 1877, by original designation.

Trochosomma: Trochosa annulipes L. Koch 1875, by original designation.

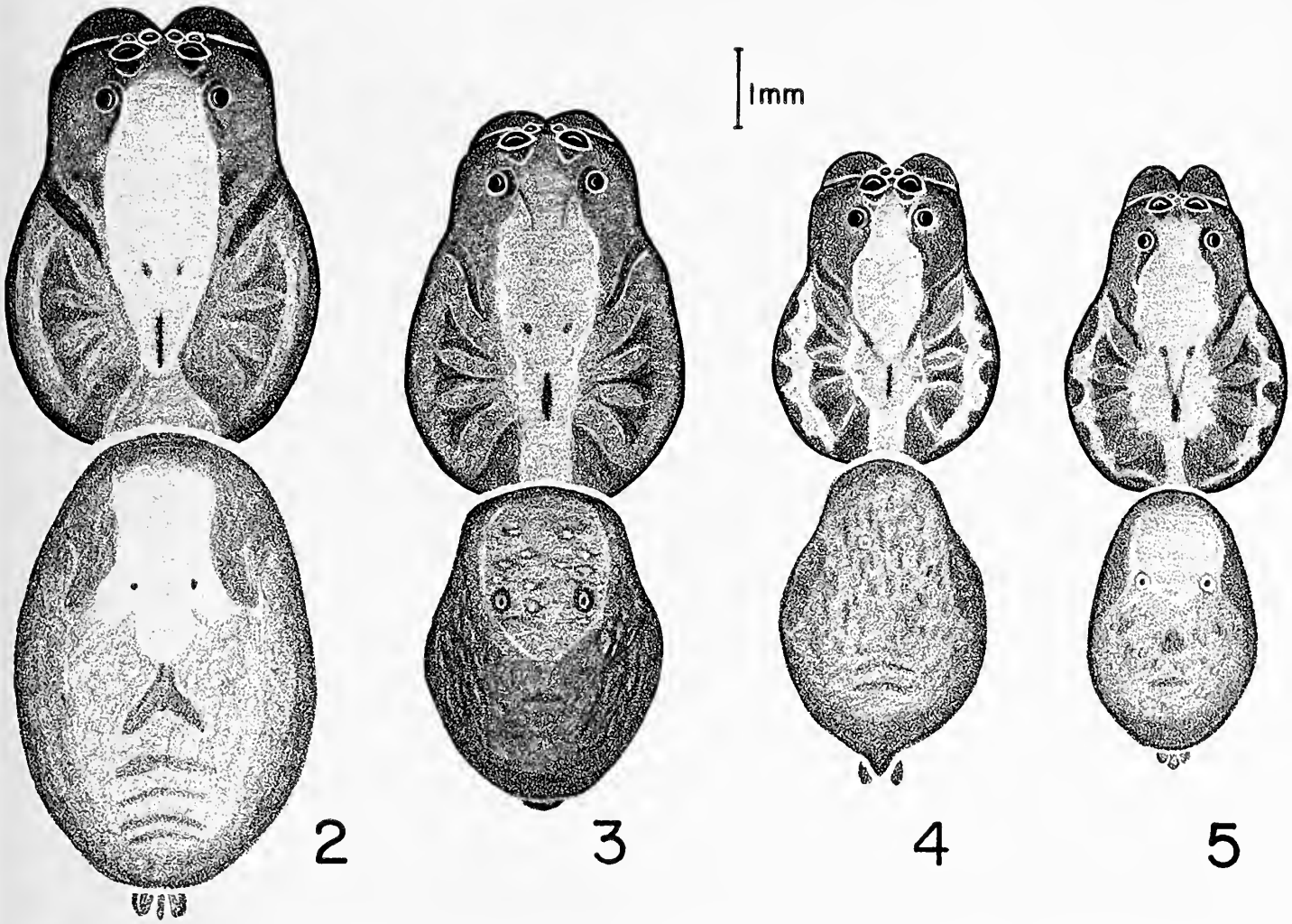
Trochosa sepulchralis (Montgomery 1902)
Figs. 2, 3, 6–15

Lycosa sepulchralis Montgomery 1902:534, plate 29, fig. 7; Montgomery 1903:645, plate 29, fig. 1; Gertsch 1934:3.
Trochosa sepulchralis (Montgomery): Montgomery 1904:307.
Lycosa modesta Chamberlin 1908:568 (misidentification).
Lycosa acompa Chamberlin 1924:29; Gertsch & Wallace 1935:1, fig. 31; Wallace 1947:36. **New synonomy**.
Varacosa acompa (Chamberlin): Roewer 1955:306; Breene et al. 1993:98, figs. 139A, B.
Geolycosa sepulchralis (Montgomery): Roewer 1955:245.

Material examined.—*Lycosa sepulchralis:* Holotype female, USA: *Pennsylvania*: Philadelphia County, Philadelphia, 39°57′N, 075°09′W, 1904, Montgomery (AMNH).

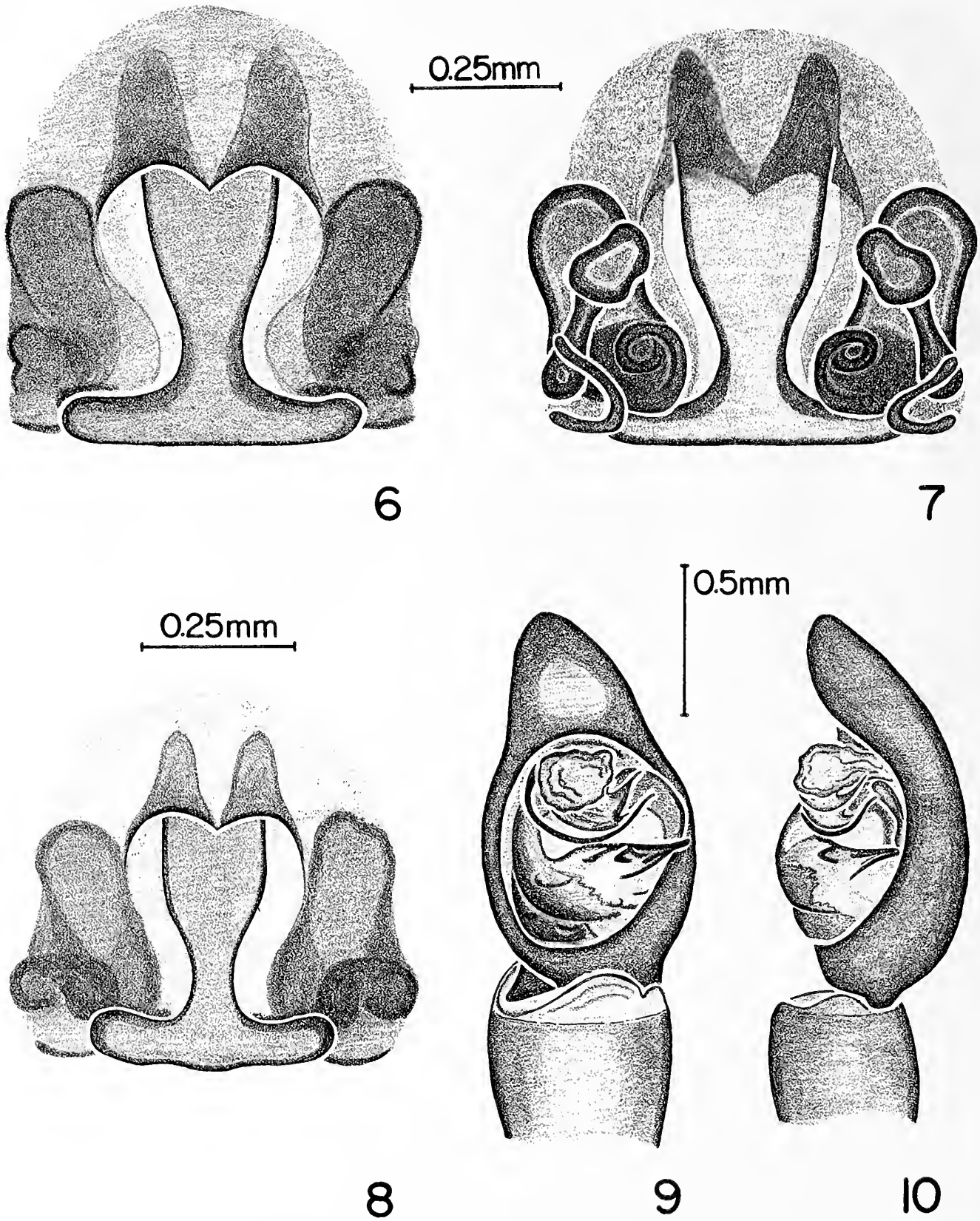
Lycosa acompa: Holotype female, USA: *Louisiana*: Orleans Parish: New Orleans, 29°57′N, 090°04′W, March 1924, H.E. Hubert (MCZ).

Other material examined: Localities from which specimens were measured indicated by *. USA: *Alabama*: 1 ♂, Macon County: 32°24′N, 085°49′W, 11 April 1954, H.K. Wallace (AMNH). *Arkansas*: 1 ♂, 1 ♀, Hempstead County: Hope, 33°40′N, 095°33′W, 1–19 June 1931, L. Knoble (AMNH)*; 2 ♀, Lawrence County: Imboden, 36°12′N, 091°10′W, B.C.

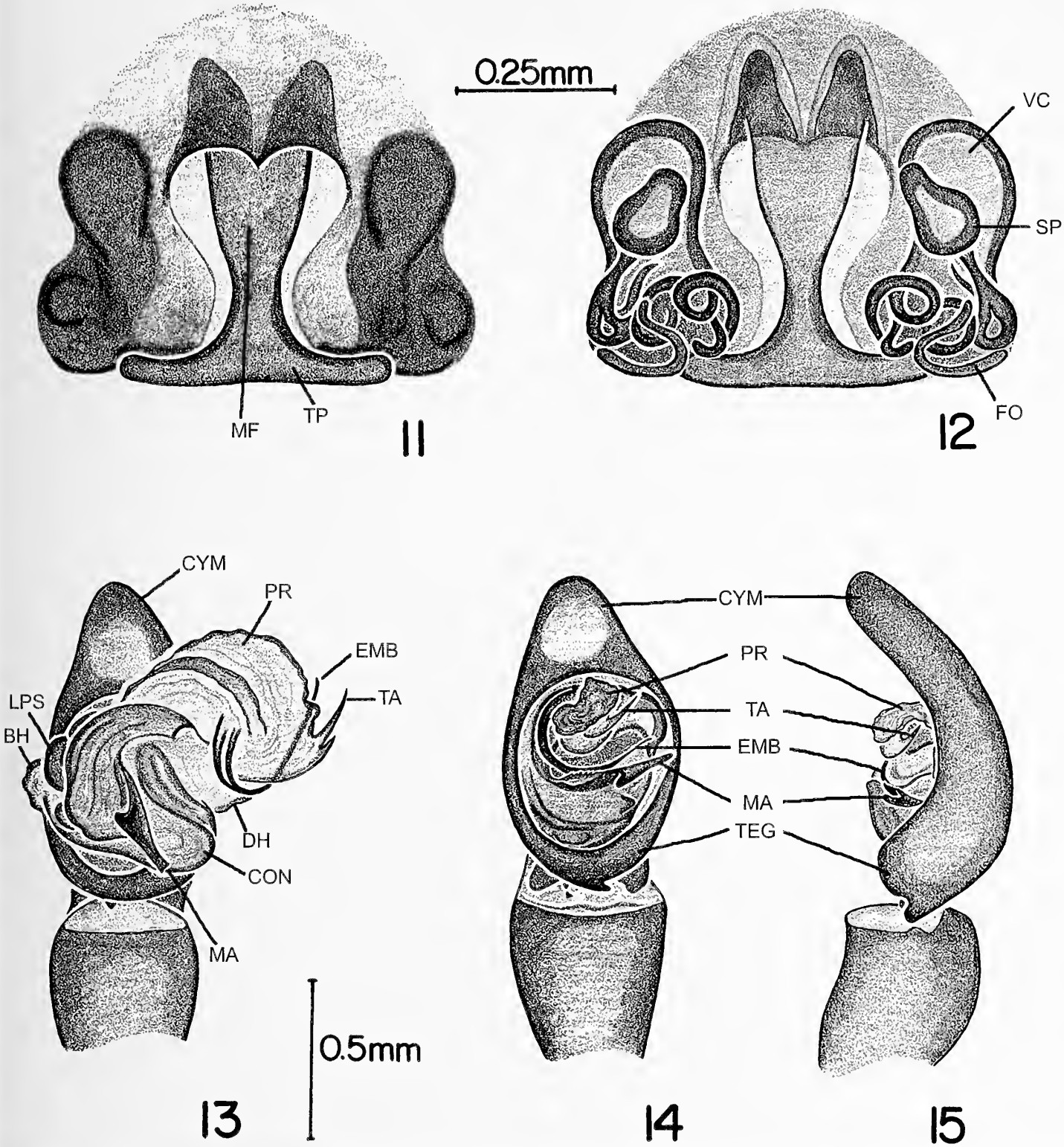


Figures 2–5.—Dorsal patterns of male and female *Trochosa sepulchralis* (Montgomery) and *Trochosa abdita* (Gertsch): 2. *T. sepulchralis* female from Pontotoc, Mississippi, 1962; 3. *T. sepulchralis* male from Livingston, Texas, 9 May 1952; 4. *T. abdita* female from Newnan's Lake, Gainesville, Florida, 13 June 1935; 5. *T. abdita* male from Sugarfoot Hammock, Gainesville, Florida, 19 March 1938.

Marshall (AMNH)*; 4 ♂, Logan County: Mt. Magazine Mossback Ridge, south slope, 35°10′N, 93°38′W, 16 June 1990 (AMNH); 1 ♀, same location, 20 June 1990 (AMNH); 2 ♂, same location, 23 June 1990 (AMNH). *Florida*: 2 ♀, Escambia County: Escambia, 30°40′N, 087°20′W, 6 July 1934, H.K. Wallace (AMNH); 1 ♂, 1 ♀, Liberty County: 30°25′N, 084°58′W, 10 March 1935, H.K. Wallace (AMNH); 4 ♂, 4 ♀, same location, 10 April 1935, H.K. Wallace (AMNH); 7 ♂, 5 ♀, Liberty County: Torreya Ravine, 30°34′N084°56′W, 16 April 1938, W.J. Gertsch & W. Ivie (AMNH); 2 ♂, 3 ♀, 1 juvenile, Liberty County: Torreya State Park, 30°34′N084°56′W, 13 May 1996, A.R. Brady (HCC). *Louisiana*: Grant Parish: Kisatchie, Port Grant, 31°27′N, 092°26′W, June 1941, Jones & Archer (AMNH); 1 ♀, Lincoln Parish: Ruston, 32°31′N, 092°38′W, 10 July 1950, M.A. Cazier (AMNH); 1 ♀, Orleans Parish: 29°57′N, 090°04′W, July 1954 (AMNH); 1 ♀, St. Landry Parish: Eunice, 30°29′N, 092°25′W, 31 August 1943, S. & D. Mulaik (AMNH). *Mississippi*: 1 ♀, Hinds County: Clinton, 32°20′N, 090°19′W, Spring 1926, Bailey (AMNH); 1 ♀, Jackson County: Ocean Springs, 30°24′N, 088°49′W, 19 June 1967, A. Moreton (AMNH); 2 ♀, Pontotoc County: Pontotoc, 34°14′N, 088°59′W, 1962 , P. Dorris (AMNH)*; 1 ♀, Scott County: 5 km W. of Forest, 32°21′N, 089°28′W, 11 April 1963, W.J. Gertsch & W. Ivie (AMNH); 3 ♂, Washington County: Leland 101 Lysbeth St., 33°24′N, 090°53′W, 23-25 May 1983, T.C. Lockley, pitfall trap in mixed grasses (HCC); 3 ♂, 1 ♀, same location, 31 May–3 June 1983, T.C. Lockley, pitfall trap in mixed grasses (HCC); 1 ♂, 3 juveniles, same location, 5–8 June 1983, T.C. Lockley (HCC). *Missouri*: 1 ♂, Phelps County: Rolla, 37°57′N, 091°46′W, H. Frizzell (AMNH)*. *New York*: 1 ♂, Queens County: Flushing, 40°45′N, 073°49′W, 1938, K. Cooker (AMNH); 1 ♂, Suffolk County: Long Pond, 40°56′N072°19′W, 29 June 1929, H.K. Wallace (AMNH). *North Carolina*: 1 ♂, Mecklenberg County: Davidson, 35°29′N, 080°50′W, 16 May 1954, E.E. Brown (AMNH). *Oklahoma*: 3 ♂, Comanche County: Wichita Mts. Wildlife Refuge, 34°43′N, 098°42′W, 18 April 1978, F. Bryce, pitfall (HCC); 3 ♂, same location, 5 May 1978, F. Bryce (HCC); 2 ♂, same location, 20 May 1978, F. Bryce (HCC); 2 ♂, same location, 15 April 1978, E.F. Bruce & T.C. Cokendolpher (HCC). *Pennsylvania*: 3 ♀, Philadelphia County: Woodlawn Cemetery, Philadelphia, 39°57′N, 075°09′W, 1 May 1910, T.H. Montgomery Jr. (AMNH). *Tennessee*: 1 ♀, Wilson



Figures 6–10.—Female and male genitalic structures of *Trochosa sepulchralis* (Montgomery): 6. Epigynum of *T. sepulchralis* holotype from Philadelphia, Pennsylvania; 7. Internal genitalia of same; 8. Epigynum of *T. acompa* (= *sepulcharlis*) holotype from New Orleans, Louisiana; 9. Male palp, ventral view, of *T. sepulchralis* "type" from Philadelphia, Pennsylvania; 10. Retrolateral view of same.



Figures 11–15.—Female and male genitalic structures of *Trochosa sepulchralis*: 11. Epigynum of *T. sepulchralis* from Pontotoc, Mississippi, 1962; 12. Internal genitalia of same; 13. Expanded palp of male *T. sepulchralis* from Livingston, Texas, 9 May 1952; 14. Ventral view of same; 15. Retrolateral view of same.

County: Cedars of Lebanon, 36°05′N, 086°22′W, A.R. Brady (HCC). *Texas*: 1 ♀, Archer County, 33°35′N, 098°37′W, 20 March 1973, Zaltsberg (HCC); 1 ♀, Austin County: Bellville, 29°57′N, 096°15′W, 18 April 1941, O. Sanders (AMNH); 1 ♀, Austin County: State Park near Sealy, 29°48′N, 096°06′W, 19 April 1942, O. Sanders (AMNH); 1 ♀, Brown County, 31°42′N, 098°59′W, April 1983, K. Flatt (HCC); 1 ♀, Cameron County: Harlingen, 26°11′N, 097°41′W, 17 November 1934, S. Mulaik (AMNH); 2 ♀, 4 juvenile, same location, 18 November 1934, S. Mulaik (AMNH); 1 ♂, same location,

March 1936, L. Davis (AMNH); 1 ♀, Clay County, 33°49′N, 098°11′W, 18 August 1972, Zaltberg (HCC); 4 ♂, 2 ♀, Grayson County: Sherman, 33°38′N, 096°36′W, October 1964 K. W. Haller (AMNH)*; 1 ♀, same location,15 September 1963, K.W. Haller (AMNH)*; 4 ♂, 4 ♀, same location, May 1965 K.W. Haller (AMNH)*; 7 ♂, 8 ♀, 6 juveniles, same location, May 1965, K.W. Haller (AMNH)*; 1 ♀, same location, May 1966, K.W. Haller (AMNH); 1 ♀, Harrison County: Caddo Lake State Park, 32°41′N, 094°10′W, 31 May 1940, S. & D. Mulaik (AMNH); 2 ♂, 1 juvenile, Hidalgo County: Edinburg, 26°18′N, 098°09′W, February 1934, S. Mulaik (AMNH); 2 ♀, same location, 27 October 1934, S. Mulaik (AMNH); 1 ♀, same location, 10–20 June 1935, S. Mulaik; (AMNH); 1 ♀, same location, 15 October 1935, Schulle (AMNH); 1 ♂, same location, March 1936, S. Mulaik (AMNH); 1 ♂, same location, 25 March 1936, C. Rutherford (AMNH); 2 ♂, same location, 3 May 1937, S. Mulaik (AMNH); 11 ♂, 1 ♀, same location, September 1934, S. Mulaik (AMNH); 3 ♀, same location, 31 August 1946, S. & D. Mulaik (AMNH); 1 ♀, Hidalgo County: San Juan, 26°11′N, 098°09′W, 22 February 1935, S. Mulaik (AMNH); 1 ♀, Jasper County: Jasper, 30°55′N, 093°59′W, 6 June 1936, S. Mulaik (AMNH); 1 ♀, Kerr County: Raven Ranch, 30°02′N, 099°08′W, June 1941, S. & D. Mulaik (AMNH); 1 ♀, Kimble County, 30°29′N, 099°46′W, 15 April 1972, N.V. Horner (HCC); 1 ♀, Polk County: Livingston, 30°42′N, 094°54′W, 21 August 1940, S. & D. Mulaik (AMNH); 8 ♂, 8 ♀, same location, 9 May 1952, M. Cazier, W.J. Gertsch, R. Schrammel (AMNH)*; 1 ♀, McLennan County: Camp Tonkawa Crawford, 31°32′N, 97°26′W, 18 April 1943, O. Sanders (AMNH); 1 ♀, Panola County: Carthage, 32°09′N, 094°20′W, 9 May 1952, M. Cazier, W.J. Gertsch, R. Schrammel (AMNH); 1 ♀, San Jacinto County: Oakhurst, 30°44′N, 095°18′W, 10 May 1952, M. Cazier, W.J. Gertsch, R. Schrammel (AMNH); 18 ♂, San Patricio County: 13 km. N.E. of Sinton, 28°02′N, 097°30′W, 22 March 1960, H.E. Laughlin (AMNH); 4 ♂, same location, 28 April 1960, H.E. Laughlin (AMNH); 1 ♂, 4 ♀, same location, 12 May 1960, H.E. Laughlin (AMNH); 1 ♀, same location, 26 May 1960, H.E. Laughlin (AMNH); 1 ♀, same location, 4 August 1960, H.E. Laughlin (AMNH); 2 ♀, 1 juvenile, same location, 4 August 1960, H.E. Laughlin (AMNH); 1 ♀, Taylor County: Abilene, 32°26′N, 099°43′W, Summer 1943, M.M. Willis (AMNH); 2 ♀, same location, July 1962, K.W. Haller (AMNH); 1 ♀, Terrell County: Dryden, 30°02′N, 102°06′W, 27 March 1946, C.D. Michener (AMNH); 1 ♀, Tom Green County: Water Valley, 31°40′N, 100°43′W, December 1939, D. & S. Mulaik (AMNH); 1 ♂, Travis County: Austin, 30°16′N, 097°44′W, December 1944, H. Exline (AMNH); 1 ♂, same location, 29 April 1946, H.E.& D.L. Frizzell (AMNH); 2 ♀, same location, 4 May 1947, H. Exline (AMNH); 1 ♀, Travis County: Upper Bull Creek, 30°16′N, 097°44′W, 17 March 1946, D.L.& H.E. Frizzell (AMNH); 1 ♀, Val Verde County: 3 km W. of Langtry, 29°48′N, 101°33′W, 22 October 1972, Parrish (HCC); 1 ♀, Wichita County, 33°54′N, 098°29′W, 6 April 1967, Mark Wilson (HCC); 1♀, same location, 18 April 1967, M.V. Eustice (HCC); 1♀, same location, 5 November 1967, M.V. Eustice (HCC);1 ♂, same location, 10 February 1973, L. Pierce (HCC); 1 ♀, same location, 10 March 1973, Busboom (HCC); 1 ♀, same location, 12 March 1973, Busboom (HCC); 2 ♀, same location, 14 April 1973, R. Snider (HCC); 1 ♀, same location, 25 October 1974, R. Wallenshis (HCC); 1 ♀, same location, 14 February 1975, R. Roberts (HCC); 1 ♀, same location, 3 April 1975, R. Roberts (HCC); 1 ♂, 1 ♀, same location, 20 April 1975, R. Galloway (HCC); 1 ♀, same location, 20 April 1975, M. Triddy (HCC); 1♀, same location, 20 April 1975, K. Zinn porch (HCC); 1 ♀, same location, 28 April 1977, F.D. (HCC); 1 ♂, same location, 2 April 1978, N.D. Hodson (HCC); 1 ♀, same location, 17 April 1981, Schultz (HCC); 1 ♀, same location, 27 April 1983, L. Presley (HCC); 1 ♀, same location, 1 May 1983, B. Wilkins (HCC); 1 ♂, same location, 4 May 1983, B. Wilkins (HCC).

Etymology.—The specific name was derived from the word *sepulcher*, a burial vault, and is likely a reflection upon the location from which it was first described: Philadelphia's Woodlands Cemetery, where many of Montgomery's specimens of this species were collected.

Diagnosis.—Males of *Trochosa sepulchralis* are distinguished from other Nearctic *Trochosa* by the secondary projection on the terminal apophysis, the lack of a spiraled embolus, and lack of fang excrescence. The female of *T. sepulchralis* can be separated by the lack of dash marks in the median stripe (Figs. 2, 3), b:a genitalic ratio of 4.1–7.2, and d:z ratio from 0.52–0.61 (Table 2). Both sexes are also large (6.2–13 mm), have a dark venter, and in alcohol bear inconspicuous annulations on the legs.

Description.—*Male:* Chelicerae: dark brown; often with three teeth on the anterior and posterior margins; some specimens have four teeth on posterior margin; central anterior tooth is largest; all posterior teeth of equal length. Carapace (Fig. 3): golden brown background, dark markings; median light stripe extending from within POQ to rear of carapace; stripe not highly contrasted to the background color; widest immediately posterior to the PLE, thinning behind fovea; symmetric series of five thin bands or rays extending on each side from median stripe to submarginal area. Eyes of PER encircled with black. Dorsum of abdomen: light over heart region, otherwise mottled brown, uniformly dark, or rarely provided with a dark heart mark and indistinct chevrons. Legs: indistinctly annulate; longest to shortest IV: I: II: III. Endites and labium: dark as sternum; light anterior margins. Sternum: dusky. Venter: solidly dark brown or black. Unexpanded palpus (Figs. 9, 10, 14, 15): curved embolus, origin within prolateral margin of palea; embolus may or may not curve below the upper portion of tegulum and median apophysis; tip of embolus ends within broad conductor; terminal apophysis accompanied by very small or tiny secondary projection, both structures protruding from lower portion of palea; margin where median apophysis and tegulum join often faintly serrated; lunar plate of the subtegulum at base of tegulum. Expanded palpus (Fig. 13): very prominent palea region projecting beyond the cymbium; lunar plate of the subtegulum conspicuous, overlaps portion of basal haematodocha: linear portions of embolus and terminal apophysis near their tips are not perpendicular to the median apophysis, but rather angled.

Female: Very similar to male. Chelicerae: dark brown; three teeth on anterior and posterior margins. Carapace (Fig. 2): wide median light stripe extending from middle of POQ to posterior margin of the carapace, stripe varies in intensity, not always distinct; dark radiating lines extend distally from edges

Table 1.—Measurements (mm) of *Trochosa sepulchralis* (Montgomery) and *T. abdita* (Gertsch).

Dimension	*Trochosa sepulchralis* ♂ *n* = 10		*Trochosa abdita* ♂ *n* = 10		*Trochosa sepulchralis* ♀ *n* = 10		*Trochosa abdita* ♀ *n* = 9	
	Mean ± SD	Max.–Min.	Mean ± SD	Max.–Min.	Mean ± SD	Max.–Min	Mean ± SD	Max.–Min.
Clypeus Height	0.14 ± 0.03	0.18–0.08	0.10 ± 0.03	0.15–0.07	0.18 ± 0.02	0.22–0.17	0.15 ± 0.03	0.22–0.12
AER Width	0.78 ± 0.08	0.85–0.67	0.61 ± 0.05	0.68–0.52	0.86 ± 0.07	0.96–0.73	0.62 ± 0.19	0.76–0.13
PMEW	0.94 ± 0.09	1.0–0.8	0.73 ± 0.05	0.83–0.68	1.0 ± 0.1	1.1–0.9	0.78 ± 0.07	0.88–0.70
PLEW	1.2 ± 0.1	1.3–1.0	0.92 ± 0.06	1.0–0.8	1.3 ± 0.1	1.4–1.2	1.0 ± 0.1	1.2–0.8
POQ Length	0.84 ± 0.08	0.93–0.71	0.67 ± 0.04	0.75–0.61	0.91 ± 0.07	1.0–0.8	0.70 ± 0.06	0.76–0.61
Carapace Width	3.4 ± 0.4	3.8–2.7	2.5 ± 0.2	2.8–2.2	3.6 ± 0.4	4.1–3.0	2.6 ± 0.4	3.2–2.2
CWPLE	1.9 ± 0.2	2.1–1.5	1.4 ± 0.1	1.7–1.3	2.4 ± 0.2	2.8–2.0	1.7 ± 0.2	2.0–1.5
Carapace Length	4.5 ± 0.5	5.1–3.6	3.4 ± 0.3	3.9–3.0	5.0 ± 0.4	5.5–4.2	3.7 ± 0.5	4.4–3.0
Total Length	8.2 ± 0.3	9.3–6.2	6.2 ± 0.6	7.2–5.5	11.0 ± 2.0	13.0–8.0	7.5 ± 1.4	9.0–5.6
Ant. CT	3.0 ± 0.0	3.0–3.0	3.0 ± 0.0	3.0–3.0	3.0 ± 0.0	3.0–3.0	3.0 ± 0.0	3.0–3.0
Post. CT	3.1 ± 0.3	3.5–2.5	3.1 ± 0.3	4.0–3.0	3.0 ± 0.0	3.0–3.0	2.9 ± 0.2	3.0–2.5
Labium Length	0.53 ± 0.05	0.58–0.43	0.40 ± 0.03	0.45–0.37	0.66 ± 0.08	0.80–0.52	0.45 ± 0.07	0.52–0.33
Labium Width	0.56 ± 0.06	0.63–0.43	0.41 ± 0.05	0.50–0.37	0.70 ± 0.06	0.80–0.60	0.49 ± 0.05	0.53–0.42
Femur I	3.1 ± 0.2	3.3–2.6	2.1 ± 0.2	2.6–1.1	3.0 ± 0.3	3.4–2.5	2.2 ± 0.3	2.6–1.85
PT I	4.0 ± 0.3	4.3–3.4	2.6 ± 0.5	3.3–1.3	3.9 ± 0.3	4.5–3.4	2.8 ± 0.5	3.4–2.0
Metatarsus I	2.4 ± 0.2	2.6–2.0	1.4 ± 0.2	1.5–0.7	1.8 ± 0.2	2.1–1.5	1.2 ± 0.2	1.5–0.9
Tarsus I	1.4 ± 0.07	1.5–1.3	0.98 ± 0.16	1.1–0.6	1.2 ± 0.1	1.3–1.0	0.93 ± 0.12	1.1–0.8
Total leg I	11.0 ± 1.0	12.0–9.0	7.1 ± 1.3	8.5–3.7	9.9 ± 0.9	11.0–8.0	7.1 ± 1.0	8.6–5.8
PT II	3.5 ± 0.2	3.8–3.1	2.4 ± 0.5	3.0–1.0	3.4 ± 0.3	4.0–2.9	2.5 ± 0.4	3.1–2.0
PT III	2.9 ± 0.2	3.2–2.6	2.0 ± 0.4	2.4–1.0	3.0 ± 0.3	3.3–2.8	2.2 ± 0.3	2.6–1.8
Femur IV	3.3 ± 0.2	3.5–3.0	2.4 ± 0.4	2.8–1.3	3.4 ± 0.3	4.0–2.8	2.5 ± 0.3	3.0–2.1
PT IV	4.1 ± 0.1	4.3–3.8	2.9 ± 0.6	3.6–1.4	4.2 ± 0.1	4.6–3.7	3.1 ± 0.3	3.6–2.6
Metatarsus IV	3.4 ± 0.2	3.7–3.2	2.5 ± 0.4	3.0–1.3	3.3 ± 0.9	3.6–3.0	2.4 ± 0.3	2.8–2.0
Tarsus IV	1.5 ± 0.1	1.7–1.3	1.2 ± 0.2	1.4–0.7	1.4 ± 0.1	1.7–1.3	1.2 ± 0.1	1.4–1.1
Total leg IV	12.0 ± 1.0	13.0–11.0	8.9 ± 1.6	11.0–5.0	12.0 ± 1.0	14.0–11.0	9.2 ± 1.0	11.0–8.0
Palpal Macrosetae	20.0 ± 6.0	30.0–14.0	7.1 ± 2.1	11.0–4.0				

of the median stripe to submargin of carapace; eyes of PER encircled by black. Dorsum of abdomen: light over heart, otherwise uniformly dusky or darkly mottled; rarely marked with chevrons; apodemes often conspicuous. Legs: indistinctly annulate; longest to shortest IV: I: II: III. Venter: uniformly dark or dusky. Endites and labium: dark as sternum; light anterior margins. Sternum: dark; almost always marked with inconspicuous light stripe near anterior margin. Epigynum (Figs. 6, 8, 11): inverted "T;" large, highly visible vulval chambers on either side of copulatory openings equal in height to middle field, directly visible as darkened regions through the integument; middle field widened anteriorly, most narrow portion approximately two-thirds of its maximum width; transverse piece thin, only slightly upturned at ends; vulval chambers large and rounded, extending beyond slender middle field; internal structures also bulge laterally above darkened fertilization ducts; epigynum nearly as wide as long. Internal genitalia (Figs. 7, 12): high level of complexity; spermathecae

Table 2.—Measurements (mm) of epigyna of *Trochosa sepulchralis* and *T. abdita*.

Dimension	*Trochosa sepulchralis* ♀ *n* = 10		*Trochosa abdita* ♀ *n* = 9	
	Mean ± SD	Max.–Min.	Mean ± SD	Max.–Min.
a	0.09 ± 0.02	0.13–0.07	0.07 ± 0.01	0.09–0.05
b	0.47 ± 0.06	0.54–0.35	0.32 ± 0.04	0.37–0.28
c	0.39 ± 0.03	0.47–0.30	0.30 ± 0.02	0.34-0.26
d	0.38 ± 0.03	0.46–0.30	0.19 ± 0.03	0.24–0.13
e	0.17 ± 0.03	0.26–0.13	0.18 ± 0.03	0.23–0.15
X	0.69 ± 0.05	0.77–0.59	0.53 ± 0.06	0.61–0.43
Y	0.22 ± 0.04	0.32–0.18	0.16 ± 0.03	0.20–0.13
Z	0.68 ± 0.05	0.78–0.58	0.52 ± 0.04	0.60–0.47
Ratio d:z (mean)	0.56		0.37	
Ratio d:z (max.–min.)	0.61–0.52		0.47–0.28	
Ratio a:e (mean)	0.56		0.39	
Ratio a:e (max.–min.)	0.75–0.36		0.48–0.33	
Ratio b:e (mean)	2.9		1.9	
Ratio b:e (max.–min.)	3.6–2.0		2.4–1.4	
Ratio d:c (mean)	0.99		0.63	
Ratio d:c (max.–min.)	1.2–0.89		0.80–0.47	

superimposed over large vulval chambers, bent towards the copulatory openings, heads oblong with most narrow portion directed anteriorly; complicated mass of ducts along base of spermathecae, dorsal or ventral to fertilization ducts.

Measurements.—Ten males and ten females were measured (Tables 1, 2). Somatic features are presented in Table 1. Measurements and dimension ratios of female epigyna are in Table 2.

Distribution and habitat preferences.—*Trochosa sepulchralis* occurs throughout the central southern region of the United States. It is found from Florida in the east to Texas in the west, and north to New York (Figure 21). The habitat preference of this species is similar to other species of *Trochosa*. It prefers the edge of woods where it is often collected by hand or through the use of pitfall traps.

Trochosa abdita (Gertsch 1934)
Figs. 4, 5, 16–20

Lycosa abdita Gertsch 1934:3; Wallace 1947:36 (synonymized with *Trochosa acompa*, overlooked by subsequent workers).
Trochosa abdita (Gertsch): Barnes 1953:13.
Geolycosa abdita (Gertsch): Roewer 1955:243.

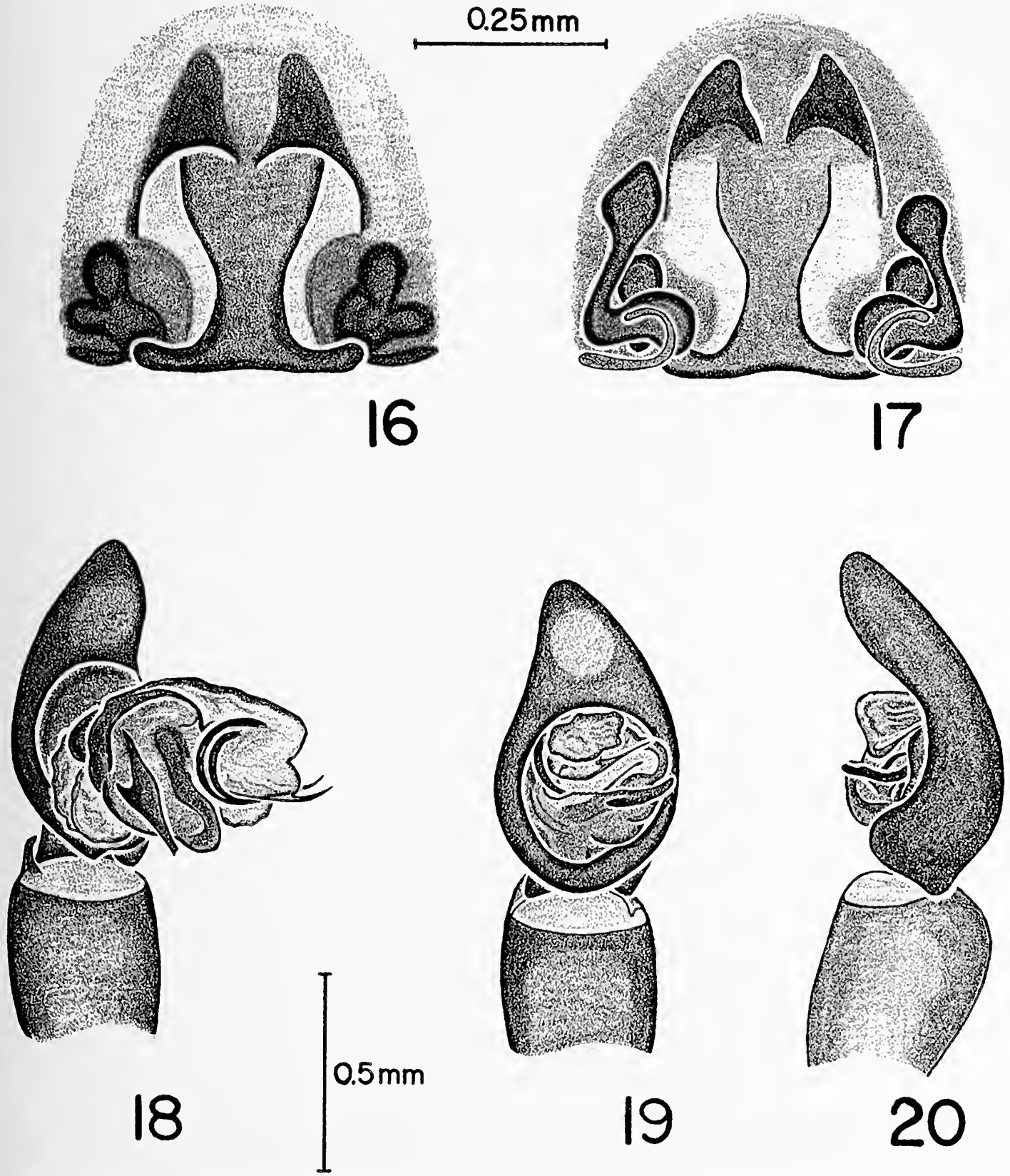
Material examined.—Holotype female: USA: *Florida*: Alachua County, Gainesville, "3608," 29°39′N, 082°19′W (AMNH).

Other material examined.—Specimens measured are indicated by *. USA: *Florida*: 1 ♀, Alachua County: Newnan's Lake, 29°39′N, 082°19′W, 13 June 1935, W. Ivie (AMNH)*; 1 ♂, same location, 19 March 1938, W.J. Gertsch (AMNH)*; 1 ♂, same location, 15 May 1926, Hubbell (AMNH); 1 ♂, Alachua County: Sugarfoot Hammock near Gainesville, 29°39′N, 082°19′W, 19 March 1938, W.J. Gertsch (AMNH)*; 1 ♀, 2 , same location, 19 March 1938, W.J. Gertsch (AMNH)*; 1 ♂, Alachua County, 29°39′N, 082°19′W, 14 March 1934, H.K. Wallace (AMNH); 5 ♂, 3 ♀, 1 juvenile, Alachua County: Newnan's Lake, Gainesville, 29°39′N, 082°19′W, 28 March 1957, Gertsch & Forster (AMNH); 1 ♂, Calhoun County: Blountstown, 30°26′N, 085°02′W, 17 April 1938, Gertsch (AMNH)*; 1 ♂, Highlands County: Archbold Biological Station, 27°17′N, 081°21′W, 19 December 1962, W. Ivie (AMNH)*; 2, same location, 19 December 1962, W. Ivie (AMNH)*; 1 ♂, Highlands County: Highlands Hammock near Sebring, 27°29′N, 081°26′W, 14 March 1938, W.J. Gertsch (AMNH)*; 1 ♂, same location, 24 March 1938, W.J. Gertsch (AMNH)*; 1 ♀, Highlands County: Sebring, 27°29′N, 081°26′W, 7 March 1939, F.E. Lutz (AMNH)*; 1 ♂, Miami-Dade County: Homestead, 25°28′N, 080°28′W, 30 January 1959, R.E. Woodruff (AMNH)*; 1 ♂, Miami-Dade County: Miami, 25°43′N, 080°14′W, 1 February 1967 (AMNH); 1 ♀, Okeechobee County: Okeechobee, 27°14′N, 080°49′W, 26 March 1938, W.J. Gertsch (AMNH)*; 1 ♂, same location, 28 March 1938, W.J. Gertsch (AMNH)*; 1 ♂, Martin County: Port Mayaca, Lake Okeechobee, 26°59′N, 080°36′W, 29 March 1938, W.J. Gertsch (AMNH)*; 1 ♂, Monroe County: Key West, 24°33′N, 081°47′W, 5 February 1967 (AMNH); 1 ♀, Putnam County: Welaka Reserve, 29°28′N, 081°40′W, 5 May 1973, A.R. Brady, pine litter (HCC)*; 1 ♀, Sarasota County: Lido Key, 27°20′N, 082°31′W, 28 March 1943, B. Malkin (AMNH)*; 1 ♂, Seminole County: Sanford, 28°48′N, 081°16′W, 30 March 1942, W.H.&L.F. Stickel (AMNH); 2 ♂1 ♀, Taylor County: Stephensville, 29°40′N, 083°23′W, 26 March 1933, H.K. Wallace (AMNH); 1 ♂, 1 ♀, Volusia County: Benson Spring, 28°51′N, 081°19′W, 11 November 1933, H.K. Wallace (AMNH)*; 1 ♀, Volusia County: Deland, 29°01′N, 081°18′W, 25 March 1939, F.E. Lutz (AMNH)*. 1 ♀, *North Carolina*: 1 ♀, Carteret County: Carrot Island, Beaufort, 34°43′N, 076°39′W, 15 July 1951, R.D. Barnes (AMNH)*; 1 ♀, same location, 8 August 1951, R.D. Barnes (AMNH).

Etymology.—The specific name is Latin, and means hidden or obscure.

Diagnosis.—Males of *Trochosa abdita* can be distinguished from other Nearctic *Trochosa* by the lack of a secondary projection on the terminal apophysis of the palpus, no spiraling of the embolus, and lack of fang excrescence. Likewise females do not have darkened dash marks (Figs. 4, 5) within the median light stripe, and an epigynum with b:a ratio of 4.0–5.75 and d:z ratio 0.28–0.47 (Table 2). Both sexes of this spider are small (5.5–9.0 mm) with a light or spotted venter, strong annulations on all leg segments, and a distribution almost entirely limited to peninsular Florida (Fig. 21).

Description.—*Male:* Chelicerae: darkened, most often same color as carapace; usually armed with three teeth on both anterior and posterior margins; occasionally with four posterior teeth. Central anterior tooth is largest; all posterior teeth of equal size. Carapace (Fig. 5): golden brown background, markings in dark brown; light median area running from immediately posterior the PMER to the most posterior margin of the carapace, wider behind the PMER, tapering at the posterior declivity; series of narrow or thin bands radiating outward which extend from the fovea, beginning outside of the median light stripe and terminating at submarginal light stripes. Submarginal stripes undulate between the ends of the radiating bands and dark markings proximal to margin of carapace; eyes of AME and PER encompassed by very dark nacelles. Dorsum of abdomen: nearly uniform background mottled dark; faint traces of chevrons; two spotted apodemes. Legs: annulate or banded, especially femora; unambiguous and visible without magnification; longest to shortest IV: I: II: III. Endites: somewhat lighter than the labium; curved slightly inward. Labium: square or slightly wider than long; dark posteriorly and at the margins. Sternum: typically light, taking on dusky quality in some specimens. Venter: mottled with dark spots; usually more heavily so around margins; central region may be light, or have a dusky tinge. Unexpanded palpus (Figs. 19, 20): spiraled embolus curving from behind the palea, dips below the tegulum briefly and terminates within the cup of the conductor; terminal apophysis arising from below palea and extending over upper portion of the conductor; distal margin of area where the tegulum joins median apophysis often marked by very subtle serration; median apophysis dark, protruding slightly over cymbium, as does conductor; lip or margin of conductor slightly swollen, producing a concavity; tip of palpus never armed with more than twelve robust macrosetae, though these may be accompanied by a number of longer hairs and/or setae of weaker constitution. Expanded palpus (Fig. 18): palea swollen; embolus and ejaculatory duct extended, join together immediately before terminal apophysis which projects over and across them; lunar plate of subtegulum below the tegulum and above the basal haematodocha; distal haematodocha



Figures 16–20.—Female and male genitalic structures of *Trochosa abdita* (Gertsch): 16. Epigynum of *T. abdita* from Newnan's Lake, Gainesville, Florida, 13 June, 1935; 17. Internal genitalia of same; 18. Expanded palp of male *T. abdita* from Sugarfoot Hammock, Gainesville, Florida, 19 March 1938; 19. Ventral view of same; 20. Retrolateral view of same.

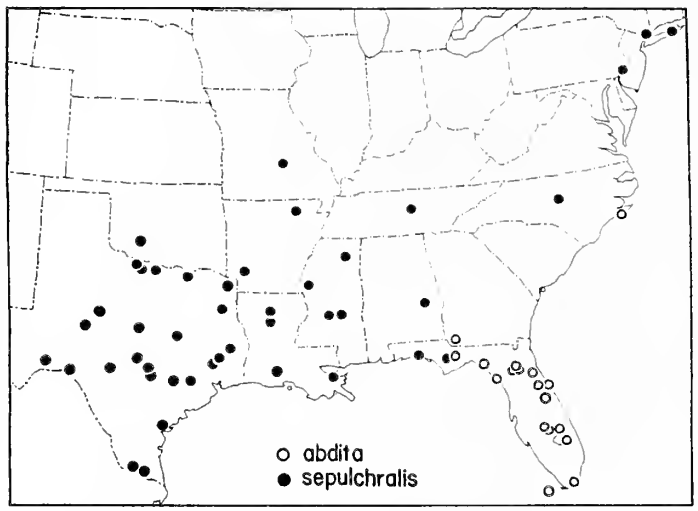


Figure 21.—Distribution map of *Trochosa abdita* and *T. sepulchralis.*

partly visible beneath embolus and terminal apophysis relative to the position of the median apophysis. The embolus and terminal apophysis project themselves nearly perpendicular to the median apophysis.

Female: Very similar to male. Chelicerae: dusky to dark; three teeth on both margins; posterior margins may be armed with only a pair of teeth; teeth sizes follow that of the male. Carapace (Fig. 4): golden; marked by median light stripe of varying width, extending from PME to rear of the carapace; dark bands or rays extend towards undulating submarginal light stripes where they terminate. Margins of carapace marked by numerous dark projections; eyes encircled by a dark color. Dorsum of abdomen: uniformly mottled; heart mark may be visible anteriorly and faint chevrons may be seen posteriorly. Legs: moderately to strongly annulate; longest to shortest IV: I: II: III. Endites, labium, and sternum: light; labium often darker near posterior margin. Venter: mottled with dark spots on a light background. Epigynum (Fig. 16): inverted "T;" middle field widened anteriorly; narrowest portion of middle field about half as wide as widest point; transverse piece thin, slightly directed anteriorly at both ends. Portions of internal genitalic structures visible through integument; rounded structures extend anteriorly to about two-thirds the height of middle field; project anteriorly and laterally, beneath lie two darkened areas marking fertilization ducts; epigynum nearly as long as wide. Internal genitalia (Fig. 17): with spermathecae appearing as bent arms with "elbows" projecting laterally; top of spermathecae rounded, appearing as a smooth circle atop a stalk; behind spermathecae lie vulval chambers extending vertically with widened top; fertilization ducts curl ventrally toward the midline.

Measurements.—Ten males and nine females were measured (Tables 1, 2). Somatic features are presented in Table 1. Measurements and dimension ratios of female epigyna are in Table 2.

Distribution and habitat preferences.—*Trochosa abdita* is found from southern Florida northwestward to the Florida panhandle and north to the coastal region of North Carolina (Fig. 21). In western Florida, it can be confused with a very similar looking species to which it is clearly related. This discrepancy is addressed in the discussion section. In Wallace's synonomy (1947), he reports that *T. abdita* "is one of the characteristic species of the leaf mould of mesophytic hammocks in north-central Florida; it seems to favor moist situations in these hammocks." He goes on to associate *T. abdita* with wet hammocks and swamps. Wallace also states that "It is usually found close to its retreat which is most often a shallow burrow in the ground beneath the leaf mould; sometimes it is found under or in rotten logs."

DISCUSSION

The two species treated in this manuscript are similar in morphology, but are clearly distinct from one another. *Trochosa abdita* is known from the Florida peninsula and along the southern Atlantic coast while *T. sepulchralis* (under the name *T. acompa*) is most often documented from Texas and the surrounding states (Fig. 21). *Trochosa sepulchralis* is nearly 30% larger than *T. abdita* in almost every regard (Table 1). The female epigynum differs between the two species with *T. abdita* having internal structures that are truncated and simple, while in *T. sepulchralis* they are large and complex (compare Figs. 7, 12 with Fig. 17). These differences are visible even through the integument of the venter (compare Figs. 6, 8, 11 with Fig. 16), and may also be noted quantitatively through the measurement of the epigynum as explained in the methods and Fig. 1, finally comparing the values to those from Table 2. The carapace pattern of *T. abdita* is more elaborate, with a more pronounced median light stripe, and wavy submarginal light stripes. The legs of *T. abdita* are more strongly and much more often annulate, while its light venter is contrasted with the dark venter of *T. sepulchralis.*

As previously noted, the areas in and around Liberty County, Florida are known to produce spiders with morphological characters such as color pattern similar to those of *T. abdita*, but having genitalic characters like those of *T. sepulchralis*. Currently it is unknown if these specimens represent hybrids where the distribution of these two species overlaps, or if these populations represent a third species. Conventional wisdom dictates that genitalic characters supercede somatic characters, and for this reason the authors advocate recognition of these specimens as *Trochosa sepulchralis* until their relationship to other populations is more fully understood.

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Revision of the Neotropical spider genus *Enna* (Araneae, Lycosoidea, Trechaleidae)

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Abstract. The spider genus *Enna* is revised and the five previously known species [*E. estebanensis* (Simon 1898) (Venezuela), *E. jullieni* (Simon 1898) (Panama, Colombia), *E. minor* Petrunkevitch 1925 (Panama, Colombia), *E. nesiotes* Chamberlin 1925 (Panama) and *E. velox* O. Pickard-Cambridge 1897 (type species) (Mexico)] are redescribed. *Dossenus redundans* Platnick, 1993 is transferred to *Enna* and is redescribed and illustrated. Descriptions of 18 new species include the following: *E. baeza* (Ecuador), *E. bartica* (Guyana), *E. braslandia*. (Brazil), *E. bonaldoi* (Brazil) *E. caliensis* (Colombia), *E. chickeringi* (Honduras), *E. colonche* (Ecuador), *E. eberhardi* (Costa Rica, Panama), *E. hara* (Peru), *E. huanuco* (Peru), *E. huarinilla* (Bolivia), *E. igarape* (Brazil), *E. kuyuwinieusis* (Guyana), *E. maya* (Honduras, Panama), *E. paraensis* (Brazil), *E. pecki* (Costa Rica), *E. riotopo* (Ecuador) and *E. rothi* (Ecuador). The type of *E. approximata* (O. Pickard-Cambridge), collected in Bugaba, Panama, is based on a juvenile and is considered as a *nomen dubium*. Similarities in the geographical distributions of species of *Enna* with the distributions of species in the genera *Trechalea* and *Hesydrus* are noted.

Keywords: New species, taxonomy, morphology, Neotropical region

Octavius Pickard-Cambridge (1897) created a new genus, *Enna* O. Pickard-Cambridge 1897, within the family Pisauridae Simon 1890 and designated his new species *E. velox* O. Pickard-Cambridge 1897 as its type species. The genus was transferred to the valid but totally ignored Trechaleidae Simon 1890 (Simon 1890) until the family was later revalidated (Carico 1986). These spiders are characterized by a series of morphological characters including the arrangement of the eyes, as well as features of the male palpus, female epigyna, and the shape of the egg-sac (Carico 1993). Most of the species possess flexible tarsi (e.g., *Trechalea* Thorell 1869, *Trechaleoides* Carico 2005, and *Paratrechalea* Carico 2005), which may be helpful in locomotion on the surface of the water during foraging. The habitat of the spiders of this family is the vegetation near the margins of rocky streams and small rivers (Carico 1993). In this work we present the first revision of the genus *Enna*.

Based on museum specimen labels, the representatives of *Enna* seem to inhabit rocky stream margins, like some other trechaleid species found in Brazil with which we are familiar, e.g., *Paratrechalea ornata* (Mello-Leitão 1943), *Trechaleoides keyserlingi* (F.O. Pickard-Cambridge 1903) and *Trechalea bucculenta* (Simon 1898).

In this work we redescribe five of the six previously known species (Platnick 2007), while the sixth, *E. approximata* (O. Pickard-Cambridge 1893), is considered a *nomen dubium*. By describing eighteen new species, we increase considerably the size of the genus as well as enlarge the known geographical distribution of the genus in Central and South America (Figs. 4, 5). Despite the fact that this genus contains numerous species, each is known from very few specimens from very few localities. For example, *E. velox*, the type-species of the genus, is known only from a single locality in the most northern extent of the generic range in southern Mexico (Fig. 4). Seven additional species are found in Central America in a linear sequence (Fig. 4) similar to the distribution of three species of *Trechalea* Thorell 1869 (Carico 1993) found in the same general area. In South America, there are 15 species scattered from Venezuela to central Bolivia (Fig. 5), each also with very limited distributional ranges. Two species, *E. jullieni* (Simon 1898) and *E. minor* Petrunkevitch 1925, have localities recorded from both Central America and South America. The very scattered nature of these species distributions suggests a considerable tendency towards endemism with small ranges, and we can therefore expect to find several more species with further collecting, particularly in remote areas in South America yet to be sampled adequately.

METHODS

The material examined belongs to the following institutions: American Museum of Natural History, New York (AMNH); The Natural History Museum, London (BMNH); California Academy of Sciences, San Francisco (CAS); Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil (MCN); Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil (MCTP); Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ); Musèum National d'Histoire Naturelle, Paris (MNHN); Museu Nacional do Rio de Janeiro, Brazil (MNRJ); Museu Paraense Emílio Göeldi, Belém, Pará, Brazil (MPEG); Museu de Zoologia da Universidade de São Paulo, Brazil (MZSP); Peabody Museum of Natural History, Yale University, New Haven, Connecticut (PMNH); Coleção do Departamento de Zoologia da Universidade Federal de Brasília, Distrito Federal (UnB).

The nomenclature of the male palpus and female epigynal structures follows Sierwald (1989), Carico (1993, 2005a, 2005b), Silva & Lise (2006), and Silva et al. (2006, 2007). To study some of the epigyna, the soft tissue was removed by a combination of dissection with a small surgical blade and immersion in 10% KOH for 12 h at 25° C. The scanning electron micrographs (SEM) were made with a Philips XL 30 of Centro de Microscopia e Microanálises (CEMM) of

Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). All the measurements are in millimeters. Differences in drawing styles in this article are the result of difficulties in international exchange of specimens for study.

The following abbreviations are used throughout the manuscript: AME, anterior median eye; ALE, anterior lateral eye; CO, copulatory ducts; DD, dorsal division of median apophysis; DT, distal tooth of median apophysis; ECD, ectal division of retrolateral tibial apophysis (RTA); END, ental division of RTA; G, guide; HS, head of spermathecae; LC, lower claw; LL, lateral lamella; LP, lateral projection of RTA; MF, middle field of epigynum; MOQ, median ocular quadrangle; PLE, posterior lateral eye; PME, posterior median eye; RTA, retrolateral tibial apophysis; S, spermatheca; ST, subtegulum; T, tegulum; TO, tarsal organ; UC, upper claw; VD, ventral division of median apophysis; VP, ventral protuberance of male palpal tibia.

TAXONOMY

Family Trechaleidae Simon 1890

Diagnosis.—The spider family Trechaleidae can be diagnosed as follows: eyes arranged in two rows, presence of a tibial apophysis and a ventrodistal refolded rim on male palpal tibia; male palpus with a large median apophysis with a dorsal embolic groove extending into the guide; female epigynum generally heavily sclerotized, dark and opaque, the epigynal plate is conspicuous and the anterior field wide and usually distinct from the lateral lobes and the female builds a discoid and flattened egg sac, fixed and carried on the spinnerets (Carico 1993).

Genus *Enna* O. Pickard-Cambridge 1897

Enna O. Pickard-Cambridge 1897:232, figs. 13 a, b, c; Roewer 1954:113; Bonnet 1956:1656-1657; Carico 1986:305; Sierwald 1990:8; Carico 1993:226; Sierwald 1993:63; Platnick 2007.

Type species.—*Enna velox* O. Pickard-Cambridge 1897, by original designation.

Diagnosis.—This genus resembles *Dossenus* Simon, 1898 by the general shape of the dorsal division of the median apophysis which is concave and ends in an acute guide (Figs. 9, 10) and by the tarsi and metatarsi that are short and straight compared to the long and flexible tarsi of *Trechalea* Thorell 1869 and *Trechaleoides* Carico 2005. The dorsal division of the median apophysis is always larger than the ventral division and is usually concave. The guide of the distal portion of the dorsal division of the median apophysis is curved, directed retrolaterally, and narrowed to an acute point. The ventral division of the median apophysis is absent or extremely reduced, e.g., *E. estebanensis* (Simon), *E. colonche* new species and *E. caliensis* new species (Figs. 58, 59, 67, 81, 82). The ectal division of the retrolateral tibial apophysis is prominent, generally with a small lateral translucent but sclerotized projection (LP, Fig. 1). The middle field of the epigynum is conspicuous, hood-like, concave beneath, and comprises part of the dorsal rim of the epigastric furrow. Internally, each side of the epigynum has a large, conspicuous globose dorsal spermatheca and a small ventral spermatheca (Fig. 2).

Description.—Carapace moderately high (Figs. 63, 86, 98). Anterior eye row straight to moderately recurved, posterior recurved (Figs. 6, 17, 62, 85, 99, 133). Cheliceral paturon usually enlarged in males, some species with conspicuous lateral carina (Figs. 63, 134); females with setaceous chelicerae. Promargin and retromargin of left cheliceral fang furrow with three teeth equidistant and equal in size, some species present four teeth on right promargin (Fig. 136). Leg lengths variable, usually leg III smallest; all tarsal claws pectinated, number of teeth on upper claws varying from eight to thirteen and lower claw with only one long and slender tooth (Figs. 28, 29, 56, 96, 111, 143). Tarsal organ conspicuous (Figs. 52, 53, 108, 109, 139, 140). Ventral pairs of macrosetae on tibiae: I-4; II-4; III-3; IV-3 or 4 (Figs. 51, 131, 132). Bothrium of trichobothria with conspicuous hood (Figs. 26, 27, 55, 110, 141).

Male palpus (Figs. 1, 2) with rounded and concave median apophysis (Fig. 1), its dorsal division is curved. Guide pointed retrolaterally and acuminate (Fig. 1). Ventral division of the median apophysis absent in some species (Figs. 9, 13, 35, 73, 90, 93) and conspicuous (Figs. 100, 104, 114, 117) or extremely reduced (Figs. 58, 67, 81). Retrolateral tibial apophysis prominent, ectal division prominent, with a small translucent lateral projection (LP) (Figs. 95, 106); ental division usually smaller than ectal division (Figs. 8, 14, 34, 59, 66, 73, 80). Female epigynum, small, with middle field convex or elevated with posterior margin slightly projected (Figs. 11, 45, 61, 70, 84, 150); spermatheca longer than wide, head of spermatheca with rounded or elliptical shape (Figs. 10, 15, 19, 38, 41, 60, 69, 83, 149).

Distribution.—Members of this genus have been found in North America (southern Mexico) and Central America (Panama, Ecuador, Honduras, Costa Rica) to northern South America (Peru, Bolivia, Colombia, Venezuela, Brazil) (Figs. 4, 5).

Natural history.—Based on the collection data on the labels with some species, these spiders seem to inhabit wet areas near rivers and small rocky streams.

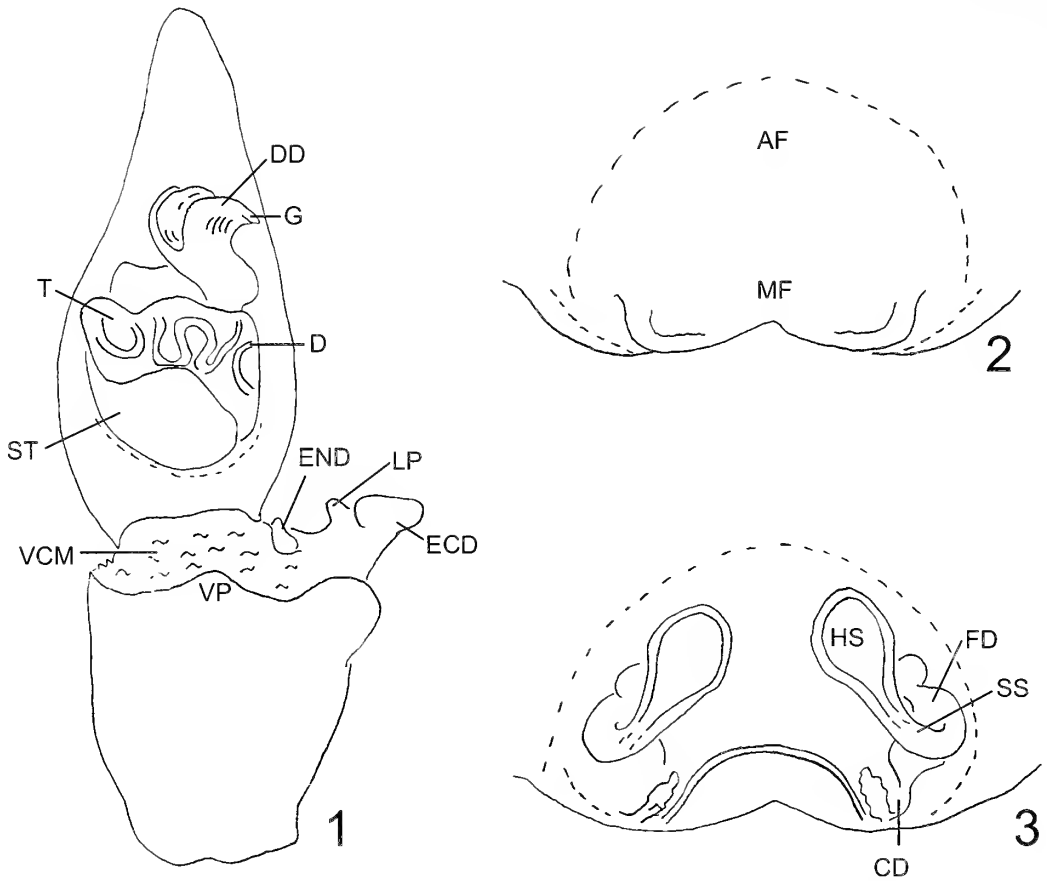
Enna velox O. Pickard-Cambridge 1897
Figs. 4, 6–11

Enna velox O. Pickard-Cambridge 1897:232, figs. 2, 3, F.O. Pickard-Cambridge 1901:311, figs. 13, 14; Simon 1903:1046; Banks 1909:215; Petrunkevitch 1911:544; Petrunkevitch 1928:101; Roewer 1954:113; Bonnet 1956:1657; Platnick 2007.

Type material.—Male holotype: MEXICO: *Tabasco*: Teapa, 21°52′N, 102°55′W, H.H. Smith (BMNH 1905.4.28.864-873). Female paratype: same data as holotype (BMNH 1905.4.28.864-873).

Diagnosis.—This is the only species of *Enna* in which males have a small distal tooth (DT) on the guide (Figs. 8, 9). The lateral projection of the ectal division of the retrolateral tibial apophysis (RTA) is large compared to the size of ental division of RTA and acuminate (Fig. 7). This is the only species in which the female epigynum has the posterior margin medially indented, with two sinuous paramedian grooves (Fig. 11).

Description.—*Male (holotype):* Carapace (Fig. 6), 4.10 long, 3.50 wide, brown, darker on cephalic area, with indistinct submarginal lighter bands that do not extend



Figs. 1–3.—Diagrammatic genitalia of *Enna*. 1. Left male palpus, ventral view; 2, 3. Female genitalia; 2. Ventral view; 3. Dorsal view. Abbreviations: AF, anterior field of epigynum; CD, copulatory duct; D, duct; DD, dorsal division of median apophysis; ECD, ectal division of retrolateral tibial apophysis; END, ental division of retrolateral tibial apophysis; FD, fertilization duct; G, guide; HS, head of spermathecae; LP, lateral projection of ECD; MF, middle field of epigynum; SS, stalk of spermathecae; ST, subtegulum; T, tegulum; VD, ventral division of median apophysis; VCM, ventral cymbio-tibial membrane; VP, ventral protuberance of male palpal tibia.

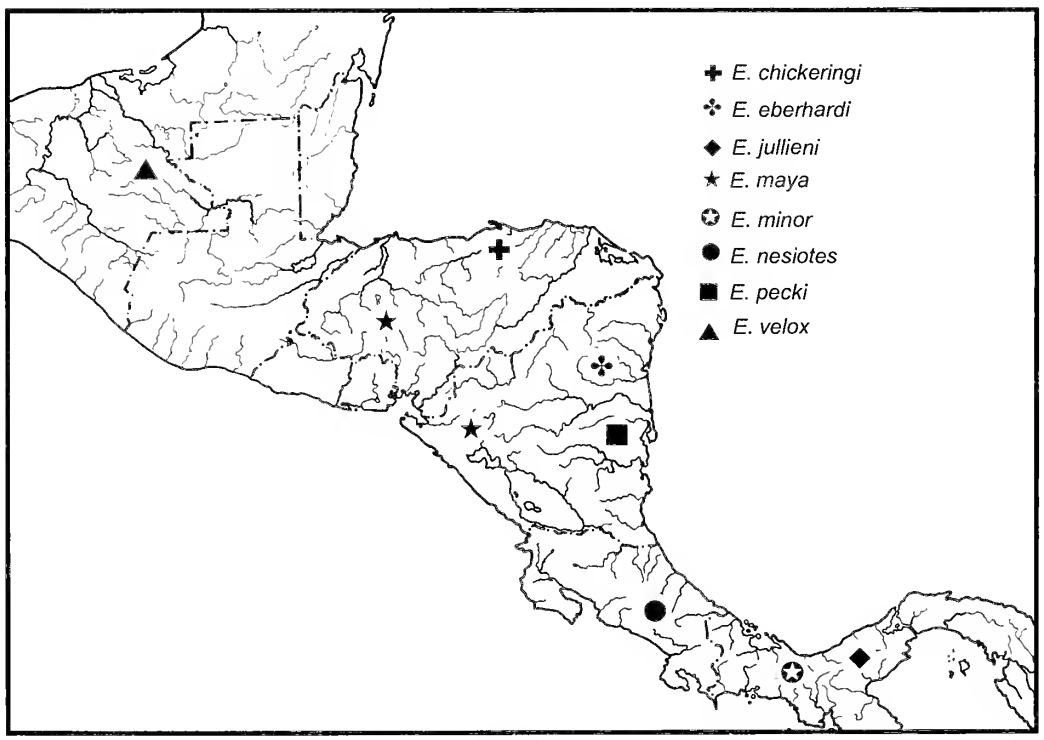


Fig. 4.—Distribution of *Enna* species in Central America.

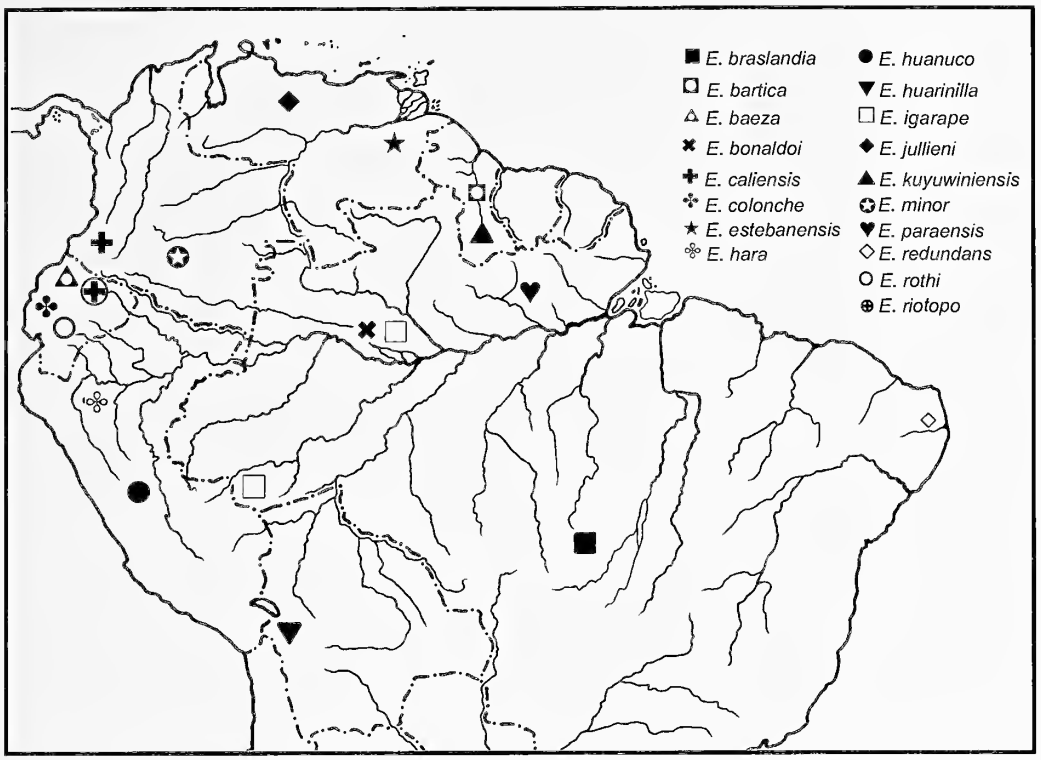


Fig. 5.—Distribution of *Enna* species in South America.

posteriorly, three light spots on each lateral margin (Fig. 6). Clypeus dark brown, lighter medially, 0.40 high. Anterior eye row straight, 1.04 wide; posterior 1.86 wide. Eye diameters, interdistances, and median ocular quadrangle: AME 0.27, ALE 0.19, PME 0.27, PLE 0.30; AME–AME 0.15, AME–ALE 0.05, PME–PME 0.56, PME–PLE 0.34, MOQ, 0.67 long, frontal view, anterior width 0.70, posterior width 1.04. Chelicerae reddish brown, slightly lighter distally, enlarged anteriorly with a flattened area above fangs, without lateral carina; promargin and retromargin of fang furrow with three teeth equidistant and equal in size. Sternum light brown, darker at margins; 1.90 long, 1.92 wide. Labium brownish, lighter at anterior margin, darker laterally; 1.28 long, 0.76 wide. Legs light brown, relative length: I-IV-II-III, I – femur 4.60/ tibia-patella 6.50/ metatarsus 4.80/ tarsus 2.20/ total 18.10; II – 4.60/ 6.20/ 4.50/ 1.90/ 17.20; III – 3.70/ 4.60/ 3.60/ 1.50/ 13.40; IV – 4.50/ 5.70/ 5.20/ 2.00/ 17.40. Abdomen dorsum and sides with very faint light markings due to age of preserved specimen (Fig. 6). Venter light brown, scattered setae. Ventral division of median apophysis absent (Figs. 8, 9); guide with a small tooth distally (Fig. 9). Retrolateral tibial apophysis (RTA) prominent, ectal division rounded at apex (Fig. 7); ental division small and subtriangular (Fig. 8).

Female (paratype): Carapace 3.60 long, 3.61 wide, light brown, darker anteriorly, indistinct submarginal lighter bands. Clypeus dark brown, lighter at anterior-medial margin, 0.28 high. Anterior eye row straight, 0.94 wide; posterior 1.70 wide. AME 0.25, ALE 0.21, PME 0.30, PLE 0.29; AME–AME 0.13, AME–ALE 0.04, PME–PME 0.48, PME–PLE 0.30, MOQ, 0.63 long, frontal view, anterior width 0.58, posterior width 0.94. Chelicerae: reddish brown; promargin of fang furrow with three teeth, middle largest, proximal smallest, retromargin with three teeth equidistant and equal in size. Sternum light brown, darker at margins; 0.86 long, 0.91 wide. Labium light brown, lighter at anterior margin, darker laterally at base; 0.40 long, 0.34 wide. Legs light brown, I – missing; II – femur 4.50/ tibia-patella 5.90; III – femur 4.00/ tibia-patella 4.50/ metatarsus 3.50/ tarsus 1.50/ total 13.50. Abdomen dorsum light and with indistinct pattern, mostly devoid of setae except at antero-dorsal margin. Epigynum with anterior field wide, middle field elevated with two small projections on posterior margin (Fig. 11). Spermathecae short, rounded at apex (Fig. 10).

Distribution.—This species has only been collected from a single location in Mexico (Tabasco) (Fig. 4).

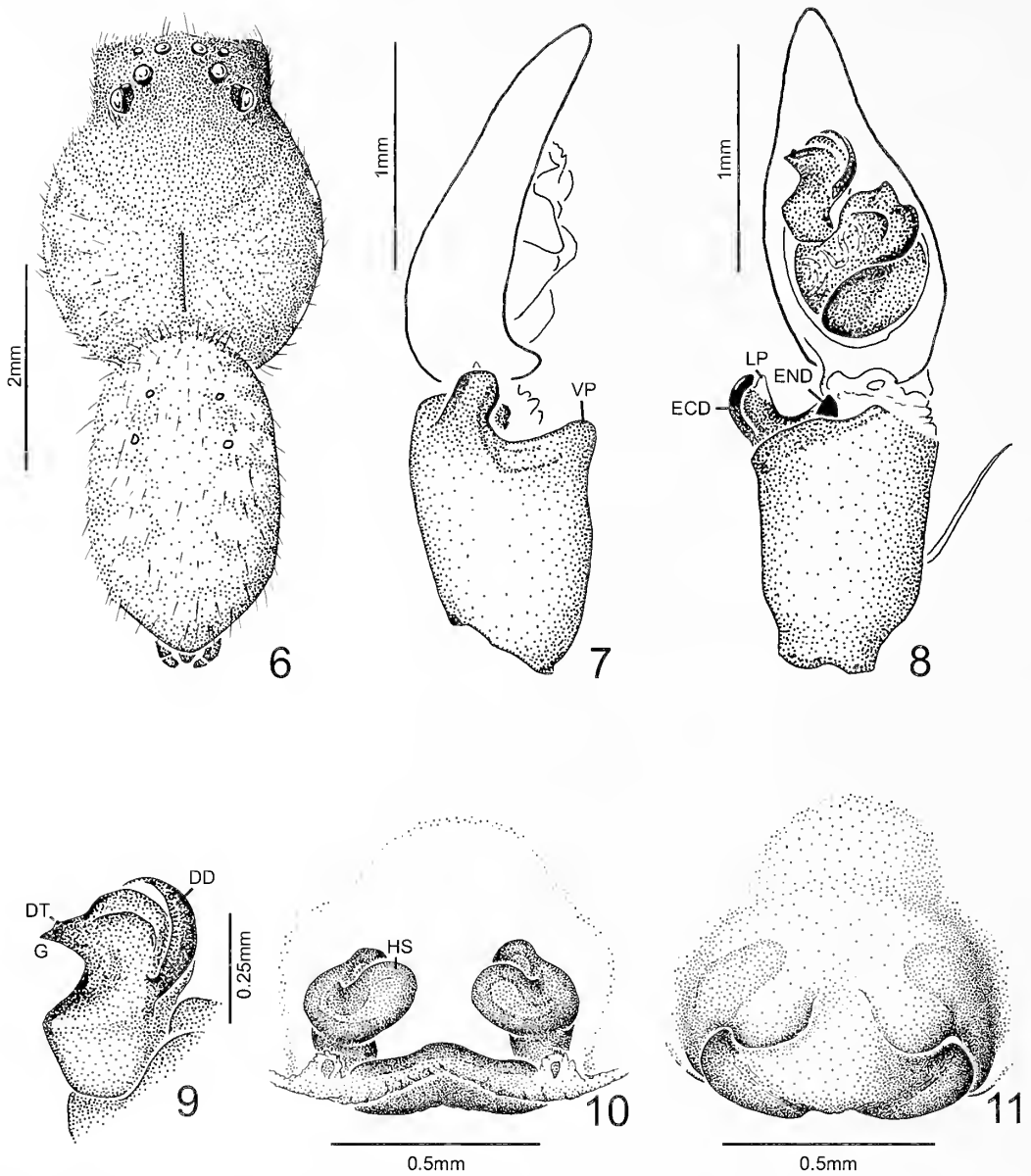
Enna eberhardi new species
Figs. 4, 12–16

Type material.—Holotype male, PANAMA: Boquete, 10°07′N, 85°21′W, 14 August 1983, W. Eberhard et al. (MCZ 69711). Female paratype, same locality as holotype (MCZ 69712).

Other material examined.—COSTA RICA: *San Jose*: 4 ♀, San Antonio de Iscazu, 10°58′N, 85°08′W, July 1983, W. Eberhard (MCZ 67209, 67211, 67212, 67213), 1 ♀ same data except 14 August 1983, J.E. Carico (MCZ 69713); *Bajo la Hondura*: 1 ♀, Braulio Carrillo, 26 July 1983, W. Eberhard (MCZ63819).

Etymology.—The specific name is a patronym in honor of the collector of the types, W.G. Eberhard.

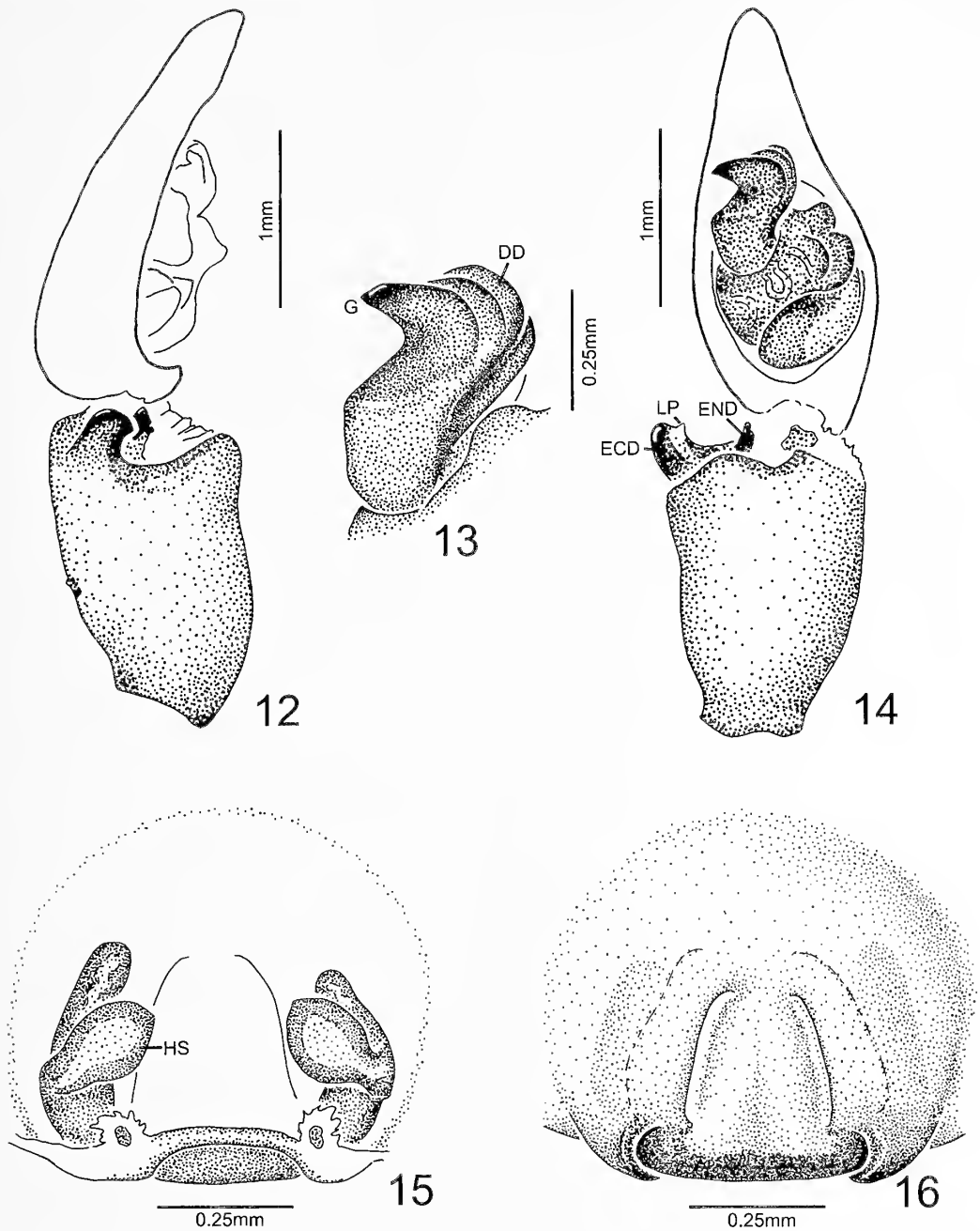
Diagnosis.—The males of *E. eberhardi* are similar to those of *E. velox* in the general shape of the median apophysis (Figs. 7–9), but can be distinguished by the absence of the distal tooth on the guide (Figs. 13, 14) and the shorter ectal division of the



Figs. 6–11.—*Enna velox*. 6. Male, dorsal view. 7–9. Right male palpus: 7. Retrolateral view; 8. Ventral view; 9. Detail of median apophysis. 10, 11. Epigynum: 10. Dorsal view; 11. Ventral view. Abbreviations: DD, dorsal division of median apophysis; DT, distal tooth of median apophysis; G, guide; HS, head of spermathecae; LP, lateral projection of RTA; ECD, ectal division of RTA; END, ental division of RTA; VP, ventral protuberance of male palpal tibia.

retrolateral tibial apophysis (Fig. 12). The female epigynum is flattened, straight and smooth at the posterior margin, bearing two rounded projections laterally (Fig. 16).

Description.—*Male (holotype):* Carapace 3.90 long, 3.20 wide, brown, darker on cephalic area, with indistinct submarginal lighter bands, three light spots on each lateral margin. Clypeus brownish, lighter medially, 0.30 high. Anterior eye row straight to slightly recurved, 0.94 wide; posterior 1.66 wide. AME 0.20, ALE 0.14, PME 0.28, PLE 0.30; AME–AME 0.12, AME–ALE 0.04, PME–PME 0.40, PME–PLE 0.25, MOQ, 0.58 long, frontal view, anterior width 0.55, posterior width 0.92. Chelicerae expanded anteriorly, without flattened area or lateral carina, reddish brown, slightly lighter distally; promargin with three teeth, middle largest and retromargin of left cheliceral fang furrow with three teeth equidistant and equal in size on right side and one retromarginal on right one. Sternum light brown, darker at margins; 3.70 long, 3.50 wide. Labium light brown, lighter at anterior margin, darker laterally; 0.80 long, 0.65 wide. Legs light brown, relative length: I-II-IV-III, I – femur 4.50/ tibia-patella 6.20/ metatarsus 4.70/ tarsus 2.00/ total 17.40; II – 4.70/ 6.20/ 4.60/ 1.90/ 17.40; III – 3.90/ 4.70/ 3.70/ 1.40/ 13.70; IV – 4.60/ 5.70/ 5.40/ 1.90/ 17.00. Abdomen rounded, dorsum light brown with three parallel longitudinal light marks anteriorly and six pairs of light spots posteriorly, sides with scattered light marks. Venter light, with scattered setae. Palpus with small lateral projection (LP), almost same size of ental division of retrolateral tibial apophysis (Fig. 14). Retrolateral tibial



Figs. 12–16.—*Enna eberhardi*. 12–14. Right male palpus: 12. Retrolateral view; 13. Detail of median apophysis; 14. Ventral view. 15, 16. Epigynum: 15. Dorsal view; 16. Ventral view. Abbreviations: DD, dorsal division of median apophysis; G, guide; HS, head of spermathecae; LP, lateral projection of RTA; ECD, ectal division of RTA; END, ental division of RTA.

apophysis prominent, ectal division with curved apex (Fig. 12).

Female (paratype): Carapace 3.30 long, 2.90 wide, light brown, dark on cephalic area, indistinct submarginal lighter bands, except posteriorly and three light spots on each lateral margin. Clypeus light brown, lighter medially, 0.26 high. Anterior eye row straight to slightly recurved, 0.86 wide; posterior 1.66 wide. AME 0.20, ALE 0.14, PME 0.24, PLE 0.30; AME–AME 0.12, AME–ALE 0.06, PME–PME 0.50, PME–PLE 0.30, MOQ, 0.58 long, frontal view, anterior width 0.86, posterior width 0.96. Chelicerae reddish brown, slightly lighter distally; promargin with three teeth, middle largest and retromargin of right cheliceral fang furrow with three teeth equidistant and equal in size. Sternum light brown, darker at margins; 1.54 long, 1.60 wide. Labium brownish, lighter at anterior margin, darker laterally; 0.66 long, 0.60 wide. Legs light brown, indistinct maculae dorsally, relative length: I-IV-II-III, I – femur 3.60/ tibia-patella 5.00/ metatarsus 3.40/ tarsus 1.50/ total 13.50; II – 3.70/ 4.70/ 3.20/ 1.40/ 13.00; III – 3.20/ 3.70/ 2.80/ 1.20/ 10.90; IV – 3.70/ 4.40/ 3.90/ 1.50/ 13.50. Abdomen, rounded, dorsum dark brown with three pairs of light spots, sides diffuse and with scattered light brown spots. Venter light brown, with scattered setae. Epigynum with posterior margin straight, middle field with two concave

grooves (Fig. 16). Spermathecae short and head of spermathecae elliptical (Fig. 15).

Variation.—Five females, carapace length 2.8–3.5; 2.4–2.9 wide.

Distribution.—This species is only known from Panama (Boquete) and Costa Rica (San Jose) (Fig. 4).

Remarks.—The male holotype is missing right leg I. The female allotype is missing right leg IV.

Enna nesiotes Chamberlin 1925
Figs. 4, 17–19

Enna nesiotes Chamberlin 1925:224; Roewer 1954:113; Bonnet 1956:1657; Platnick 2007.

Type material.—Holotype female: PANAMA: Barro Colorado Island, 09°09′N, 79°50′W, W.C. Allee (MCZ 1290).

Diagnosis.—The females of *E. nesiotes* can be distinguished from the other females of *Enna* by bearing two rounded deep excavations in the middle field of the epigynum (Fig. 18).

Description.—*Female (holotype):* Carapace (Fig. 17) 3.50 long, 3.00 wide, dark brown, lighter on cephalic area, irregular, lighter sub-marginal bands, three light spots on each lateral margin. Clypeus brown, lighter medially, 0.28 high. Anterior eye row straight, 0.92 wide; posterior 1.70 wide. AME 0.22, ALE 0.18, PME 0.28, PLE 0.30; AME–AME 0.13, AME–ALE 0.04, PME–PME 0.49, PME–PLE 0.30, MOQ, 0.64 long, frontal view, anterior width 0.55, posterior width 0.98. Chelicerae light reddish brown, slightly lighter distally; promargin with three teeth, middle largest and retromargin of fang furrow with three teeth equidistant and equal in size. Sternum light brown, darker on margins; 1.54 long, 1.60 wide. Labium brown, lighter on anterior margin, darker laterally; 0.70 long, 0.64 wide. Legs light brown, alternating light and dark bands, darker dorsally, relative length: IV-I-II-III, I – femur 3.60/ tibia-patella 5.00/ metatarsus 3.40/ tarsus 1.60/ total 13.60; II – 3.70/ 5.00/ 3.40/ 1.50/ 13.60; III – 3.20/ 3.90/ 2.90/ 0.80/ 10.80; IV – 3.80/ 4.50/ 4.00/ 1.50/ 13.80. Abdomen dorsum light brown at cardiac area, parallel series of light spots lateral to cardiac area and sides with scattered light setae (Fig. 17). Venter light brown with scattered setae. Epigynum with posterior margin slightly projecting (Fig. 18); spermathecae rounded and narrower distally (Fig. 19).

Distribution.—This species is known only from the type locality in Panama (Fig. 4).

Enna chickeringi new species
Figs. 4, 20, 21

Type material.—Female holotype: HONDURAS: Lancetilla, 15°42′N, 87°28′W, 19 July 1929, A.M. Chickering (MCZ 63821). Paratype: 1 female, same locality as holotype (MCZ 63822).

Etymology.—The specific name is a patronym in honor of the collector of the type, A.M. Chickering.

Diagnosis.—The female of *E. chickeringi* is similar to that of *E. colonche* by having an excavation on the posterior margin of the epigynum (Fig. 61), but can be distinguished by bearing a heavily sclerotized margin and having a deeper excavation on the posterior margin (Fig. 21).

Description.—*Female (holotype):* Carapace 2.80 long, 2.50 wide, pale brown. Clypeus light brown, 0.22 high. Anterior eye row straight, 0.57 wide; posterior 1.46 wide. AME 0.18, ALE 0.12, PME 0.24, PLE 0.27; AME–AME 0.13, AME–ALE 0.03, PME–PME 0.46, PME–PLE 0.24, MOQ, 0.45 long, dorsal view, frontal view 0.50, anterior width 0.52, posterior width 0.82. Chelicerae reddish-brown; promargin with three teeth, median largest and retromargin of fang furrow with three equidistant and equal in size. Sternum dark brown 1.50 long, 1.40 wide. Labium light brown, yellowish at anterior margin; 0.60 long, 0.52 wide. Legs yellowish, without distinct pattern, relative length: I-IV-III, I – femur 3.10/ tibia-patella 4.40/ metatarsus 2.90/ tarsus 1.40/ total 11.80; II – missing; III – 2.80/ 3.30/ 2.40/ 1.00/ 9.00; IV – 3.10/ 3.80/ 3.30/ 1.50/ 11.70. Abdomen rounded, with scattered setae, dorsum brownish, with numerous whitish spots and paramedian brownish bands, yellowish laterally, venter light brown. Middle field of epigynum with two long paramedian grooves (Fig. 21); head of spermathecae short and circular (Fig. 20).

Distribution.—This species is known only from the type locality in Honduras (Fig. 4).

Remarks.—The holotype is missing right leg II.

Enna minor Petrunkevitch 1925
Figs. 4, 5, 22–29

Enna minor Petrunkevitch 1925:167, 168, fig. 68; Roewer 1954:113; Bonnet 1956:1656; Platnick 2007.

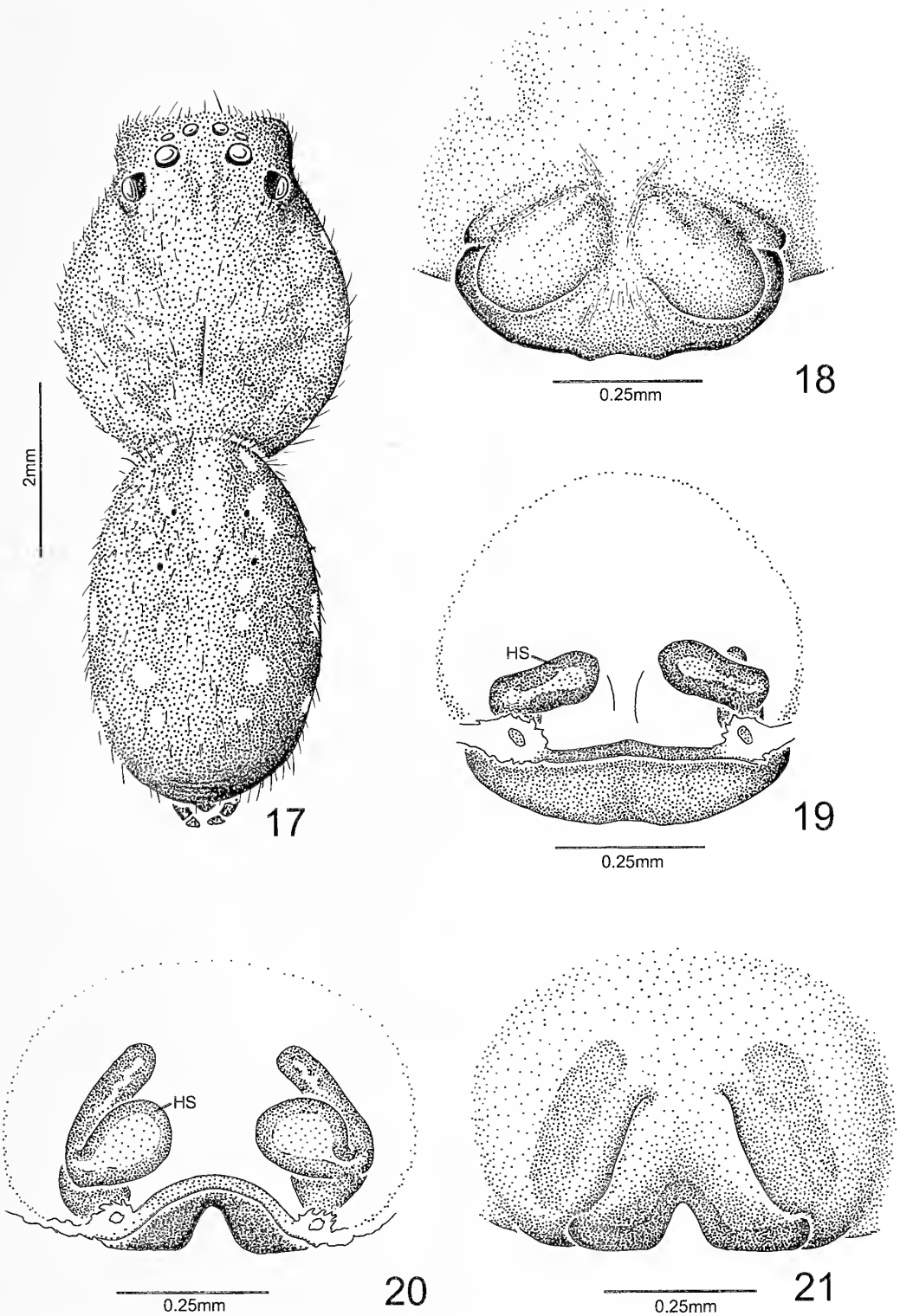
Type material.—Holotype female: PANAMA: Santiago, 08°06′N, 80°59′W (PMNH).

Other material examined.—COLOMBIA: *Departamento de Santander*: 1 ♀, Hacienda La Estrella, Quebrada, Oquina, 9°15′N, 73°34′W, 28 February 1959 (AMNH).

Diagnosis.—The female epigynum of *E. minor* (Fig. 23) is similar to that of *E. julieni* (Fig. 32) by having a small projection on the middle field of the epigynum, but can be distinguished by a longer and narrower median projection on the posterior margin of the epigynum and by the two lateral projections fitted in a large, middle scape (Fig. 23).

Description.—*Female (holotype):* Carapace (Fig. 22) 5.14 long, 4.81 wide; pale brown, darker laterally. Clypeus light brown, darker laterally, 0.40 high. Anterior eye row slightly recurved, 1.24 wide; posterior 2.13 wide. AME 0.24, ALE 0.22, PME 0.27, PLE 0.21; AME–AME 0.18, AME–ALE 0.12, PME–PME 0.55, PME–PLE 0.34, MOQ, 0.71 long, dorsal view, frontal view 0.74, anterior width 0.65, posterior width 1.12. Chelicerae reddish brown with thin and small brownish setae; promargin and retromargin of fang furrow with three subequal and equidistant teeth. Sternum yellowish with numerous light setae; 2.17 long, 2.48 wide. Labium orange, light at posterior margin; 0.62 long, 0.77 wide. Legs dark brown, femora with pale brown spots dorsally, relative length: I-IV-II-III, I – femur 7.22/ tibia-patella 9.71/ metatarsus 6.72/ tarsus 2.98/ total 26.63; II – 7.04/ 8.24/ 7.31/ 2.93/ 25.32; III – 6.05/ 6.88/ 5.47/ 3.15/ 21.55; IV – 7.71/ 9.70/ 9.04/ -/ 26.45. Dorsal surface of legs with modified chemosensitive setae (Fig. 25). Trichobothria with distinct hood (Figs. 26, 27). Tarsal claw pectinated, upper claw with eleven teeth and lower claw with one short, slender tooth (Figs. 28, 29). Abdomen grayish, setaceous, light brown ventrally. Epigynum with posterior margin projected (Fig. 23); spermathecae long and slender; head of spermathecae rounded (Fig. 24).

Distribution.—This species is known from Panama and Colombia (Figs. 4, 5).



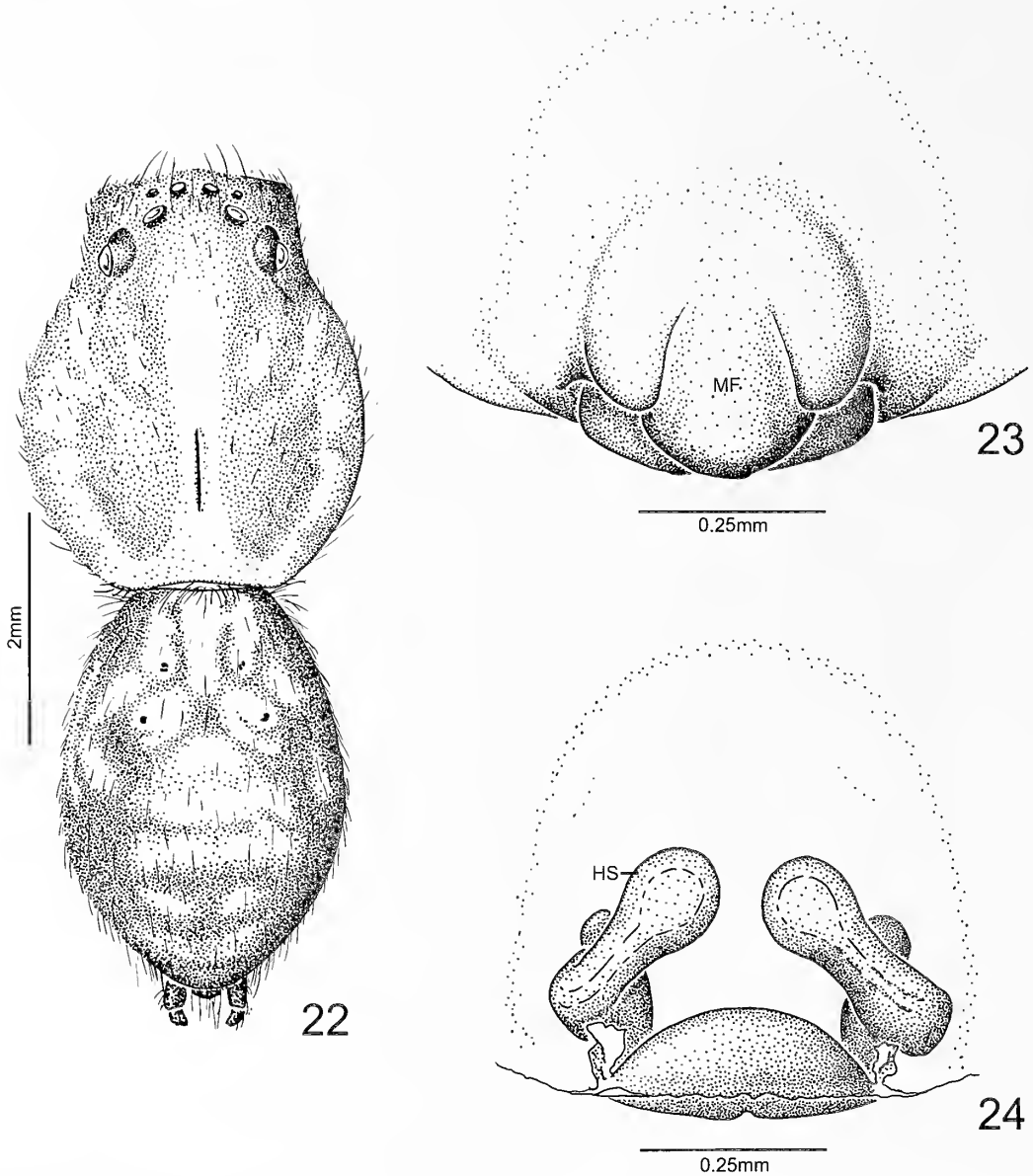
Figs. 17–21.—*Enna* spp. 17–19. *E. nesiotes*: 17. Female, dorsal view; 18. Epigynum ventral view; 19. Epigynum dorsal view. 20, 21. *E. chickeringi* epigynum: 20. Dorsal view; 21. Ventral view. Abbreviations: HS, head of spermathecae; LP, lateral projection of RTA.

Enna jullieni (Simon 1898)
Figs. 4, 5, 30–33

Hesydrus jullieni Simon 1898:20.
Enna jullieni (Simon): F.O. Pickard-Cambridge 1901:312; Roewer 1954:113; Bonnet 1956:1656; Platnick 2007.

Type material.—Holotype female: PANAMA: Obispo, Jullien (MNHN 9692).

Other material examined.—PANAMA: Jullien, 1 ♀ (MNHN 9692). COLOMBIA: *Antioquia*: 1 ♀, Mutatá, 07°14′N, 76°26′W, December 1963, P.B. Schneble (MCZ).



Figs. 22–24.—*Enna minor*. 22. Female, dorsal view; 23, 24. Epigynum: 23. Ventral view; 24. Dorsal view. Abbreviations: MF, middle field of epigynum; HS, head of spermathecae.

Diagnosis.—The female epigynum of *E. jullieni* (Fig. 32) is similar to that of *E. maya* (Fig. 39) by the shape of the middle field of the epigynum, but can be distinguished by the presence of a median scape-like projection, and by the middle field of the epigynum that is strongly projected (Fig. 31).

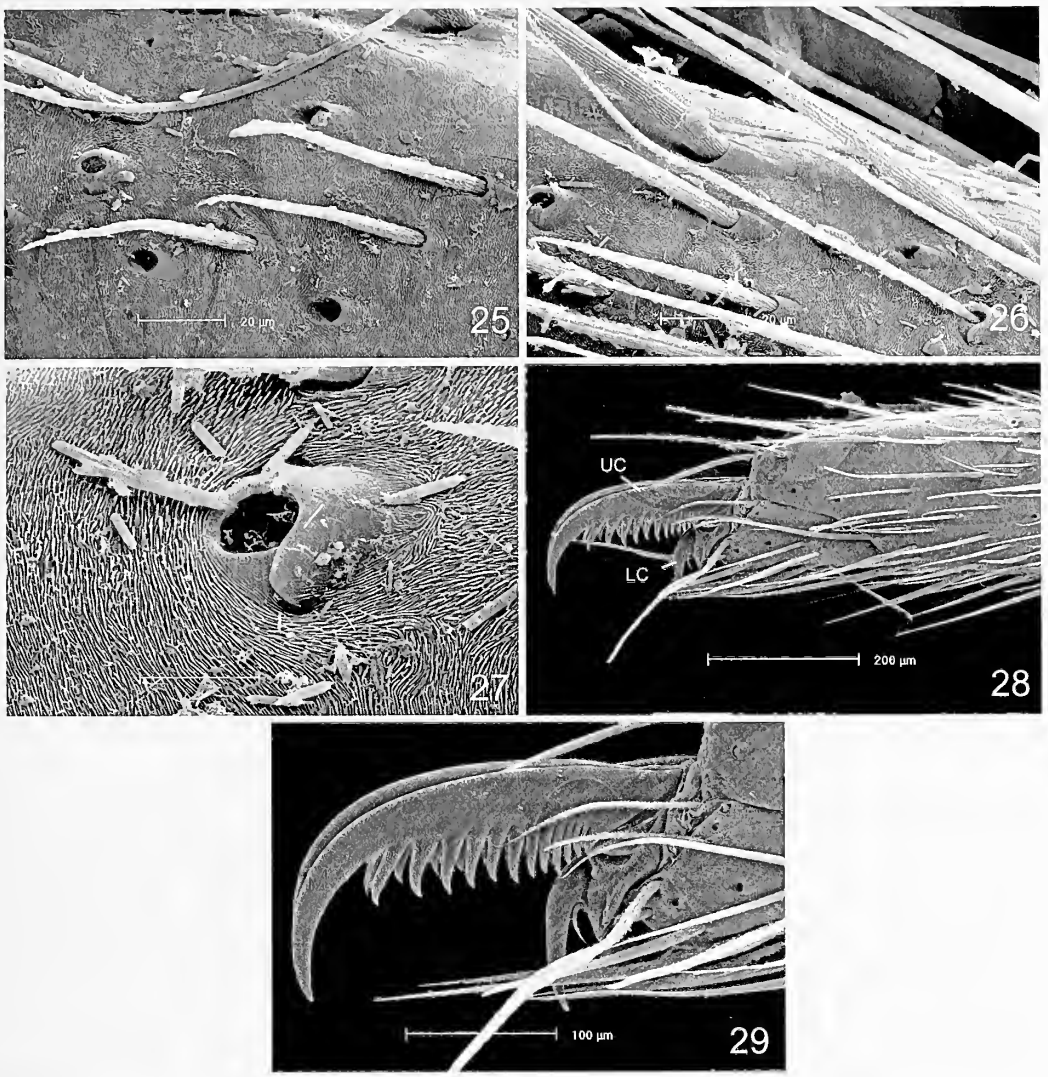
Description.—*Female (holotype):* Carapace (Fig. 30) 3.01 long, 2.53 wide; grayish laterally. Clypeus yellowish, 0.25 high. Anterior eye row slightly recurved, 0.75 wide; posterior 1.42 wide. AME 0.17, ALE 0.12, PME 0.25, PLE 0.25; AME–AME 0.15, AME–ALE 0.06, PME–PME 0.40, PME–PLE 0.31, MOQ, 0.40 long, dorsal view, frontal view 0.49, anterior width 0.81, posterior width 0.45. Chelicerae orange with small light setae; promargin and retromargin of fang furrow with three teeth equal in size and equidistant. Sternum yellowish with brown setae; 1.32 long, 1.40 wide. Labium orange, darker on anterior margin; 0.55 long, 0.49 wide. Legs yellowish, relative length: IV-I-II-III, I – femur 3.21/ tibia-patella 4.32/ metatarsus 3.02/ tarsus 1.32/ total 11.87; II – 3.12/ 4.12/ 2.83/ 1.19/ 11.26; III – 2.53/ 3.10/ 2.42/ 1.03/ 9.08; IV – 3.23/ 3.81/ 3.60/ 1.24/ 11.88. Abdomen rounded, setaceous, grayish (Fig. 30); venter yellowish. Middle field of epigynum with two lateral elevations, posterior margin divided and slightly projected (Figs. 31, 32). Head of spermathecae rounded and curved at base (Fig. 33).

Distribution.—Panama, Colombia, Venezuela (Figs. 4, 5).

Remarks.—The holotype has the abdomen and carapace disarticulated, all legs are detached, and female left palpus missing.

Enna braslandia new species
Figs. 5, 34–36

Type material.—Holotype male: BRAZIL: *Distrito Federal*: Braslândia, "Labirinto da Lama," 15°42′S, 48°13′W, 26 January 2004, F. Jordão (UnB 3097).



Figs. 25–29.—Morphological details of *E. minor*: 25. Chemosensitive setae on tarsus of leg IV; 26. General view of trichobothria on tarsus IV; 27. Bothrium; 28. Tarsal claw, general view; 29. Tarsal claw of leg IV. Abbreviations: LC, lower claw; UC, upper claw.

Etymology.—The specific name is a noun in apposition taken from the type locality.

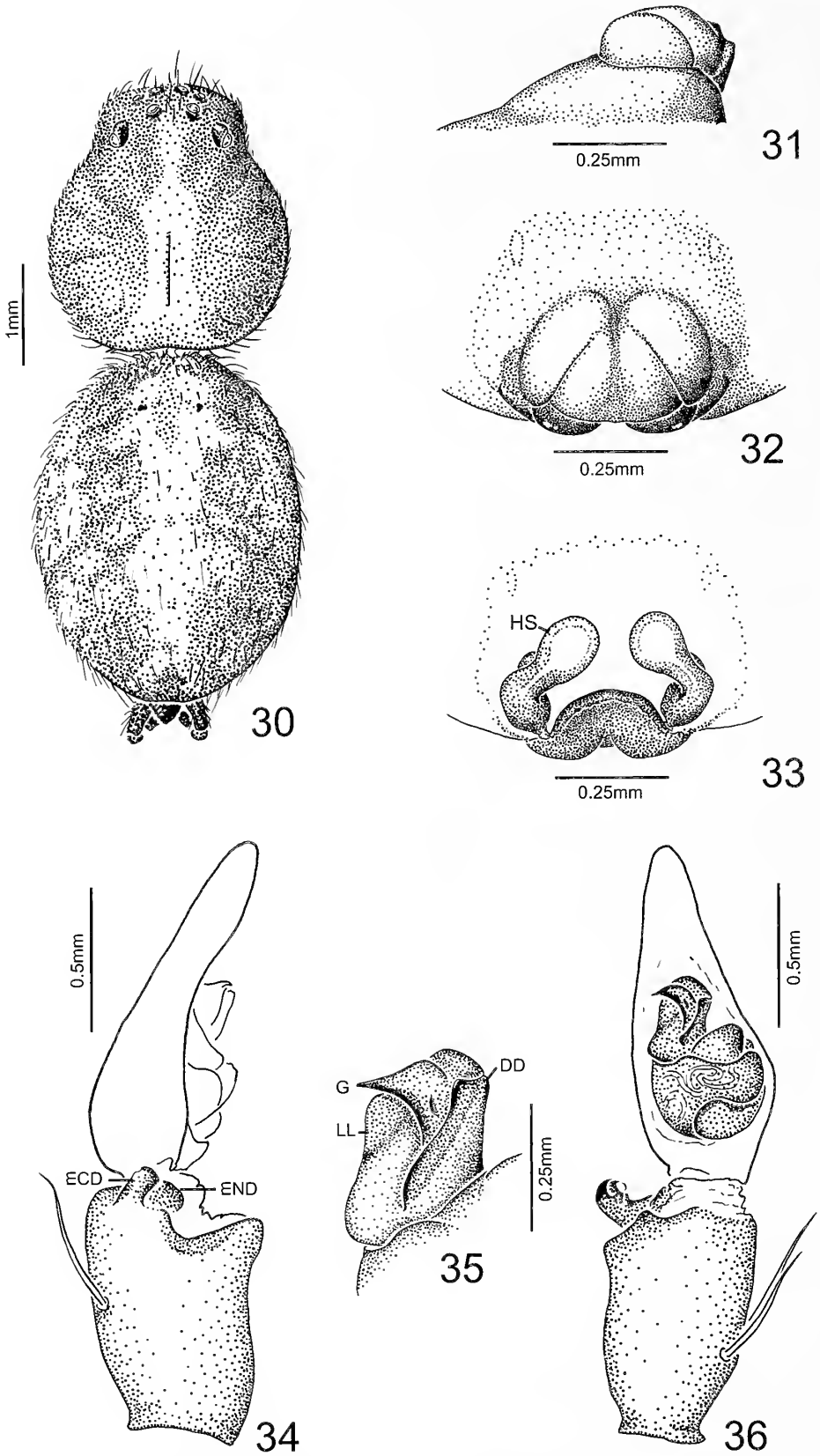
Diagnosis.—The male palpus of *E. braslandia* (Figs. 35, 36) resembles that of *E. huanuco* (Fig. 73) by the shape of the lateral lamella (LL) of the median apophysis, but can be differentiated by a long, slender and acute guide.

Description.—*Male (holotype):* Carapace 4.30 long, 3.50, yellowish, with indistinct submarginal band, lateral margins with three light brown spots; covered with short, dark, setae. Clypeus yellowish, 0.37 high. Anterior eye row straight, 0.92 wide; posterior 1.70 wide. AME 0.23, ALE 0.17, PME 0.30, PLE 0.33; AME–AME 0.10, AME–ALE 0.06, PME–PME 0.31, PME–PLE 0.35, MOQ, 0.64 long, dorsal view, anterior width 0.50, posterior width 0.84. Chelicerae dark reddish brown, irregular maculae on faces, lateral carina conspicuous on distal lateral third, no frontal flat surfaces; promargin with three teeth, middle largest; retromargin with three teeth, equal in length. Sternum pale yellow, 2.10 long, 1.90 wide. Labium dark brown, lighter on anterior margin, 0.84 long, 0.72 wide. Legs light yellow, alternating and indistinct dark markings on dorsal surface of femora, I – femur 6.10/ tibia-patella 8.80/ metatarsus 6.90/ tarsus 2.70/ total 24.50, II – 5.90/ 8.00/ 6.20/ 2.50/ 22.60, III – 4.60/ 5.30/ 4.30/ 1.70/ 15.90, IV – 5.90/ 7.00/ 7.20/ 2.50/ 22.60. Ventral pairs of macrosetae on tibiae: I-4, II-4, III-3, IV-4. Abdomen rounded, dorsum and sides light background color with diffuse pattern above and longitudinal bands laterally; ventrally, with many long dorsal setae, shorter ventrally. Palpus with ventral division of median apophysis absent; guide small and acuminate, without basal tooth (Figs. 35, 36). Retrolateral tibial apophysis with ectal division (ECD) prominent, rounded on apex (Fig. 34); lateral projection (LP) rounded. Ental division (END) small, bearing a semi-circular shape (Fig. 34).

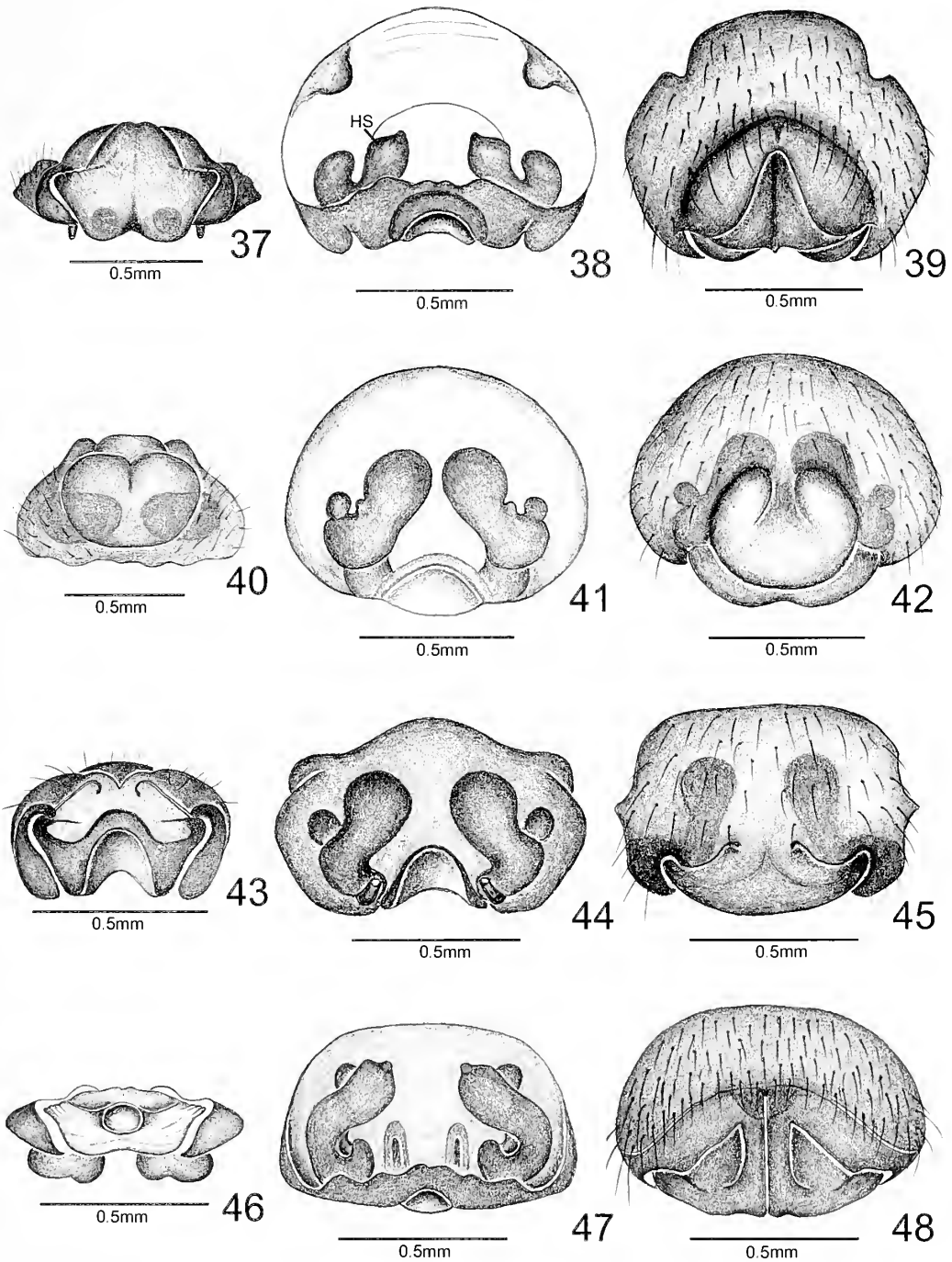
Distribution.—This species is known only from the type locality in Brazil (Fig. 5).

Enna maya new species
Figs. 4, 37–39

Type material.—Holotype female, HONDURAS: Copan, 14°55′S, 88°55′W, 8 March 1939 (AMNH). Paratype: 1 female: COSTA RICA: N. Banks (MCZ 63820).



Figs. 30–36.—*Enna* spp. 30–33. *Enna jullieni*: 30. Female, dorsal view; 31–33. Epigynum: 31. Lateral view; 32. Ventral view; 33. Dorsal view. 34–36. *E. braslandia*, right male palpus: 34. Retrolateral view; 35. Detail of median apophysis; 36. Ventral view. Abbreviations: DD, dorsal division of median apophysis; G, guide; HS, head of spermathecae; LL, lateral lamella; ECD, ectal division of RTA; END, ental division of RTA.



Figs. 37–48.—*Enna* spp., female epigyna. 37–39. *E. maya*: 37. Posterior view; 38. Dorsal view; 39. Ventral view. 40–42. *E. pecki*: 40. Posterior view; 41. Dorsal view; 42. Ventral view. 43–45. *E. paraensis*: 43. Posterior view; 44. Dorsal view; 45. Ventral view. 46–48. *E. rothi*: 45. Posterior view; 47. Dorsal view; 48. Ventral view.

Etymology.—The specific name is a noun in apposition and refers to the Mayan civilization, occupant of the type locality in the 16th century.

Diagnosis.—The female of *E. maya* is similar to that of *E. jullieni* (Fig. 31) by having a ventrally projected epigynum (Fig. 37), but can be distinguished by the median marginal projection (Fig. 39) of the posterior margin of the epigynum and the small projections on the head of spermathecae (Fig. 38).

Description.—*Female (holotype):* Carapace 4.39 long, 3.98 wide, orange, darker laterally. Clypeus dark brown, 0.31 high. Anterior eye row straight, 1.14 wide; posterior 2.07 wide. AME 0.27, ALE 0.15, PME 0.58, PLE 0.18; AME–AME 0.15, AME–ALE 0.12, PME–PME 0.55, PME–PLE 0.46, MOQ, 0.55 long, dorsal view, frontal view 0.65, anterior width 0.68, posterior width 1.48. Chelicerae orange with small light setae; promargin with three teeth equidistant, middle largest; retromargin with three teeth equidistant, subequal in size. Sternum

pale brown with dark setae; 1.92 long, 1.89 wide. Labium reddish brown, darker on posterior margin, 0.71 long, 0.68 wide. Legs light brown, yellowish ventrally, relative length: I-IV-II-III, I – femur 4.15/ tibia-patella 6.05/ metatarsus 4.16/ tarsus 1.66/ total 16.02; II – 4.23/ 5.64/ 4.06/ 1.24/ 15.17; III – 3.81/ 4.39/ 3.32/ 1.07/ 12.59; IV – 3.90/ 5.39/ 4.39/ 1.74/ 15.42. Abdomen oval, grayish, setaceous, indistinct light brown pattern dorsally, grayish ventrally. Middle field of epigynum with a median irregular projection (Figs. 37, 39). Spermathecae small, rounded with distal projections (Fig. 38).

Distribution.—Honduras (Copan), Costa Rica (Fig. 4).

Remarks.—The material is badly preserved, with thin euticle, left legs II and III missing, the left leg I missing the metatarsus and tarsus, and the left leg IV missing the tarsus.

Enna pecki new species
Figs. 4, 40–42

Type material.—Holotype female: COSTA RICA: *Guanacaste Debris*: Potrero Bagaces river, 10°00′N, 84°00′W, 7 July 1966, S. Peck (AMNH).

Etymology.—The specific name is a patronym in honor of the collector of the type, S.B. Peck.

Diagnosis.—The female of *E. pecki* resembles those of *E. velox* (Fig. 11) by bearing a rounded scape-like projection on the middle field of the epigynum (Fig. 42), but can be distinguished by the larger and rounded head of the spermathecae (Fig. 41).

Description.—*Female (holotype):* Carapace 2.93 long, 2.79 wide; brownish, dark brown laterally. Clypeus dark brown, 0.14 high. Anterior eye row straight, 0.76 wide; posterior 1.38 wide. AME 0.14, ALE 0.11, PME 0.21, PLE 0.16; AME–AME 0.06, AME–ALE 0.08, PME–PME 0.26, PME–PLE 0.14, MOQ, 0.40 long, dorsal view, frontal view 0.49, anterior width 0.43, posterior width 0.78. Chelicerae dark brown, sparse brownish setae; promargin with three teeth equidistant and equal in size, retromargin with three teeth, middle largest. Sternum yellowish with dark brown setae; 1.21 long, 1.06 wide. Labium light brown, lighter at posterior margin; 0.32 long, 0.31 wide. Legs yellowish, relative length: IV-II-I-III, I – femur 2.92/ tibia-patella 4.52/ metatarsus 2.93/ tarsus 1.33/ total 11.70; II – 3.05/ 4.53/ 3.05/ 1.46/ 12.09; III – 2.52/ 3.32/ 1.99/ 1.05/ 8.89; IV – 3.32/ 4.12/ 3.33/ 1.59/ 12.35. Abdomen brownish, dorsum with indistinct light spots, grayish ventrally. Posterior margin of epigynum elevated and heavily sclerotized (Figs. 40, 42). Stalk and head of spermathecae almost touching each other (Fig. 41).

Distribution.—This species is known only from the type locality in Costa Rica (Fig. 4).

Remarks.—The holotype is missing right legs I, II and III, and left leg IV is missing the metatarsus and tarsus.

Enna paraensis new species
Figs. 5, 43–45

Type material.—Holotype female: BRAZIL: *Pará*: Mapuerá river, 01°45′S, 55°51′W, 15 January 1938, H.G. Hassler (AMNH).

Etymology.—The specific name refers to the type locality.

Diagnosis.—The female of *E. paraensis* (Fig. 45) resembles those of *E. caliensis* (Fig. 84) by the shape of the projection of the posterior margin of the epigynum, but can be distinguished by the rounded head of the spermathecae (Fig. 44).

Description.—*Female (holotype):* Carapace 3.73 long, 3.32 wide, two paramedian yellow bands dorsally. Clypeus yellowish, brownish laterally, 0.27 high. Anterior eye row slightly recurved, 0.86 wide; posterior 1.76 wide. AME 0.18, ALE 0.12, PME 0.25, PLE 0.21; AME–AME 0.15, AME–ALE 0.07, PME–PME 0.53, PME–PLE 0.28, MOQ, 0.52 long, dorsal view, frontal view 0.66, anterior width 0.55, posterior width 1.03. Chelicerae orange with small setae, darker on anterior margin; promargin and retromargin of fang furrow with three teeth. Sternum yellowish with small dark brown setae; 1.66 long, 1.57 wide. Labium dark brown, lighter on posterior margin, 0.58 long, 0.49 wide. Legs yellowish, relative length: I-IV-II-III, I – femur 4.06/ tibia-patella 5.97/ metatarsus 3.98/ tarsus 1.82/ total 15.83; II – 3.98/ 5.88/ 3.73/ 1.74/ 15.33; III – 3.32/ 3.90/ 2.65/ 1.33/ 11.20; IV – 4.15/ 4.73/ 4.81/ 1.66/ 15.35. Abdomen setaceous, yellowish dorsally with sparse dark spots, lighter ventrally. Middle field of the epigynum with lateral sulci, posterior margin smooth (Fig. 43, 45).

Distribution.—This species is known only from the type locality in Brazil (Fig. 5).

Remarks.—The holotype has the right leg III missing the tarsus, right leg IV and left leg II.

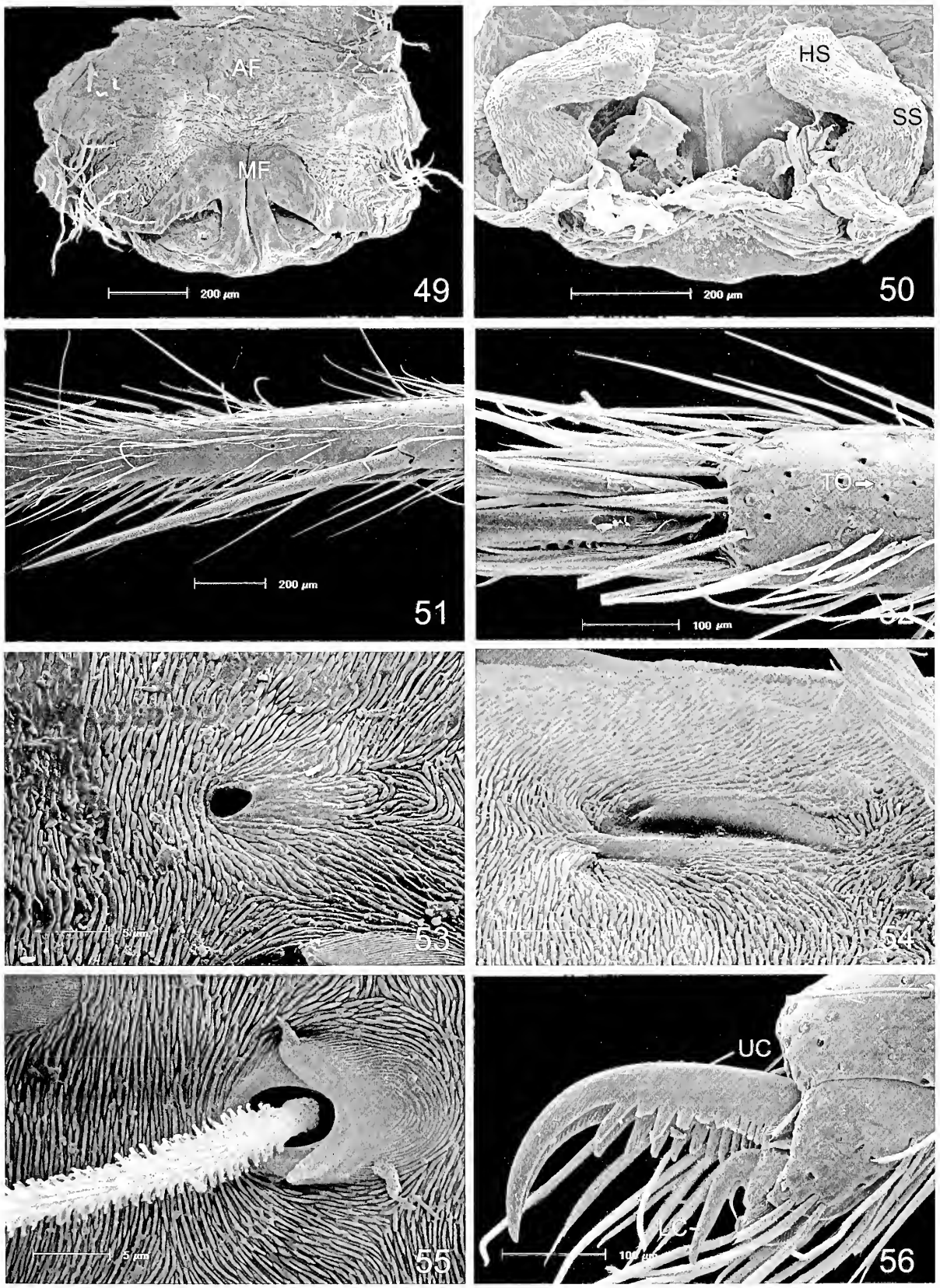
Enna rothi new species
Figs. 5, 46–56

Type material.—Holotype female: ECUADOR: *Quijos*: Napo, 12 km from Baeza, 00°27′S, 77°53′W, 10 September 1994, V. Roth (CAS).

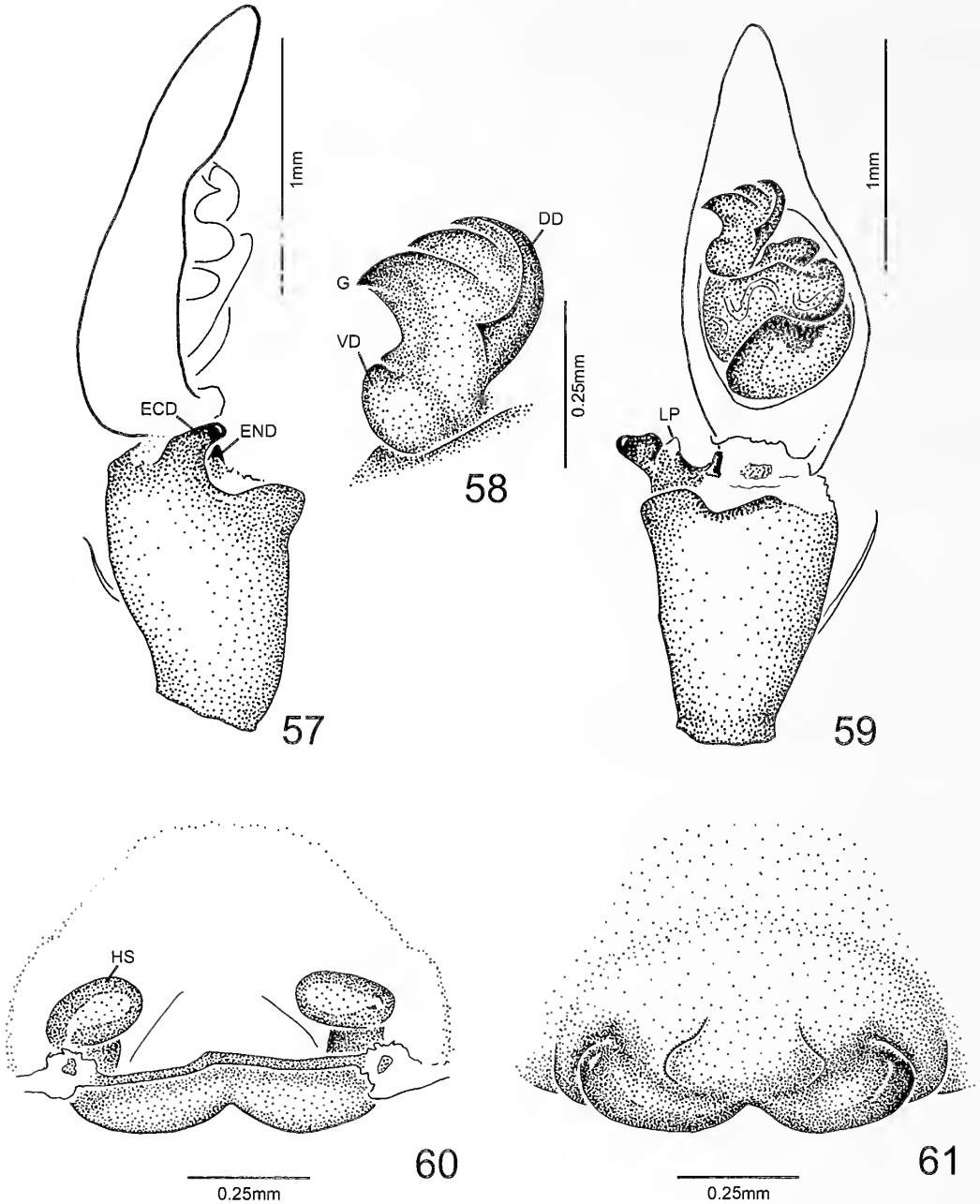
Etymology.—The specific name is a patronym in honor of the collector of the type, V.D. Roth.

Diagnosis.—The female of *E. rothi* is similar to those of *E. hara* (Fig. 76) and *E. baeza* (Fig. 79) by the shape of the projection of the middle field of the epigynum (Figs. 48, 49), but can be separated from them by the shape of the head of the spermathecae (Figs. 47, 50).

Description.—*Female (holotype):* Carapace 4.78 long, 4.25 wide, low dark brown, darker laterally. Clypeus light brown, darker laterally, 0.21 high. Anterior eye row slightly straight, 1.12 wide; posterior 1.86. AME 0.24, ALE 0.20, PME 0.28, PLE 0.30; AME–AME 0.12, AME–ALE 0.14, PME–PME 0.40, PME–PLE 0.50, MOQ, 0.49 long, dorsal view, frontal view 0.65, anterior width 0.62, posterior width 0.99. Chelicerae reddish brown with yellowish setae, darker laterally; promargin and retromargin with three teeth equidistant and subequal in size. Sternum yellowish with sparse light setae, 2.07 long, 2.01 wide. Labium dark brown, yellowish laterally; 0.71 long, 0.80 wide. Legs light brown, femora with sparse brownish spots dorsally, relative length: IV-I-II-III, I – femur 7.04/ tibia-patella 9.71/ metatarsus 6.78/ tarsus 2.66/ total 26.19; II – 6.51/ 9.44/ 5.71/ 2.79/ 24.45; III – 5.32/ 5.71/ 5.45/ 1.59/ 18.07; IV – 6.65/ 8.11/ 6.91/ 2.92/ 24.59. Base of macrosetae prominent (Fig. 51). Tarsal organ conspicuous on dorsal surface of leg IV (Figs. 52, 53). Bothrium with prominent hood (Fig. 55). Tarsal claw pectinated, with eleven distinct teeth on upper claw and one short, slender tooth on lower claw (Fig. 56). Slit sense organ on lateral side of right leg II conspicuous (Fig. 54). Abdomen small, dorsum light brown with two



Figs. 49–56.—Morphological details of *Enna rothi*. 49, 50. Epigynum: 49. Ventral view; 50. Dorsal view. 51. Ventral macrosetae of tibia I. 52. Tarsal organ of leg IV, general view. 53. Tarsal organ of leg IV. 54. Slit sense organ of right leg II. 55. bothrium of leg IV. 56. Tarsal claw of leg IV. Abbreviations: AF, anterior field of epigynum; HS, head of spermathecae; LC, lower claw; MF, middle field of epigynum; SS, stalk of spermathecae; TO, tarsal organ; UC, upper claw.



Figs. 57–61.—*Enna colonche*. 57–59. Right male palpus: 57. Retrolateral view; 58. Detail of median apophysis; 59. Ventral view. 60, 61. Epigynum: 60. Dorsal view; 61. Ventral view. Abbreviations: DD, dorsal division of median apophysis; G, guide; HS, head of spermathecae; LP, lateral projection of RTA; ECD, ectal division of RTA; END, ental division of RTA; VD, ventral division of median apophysis.

paramedian brown bands, setaceous, grayish ventrally. Middle field of epigynum with two deep grooves; posterior margin elevated (Figs. 46, 48, 49). Head of spermathecae rounded and small (Figs. 47, 50).

Distribution.—Known only from the type locality in Ecuador (Fig. 5).

Remarks.—The holotype has the left leg IV missing.

Enna colonche new species
Figs. 5, 57–61

Type material.—Holotype male: ECUADOR: Colonche River, 02°01′S, 80°40′W (CAS). Paratypes: 2 females, same data as holotype (CAS).

Etymology.—The specific name is a noun in apposition taken from the type locality.

Diagnosis.—The male of *E. colonche* (Figs. 57–59) resembles those of *E. estebanensis* males (Fig. 67) by the presence of a lateral acute projection on the dorsal division of the median apophysis and a reduced ventral division of the median apophysis, but differs by the less curved guide (Figs. 58, 59) and by the ectal division of the tibial apophysis, which is curved and ventrally pointed (Fig. 57). The female bears a rounded median excavation on the posterior margin of the epigynum (Fig. 61).

Description.—*Male (holotype):* Carapace 3.60 long, 3.00 wide, dark brown; blanched due to drying. Clypeus blanched

due to drying, 0.35 high. Anterior eye row straight to slightly procurved, 0.90 wide; posterior 1.70 wide. AME 0.23, ALE 0.16, PME 0.28, PLE 0.28; AME–AME 0.16, AME–PLE 0.03, PME–PME 0.52, PME–PLE 0.30, MOQ, 0.62 long, dorsal view, frontal view 0.68, anterior width 0.56, posterior width 0.96. Chelicerae reddish brown, lighter distally, lateral carina present; promargin with three teeth, equidistant, middle largest and retromargin of fang furrow with three teeth, proximal two, closer together. Sternum blanched due to drying; 1.45 long, 1.50 wide. Labium pale brown, lighter on anterior margin; 0.63 long, 0.61 wide. Legs blanched due to drying, relative length: I-IV-II-III, I – femur 3.70/ tibia-patella 5.50/ metatarsus 4.00/ tarsus 1.90/ total 15.10; II – 3.80/ 5.30/ 3.60/ 1.70/ 14.40; III – 3.20/ 3.80/ 2.80/ 1.30/ 11.10; IV – 3.80/ 4.60/ 4.30/ 1.80/ 14.50. Abdomen blanched due to drying, with scattered setae. Palpus with dorsal division with two distal grooves (Figs. 58, 59). Ectal division of RTA with lateral projection (LP) triangular and ental division slender and acuminate (Fig. 57).

Female (paratype): Carapace as in male, 2.70 long, 2.70 wide. Clypeus as in male, 0.25 high. Anterior eye row straight to slightly procurved, 0.82 wide; posterior 1.52 wide. AME 0.20, ALE 0.13, PME 0.22, PLE 0.22; AME–AME 0.12, AME–ALE 0.05, PME–PME 0.48, PME–PLE 0.26, MOQ, 0.52 long, dorsal view, anterior width 0.49, posterior width 0.90. Chelicerae reddish brown, lighter distally; promargin and retromargin with three teeth. Sternum as in male; 1.35 long, 1.45 wide. Labium as in male; 0.63 long, 0.55 wide. Legs blanched due to drying, relative length: IV-II-I-III, I – femur 2.90/ tibia-patella 3.90/ metatarsus 2.40/ tarsus 1.20/ total 10.40; II – 3.10/ 3.80/ 2.60/ 1.20/ 0.70; III – 2.70/ 3.00/ 2.20/ 1.10/ 9.00; IV – 3.20/ 3.80/ 3.50/ 1.40/ 11.90. Ventral pairs of macrosetae on tibiae: I-4; II-4; III-3; IV-4. Abdomen as in male, with scattered setae. Epigynum with short, elliptical spermathecae, largely separated from each other (Fig. 60).

Distribution.—This species is known only from the type locality in Ecuador (Fig. 5).

Remarks.—The holotype was apparently dried resulting in blanching of the color pattern along with shriveling of the abdomen and some distortion of the legs and carapace.

Enna estebanensis (Simon 1898)
Figs. 5, 62–70

Hesydrus estebanensis Simon 1898:20; Roewer 1954:137
Enna estebanensis (Simon): Carico 2005a: 786; Platnick 2007.

Type material.—Lectotype (present designation) male: VENEZUELA: San Esteban (MNHN 17925). Paralectotypes: 2 males, 3 females, same data as lectotype (MNHN).

Diagnosis.—The male palpus of *E. estebanensis* (Figs. 65–67) is similar to that of *E. colouche* (Figs. 57–59) by the general shape of the median apophysis and the reduced ventral division of the median apophysis (Fig. 66), but can be differentiated by a small protuberance on the dorsum of the ectal division of the retrolateral tibial apophysis (Fig. 67), and the female epigynum which bears a small median groove on the posterior margin of the epigynum (Fig. 70).

Description.—*Male (lectotype):* Carapace (Figs. 62, 63) 3.48 long, 2.85 wide, light brown, moderately high. Clypeus dark brown, 0.31 high. Anterior eye row straight (Fig. 64), 0.86 wide; posterior 1.61 wide. AME 0.15, ALE 0.10, PME 0.21, PLE 0.12; AME–AME 0.15, AME–ALE 0.06, PME–PME 0.46, PME–PLE 0.34, MOQ, 0.41 long, dorsal view, frontal view 0.49, anterior width 0.37, posterior width 0.89. Chelicerae orange, with light setae, projected anteriorly (Fig. 63), and with distal depressions on anterior surface (Fig. 64); lateral carina prominent (Fig. 63); promargin and retromargin of fang furrow with three subequal and equidistant teeth. Sternum yellowish, with small brownish setae; 1.39 long, 1.42 wide. Labium yellowish, lighter on anterior margin; 0.31 long, 0.46 wide. Legs yellowish, relative length: I-IV-II-III, I – femur 3.76/ tibia-patella 5.06/ metatarsus 3.81/ tarsus 1.99/ total 14.62; II – 3.40/ 4.56/ 3.23/ 1.57/ 12.76; III – 2.49/ 3.48/ 2.90/ 1.24/ 10.11; IV – 3.81/ 4.23/ 4.15/ 1.66/ 13.85. Abdomen (Figs. 62, 63) elongated, setaceous, dorsum with sparse grayish spots, yellowish ventrally. Palpus with a reduced ventral division; dorsal division with a small pointed lateral lamella (Fig. 67). Ectal division prominent (Figs. 65, 66). Ental division of retrolateral tibial apophysis sclerotized and subtriangular (Fig. 66).

Female (paralectotype): Carapace as in male, 2.94 long, 2.63 wide. Clypeus yellowish, 0.21 high. Anterior eye row slightly straight, 0.77 wide; posterior 1.42 wide. AME 0.15, ALE 0.10, PME 0.16, PLE 0.13; AME–AME 0.15, AME–ALE 0.07, PME–PME 0.43, PME–PLE 0.31, MOQ, 0.40 long, dorsal view, frontal view 0.43, anterior width 0.46, posterior width 0.83. Chelicerae as in male, without lateral carina; promargin and retromargin of fang furrow with three teeth. Sternum light brown, with brownish setae; 1.17 long, 1.48 wide. Labium dark brown, lighter on anterior margin; 0.49 long, 0.52 wide. Legs yellowish, relative length: IV-I-II-III, I – femur 2.82/ tibia-patella 4.31/ metatarsus 2.98/ tarsus 1.41/ total 11.52; II – 2.90/ 4.15/ 2.40/ 1.25/ 10.70; III – 2.57/ 2.82/ 2.15/ 1.07/ 8.61; IV – 3.32/ 3.90/ 3.56/ 1.32/ 12.10. Abdomen rounded, setaceous, coloration as in male. Epigynum with posterior margin excavated (Figs. 68, 70). Head of spermathecae elliptical and copulatory openings conspicuous in dorsal view (Fig. 69).

Distribution.—This species is known only from the type locality in Venezuela (Fig. 5).

Remarks.—A male has been selected as the lectotype and a female as paralectotype since in Simon's first description of this species a holotype was designated.

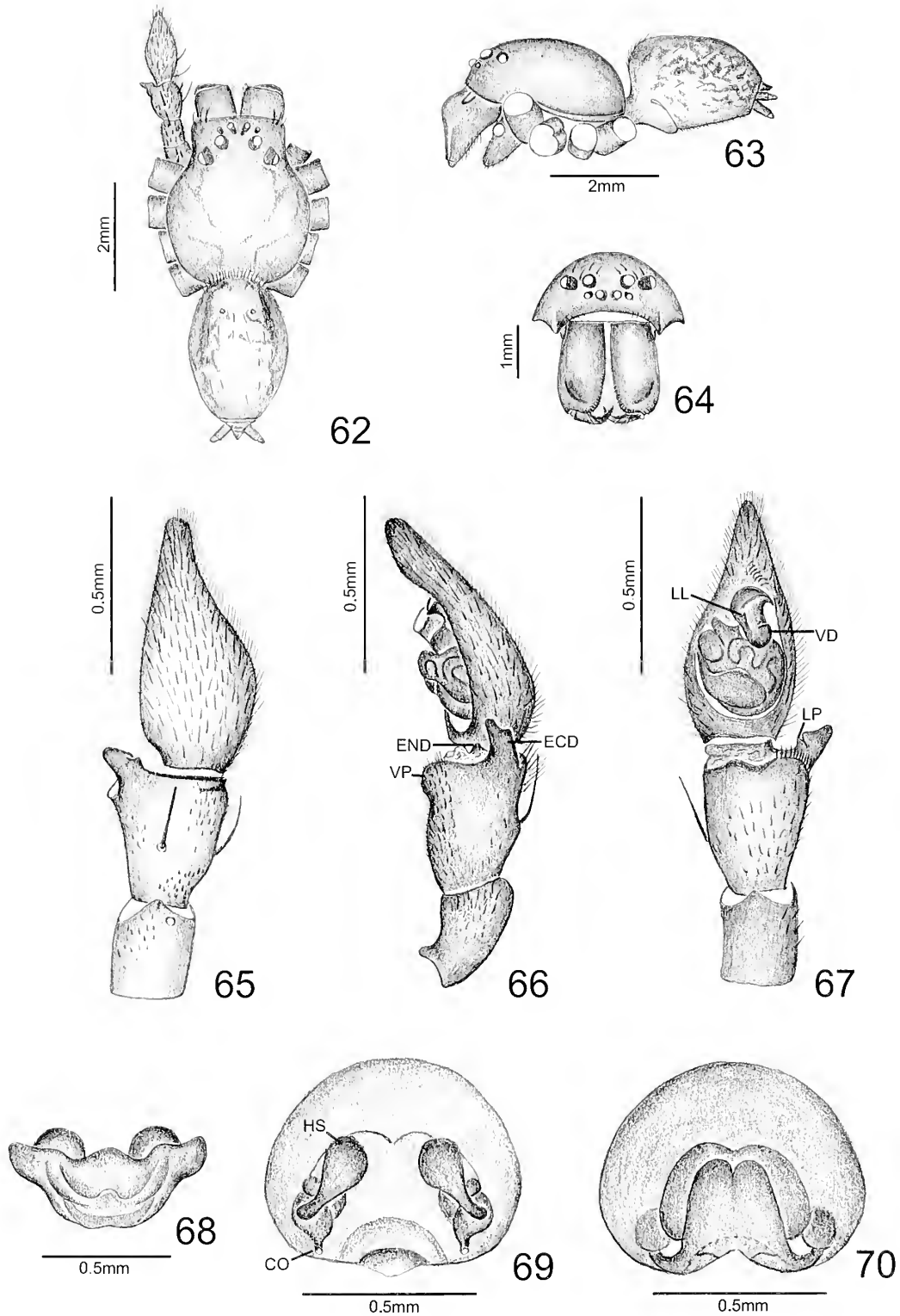
Enna huanuco new species
Figs. 5, 71–73

Type material.—Holotype male: PERU: *Huanuco*: Divisoria, 09°30′S, 75°50′W, 23 September 1946 (AMNH).

Etymology.—The specific name is a noun in apposition taken from the type locality.

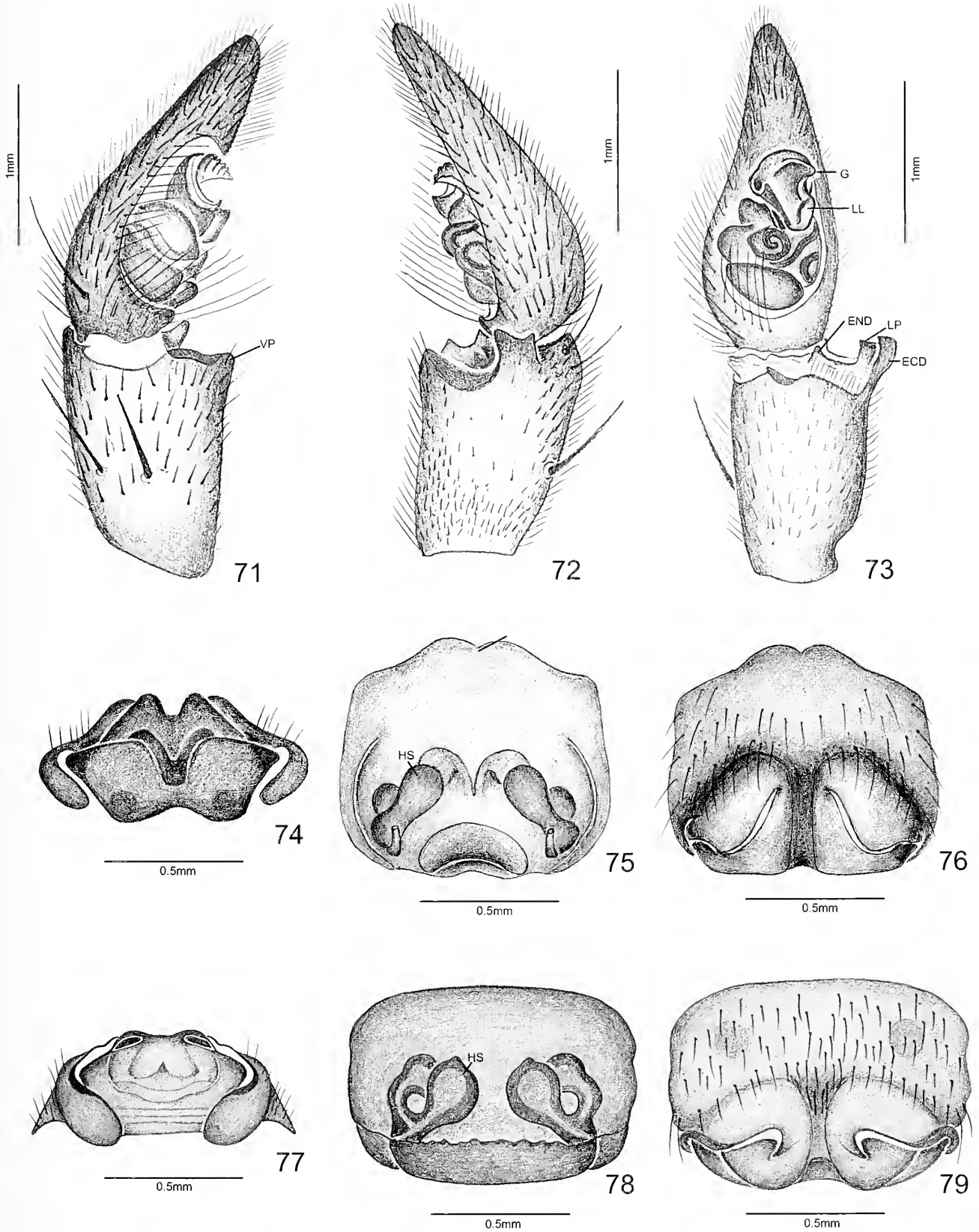
Diagnosis.—The male of *E. huanuco* is similar to that of *E. braslandia* by the general shape of the median apophysis and the retrolateral tibial apophysis (Fig. 35), but can be distinguished by the smaller and rounded guide of the median apophysis (Figs. 71–73).

Description.—*Male (holotype):* Carapace 4.39 long, 3.73 wide, moderately low, dark brown with lateral brownish bands. Clypeus light brown, 0.25 high, Anterior eye row slightly straight, 1.02 wide; posterior 2.01 wide. AME 0.23, ALE 0.12, PME 0.24, PLE 0.25; AME–AME 0.46, AME–ALE 0.16, PME–PME 0.58, PME–PLE 0.44, MOQ, 0.52 long,



Figs. 62–70.—*Enna estebanensis*. 62–64. Male: 62. Dorsal view; 63. Lateral view; 64. Frontal view. 65–67. Left male palpus: 65. Dorsal view; 66. Retrolateral view; 67. Ventral view. 68–70. Epigynum: 68. Posterior view; 69. Dorsal view; 70. Ventral view. Abbreviations: CO, copulatory ducts; HS, head of spermathecae; LL, lateral lamella; LP, lateral projection of RTA; ECD, ectal division of RTA; END, ental division of RTA; VD, ventral division of median apophysis; VP, ventral protuberance of male palpal tibia.

dorsal view, frontal view 0.65, anterior width 0.64, posterior width 1.05. Chelicerae dark brown with small light brown setae, slightly enlarged at base; promargin and retromargin of fang furrow with equal and equidistant teeth. Sternum brownish, with dark setae; 1.51 long, 1.55 wide. Labium brownish, lighter on anterior margin; 0.46 long, 0.71 wide. Legs light brown, relative length: IV-I-II-III, I – femur 4.81/ tibia-patella 6.97/ metatarsus 4.64/ tarsus 2.07/ total 18.49; II –



Figs. 71–79.—*Enna* spp. 71–73. *E. huanuco*, left male palpus: 71. Prolateral view; 72. Retrolateral view; 73. Ventral view. 74–76. *E. hara*, epigynum: 74. Posterior view; 75. Dorsal view; 76. Ventral view. 77–79. *E. baeza*, epigynum: 77. Posterior view; 78. Dorsal view; 79. Ventral view. Abbreviations: G, guide; HS, head of spermathecae; LL, lateral lamella; LP, lateral projection of RTA; ECD, ectal division of RTA; END, ental division of RTA; VP, ventral protuberance of male palpal tibia.

4.89/ 6.31/ 4.31/ 1.82/ 17.33; III – 4.15/ 4.88/ 3.41/ 1.49/ 13.93; IV – 4.73/ 5.72/ 4.87/ 1.99/ 17.31. Abdomen oval, grayish, setaceous, dorsum with light brown spots anteriorly, light brown ventrally. Dorsal division of median apophysis with small grooves (Fig. 73). Median apophysis without basal tooth (Fig. 73). Ectal division of retrolateral tibial apophysis acuminate (Fig. 72). Ventral protuberance of male palpal tibia prominent (Fig. 71).

Distribution.—This species is known only from the type locality in Peru (Fig. 5).

Enna hara new species
Figs. 5, 74–76

Type material.—Holotype female: PERU: *San Martin*: Hara, 07°00′S, 76°50′W, 1–30 June 1947, F. Woytkowski (AMNH).

Etymology.—The specific name is a noun in apposition taken from the type locality.

Diagnosis.—The female of *E. hara* is similar to that of *E. baeza* by the general shape of the middle field of the epigynum (Fig. 79), but can be distinguished by the rounded shape of the head of the spermathecae (Fig. 75).

Description.—*Female (holotype):* Carapace 5.47 long, 4.81 wide, moderately low, dorsum light brown with three light brown paramedian bands near cephalic area. Clypeus, orange, 0.37 high. Anterior eye row straight, 1.27 wide; posterior 2.35 wide. AME 0.24, ALE 0.18, PME 0.31, PLE 0.15; AME–AME 0.22, AME–ALE 0.09, PME–PME 0.21, PME–PLE 0.25, MOQ, 0.69 long, dorsal view, frontal view 0.71, anterior width 0.71, posterior width 1.17. Chelicerae dark brown with small light brown setae; promargin and retromargin of fang furrow with three subequal and equidistant teeth. Sternum brownish, with small brownish setae; 2.01 long, 2.23 wide. Labium light brown, darker on anterior margin; 1.02 long, 0.93 wide. Legs light brown, relative length: I-IV-II-III, I – femur 5.47/ tibia-patella 8.63/ metatarsus 5.56/ tarsus 2.65/ total 22.31; II – 4.73/ 6.88/ 5.39/ 2.57/ 19.57; III – 4.39/ 5.97/ 4.48/ 2.07/ 16.91; IV – 5.39/ 7.05/ 6.60/ 2.73/ 21.77. Abdomen oval, grayish, setaceous, dorsum with light brown spots on anterior region, yellowish ventrally. Epigynum with middle field bearing two lateral sulci (Fig. 76). Posterior margin of epigynum smooth (Figs. 74, 76). Spermathecae small (Fig. 75); head of spermathecae rounded and elongated (Fig. 75).

Distribution.—This species is known only from the type locality in Peru (Fig. 5).

Remarks.—The holotype has right legs I and III missing, and right leg IV detached.

Enna baeza new species
Figs. 5, 77–79

Type material.—Holotype female: ECUADOR: *Quijos*: Napo, 12 km from Baeza, 00°27′S, 77°53′W, 10 September 1994, V. Roth (CAS).

Etymology.—The specific name is a noun in apposition taken from the type locality.

Diagnosis.—The female epigynum of *E. baeza* (Fig. 79) is similar to that of *E. rothi* (Figs. 48, 49) by the general shape and by the presence of a short projection on the head of the spermathecae (Fig. 47, 50, 78) but can be distinguished by the shape of the middle field of the epigynum and by the median projection on the posterior margin (Fig. 79).

Description.—*Female (holotype):* Carapace 4.52 long, 3.99 wide, low, light brown, darker laterally. Clypeus light brown, 0.23 high. Anterior eye row slightly straight, 1.13 wide; posterior 1.87. AME 0.19, ALE 0.18, PME 0.32, PLE 0.20; AME–AME 0.26, AME–ALE 0.12, PME–PME 0.44, PME–PLE 0.40, MOQ, 0.51 long, frontal view, anterior width 0.58, posterior width 1.01. Chelicerae reddish brown with yellowish setae, darker laterally; promargin and retromargin with three teeth equidistant and equal in size. Sternum yellowish with short light brown setae, 2.00 long, 2.21 wide. Labium dark brown, 0.66 long, 0.81 wide. Legs light brown, femora slightly darker dorsally, relative length: I-II-IV-III, I – femur 5.98/ tibia-patella 8.64/ metatarsus 5.71/ tarsus 2.26/ total 22.59; II – 6.11/ 8.24/ 5.32/ 2.39/ 22.06; III – 4.65/ 5.32/ 4.52/ 1.86/ 16.35; IV – 6.13/ 6.91/ 2.79/ 2.24/ 18.07. Abdomen short with a wide spot anteriorly, near to cardiac region and two paramedian white bands extending to posterior region; dorsum dark brown, setaceous, yellowish ventrally. Middle field of epigynum with a pair of median deep grooves (Fig. 77); posterior margin moderately elevated and with two lateral projections (Fig. 79). Head of the spermathecae rounded, short and with short pointed projections (Fig. 78).

Distribution.—This species is known only from the type locality in Ecuador (Fig. 5).

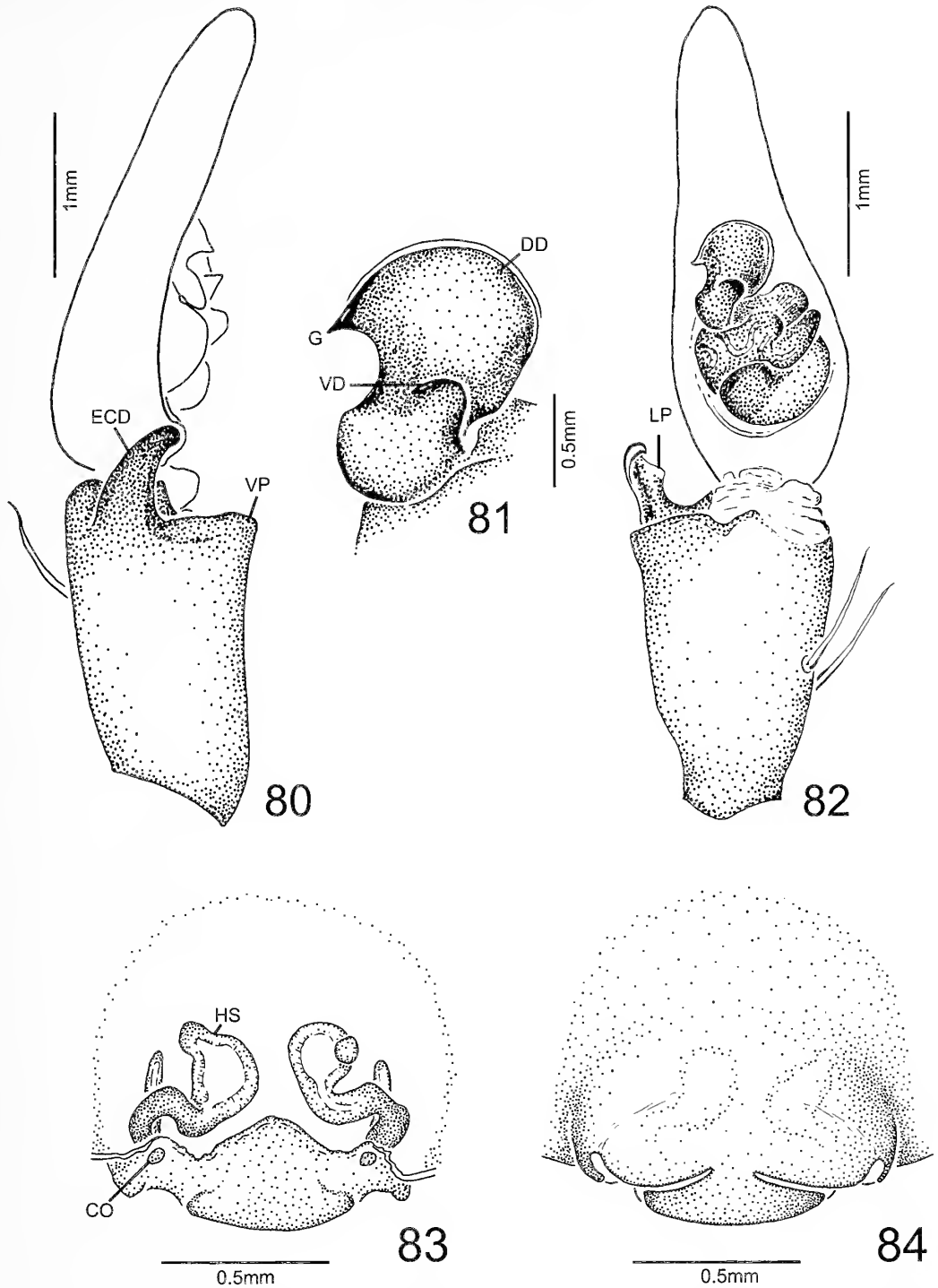
Enna caliensis new species
Figs. 5, 80–84

Type material.—Holotype male: COLOMBIA: *Cali*: Valle, 03°26′N, 76°31′W, 5 March 1973, H. Levi (MCZ 63818). Paratype: 1 female, same data as holotype (MCZ 70112).

Etymology.—The specific name refers to the type locality.

Diagnosis.—The male palpus of *E. caliensis* (Figs. 80-82) is similar to that of *E. lmarinilla* (Figs. 90–93) by the shape of the lateral projection of the ectal division of the retrolateral tibial apophysis, but can be distinguished by the presence of a reduced, laterally projected ventral division of the median apophysis (Figs. 81, 82). The female epigynum bears a median scape-like projection on the posterior margin (Fig. 84), and the head of the spermathecae has a small, rounded lateral projection (Fig. 83).

Description.—*Male (holotype):* Carapace 7.00 long, 5.70 wide, lighter distally, darker on anterior region of cephalic area, scattered long setae. Clypeus, dark brown, 0.62 high. Anterior eye row straight, 1.46 wide; posterior 2.65. AME 0.38, ALE 0.25, PME 0.33, PLE 0.40; AME–AME 0.24, AME–ALE 0.11, PME–PME 0.67, PME–PLE 0.55, MOQ, 0.77 long, frontal view, anterior width 0.80, posterior width 1.40. Chelicerae reddish brown, with distinct basal lateral carina, flattened area distally and frontally; promargin with three teeth, middle largest and retromarginal with three teeth on fang furrow, equidistant and equal in size, distal two close to each other, small tooth proximal to other three and near base of third tooth. Sternum yellowish, darker on margins; 3.12 long, 3.04 wide. Labium dark brown, lighter at anterior margin, darker laterally; 1.60 long, 1.28 wide. Legs light brown, covered by dense setae, relative length: I-II-IV-III, I – femur 8.00/ tibia-patella 11.60/ metatarsus 8.30/ tarsus 4.65 / total 31.40; II – 8.00/ 11.00/ 7.70/ 3.19/ 29.90; III – 6.80/ 8.12/



Figs. 80–84.—*Enna caliensis*. 80–82. Right male palpus: 80. Retrolateral view; 81. Detail of median apophysis; 82. Ventral view. 83, 84. Epigynum: 83. Dorsal view; 84. Ventral view. Abbreviations: CO, copulatory ducts; DD, dorsal division of median apophysis; ECD, ectal division of retrolateral tibial apophysis (RTA); G, guide; HS, head of spermathecae; LP, lateral projection of RTA; VD, ventral division of median apophysis; VP, ventral protuberance of male palpal tibia.

6.21/ 2.79/ 23.90; IV – 7.70/ 9.70/ 8.20/ 3.30/ 28.90. Ventral pairs of macrosetae on tibiae: I-4; II-4; III-3; IV-4. Abdomen dorsum dark brown, light at cardiac area, pair of longitudinal light spots lateral to cardiac area, continued posteriorly with three pairs of light spots, venter light, integument folded, dense long setae, shorter ventrally. Palpus with dorsal division of median apophysis without distal grooves (Figs. 81, 82); ectal division of RTA prominent and curved, rounded at apex (Fig. 80). Tegulum with small lateral groove (Fig. 82). Ventral protuberance of male palpal tibia prominent (Fig. 80).

Female (paratype).—Carapace 6.70 long, 5.70 wide, pale brown, darker on anterior part of cephalic area, scattered setae. Clypeus dark brown, 0.64 high. Anterior eye row straight, 1.50 wide; posterior 2.66 wide. AME 0.32, ALE 0.22,

PME 0.38, PLE 0.42; AME–AME 0.22, AME–ALE 0.12, PME–PME 0.66, PME–PLE 0.62, MOQ, 0.90 long, dorsal view, frontal view 0.87, anterior width 0.84, posterior width 1.36. Chelicerae dark reddish brown; promargin with three teeth, middle largest and retromargin of fang furrow with three teeth, equal in size, distal two closer to each other. Sternum, as in male; 3.00 long, 3.10 wide. Labium dark brown, light on anterior margin, darker laterally; 1.50 long, 1.25 wide. Legs brownish, covered with dense setae, relative length: IV-I-II-III, I – femur 7.10/ tibia-patella 9.80/ metatarsus 6.60/ tarsus 3.00/ total 26.50; II – 7.20/ 9.80/ 6.30/ 2.80/ 26.10; III – 6.20/ 7.71/ 5.31/ 2.30/ 21.70; IV – 7.20/ 8.90/ 7.50/ 3.10/ 26.70. Abdomen dorsum and sides dark brown, lighter ventrally, venter with dense long setae. Epigynum with conspicuous copulatory ducts (Fig. 83); posterior margin slightly projected (Fig. 84).

Distribution.—This species is known only from the type locality in Colombia (Fig. 5).

Enna huarinilla new species
Figs. 5, 85–96

Type material.—Holotype male: BOLIVIA: *La Paz*: near Coroico (Huarinilla river), 16°30′S, 68°09′W, elevation 3000 m, 31 July 1994, A.D. Brescovit (MCN 23799).

Etymology.—The specific name is a noun in apposition and refers to the type locality.

Diagnosis.—The palpus of *E. huarinilla* (Figs. 88–90) is similar to that of *E. caliensis* (Figs. 80–82) by the general shape of the retrolateral tibial apophysis (Figs. 89, 90, 94), but can be distinguished by the absence of the ventral division of the median apophysis and a shorter and less acute guide (Figs. 90–93).

Description.—*Male (holotype):* Carapace (Fig. 86) 6.88 long, 5.89 wide, dark brown, with a median light brown stripe at cephalic area (Fig. 85). Clypeus, dark brown, 0.70 high. Anterior eye row slightly procurved (Fig. 87), 1.50 wide; posterior 2.63. AME 0.34, ALE 0.20, PME 0.40, PLE 0.41; AME–AME 0.20, AME–ALE 0.10, PME–PME 0.70, PME–PLE 0.60, MOQ, 0.78 long, frontal view, anterior width 0.82, posterior width 1.37. Chelicerae reddish brown, without lateral carina (Fig. 86); promargin with three teeth and retromargin with three teeth on fang furrow, equidistant and equal in size. Sternum light brown, small setae, darker on margins; 2.57 long, 2.91 wide. Labium dark brown, lighter on anterior margin; 1.24 long, 1.32 wide. Legs light brown, relative length: I-II-IV-III, I – femur 10.10/ tibia-patella 15.82/ metatarsus 11.71/ tarsus 4.67 / total 42.28; II – 9.71/ 14.63/ 10.11/ 3.19/ 37.64; III – 8.11/ 10.12/ 8.11/ 2.79/ 29.13; IV – 9.04/ 11.83/ 10.91/ 3.85/ 35.63. Ventral pairs of macrosetae on tibiae: I-4; II-4; III-3; IV-3. Tarsal claw with nine teeth on upper claw and one short, slender tooth on lower claw (Fig. 96). Abdomen setaceous, dorsum dark brown to grayish, three light brown small bands anteriorly (Fig. 85); venter light brown. Palpus with dorsal division of median apophysis concave (Figs. 90–93); ectal division of RTA long and rounded at apex (Figs. 89, 94). Lateral projection prominent and subtriangular (Figs. 88, 90, 95). Tegulum with small median protuberance (Figs. 91, 92). Ventral protuberance of male palpal tibia prominent (Fig. 89).

Distribution.—This species is known only from the type locality in Bolivia (Fig. 5).

Enna igarape new species
Figs. 5, 97–111

Type material.—Holotype male: BRAZIL: *Amazonas*: Igarapé da Lontra, Rio Urucú, Porto Urucú, Coari, 04°21′S, 49°32′W, 23 July 2003, D.D. Guimarães (MPEG 1435). Female allotype: same data as holotype (MPEG 1433). Paratypes: BRAZIL: *Amazonas*: 3 females, Estrada LUC 36, Rio Urucú, Porto Urucú, Coari, 23 July 2003, D.D. Guimarães (MPEG 1432); 1 female, same data as holotype (AMNH); 1 female, same data as holotype (MCZ 69736).

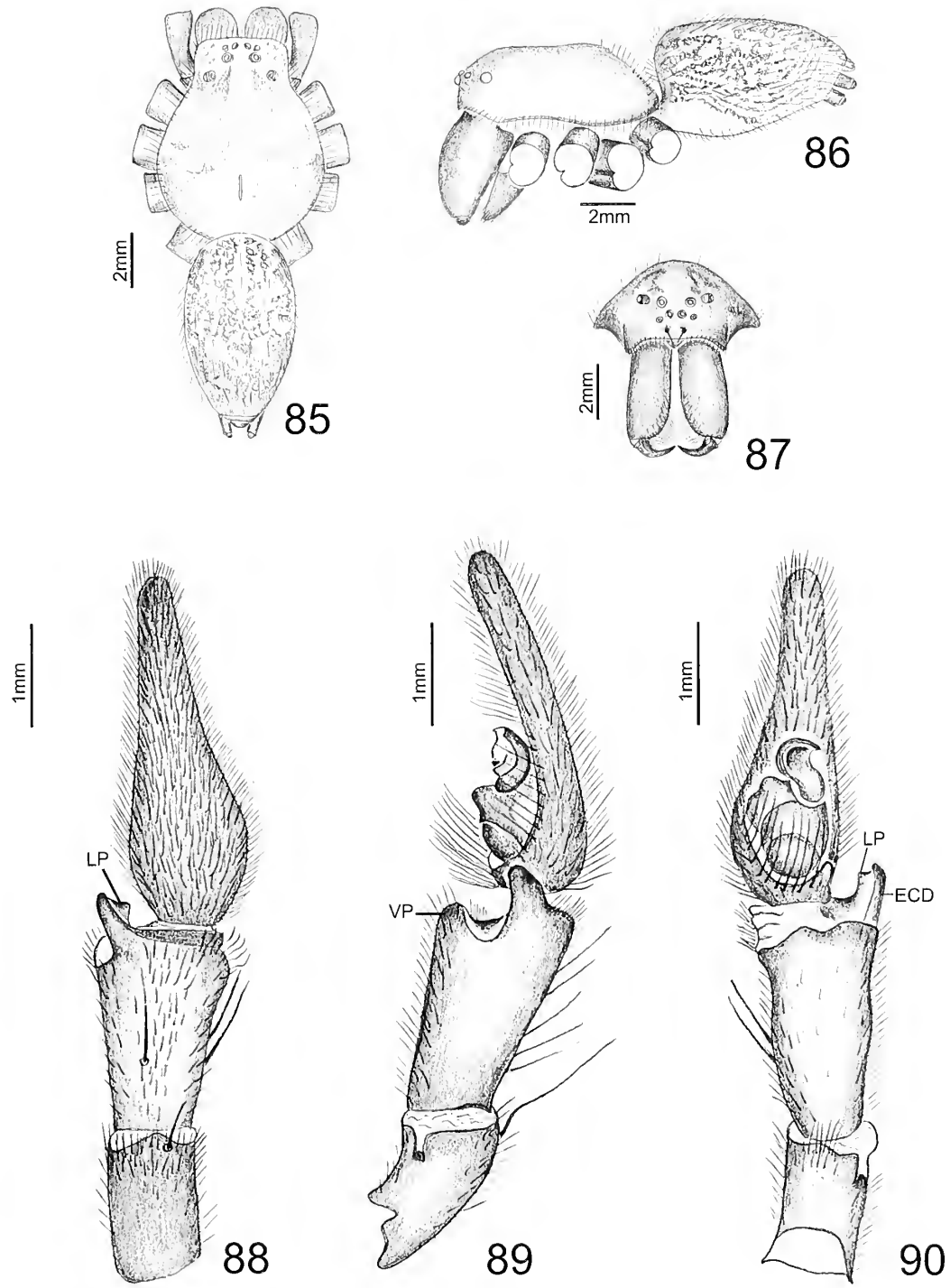
Other material examined.—BRAZIL: *Acre*: 1 ♀, Senador Guiomard, Rio Iquiri, 10°10′S, 67°50′W, Expedição Departamento de Zoologia USP (MZSP 11730).

Etymology.—The specific name is a noun in apposition and refers to "igarapé," a Tupi-Guarani Indian name for narrow channel between two small portions of land.

Diagnosis.—The male palpus of *E. igarape* (Figs. 100, 101) is similar to that of *E. kuyuwiniensis* (Figs. 112–114) by the shape of the lateral projection on the retrolateral tibial apophysis, but can be distinguished from *E. bartica* (Figs. 116, 118) by the presence of only one basal tooth on the dorsal division of the median apophysis. The female epigynum bears a median excavation on the posterior margin (Figs. 102, 107) and small spermathecae, which are widely separated (Fig. 103).

Description.—*Male (holotype):* Carapace (Figs. 97, 98) 2.57 long, 2.13 wide, pale brown with a paramedian yellowish band, light brown laterally. Clypeus, brownish, 0.18 high. Anterior eye row straight (Fig. 99), 0.65 wide; posterior 1.33 wide. AME 0.14, ALE 0.09, PME 0.24, PLE 0.15; AME–AME 0.09, AME–ALE 0.06, PME–PME 0.37, PME–PLE 0.21, MOQ, 0.37 long, dorsal view, frontal view 0.46, anterior width 0.43, posterior width 0.77. Chelicerae dark brown with small setae. Sternum yellowish with small light brown setae, 1.08 long, 1.17 wide. Labium dark brown, lighter on anterior margin; 0.48 long, 0.46 wide. Legs yellowish, relative length: I-IV-II-III, I – femur 3.07/ tibia-patella 4.56/ metatarsus 3.23/ tarsus 1.41/ total 12.27; II – 2.98/ 4.39/ 2.98/ 1.24/ 11.59; III – 2.40/ 2.98/ 2.41/ 0.91/ 8.70; IV – 2.98/ 3.73/ 3.75/ 1.23/ 11.69. Tarsal organ conspicuous (Figs. 108, 109). Bothrium prominent (Fig. 110). All tarsal claws pectinated, upper claw with nine teeth and lower claw with one long tooth (Fig. 111). Abdomen (Figs. 97, 98) rounded, setaceous, dorsum pale brown with sparse light spots, darker at laterals, yellowish ventrally. Palpus with ental division of retrolateral tibial apophysis absent (Figs. 100, 101, 106). Dorsal division of median apophysis concave (Figs. 101, 104); guide very short (Fig. 104). Subtegulum with two small projections at posterior margin (Figs. 101, 104).

Female (paratype): Carapace as in male, 2.38 long, 2.07 wide. Clypeus light brown, 0.15 high. Anterior eye row straight, 0.68 wide; posterior 1.33. AME 0.15, ALE 0.07, PME 0.16, PLE 0.12; AME–AME 0.11, AME–ALE 0.06, PME–PME 0.40, PME–PLE 0.21, MOQ, dorsal view 0.36, frontal view 0.43, anterior width 0.43, posterior width 0.74. Chelicerae reddish brown, with brownish light setae. Sternum medium brown; 1.02 long, 1.08 wide. Labium dark brown; 0.40 long,



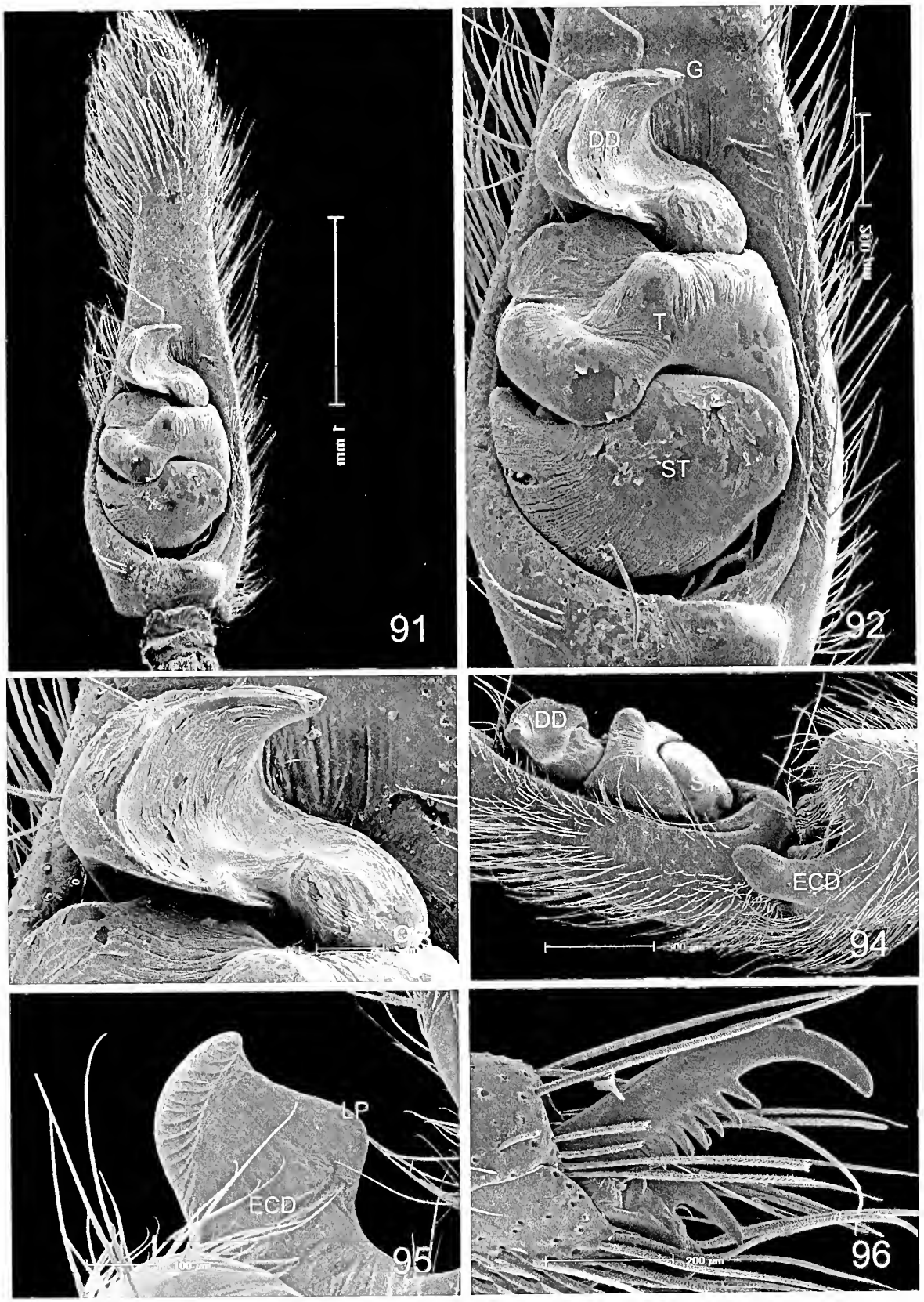
Figs. 85–90.—*Enna huarinilla.* 85–87. Male: 85. Dorsal view; 86. Lateral view; 87. Frontal view. 88–90. Left male palpus: 88. Dorsal view; 89. Retrolateral view; 90. Ventral view. Abbreviations: ECD, ectal division of retrolateral tibial apophysis (RTA); LP, lateral projection of RTA; VP, ventral protuberance of male palpal tibia.

0.38 wide. Legs yellowish, dorsum of femora with sparse brownish spots, relative length: IV-I-II-III, I – femur 3.56/ tibia-patella 4.98/ metatarsus 3.41/ tarsus 0.99/ total 12.94; II – 3.65/ 4.31/ 2.57/ 1.16/ 11.69; III – 2.90/ 3.40/ 2.73/ 0.98/ 10.01; IV – 3.32/ 4.48/ 4.31/ 1.49/ 13.60. Abdomen coloration as in male. Epigynum small, posterior margin elevated and sclerotized with a median groove (Figs. 102, 107). Spermathecae short, with rounded head (Fig. 103).

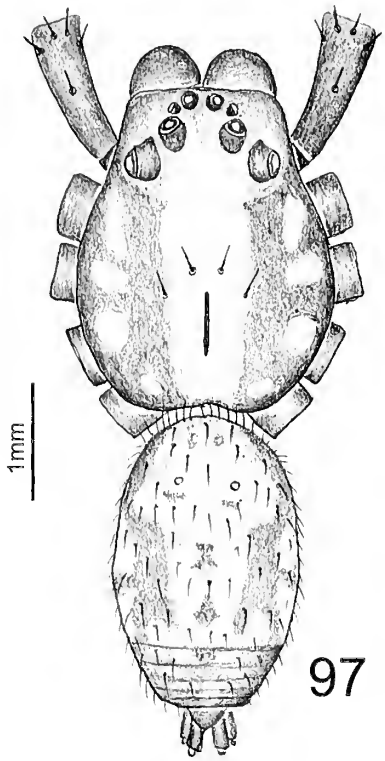
Distribution.—This species is known from Brazil (Amazonas, Acre) (Fig. 5).

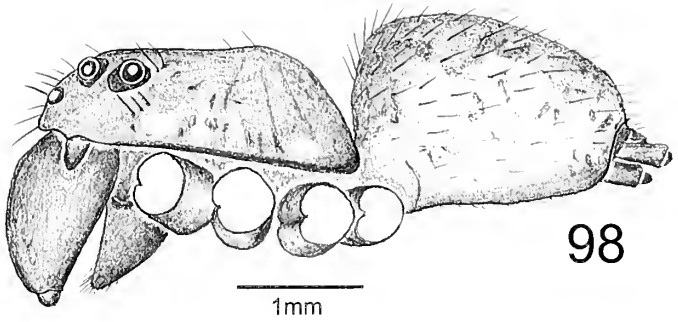
Enna kuyuwinieusis new species
Figs. 5, 112–115

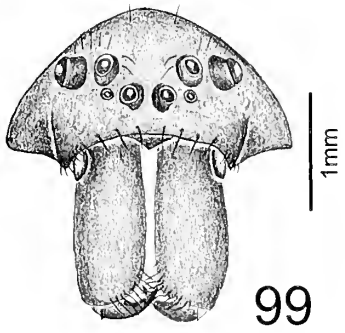
Type material.—Holotype male: GUYANA: *Kuyuwini*: River Kuyuwini, 02°13′N, 59°18′W, 20 November 1937, H.S. Hassler (AMNH).

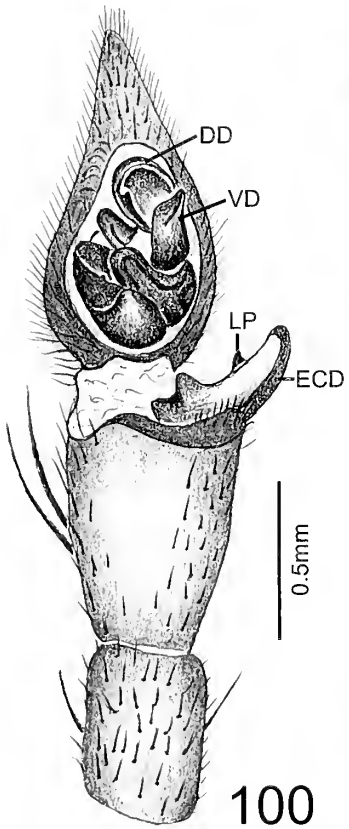


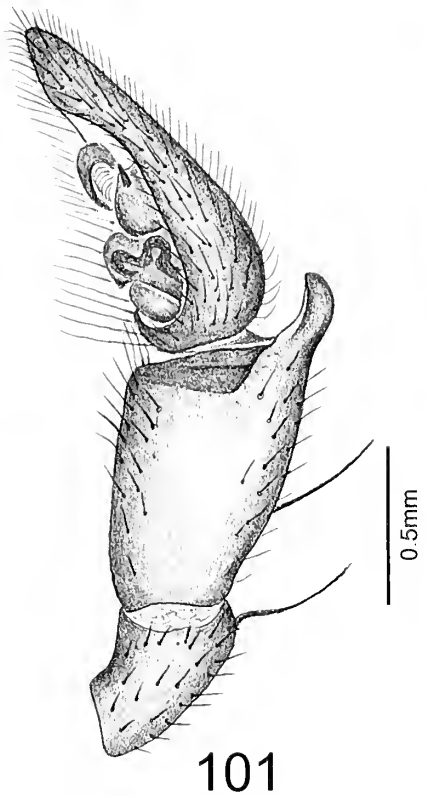
Figs. 91–96.—Morphological details of *Enna huarinilla*. 91–95. Left male palpus: 91. Ventral view; 92. Palpal bulb, ventral view; 93. Median apophysis, ventral view; 94. Retrolateral view; 95. Ectal division of retrolateral apophysis. 96. Tarsal claw of right leg IV. Abbreviations: DD, dorsal division of median apophysis; ECD, ectal division of retrolateral tibial apophysis; G, guide; LP, lateral projection of retrolateral tibial apophysis; ST, subtegulum; T, tegulum.

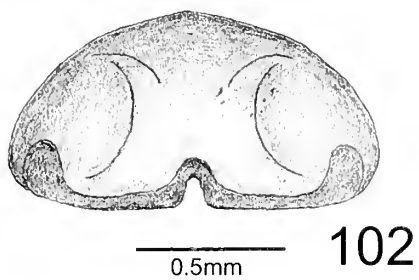


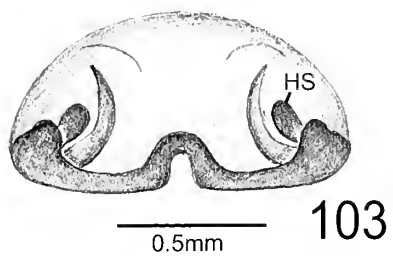




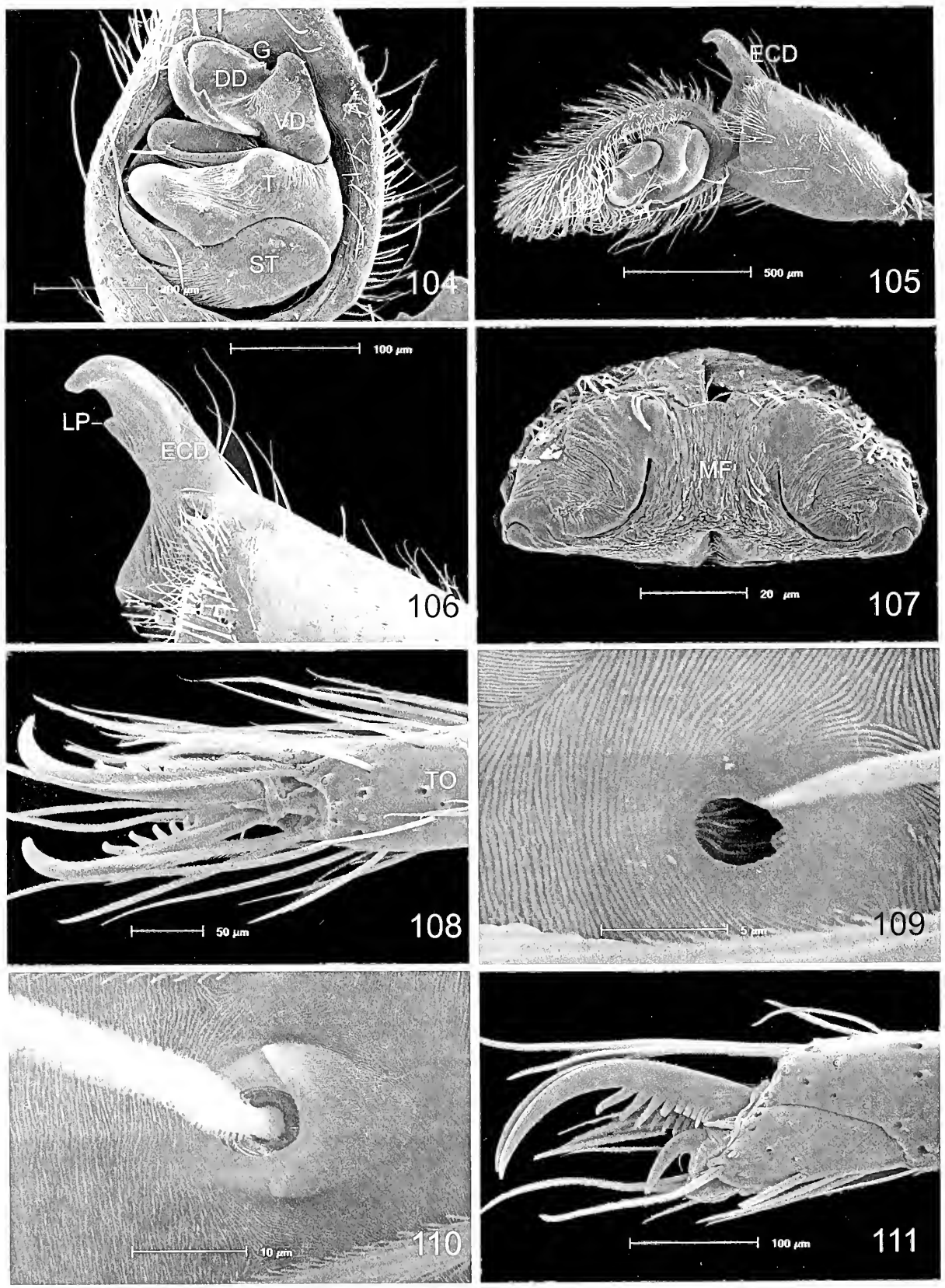




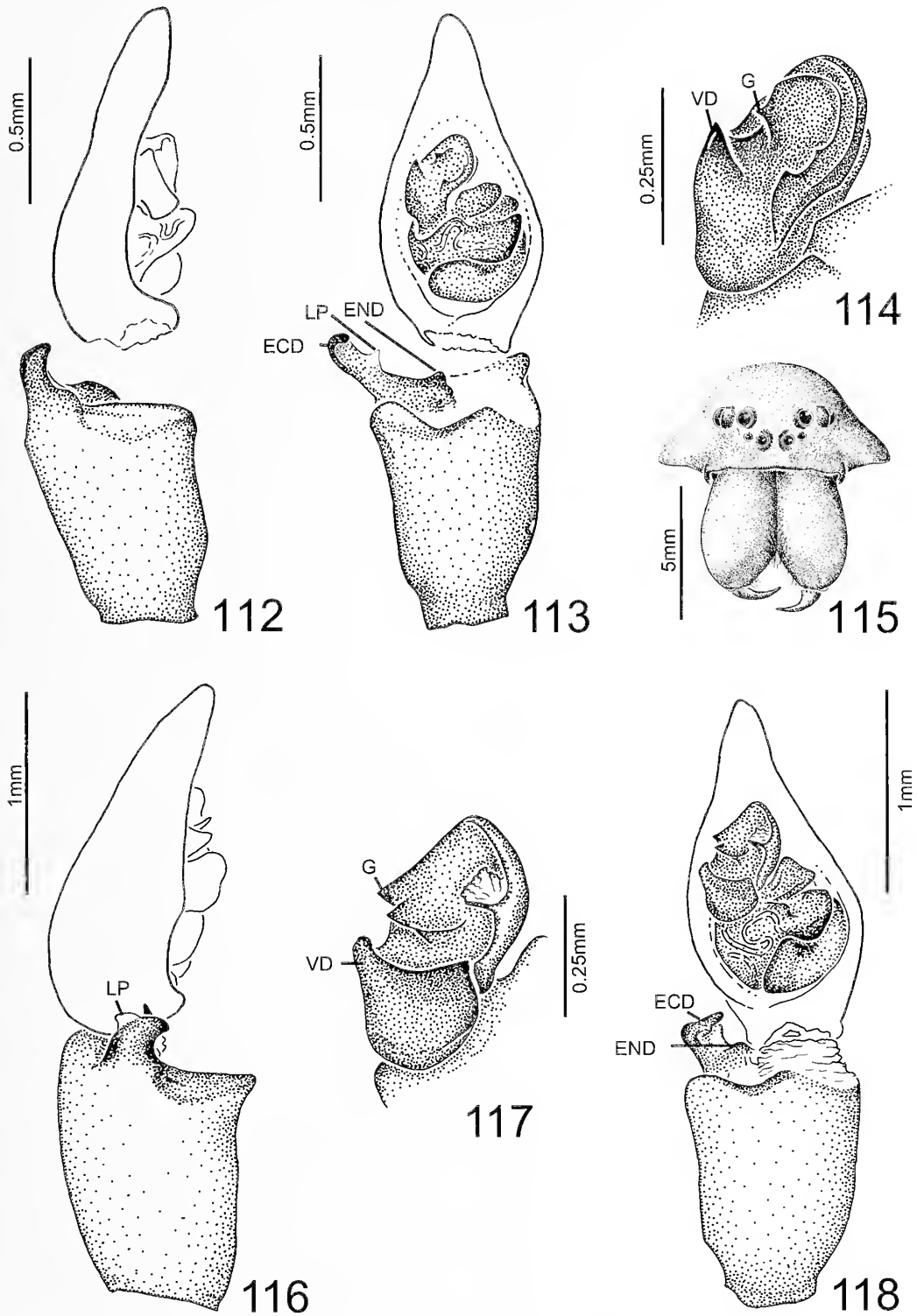




Figs. 97–103.—*Enna igarape*. 97–99. Male: 97. Dorsal view; 98. Lateral view; 99. Frontal view. 100, 101. Left male palpus: 100. Ventral view; 101. Retrolateral view. 102–103. Female epigynum: 102. Ventral view; 103. Dorsal view. Abbreviations: DD, dorsal division of median apophysis; ECD, ectal division of retrolateral tibial apophysis (RTA); HS, head of spermathecae; LP, lateral projection of RTA; VD, ventral division of median apophysis.



Figs. 104–111.—Morphological details of *Enna igarape*. 104–106. Left male palpus: 104. Ventral view of bulb; 105. Retrolateral view; 106. Eetal division of retrolateral tibial apophysis. 107. Female epigynum, ventral view. 108. Tarsal claw of right leg IV, general view. 109. Detail of tarsal organ. 110. Bothrium of left leg II. 111. Tarsal claw of leg II. Abbreviations: DD, dorsal division of median apophysis; ECD, eetal division of retrolateral tibial apophysis; G, guide; LP, lateral projection of retrolateral tibial apophysis; ST, subtegulum; T, tegulum.



Figs. 112–118.—*Enna* spp. 112–114. *E. kuyuwiniensis*, right male palpus: 112. Retrolateral view; 113. Ventral view; 114. Detail of median apophysis. 115. *E. kuyuwiniensis,* frontal view of carapace. 116–118. *E. bartica*, right male palpus: 116. Retrolateral view; 117. Detail of median apophysis; 118. Ventral view. Abbreviations: DD, dorsal division of median apophysis; G, guide; LP, lateral projection; ECD, ectal division of RTA; END, ental division of RTA; VD, ventral division of median apophysis.

Etymology.—The specific name refers to the type locality.

Diagnosis.—The male palpus of *E. kuyuwiniensis* (Figs. 12–14) resembles that of *E. igarape* (Figs. 100, 101, 104) by the shape of the lateral projection of the retrolateral tibial apophysis, but differs from the other males of *Enna* by the presence of a prominent and acuminate ventral division of the median apophysis (Figs. 113, 114). The dorsal division of the median apophysis bears two lateral teeth (Figs. 113, 114).

Description.—*Male (holotype):* Carapace 3.30 long, 2.60 wide, light brown, indistinct submarginal lighter bands, three

spots on each lateral margin, Clypeus dark brown, lighter on anterior margin, 0.30 high. Anterior eye row slightly recurved (Fig. 115), 0.84 wide; posterior 1.56 wide. AME 0.20, ALE 0.14, PME 0.26, PLE 0.28; AME–AME 0.12, AME–ALE 0.02, PME–PME 0.50, PME–PLE 0.26, MOQ, 0.37 long, dorsal view, anterior width 0.50, posterior width 0.97. Chelicerae, light reddish, scattered longitudinal dark spots. Sternum light brown, darker on margins, 1.40 long, 1.44 wide. Labium dark brown, lighter at anterior margin, darker laterally, 0.64 long, 0.50 wide. Legs light brown, I – missing, II – femur 3.80/ tibia-patella 5.00/ metatarsus 3.51, IV – femur 3.7. Ventral pairs of macrosetae on tibiae: II-4. Abdomen rounded, dorsum light with one pair of irregular dark spots laterally in anterior 2/3; posterior 1/3 with transverse alternating dark and light lines corresponding to folds in integument. Sides of abdomen with scattered smaller dark spots. Venter light brown, with scattered setae. Palpus with median apophysis prominent; guide short (Fig. 114). Retrolateral tibial apophysis with ectal division (ECD) prominent, elongated and acuminate, with curved tip (Figs. 112, 113); lateral projection of ECD is triangular (Fig. 113) and ental division (END) is short, sub-triangular (Fig. 113).

Distribution.—This species is known only from the type locality in Guyana (Fig. 5).

Remarks.—The holotype has the legs and palpus disarticulated, setae removed.

Enna bartica new species
Figs. 5, 116–118

Type material.—Holotype male, GUYANA: *Cuyuni-Mazaruni*: Kartabo, Tropical Research Station, Bartica, 06°24′N, 58°37′W, New York Zoological Society (AMNH). Paratype: BRAZIL: *Amazonas*: 1 male, Uatumã River, 03°06′S, 60°48′W, 30 August 1985, G.A. Languth (MCN 23793).

Etymology.—The specific name is a noun in apposition and refers to the type locality.

Diagnosis.—The male palpus of *E. bartica* (Figs. 116–118) resembles that of *E. igarape* (Figs. 101, 104) by the shape of the ventral division of the median apophysis, but can be distinguished by the shape of the median apophysis which bears two lateral teeth (Figs. 117, 118).

Description.—*Male (holotype):* Carapace 3.90 long, 3.40 wide, light brown, faint evidence of wide submarginal light band; pattern obscured due to age of specimen, with indistinct brown bands, dark brown laterally. Clypeus light brown, 0.36 high. Anterior eye row straight, 0.96 wide; posterior 1.80 wide. AME 0.25, ALE 0.16, PME 0.30, PLE 0.32; AME–AME 0.13, AME–ALE 0.03, PME–PME 0.53, PME–PLE 0.30, MOQ, 0.56 long, frontal view 0.64, anterior width 0.62, posterior width 1.04. Chelicerae reddish-brown, lighter distally. Sternum light, 1.72 long, 1.68 wide. Labium dark reddish-brown, lighter at anterior margin, 0.84 long, 0.72 wide. Legs light brown, obscure dark brown markings on dorsal surface of femora, III – femur 3.80/ tibia-patella 4.60/ metatarsus 3.60/ tarsus 1.50/ total 13.50; IV – 5.00/ 6.00/ 5.70. Abdomen dorsum light brown with scattered pairs of dark maculae; sides light with scattered dark maculae. Venter light brown. Palpus with dorsal and ventral divisions of median apophysis prominent (Figs. 117, 118); RTA prominent, ental division absent and ectal division coiled and rounded at apex (Fig. 118). Ventral protuberance on male palpal tibia prominent (Fig. 116).

Distribution.—This species is known from Guyana (Kartabo) and Brazil (Amazonas) (Fig. 5).

Enna bonaldoi new species
Figs. 5, 119–146

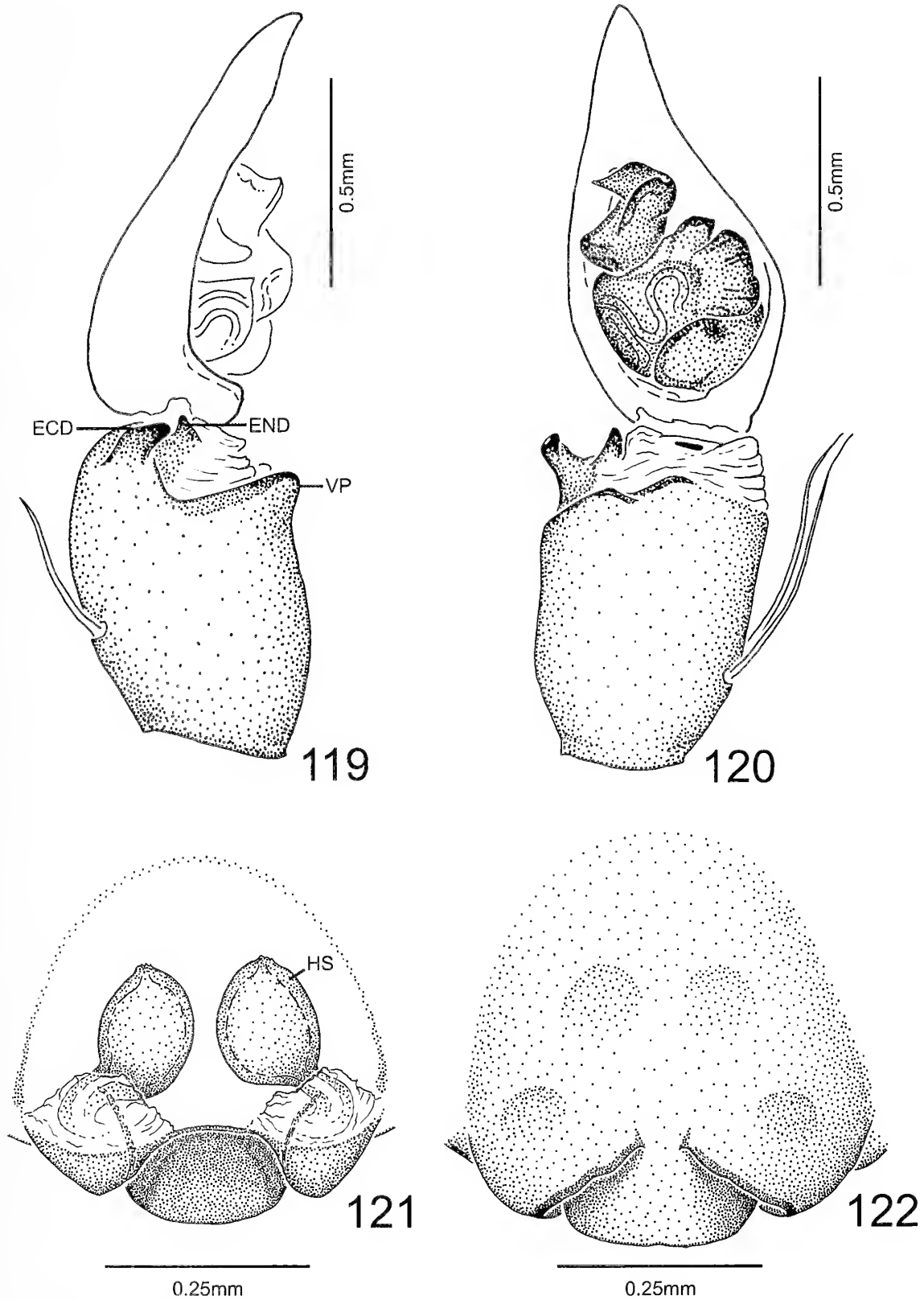
Type material.—Holotype male, BRAZIL: *Amazonas*: Igarapé da Tartaruga, Rio Urucú, Porto Urucú, Coari, 04°21′S, 49°32′W, 23 July 2003, A.B. Bonaldo (MPEG 2662). Paratype: BRAZIL: *Amazonas*: 1 female, Porto Urucú, rio Urucú, Igarapé da Lontra, Coari, 04°31′S, 49°38′W, 23.VII.2003, A.B. Bonaldo (MPEG 1427).

Other material examined.—BRAZIL: *Amazonas*: 2 ♀, Igarapé da Tartaruga, Porto Urucú, rio Urucú, Coari, 04°21′S, 49°32′W, 24 July 2003, D.D. Guimarães (MPEG 1429), A.B. Bonaldo; 1 ♂, 1 ♀, same data except A.B. Bonaldo (MPEG 1430); 3 ♂, 6 ♀, same data except 24 July 2003, D.D. Guimarães (MPEG 1425); 1 ♂, Igarapé da Lontra, 04°31′S, 49°38′W, 23 July 2003, A.B. Bonaldo (MPEG 1431); 6 ♂, 4 ♀, same data (MPEG 1426); 3 ♂, 2 ♀, same data except D.D. Guimarães(MPEG 1428); 3 ♂, 2 ♀ same data (MPEG 1427); 1 ♂, 1 ♀, same data (MCN 41060); 1 ♂, 1 ♀ (MCTP 19478); 1 ♂, 1 ♀, same data (IBSP 63148); 1 ♂, 1 ♀, same data (AMNH).

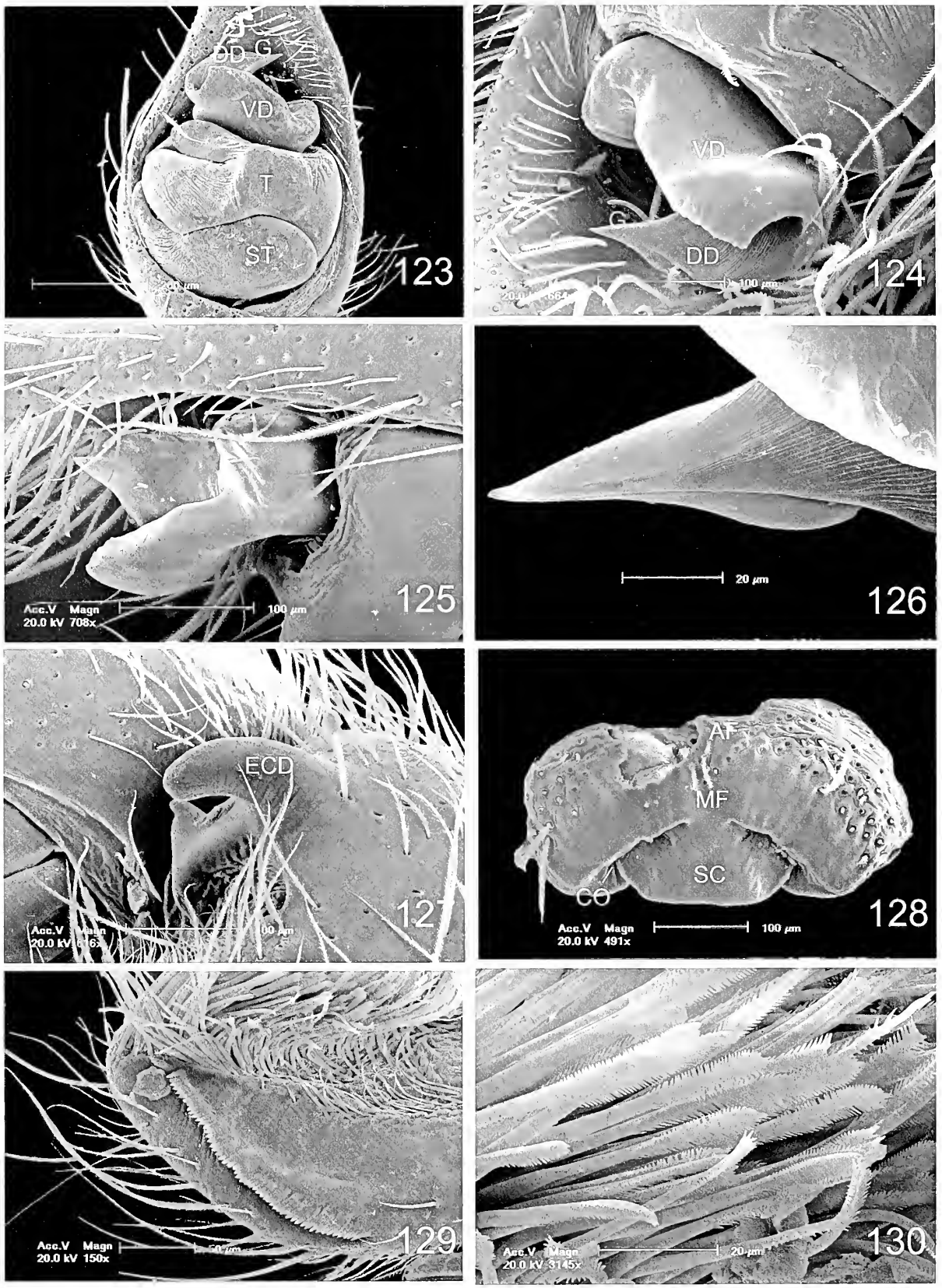
Etymology.—The specific name is a patronym in honor of the collector of the types, A.B. Bonaldo.

Diagnosis.—The male palpus of *E. bonaldoi* (Figs. 119–127) is similar to that of *E. riotopo* (Figs. 147, 148) by the general shape of the median apophysis, but can be distinguished by the shape of the guide (Fig. 120), which is acuminate and subtriangular and by the shape of the ental division of the retrolateral tibial apophysis (Figs. 119, 120). The middle field of the female epigynum is small and the heads of the spermathecae are small and rounded (Figs. 121, 122, 128).

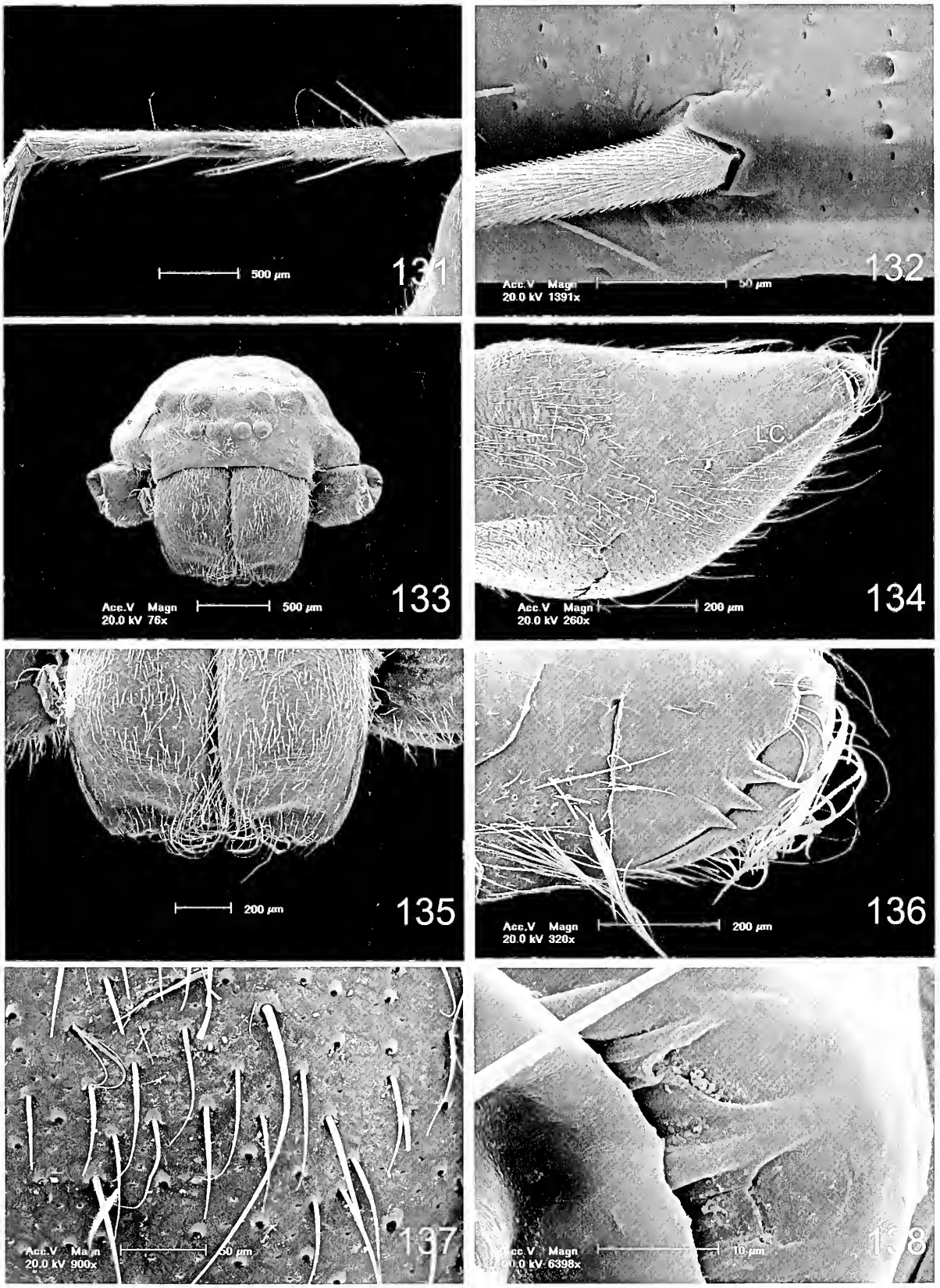
Description.—*Male (holotype):* Carapace 2.40 long, 2.00 wide, yellowish, no distinct pattern, covered with short, dark setae. Clypeus pale, no distinct pattern, 0.22 high. Anterior eye row straight (Fig. 133), 0.63 wide; posterior 1.15 wide. AME 0.15, ALE 0.11, PME 0.23, PLE 0.25; AME–AME 0.06, AME–ALE 0.03, PME–PME 0.25, PME–PLE 0.16, MOQ, 0.46 long, frontal view, anterior width 0.34, posterior width 0.65. Chelicerae dark brown with small setae, slightly enlarged anteriorly, with distinct lateral carina (Figs. 134–138). Sternum yellowish with small light brown setae, 1.20 long, 1.20 wide. Labium dark reddish-brown, lighter at anterior margin; 0.42 long, 0.42 wide. Legs pale brown, obscure annular dark markings on all segments except tarsi, relative length: IV-I-II-III, I – femur 2.90/ tibia-patella 4.00/ metatarsus 3.12/ tarsus 1.40/ total 10.90; II – 2.80/ 3.56/ 2.70/ 1.20/ 9.06; III – 2.16/ 2.52/ 2.08/ 0.88/ 7.64; IV – 2.68/ 3.20/ 3.40/ 1.40/ 10.68. Straight tarsi, all claws dentate, upper claw with ten teeth and lower claw with one long, slender tooth (Fig. 143). Tarsal organ located on anterior third of tarsus (Fig. 139), slightly elevated (Fig. 140). Trichobothria conspicuous (Fig. 141). Sensory organs (slit sense) laterally on tarsus (Fig. 142). Spinnerets (Fig. 144): ALS (Fig. 145) yellowish, with numerous piriform gland spigots (PI); PLS (Fig. 146) light, with numerous aciniform glands spigots (AC). Abdomen 2.3 long, dorsum white, fine reticulations, scattered pairs of dark maculae; sides with scattered dark maculae. Venter white



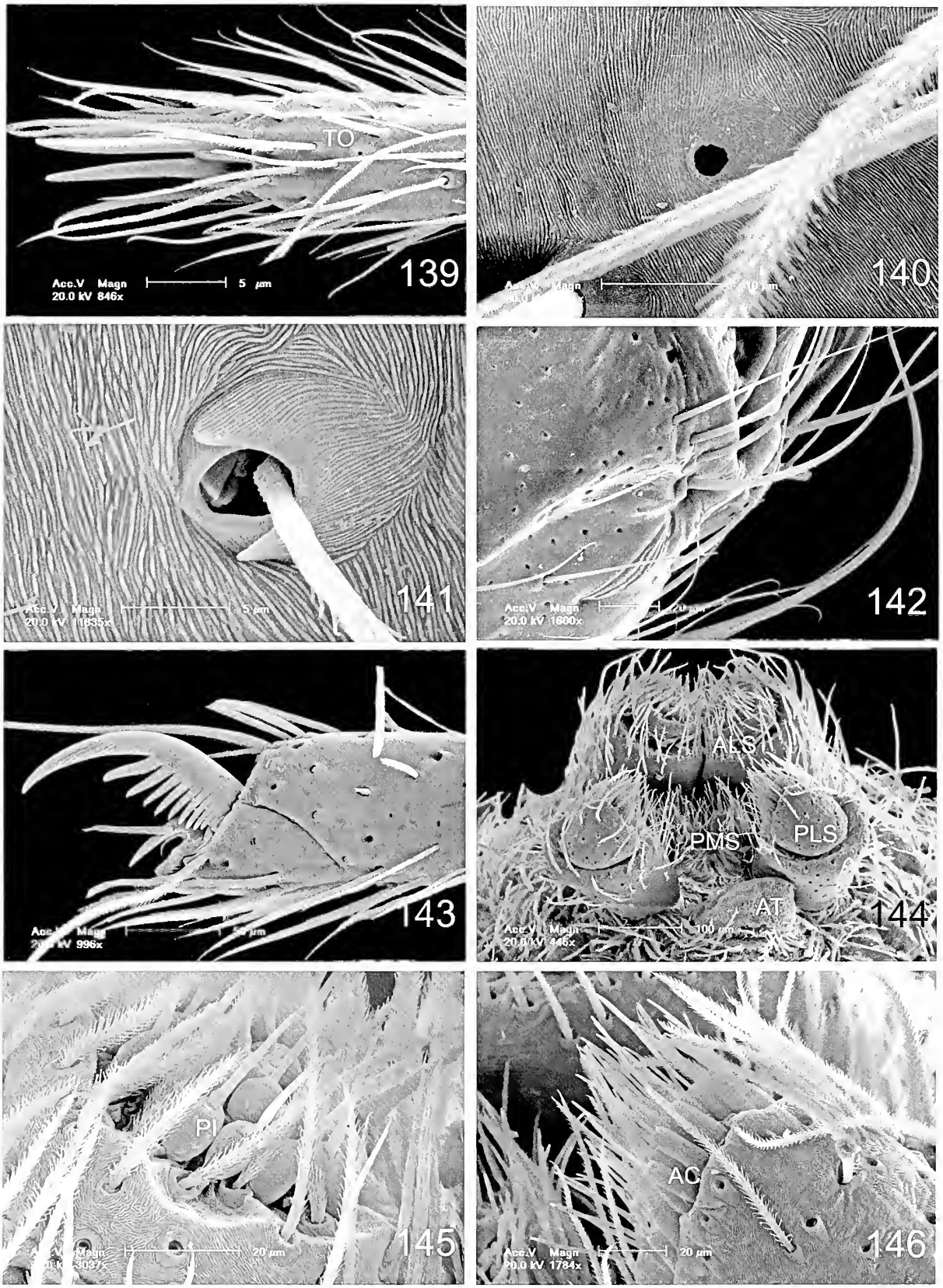
Figs. 119–122.—*Enna bonaldoi.* 119, 120. Right male palpus: 119. Retrolateral view; 120. Ventral view. 121, 122. Epigynum: 121. Dorsal view; 122. Ventral view. Abbreviations: ECD, ectal division of retrolateral tibial apophysis; HS, head of spermathecae; VP, ventral protuberance of male palpal tibia.



Figs. 123–130.—Morphological details of *Enna bonaldoi*. 123–127. Left male palpus: 123. Ventral view of bulb; 124. Median apophysis; 125. General view of guide; 126. Guide; 127. Eetal division of retrolateral tibial apophysis. 128. Female epigynum, ventral view. 129. Serrula of left endite. 130. Scopula of left endite. Abbreviations: AF, anterior field of epigynum; CO, copulatory opening; DD, dorsal division of median apophysis; ECD, eetal division of retrolateral tibial apophysis; G, guide; MF, middle field of epigynum; SC, seape of epigynum; ST, subtegulum; T, tegulum; VD, ventral division of median apophysis.



Figs. 131–138.—Morphological details of *Enna bonaldoi*: 131. Tibial macrosetae, general view; 132. Base of macrosetae; 133. Male carapace, frontal view; 134. Lateral carina of male chelicerae; 135. Anterior depression of chelicerae; 136. Promarginal teeth of chelicerae; 137. Setae of chelicerae; 138. Anterior sulci of chelicerae, posterior view. Abbreviation: LC, lateral carina.



Figs. 139–146.—Morphological details of *Enna bonaldoi*: 139. Position of tarsal organ of leg II; 140. Tarsal organ; 141. Bothrium; 142. Slit sense organ of tarsus IV; 143. Tarsal claw of leg IV; 144. Male spinnerets, general view; 145. Anterior lateral spinneret; 146. Posterior lateral spinneret. Abbreviations: AC, aciniform gland spigot; ALS, anterior lateral spinneret; AT, anal tubercle; LC, lateral carina; PI, piriform gland spigot; PLS, posterior lateral spinneret; PMS, posterior median spinneret; TO, tarsal organ.

laterally, otherwise pale. Palpal tibia with ventral protuberance prominent (Fig. 119). Retrolateral tibial apophysis with ectal division short and coiled at distal portion; ental division small and covered by ectal division in retrolateral view (Figs. 119, 127). Palpal bulb with tegulum and subtegulum prominent (Figs. 120, 123).

Female (paratype): Carapace as in male, 2.28 long, 2.00 wide. Clypeus, light brown, dark, transverse spot medially under AME, 0.20 high. Anterior eye row straight, 0.60 wide; posterior 1.15. AME 0.14, ALE 0.10, PME 0.22, PLE 0.23; AME–AME 0.07, AME–ALE 0.04, PME–PME 0.27, PME–PLE 0.16, MOQ, dorsal view 0.44, frontal view, anterior width 0.35, posterior width 0.66. Chelicerae light brown, no distinct pattern. Sternum pale brown; 1.12 long, 1.16 wide. Labium dark brown, lighter at anterior margin; 0.40 long, 0.42 wide. Legs color as in male, relative length: IV-I-II-III, I – femur 2.50/ tibia-patella 3.36/ metatarsus 2.40/ tarsus 1.16/ total 9.42; II – 2.40/ 3.12/ 2.20/ 1.06/ 8.78; III – 2.00/ 2.30/ 1.80/ 0.86/ 6.96; IV – 2.84/ 3.00/ 3.24/ 1.28/ 10.36. Abdomen 3.04 long, coloration as in male. Epigynum small, posterior margin smooth (Figs. 121, 128). Head of spermathecae short, rounded and with small apical projections (Fig. 122).

Distribution.—This species is known only form the type locality in Brazil (Amazonas) (Fig. 5).

Enna riotopo new species
Figs. 5, 147–150

Type material.—Holotype male: ECUADOR: *Tungurahua*: Rio Topo valley, 01°24′S, 78°12′W, 17 June 1943, HEF DLF – Exline/Peck (CAS). Paratypes: ECUADOR: 2 males, 1 female, Pastaza river near Wapota, 01°30′S, 78°05′W, elevation 1300 m, 2 April 1938, W.C. MacIntyre (MCZ).

Etymology.—The specific name is a noun in apposition taken from the type locality.

Diagnosis.—The male palpus of *E. riotopo* (Figs. 147, 148) resembles that of *E. bonaldoi* (Figs. 119, 120) by the shape of the median apophysis and the absence of the ventral division of the median apophysis, but differs by the small grooves on the lateral lamella (Fig. 148) and by the slender shape of the ectal division of the retrolateral tibial apophysis that is curved and ventrally pointed (Fig. 147). The female bears a rounded median triangular excavation on the posterior margin of the epigynum and two small median accessory spermathecae (Fig. 150).

Description.—*Male (holotype):* Carapace 2.32 long, 2.00 wide, pale brown, no clear pattern, covered with short, light setae, blanched due to drying. Clypeus pale brown, no distinct pattern, light setae, 0.20 high. Anterior eye row straight, 0.65 wide; posterior 1.10 wide. AME 0.17, ALE 0.12, PME 0.21, PLE 0.22; AME–AME 0.05, AME–PLE 0.05, PME–PME 0.26, PME–PLE 0.18, MOQ, 0.45 long frontal view 0.68, anterior width 0.35, posterior width 0.64. Chelicerae dark brown, slightly enlarged anteriorly, no distinct groove above fang but flattened area instead, lateral carina conspicuous; promargin with three teeth, equidistant, middle largest and retromargin of fang furrow with four teeth, equidistant, proximal two largest. Sternum light brown, 1.10 long, 1.10 wide. Labium dark reddish-brown, lighter at anterior margin; 0.41 long, 0.42 wide. Legs pale brown, obscure annular dark markings on all segments except tarsi, relative length: I-IV-II-III, I – femur 2.80/ tibia-patella 3.90/ metatarsus 2.92/ tarsus 1.40/ total 11.02; II – 2.64/ 3.32/ 2.50/ 1.16/ 9.62; III – 1.76/ 2.30/ 1.94/ 0.96/ 6.96; IV – 2.72/ 3.00/ 3.32/ 1.32/ 10.36. Abdomen 1.9 long, shriveled and pattern obscured due to drying. Palpus with dorsal division with two pointed projections at anterior portion (Fig. 148). Ectal division of RTA prominent, rounded at apex and ventrally pointed and ental division enlarged at base and dorsally pointed (Fig. 147).

Female (paratype): Carapace as in male, 2.24 long, 2.00 wide. Clypeus, as in male, 0.25 high. Anterior eye row straight, 0.67 wide; posterior recurved 1.20 wide. AME 0.16, ALE 0.11, PME 0.21, PLE 0.22; AME–AME 0.06, AME–ALE 0.06, PME–PME 0.30, PME–PLE 0.20, MOQ, 0.48 long, dorsal view, anterior width 0.36, posterior width 0.69. Chelicerae dark brown, lighter distally, no pattern, long light setae; promargin with three teeth, middle largest and retromargin with three teeth, distal largest, proximal smallest. Sternum as in male; 1.05 long, 1.25 wide. Labium as in male; 0.46 long, 0.45 wide. Legs as in male, relative length: IV-I-II-III, I – femur 2.76/ tibia-patella 3.64/ metatarsus 2.50/ tarsus 1.20/ total 10.10; II – 2.64/ 3.30/ 2.28/ 1.04/ 9.26; III – 2.24/ 2.50/ 1.94/ 1.00/ 7.68; IV – 2.96/ 3.28/ 3.40/ 1.28/ 10.92. Abdomen 2.6 long, coloration as in male, with scattered setae. Epigynum with short, posterior margin a deep triangular excavation (Fig. 150); rounded spermathecae, with two small accessory spermathecae (Fig. 149).

Distribution.—This species is known only from the type locality in Ecuador (Fig. 5).

Enna redundans (Platnick, 1993) new combination
Figs. 5, 151–155

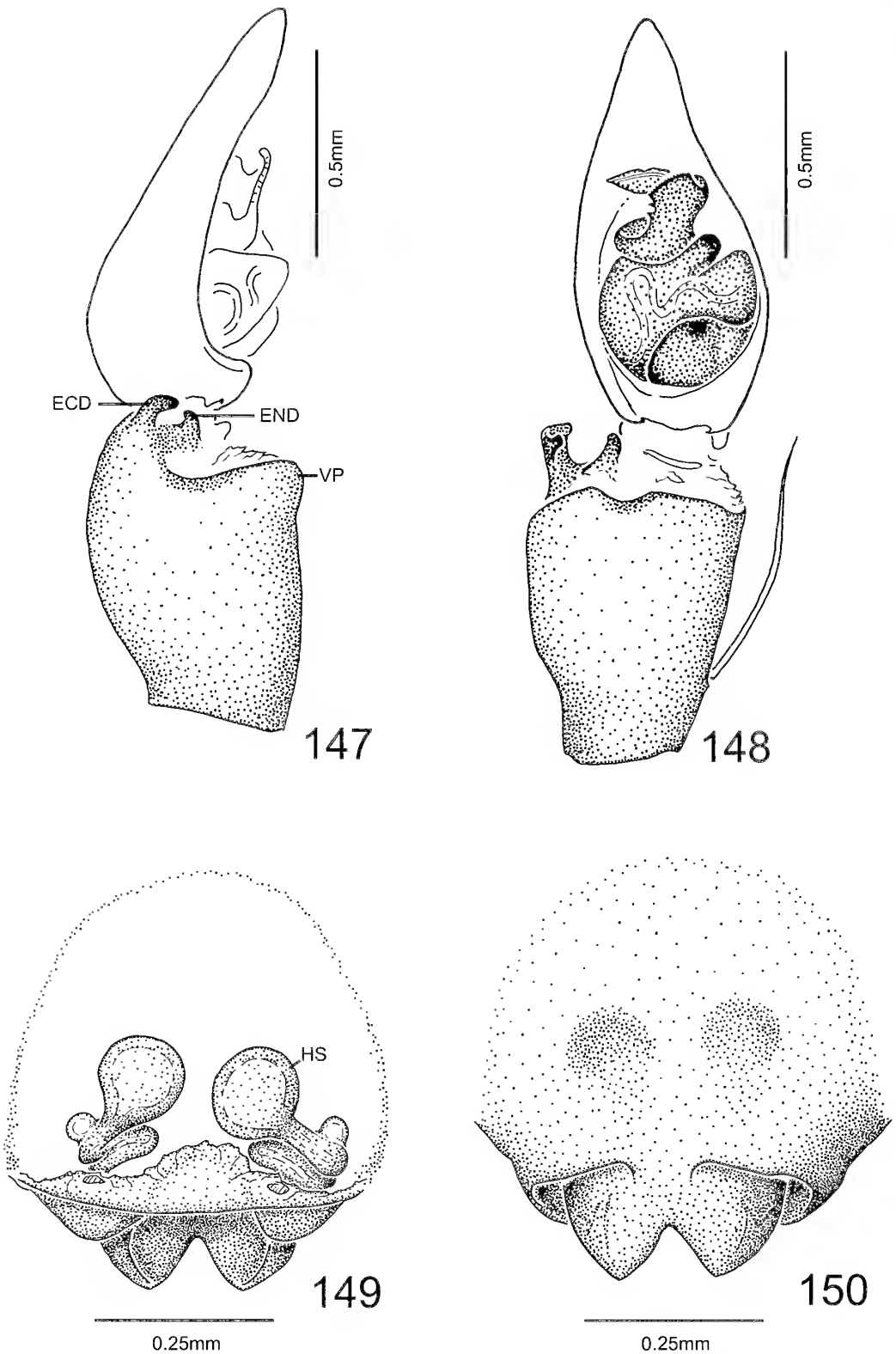
Dossenus fidelis Mello-Leitão 1943:165 (junior primary homonym of *Dossenus fidelis* Mello-Leitão 1920).

Dossenus redundans Platnick, 1993:523 (replacement name for *Dossenus fidelis* Mello-Leitão 1943); Platnick 2007.

Type material.—Lectotype male (present designation): BRAZIL: *Paraíba*: Soledade, 7°03′S, 36°21′W (MNRJ 58301). Paralectotype: 1 female, same data as holotype (MNRJ).

Diagnosis.—The males of *E. redundans* are similar to those of *E. braslandia* in the general shape of the median apophysis (Figs. 34–36), but can be distinguished by the shorter lateral lamella (Figs. 35, 152) and the shorter ental division of the retrolateral tibial apophysis (Fig. 151). The female epigynum resembles the one of *E. coloncle* (Fig. 61) but can be distinguished by the presence of a short median scape (Fig. 155).

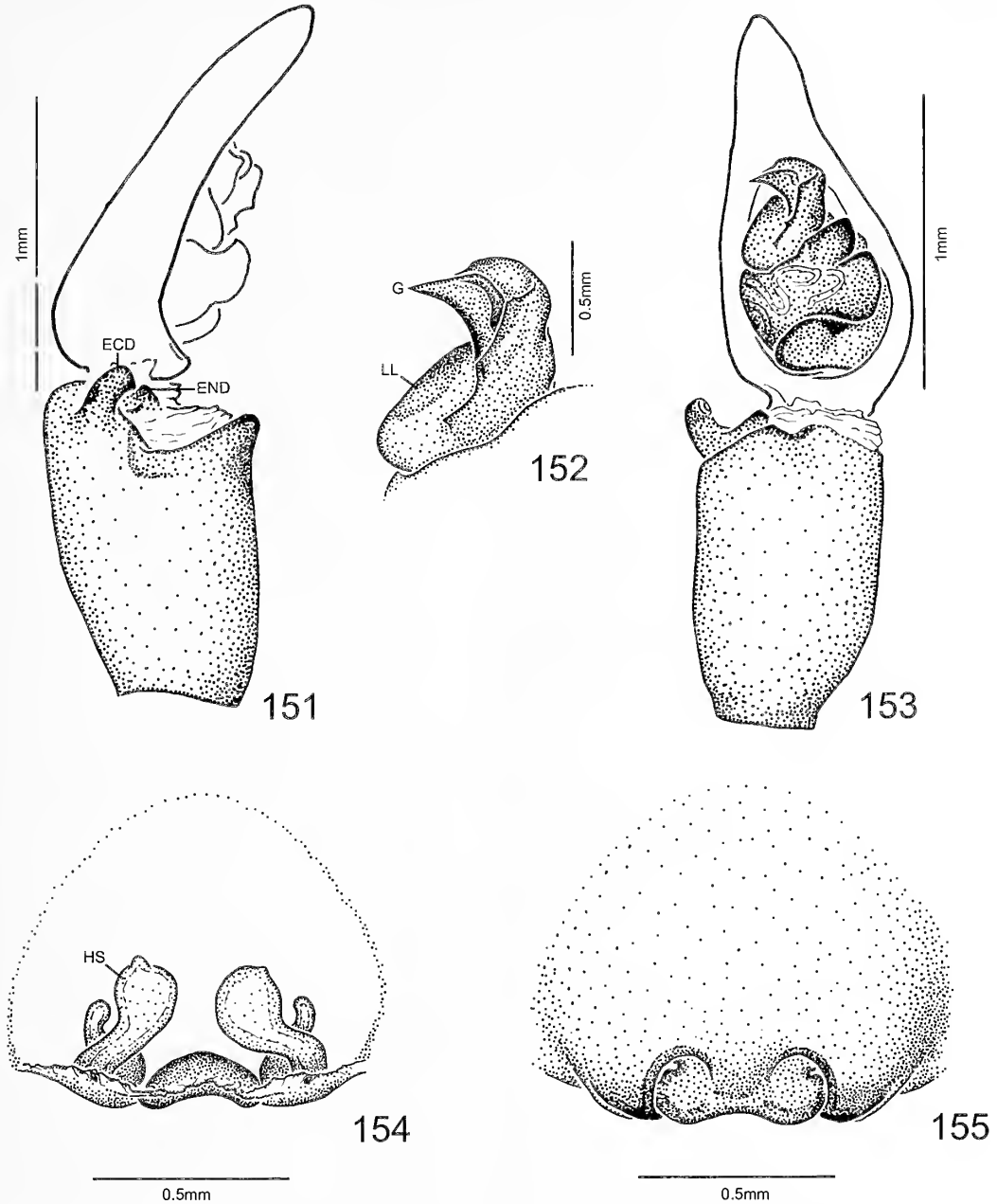
Description.—*Male (lectotype):* Carapace 3.81 long, 3.32 wide, yellowish with indistinct pattern, brownish in ocular region. Clypeus, eye diameters and interdistances could not be measured due to specimen's bad preservation. Chelicerae removed, slightly wider at base, glabrous, reddish brown, lateral carinae absent. Sternum yellowish, 1.99 long, 1.90 wide, labium yellowish, whitish distally, 0.77 long, 0.58 wide. Legs yellowish. Measurements: I – femur 4.39; II – femur 2.98; III – femur 4.15/ patella-tibia 4.64/ metatarsus 3.81/ tarsus 1.32; IV – 4.56/ 6.22/ 6.14/ 1.90. Abdomen, 2.98 long, yellowish; brownish ventrally. Palpus short, guide long and slender (Figs. 152, 153). Retrolateral tibial apophysis prominent with



Figs. 147–150.— *Enna—riotopo.* 147, 148. Right male palpus: 147. Retrolateral view; 148. Ventral view. 149, 150. Epigynum: 149. Dorsal view; 150. Ventral view. Abbreviations: ECD, ectal division of retrolateral tibial apophysis; END, ental division of the retrolateral tibial apophysis; HS, head of spermathecae; VP, ventral protuberance of male palpal tibia.

ectal division concave and coiled at apex (Fig. 151); ental division short, subtriangular (Fig. 151).

Female (paralectotype): Carapace 3.56 long, 3.15 wide, coloration as in male. Clypeus light brown, 0.15 high, 1.55 long. Anterior eye row recurved, 0.89 wide, posterior 1.12. AME 0.12, ALE 0.09, PME 0.15, PLE 0.16, AME–AME 0.09, AME–ALE 0.03, PME–PME 0.34, PME–PLE 0.40, MOQ 0.83 long, dorsal view, 0.49, frontal view 0.51, anterior width



Figs. 151–155.—*Enna redundans.* 151–153. Right male palpus: 151. Retrolateral view; 152. Detail of median apophysis; 153.Ventral view. 154, 155. Epigynum: 154. Dorsal view; 155. Ventral view. Abbreviations: ECD, ectal division of retrolateral tibial apophysis; END, ental division of the retrolateral tibial apophysis; G, guide; HS, head of spermathecae; LL, lateral lamella.

0.48, posterior width 0.50. Chelicerae shape and coloration as in male. Sternum yellowish, 1.70 long, 1.79 wide; labium yellowish, 0.52 long, 0.62 wide. Legs yellowish ventrally, light brown dorsally. Measurements: I – missing; II – femur 4.06/ patella-tibia 2.90; III. Femur 2.90; IV. Femur 4.39/ patella-tibia 6.22/ metatarsus 4.81/ tarsus 1.74. Abdomen 3.31 long, coloration as in male. Epigynum with a small median projection on posterior margin (Fig. 155) and short head of spermathecae (Fig. 154).

Distribution.—This species is only known from Brazil (Paraíba) (Fig. 5).

Remarks.—The male syntype has been selected as the lectotype since in Mello-Leitão's first description of this species a holotype was designated. The male lectotype has all the legs and palpus disarticulated, setae removed and anterior portion of carapace damaged and chelicera removed.

NOMINA DUBIA

Enna approximata (O. Pickard-Cambridge 1893), nomen dubium

Perissoblemma approximatum O. Pickard-Cambridge 1893:105, fig. 4; Roewer 1954:113; Bonnet 1956:1656.

Enna approximata (O. Pickard-Cambridge): Petrunkevitch 1911:543; Platnick 2007.

Type material.—Holotype, immature female: PANAMA: Bugaba, 8°29′N, 82°37′W, Champion (BMNH 1905.iv.28.875/ 6).

Remarks.—This species is considered as a nomen dubium because the type specimen is an immature female and therefore does not present enough morphological characters to ensure a secure determination relative to any other species.

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Revision of the Neotropical spider genus *Dyrines* (Araneae, Lycosoidea, Trechaleidae)

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Abstract. The genus *Dyrines*, is revised for the first time since Simon provided the name in 1903 to replace the preoccupied *Drances*. A female lectotype is designated for the type species, *Dyrines striatipes* (Simon 1898), which is redescribed and illustrated. The holotype of *D. taeniatus* Mello-Leitão 1943 is a tiny spiderling and is considered a *nomen dubium*. *Dyrines lineatipes* Petrunkevitch 1925 is regarded as a junior synonym of *D. striatipes*. *Dyrines rubriosignatus* Mello-Leitão 1943 is transferred to the genus *Thaumasia*, resulting in *Thaumasia rubrosignata* (Mello-Leitão 1943b), new combination. Two new species are described and illustrated: *D. huanuco* from Huanuco, Peru, and *D. ducke* from Reserva Florestal Adolfo Ducke near Manaus, Brazil.

Keywords: South Ameriea, new species, taxonomy, morphology

The name *Dyrines* was provided by Simon (1903) for a genus he described as *Drances* (1898a) because the latter was preoccupied in Coleoptera. In this work we have revised the genus for the first time. Species of this monophyletic genus are small, delicate, rather pale and without distinctive patterns except for the rather distinctive five or less dark, longitudinal lines on the legs and pedipalpi. Based on our survey of the collections as potential sources of material, specimens are relatively rare. Since they are among the smallest examples in a family better known for having very large species, e.g., *Trechalea* Thorell 1869, and seem atypical for the family, it is possible that specimens have been sorted to other genera or perhaps other families. We hope that this generic review will provide the basis for workers to identify specimens so that we might have more material in order to learn the extent of their diversity and develop an understanding of their biology.

METHODS

Specimens were loaned from the following museums: American Museum of Natural History, New York (AMNH), Muséum National d'Histoire Naturelle, Paris (MNHN), Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ), Peabody Museum of Natural History, Yale University, New Haven, Connecticut (PMNH); California Academy of Sciences, San Francisco (CAS), Museu de Ciências e Tecnologia, Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil (MCTP).

Abbreviations: AE, anterior eyes, or length of anterior eye row; ALE, anterior lateral eyes; AME, anterior median eyes; OQA, anterior part of oeular quadrangle, or length of line composed of anterior median eyes; OQH, ocular quadrangle height, or length of a line composed of anterior median eye and posterior median eye; OQP, posterior part of ocular quadrangle, or length of line composed of posterior median eyes; PE, posterior eyes, or length of posterior eye row; PLE, posterior lateral eyes; PME, posterior median eyes.

All measurements are in millimeters. Following critical point drying, the scanning electron micrograph (SEM) of the specimen was made with a Philips XL 30 scanning electron microscope in the Centro de Microscopia e Microanálises of Pontificia Universidade Católica do Rio Grande do Sul.

TAXONOMY

Family Trechaleidae Simon 1890

Diagnosis.—The spider family Trechaleidae was diagnosed by Silva et al. (2008), as follows: eyes arranged in two rows, presence of a tibial apophysis and a ventrodistal refolded rim on male palpal tibia; male palpus with a large median apophysis with a dorsal embolic groove extending into the guide; female epigynum generally heavily sclerotized, dark and opaque, the epigynal plate is conspicuous and the anterior field wide and usually distinct from the lateral lobes and the female builds a discoid and flattened egg sac, fixed and carried on the spinnerets (Carico 1993).

Genus *Dyrines* Simon 1903

Drances Simon 1898a:314 (junior homonym of *Drances angustatus* Champion 1889 (Coleoptera)).

Dyrines Simon 1903:1045 (replacement name for *Drances* Simon 1898a); Roewer 1954:136; Bonnet 1956:1615; Lehtinen 1967:372; Carico 1986:305; Sierwald 1990:51; Carico 1993:226; Sierwald 1993:63; Carico 2005:785; Platnick 2008.

Type species.—*Drances striatipes* Simon 1898b, by original designation.

Diagnosis.—Metatarsi and tarsi of the legs are straight and not bent and flexible as in some other relatively familiar trechaleid genera, i.e., *Trechalea* and *Hesydrus*. Males and females are distinguished from all other genera, except *Paradossenus* F.O. Pickard-Cambridge 1903, by the length of leg I which is about twice the length of leg III. Further, the legs share with no other genus the distinct longitudinal dark lines on the legs reducing in number towards apical segments.

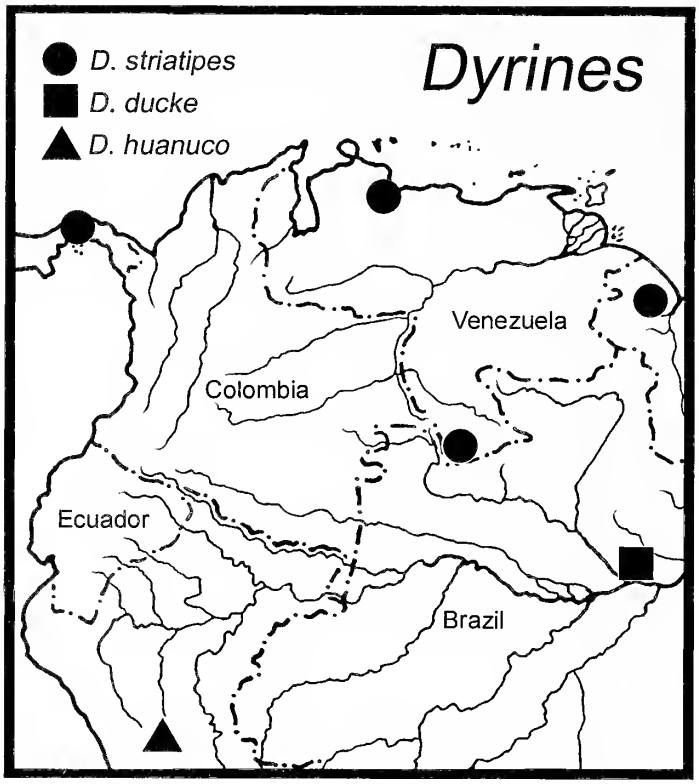


Figure 1.—Distribution of species of *Dyrines*.

The median apophysis of the male palpus lacks a ventral division and the guide is uniquely directed prolaterally (Fig. 2) rather than retrolaterally as in all other genera. The female epigynum is variable but with a distinct, posteriorly located, middle field (Fig. 6). *Dyrines* expresses the principal characteristics of the family Trechaleidae; especially the basic architecture of the male palpus (Carico 1993).

Description.—Carapace moderately high, length 1.9–2.4, cephalic area not distinct, AE row straight. Sternum unmarked. Basal elements of chelicerae promarginal teeth three with center one largest, three retromarginal teeth variable in size and spacing. Legs straight with III always smallest and I longest with the length about twice length of III; all legs and pedipalpi pale with 4-1 distinct dark, longitudinal pigmented lines.

Palpal bulb of male with large median apophysis, ventral division absent, dorsal division with the guide arising first retrolaterally but curving prolaterally; tibia distinctly shorter than cymbium, ectal division of retrolateral apophysis with small point arising from the tibial ventral rim, ental division arising very close to the cymbium and variable (Fig. 2). Female epigynum variable but with distinct, posteriorly located, middle field (Figs. 6, 10, 14).

Distribution.—Species of this genus are found from Panama southward into South America to northern Peru in the west and to Guyana and the central Amazon River Basin in the east (Fig. 1).

Dyrines striatipes (Simon 1898)
Figs. 1, 4–7

Drances striatipes Simon 1898b:18.

Dyrines striatipes (Simon): Simon 1903:1045; Petrunkevitch 1925:543; Roewer 1954:136; Bonnet 1956:1615; Sierwald 1990:33; Platnick 2008.

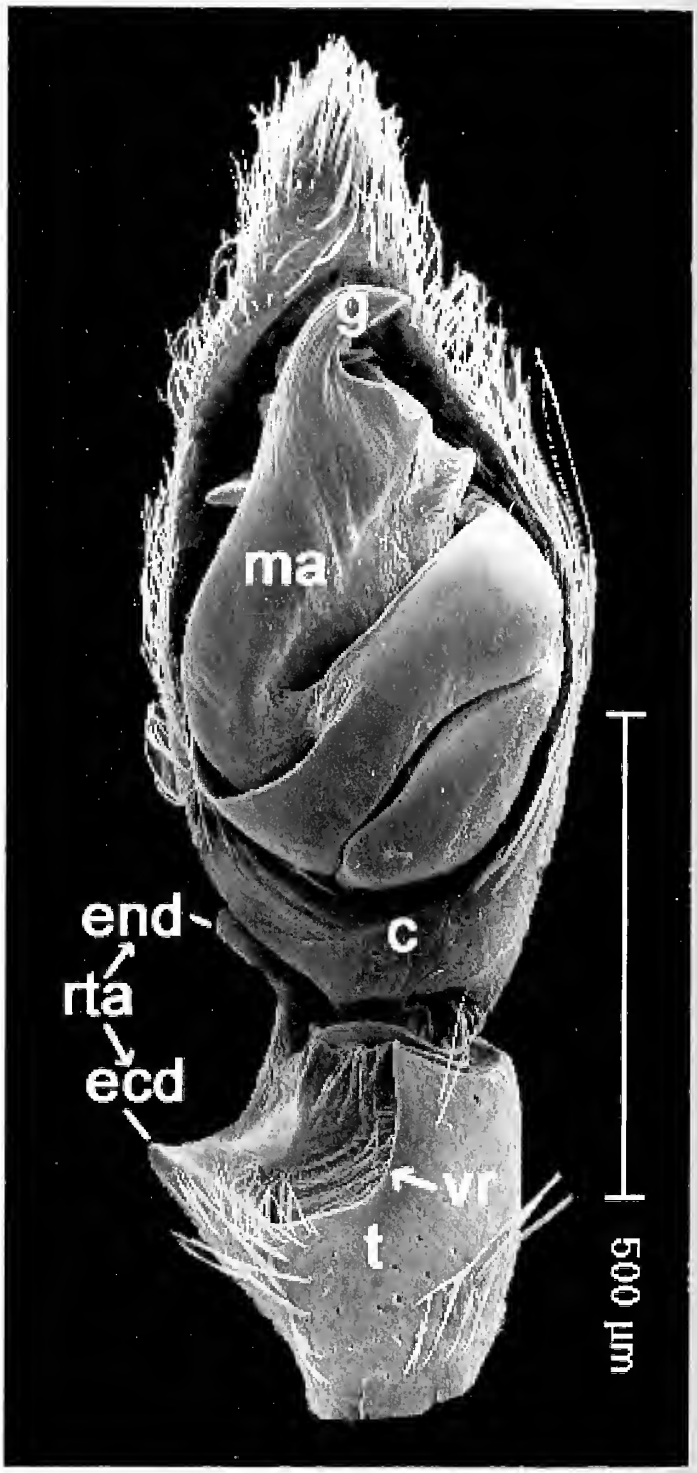
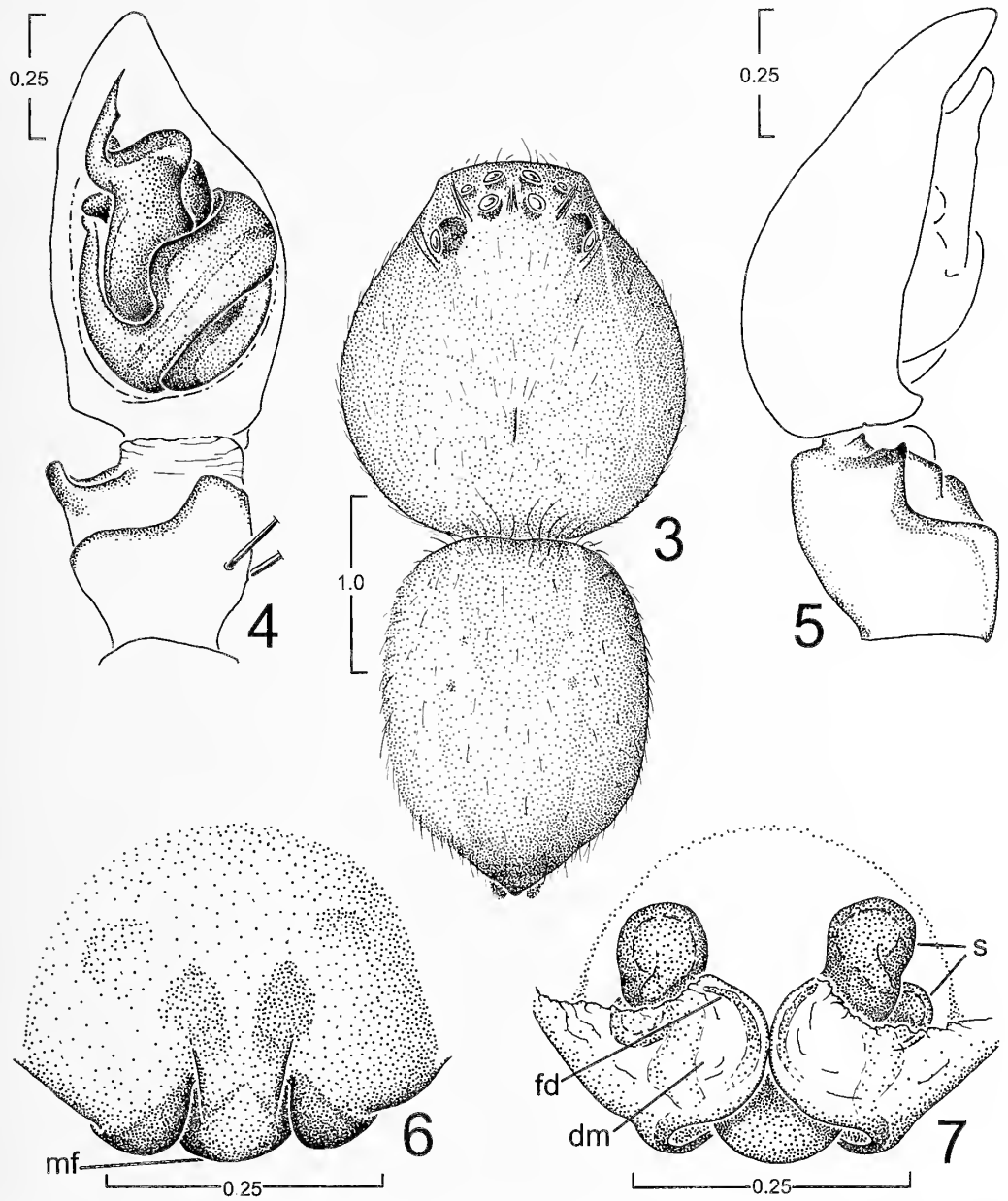


Figure 2.—*Dyrines ducke*, paratype, male palpus, ventral view. Abbreviations: c, cymbium; ecd, ectal division of retrolateral tibial apophysis (rta); end, ental division of rta; g, guide; ma, median apophysis.

Dyrines lineatipes Petrunkevitch 1925:166, figs. 86, 87. Platnick 2008. NEW SYNONYMY.

Material examined.—*Drances striatipes:* female lectotype (present designation), VENEZUELA: *Carabobo*: San Esteban, Venezuela (10°24′N, 068°05′W) (MNHN). Paralectotypes: 1



Figures 3–7.—*Dyrines striatipes*: 3. Dorsal pattern of paralectotype male; 4. Right palpus, paralectotype male, ventral view; 5. Same, retrolateral view; 6. Female genitalia, lectotype, ventral view; 7. Same, dorsal view. Abbreviations: dm, dorso-lateral membrane; fd, fertilization duct of female epigynum; mf, middle field of epigynum; s, spermathecae.

male, 1 female, 1 immature male, same data as lectotype (MNHN).

Dyrines lineatipes: male holotype PANAMA: *Veraguas*: San Lorenzo, Chiriquí, Wilcox Camp (08°18′N, 82°06′W), 12 April 1924, A. & W. Petrunkevitch (PMNH, examined).

Other material: GUYANA: *Essequibo*: 2 ♂, 2 ♀, Shudicar River, upper Essequibo River (07°02′N, 058°27′W), 1 January 1938, W.G. Hassler (AMNH). VENEZUELA: *Amazonas*: 1 ♂, Rio Yaciba, 1.5 days above junction with Rio Yatua (01°29′02″N, 066°31′37″W), 6 December 1953, anonymous (AMNH).

Diagnosis.—The guide of the median apophysis of the male pedipalp differs from the other species of *Dyrines* in that it narrows apically (Fig. 4). The ental division of the retrolateral tibial apophysis is small and indistinct, a character that it shares with *D. huanuco* (Fig. 9) but differs from *D. ducke* (Fig. 13). Externally, the median division of the female epigynal plate is broadly and smoothly connected to the remainder of the epigynal plate, and posteriorly forms the middle portion of the epigastric rim (Fig. 6). Internally, the curved fertilization ducts (fd) are only similar to that of *D. huanuco* (Fig. 11), but differ from *D. ducke* (Fig. 15) in that they form an arc arising near the posterior epigynal rim, curving and touching medially and continuing antero-laterally while creating broad, thin, dorsal membranes (dm) laterally (Fig. 7).

Description.—*Paralectotype male:* Carapace (Fig. 3) pale with lateral, thin, light, longitudinal lines each side, black around each eye, length 2.12, width 1.84. Sternum: length 1.00, width 1.12; labium length 0.35, width 0.35. Clypeus unmarked,

height 0.11, width 0.86. Eyes: AE 0.65, PE 1.04, OQA 0.35, OQP 0.47, OQH 0.37, PLE 0.17, PME 0.16, ALE 0.10, AME 0.14, PLE–PME 0.18, PME–PME 0.11, ALE–AME 0.06, AME–AME 0.07. Chelicerae each with two indistinct dark longitudinal lines, one anterior and one lateral; grooves and carinae absent; three promarginal teeth, three retromarginal teeth with distal one largest and more distant. Legs, segment lengths: femur, patella-tibia, metatarsis, tarsus, total: I -3.48, 4.64, 4.12, 1.41, 13.64; II - 2.48, 3.08, 2.52, 0.96, 9.04; III - 1.72, 1.84, 1.72, 0.68, 5.72; IV -2.52, 2.92, 3.20, 0.88, 9.52; tibial ventral macrosetae pairs: I-5, II-5, III-1, IV-3. Pedipalpi with longitudinal dark lines. Abdomen (Fig. 3) pale with faint dorsal longitudinal lines anteriorly. Guide of median apophysis of male palpal bulb (Figs. 4, 5) is narrow and acute apically; retrolateral tibial apophysis with small, indistinct ental division.

Lectotype female: Carapace pale with lateral, thin, light, longitudinal lines each side, black around each eye, pencils of white setae in eye region directed anteriorly; length 2.04, width 1.84. Sternum: length 1.00, width 1.12; labium length 0.33, width 0.34. Clypeus with faint, dark marks under each anterior eye, height 0.12, width 0.79. Eyes: AE 0.60, PE 0.96, OQA 0.35, OQP 0.44, OQH 0.36, PLE 0.19, PME 0.18, ALE 0.10, AME 0.15, PLE–PME 0.18, PME–PME 0.08, ALE–AME 0.03, AME–AME 0.05. Chelicerae each with two indistinct dark longitudinal lines, one anterior and one lateral, three promarginal teeth, three retromarginal teeth equidistant with distal one largest. Legs, segment lengths: femur, patella-tibia, metatarsis, tarsus, total: I -3.08, 3.80, 3.16, 1.14, 11.18; II - missing; III - 1.70, 1.84, 1.50, 0.68, 5.72; IV - 2.60, 2.92, 2.98, 0.96, 9.44; tibial ventral macrosetae pairs: I-5, II-missing, III-3, IV-3. Pedipalpi pale with longitudinal dark lines. Externally, sides of the middle field (mf) of the female epigynal plate (Fig. 6) almost parallel, smoothly joined to epigynal plate; posteriorly forms middle portion of epigastric rim. Internally (Fig. 7), on each side are two spermathecae (s) and one dorsal, flat lamella, curved fertilization ducts (fd) arise posteriorly, curve and almost join medially then terminate anteriorly, while creating broad, thin dorso-lateral membranes (dm). Abdomen pale with dorsal, faint, longitudinal light lines anteriorly; sides and venter unmarked.

Variation.—Carapace lengths of three males are 2.12, 1.72, 1.72; average 1.85. Carapace lengths of three females are 2.04, 1.72, 1.52; average 1.76.

Distribution.—This species is found from Panama southward into southern Venezuela and northern Guyana.

Remarks.—Simon did not designate a holotype from the syntype series, however he described a female, therefore a female lectotype is selected here to provide taxonomic stability. The synonymy is based on the genitalia which show clearly that the two species are conspecific.

There are several localities in Venezuela with a place name of "San Esteban," so the locality of the type collection is assumed to be in the well-known historical area between Valencia and Puerto Cabello.

The label with the Panamanian specimen lists, "in brush near stream." One egg sac is in the type collection which is of typical trechaleid construction, i.e., composed of two valves with a "skirt" at the juncture. It is rather spherical with a diameter of 20 mm.

Dyrines huanuco new species
Figs. 1, 8–11.

Material examined.—Holotype male, PERU: *Huanuco*: Divisoria (09°40′S, 076°05′W), 23 September–3 October 1946, F. Woytkowski (AMNH).

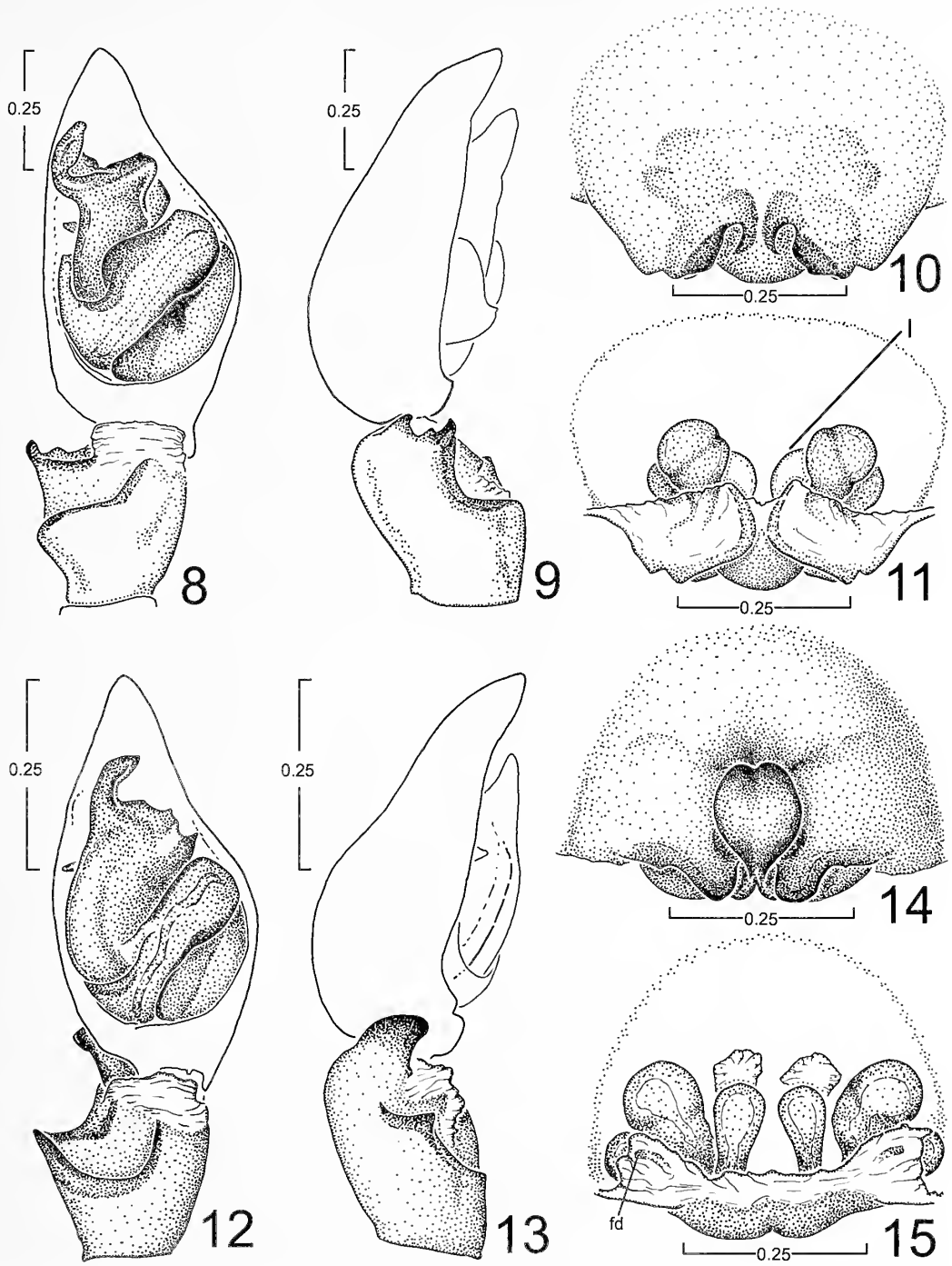
Other material: PERU: *Huanuco*: 1 ♀, Tingo Maria, Monson Valley (09°10′S, 076°00′W), 26 October 1954, E.E. Schlinger & E.S. Ross (CAS).

Etymology.—The name is a noun in apposition taken from the type locality, the state of Huanuco, Peru.

Diagnosis.—The median apophysis of the male differs from the *D. striatipes* in that it is spatulate and rounded apically, while the ental division of the retrolateral tibial apophysis is small, indistinct and acute, a character that it shares with *D. striatipes* (Fig. 5) but differs from *D. ducke* which has a large ental division (Fig. 13). Externally, the median division of the female epigynal plate differs from the other species by being narrowly connected to the remainder of the epigynal plate and by curved, antero-lateral ridges around the entrance through the epigynal plate, and forms the middle portion of the epigastric rim (Fig. 10). Internally, the curved fertilization ducts are only similar to that of *D. striatipes* (Fig. 7), but differ from *D. ducke* (Fig. 15), in that they form an arc arising near the posterior epigynal rim, curving and almost touching medially and continuing anterio-laterally while creating broad, thin dorso-lateral membranes (Fig. 11).

Description.—*Holotype male:* Carapace pale with lateral, thin, light, longitudinal line each side, black around each eye, pencils of white setae directed anteriorly from eye region, length 1.90, width 1.60. Sternum: length 1.90, width 0.98; labium length 0.29, width 0.31. Clypeus with faint dark markings under each AE, height 0.08, width 0.67. Eyes: AE 0.56, PE 0.88, OQA 0.31, OQP 0.39, OQH 0.36, PLE 0.18, PME 0.16, ALE 0.08, AME 0.15, PLE–PME 0.17, PME–PME 0.10, ALE–AME 0.05, AME–AME 0.05. Chelicerae each with two dark longitudinal lines, one anterior and one lateral; anterior groove and lateral carina absent; three promarginal teeth, three retromarginal teeth equal size and equidistant. Legs, segment lengths: femur, patella-tibia, metatarsis, tarsus, total: I - 3.16, 4.10, 3.80, 1.20, 12.26; II - 2.20, 2.60, 2.24, 0.82, 7.86; III - 1.48, 1.70, 1.40, 0.60, 5.18; IV - 2.32, 2.54, 2.72, 0.82, 8.44; tibial ventral macrosetae pairs: I-5, II-4, III-2, IV-3. Pedipalpi pale with longitudinal dark lines. Abdomen pale with three anterior light, narrow, longitudinal lines with two lateral, one medial; sides with wide white marking; venter unmarked. Guide of median apophysis of male palpal bulb is spatulate (Figs. 8, 9); retrolateral tibial apophysis with ental division short and acute (Figs. 8, 9).

Female (Peru, Tingo Maria, Monson Valley, Huanuco): Carapace pale with lateral, thin, light, longitudinal line each side, black around each eye, length 2.00, width 1.84. Sternum: length 1.10, width 1.10; labium length 0.35, width 0.35. Clypeus with faint dark markings under each AE, height 0.10, width 0.81. Eyes: AE 0.59, PE 0.97, OQA 0.33, OQP 0.44, OQH 0.37, PLE 0.18, PME 0.17, ALE 0.09, AME 0.14, PLE–PME 0.12, PME–PME 0.14, ALE–AME 0.05, AME–AME 0.12. Chelicerae each with two dark longitudinal lines, one anterior and one lateral, three promarginal teeth, three retromarginal teeth equidistant and equal in size.



Figures 8–15.—Genitalia of species of *Dyrines*. 8–11. *D. huanuco*: 8. Right palpus, holotype male, ventral view; 9. Same, retrolateral view; 10. Female genitalia, allotype, ventral view; 11. Same, dorsal view. 12–15. *Dyrines ducke*: 12. Right palpus, holotype male, ventral view; 13. Same, retrolateral view; 14. Female genitalia, allotype, ventral view; 15. Same, dorsal view. Abbreviations: l, chitinous lamella inside the epigynal plate; fd, fertilization duct.

Legs, segment lengths: femur, patella-tibia, metatarsis, tarsus, total: I - 2.92, 3.70, 3.04, 1.06, 10.72; II - 2.26, 2.80, 2.20, 0.84, 8.10; III - 1.60, 1.80, 1.52, 0.66, 5.60; IV - 2.54, 2.70, 2.76, 0.90, 8.90; tibial ventral macrosetae pairs: I-4, II-5, III-2, IV-2. Pedipalpi pale with longitudinal dark lines. Abdomen pale, unmarked, damaged dorsally. Externally, the median division of the female epigynal plate is constricted anteriorly where there is a pit on each side partially surrounded by a curved ridge, posteriorly forms middle portion of epigastric rim (Fig. 10). Internally, on each side there are two spermathecae and one dorsal, flat lamella, curved fertilization ducts arise posteriorly, curve and almost join medially then terminate anteriorly, while creating broad, thin dorso-lateral membranes (Fig.11).

Natural history.—Nothing is known of the biology of this species.

Dyrines ducke new species
Figs. 1, 2, 12–15

Material examined.—Holotype male, BRAZIL: *Amazonas*: Reserva Florestal Adolfo Ducke, near Manaus (03°05′S, 060°00′W), 3 November 1991, S. Magni (MCTP). Allotype female, same data as holotype (MCTP). Paratype male, same data as holotype (MCTP).

Etymology.—The name is a noun in apposition based on the type locality, Reserva Florestal Adolfo Ducke.

Diagnosis.—The ental division of the retrolateral apophysis of the male differs from both other species by being very pronounced and blade-like (Figs. 2 *end*, 12, 13) and the length of the large median apophysis is greater than the length of the tibia (Fig. 12). Only the male of this species has on each basal cheliceral segment a groove above the fang and an adjacent lateral carina. Characters of the epigynum found only in this species include: ventrally, (1) the oval middle field of the epigynal plate is elevated and surrounded by a suture, and (2) dorsally, on each side, there are three conspicuous spermathecae and a posteriorly situated fertilization duct (Fig. 15).

Description.—*Holotype male:* Carapace pale with lateral, thin, light, longitudinal lines each side, additional longitudinal light lines anteriorly, black around each eye, pencils of anteriorly-directed white setae in the eye region, length 2.40, width 2.22. Sternum unmarked, length 1.15, width 1.20; labium length 0.43, width 0.43. Clypeus with faint dark markings under each AE, height 0.16, width 1.10. Eyes: AE 0.69, PE 1.10, OQA 0.36, OQP 0.48, OQH 0.43, PLE 0.23, PME 0.20, ALE 0.11, AME 0.16, PLE–PME 0.23, PME–PME 0.14, ALE–AME 0.06, AME–AME 0.10. Chelicerae unmarked, each basal segment with groove above each fang and lateral carina, three promarginal teeth, three retromarginal teeth, equidistant, proximal one smaller. Leg segment lengths: femur, patella-tibia, metatarsis, tarsus, total: I - 5.60, 7.34, 6.43, 1.84, 21.21; II - 3.56, 4.14, 3.40, 1.14, 12.24; III - 2.10, 3.32, 1.86, 0.74, 8.02; IV - 3.72, 4.00, missing; tibial ventral macrosetae pairs: I-4, II-4, III-1, IV-3. Pedipalpi with longitudinal dark lines. Abdomen pale on all sides, pair of light longitudinal lines dorsally. Median apophysis of male palpal bulb large, rounded retrolaterally, guide arises subapically and curves prolaterally; ental division of retrolateral tibial apophysis large, blade-like, curved ventrally (Figs. 12, 13).

Allotype female: Carapace pale with lateral, thin, light, longitudinal lines each side, additional longitudinal light lines anteriorly, black around each eye, length 2.30, width 2.10. Sternum unmarked, length 1.10, width 1.15; labium length 0.40, width 0.38. Clypeus dark under each anterior median eye, height 0.16, width 0.95. Eyes: AE 0.65, PE 1.10, OQA 0.35, OQP 0.49, OQH 0.43, PLE 0.20, PME 0.19, ALE 0.09, AME 0.14, PLE–PME 0.20, PME–PME 0.12, ALE–AME 0.06, AME–AME 0.07. Chelicerae unmarked, three promarginal teeth, three retromarginal teeth equidistant and equal size. Legs segment lengths: femur, patella-tibia, metatarsus, tarsus, total: I - 4.40, 4.84, 4.60, 1.40, 15.24; II - 3.12, 3.74, 2.92, 1.08, 10.86; III - 2.00, 2.10, 1.70, 0.72, 6.52; IV - 3.34, 3.66, 3.58, 1.20, 11.78 ; tibial ventral macrosetae pairs: I-4, II-3, III-1, IV-2. Pedipalpi pale with dorsal longitudinal dark lines. Abdomen pale, pattern indistinct due to integument separation. Epigynum (Fig. 14) ventrally with an oval middle field surrounded by the epigynal plate; internally (Fig. 15) with three distinct spermathecae and one flat lamella each side.

Natural history.—Nothing is known of the biology of this species.

OTHER SPECIES

Dyrines taeniatus (Mello-Leitão 1943a), nomen dubium

Drances taeniatus Mello-Leitão 1943a:159, fig. 5.

Dyrines taeniatus (Mello-Leitão) Simon 1903:1045. Platnick 2008.

Material examined.—Holotype spiderling, BRAZIL: *Rio Grande do Sul*: P. Rambo (MNRJ #059117).

Remarks.—The holotype of *D. taeniatus* is a very small immature specimen and its generic affiliation cannot be determined. Mello-Leitão stated that the specimen was a 3 mm female and, although the size agrees with the type specimen, the related figure does not agree and could be of a another specimen.

Dyrines rubrosignatus Mello-Leitão 1943b

Dyrines rubrosignatus Mello-Leitão 1943b:165. Platnick 2008.

Material examined.—Holotype spiderling, *Dyrines rubrosignatus* Mello-Leitão, BRAZIL: *Paraíba*, Campina Grande, R. von Ihering (MNRJ).

Remarks.—*Dyrines rubrosignatus* is transferred to the genus *Thaumasia* (Pisauridae), based on the typical dorsal pattern in most species of the latter genus, i.e., wide median dark area with lateral white bands, thus resulting in the new combination, *Thaumasia rubrosignata* (Mello-Leitão 1943b), NEW COMBINATION.

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Revision of the Neotropical arboreal spider genus *Syntrechalea* (Araneae, Lycosoidea, Trechaleidae)

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Abstract. The spider genus *Syntrechalea* is redefined and revised with a total of seven species recognized. The previously described species *S. tenuis* F.O. Pickard-Cambridge 1902 and *S. reimoseri* Caporiacco 1947 are redefined. *Syntrechalea porschi* Reimoser 1939 is a new junior synonym of *S. tenuis*. *Trechalea syntrechaleoides* Mello-Leitão 1941 is transferred to the genus *Syntrechalea*. The males of *S. tenuis* and *S. syntrechaleoides* are described for the first time. A lectotype is designated for *Syntrechalea reimoseri* (Caporiacco 1947). Three new species, *S. adis, S. caporiacco,* and *S. brasilia*, are described from both males and females. The new species *S. caballero* is described from only the female, and *S. napoensis* is described from only the male. The arboreal nature of the genus is emphasized and discussed.

Keywords: New species, Pisauridae, taxonomy

In previous generic revisions and in other publications on genera in the family Trechaleidae the species treated are considered "semi-aquatic," i.e., they inhabit the margins of streams and lakes, which confirms the prevailing impression regarding the habitat of Trechaleidae [*Trechalea* Thorell 1869 (Carico 1993); *Hesydrus* Simon 1898 (Carico 2005a); *Trechaleoides* Carico 2005 (Carico 2005b); *Paratrechalea* Carico 2005 (Carico 2005b); and *Paradossenus* F.O. Pickard-Cambridge 1903 (Sierwald 1993) as well as three other works in preparation]. In the genus *Syntrechalea* F.O. Pickard-Cambridge 1902, however, it seems that most species are arboreal. In the species descriptions below, statements quoted from the collection labels and personal communications with some of the collectors give good evidence of this arboreal habit. This deviation from what is considered the "characteristic" aquatic habitat of a family by a terrestrial/arboreal subgroup is paralleled in the Pisauridae. In North America, the typical habitat for *Dolomedes* Latreille 1804 (Pisauridae) is aquatic; however, *Dolomedes albineus* Hentz 1845 is the arboreal exception.

Relatively few specimens were available for this study apparently because of the general inaccessibility of these species to collection from the trees in which they reside. By publishing this revision, I hope that future collectors working in this habitat will obtain additional specimens and habitat data that will enhance our knowledge of this interesting group. With further collecting in this habitat, I expect that we will add significantly to the number of species in this genus and determine the extent to which the spiders contribute to the predatory fauna in this varied habitat.

Although the genus possesses typical trechaleid characteristics (Carico 1993), there are relatively unique characters present which may be associated with their arboreal habit. Specifically, the long, slender legs (Fig. 18) in proportion to the body and a flattened profile of the carapace with an elevated cephalic area (Fig. 19) permit the spider to stay perched on a tree trunk while conforming to the physical contours of its substrate. Some species have large numbers of macrosetae pairs on the ventral side of the tibiae and metatarsi of legs I and II (up to 15), while there are a reduced number for those segments of legs III and IV. Although there are characteristics of the general morphology that unite these species into the genus *Syntrechalea*, there is considerable diversity in the genitalia, particularly of the female.

METHODS

Specimens were loaned from the following museums: Museu Nacional, Rio de Janeiro (MNRJ); American Museum of Natural History, New York (AMNH); Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ); California Academy of Sciences, San Francisco (CAS); Field Museum of Natural History, Chicago (FMNH); Museo Zoologico "La Specola", Florence (MZUF); Instituto Naçional de Pesquisas Amazônia, Manaus (INPA); U.S. National Museum of Natural History, Washington, DC (USNM); The Natural History Museum, London (BMNH); Universidade de Brasilia, Instituto de Ciencias Biologicas (DBAI); Costa Rica, Ciudad Universitaria, Universidad de Costa Rica, Museo de Zoologia (MZCR). Measurements are in mm. As an index to the size of the body, only the length of the relatively rigid carapace is given because of variability in the condition of the softer abdomen. Abbreviations and additional notes pertaining to the eye group measurements are in Table 1. Abbreviations of structures of genitalia are after Carico (1993) and Sierwald (1993).

TAXONOMY

Family Trechaleidae Simon 1890

Diagnosis.—The spider family Trechaleidae was diagnosed by Silva et al. (2008), as follows: eyes arranged in two rows, presence of a tibial apophysis and a ventrodistal refolded rim on male palpal tibia; male palpus with a large median apophysis with a dorsal embolic groove extending into the guide; female epigynum generally heavily sclerotized, dark and opaque, the epigynal plate is conspicuous and the anterior field wide and usually distinct from the lateral lobes and the female builds a discoid and flattened egg sac, fixed, and carried on the spinnerets (Carico 1993).

Table 1.—Eye measurements for species of *Syntrechalea*. Measurements are dimensions with outer limits of entities included. AE row = width of anterior eye row, PE row = width of posterior eye row, OQA = width of ocular quadrangle anteriorly or width of anterior median eyes, OQP = width of ocular quadrangle posteriorly or width of posterior median eyes, OQH = height of ocular quadrangle or height of anterior median eye at posterior median eye, PLE = diameter of posterior lateral eye, PME = diameter of posterior median eye, ALE = diameter of anterior lateral eye, AME = diameter of anterior median eye, PLE–PME = inter-distance between posterior lateral eye and posterior median eye, PME–PME = inter-distance between posterior median eyes, ALE–AME = inter-distance between anterior lateral eye and anterior median eye, AME–AME = inter-distance between anterior median eyes.

	S. tenuis, ♂	*S. tenuis*, ♀	*S. reimoseri*, ♀	*S. adis*, ♂	*S. adis*, ♀	*S. syntrechaleoides*, ♂	*S. syntrechaleoides*, ♀	*S. caporiacco*, ♂	*S. caporiacco*, ♀	*S. brasilia*, ♂	*S. brasilia*, ♀	*S. napoensis*, ♂	*S. caballero*, ♀
AE row	0.82	0.84	0.77	0.9	0.82	0.94	1.03	0.98	1.04	0.92	1.09	0.92	1.11
PE row	1.6	1.6	1.54	1.67	1.44	1.92	2.13	1.9	2.05	1.78	2.08	1.6	1.95
OQA	0.48	0.47	0.45	0.48	0.46	0.51	0.56	0.55	0.59	0.54	0.64	0.52	0.56
OQP	0.87	0.85	0.83	0.88	0.86	1.03	1.14	1.04	1.1	0.94	1.1	0.95	0.98
OQH	0.74	0.69	0.7	0.74	0.78	0.82	0.95	0.87	0.9	0.84	0.9	0.84	0.84
PLE	0.4	0.38	0.35	0.39	0.34	0.44	0.5	0.48	0.47	0.4	0.45	0.4	0.41
PME	0.38	0.35	0.33	0.34	0.38	0.45	0.49	0.46	0.49	0.41	0.43	0.4	0.35
ALE	0.12	0.13	0.12	0.13	0.12	0.15	0.16	0.15	0.16	0.15	0.16	0.15	0.15
AME	0.2	0.2	0.19	0.21	0.2	0.21	0.23	0.22	0.24	0.24	0.25	0.25	0.24
PLE–PME	0.28	0.26	0.26	0.25	0.26	0.3	0.25	0.3	0.3	0.35	0.36	0.32	0.3
PME–PME	0.2	0.19	0.2	0.16	0.2	0.25	0.27	0.21	0.25	0.22	0.29	0.2	0.31
ALE–AME	0.06	0.06	0.06	0.1	0.1	0.07	0.09	0.06	0.06	0.05	0.06	0.05	0.11
AME–AME	0.11	0.1	0.1	0.12	0.1	0.16	0.17	0.15	0.15	0.11	0.12	0.08	0.15

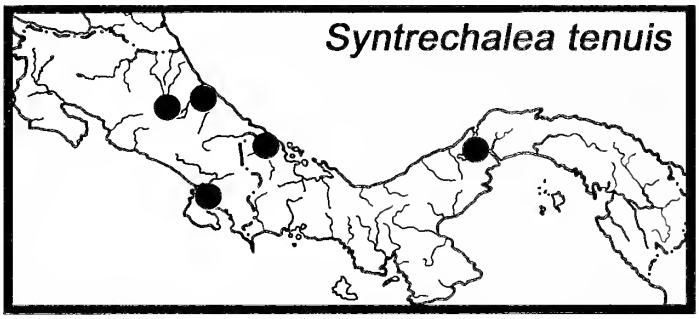


Figure 1.—Distribution of *Syntrechalea tenuis* in Central America.

Genus *Syntrechalea* F.O. Pickard-Cambridge 1902

Syntrechalea F.O. Pickard-Cambridge 1902:313, 314; Roewer 1954:139; Bonnet 1955–1959:4225; Lehtinen 1967:379; Brignoli 1983:461; (Pisauridae). Carico 1986: 305; Sierwald 1990:8; Carico 1993:226; Sierwald 1993:63 (Trechaleidae); Platnick 2007.

Type species.—*Syntrechalea tenuis* F.O. Pickard-Cambridge 1902, by original designation.

Diagnosis.—*Syntrechalea* shares only with the trechaleid genus, *Hesydrus*, the character of both having flexible tarsi and a flexible distal half of the metatarsi, but the former differs from the latter by legs that are also very thin with the leg III femur approximately twice the length of the carapace (femur III length/carapace length: *Syntrechalea* = average 1.84, range 1.37–2.33; *Hesydrus* = average 1.25, range 1.16–1.32). The legs of *Syntrechalea* are also very thin, tend to bend or curl in alcohol, and bear numerous pairs of ventral, tibial macrosetae (average 8.93, range 6–15 pairs on leg I; only 4 in all *Hesydrus* species). The carapace is low with the cephalic region uniquely elevated and the eyes more or less tuberculate. The retrolateral tibial apophysis is bifurcate with the ectal division narrow and the ental division equally prominent and flattened. The cymbium has two or three macrosetae. The cheliceral paturon is not swollen in the male. The epigynum is varied but has the middle field distinct and in a posterior position and surrounded by the anterior field anteriorly and laterally.

Description.—Carapace low with cephalic region elevated and eyes more-or-less tuberculate. AE row straight or nearly so, PE recurved. Black zone around each eye prominent and often coalescing with others. Three promarginal cheliceral teeth with median larger than other two; three retromarginal cheliceral teeth of equal size. Relative leg lengths variable but with leg III always shortest. Legs long, thin, with tarsi flexible, often curved in alcohol; distal half of metatarsi flexible and often bent. Femur III usually more than twice length of carapace. Numerous ventral macrosetae pairs on tibiae I and II ranging from 6 to 15.

Retrolateral tibial apophysis (rta) of male palpus (Figs. 8, 9) with ectal division (ecd) narrow, bilobed ental division (end) usually equal in length but flattened; ventral division (vd) of median apophysis (ma) narrowing to a point distally, guide (g) of dorsal division (dd) acute and directed laterally except in *S. syntrechaleoides*. Epigynal plate (Fig. 10) with conspicuous middle field (mf) distinct from anterior field (af), internal parts (Fig. 11, 13, 17, 23, 27, 31, 35) varied.

Distribution.—In the northern limit of the range of the genus, the best distribution records of *S. tenuis* are in Costa Rica and Panama; however, there is a record of a female from "Barrancas," Mexico, which has not yet been precisely located. The genus ranges southward through South America where the southern-most locations of *S. caporiacco* are in the state of Bahia in Brazil.

Syntrechalea tenuis F.O. Pickard-Cambridge
Figs. 1, 8–11

Syntrechalea tenuis F.O. Pickard-Cambridge 1902:314; Roewer 1954:139; Bonnet 1958:4225; Platnick 2007.

Syntrechalea porshi Reimoser 1939:339; Roewer 1954:139; Platnick 2008. **NEW SYNONYMY**

Materia examined.—Holotype of *Syntrechalea tenuis*: female, PANAMA: *Chiriquí*: Bugaba, 08°29′N, 082°37′W, Champion (BMNH).

Holotype of *Syntrechalea porshi*: male, COSTA RICA: *Limon*: Hamburg Farm (Rio Reventatou), 1930, E. Reimoser (NHMH).

Other material: COSTA RICA: *Caratago*: 1 ♀, Turrialba, 09°54′N, 083°41′W, 11 March 1967, W.B. Peck (CAS); *Limon*: 1 ♀, Hamburg Farm [location not traced], 27 March 1930, C.R. Dodge (MCZ); *Puntarenas*: 1 ♀, Rincón de Osa, date unknown, C.E.Valerio (UCR). PANAMA: *Bocas del Toro*: 1 ♂, Changuinola, 09°26′N, 082°31′W, date unknown, Swift (AMNH); *Canal Zone*: 2 ♀, Barro Colorado Island, 08°14′36″N, 078°13′22″W, 13–23 July, year unknown, Banks (MCZ); 1 ♂, 2 juveniles, Pipeline Road, 12 July 1976, GGM, Y.L. (abbreviations for unknown collectors) (UV); 2 juveniles, same data except 15 July 1976 (GGM/YL) (UV). MEXICO: 1 ♂, 150 km NE. of Barrancas (not located), 1 August 1958, A.S. Menke (AMNH).

Diagnosis.—*Syntrechalea tenuis* is the only member of the genus known in Central America. The male shares a two-pointed guide of the dorsal division of the median apophysis only with *S. napoensis* but differs from the latter by the shape of the ectal division of the retrolateral tibial apophysis in that *S. tenuis* has two acute points while *S. napoensis* has one acute point and the other rounded.

Description.—*Male (Changuinola, Bocas del Toro, Panama):* Carapace length 3.1, width 3.0, pale with indistinct narrow marginal band, black in eye region. Sternum light, unmarked, length 1.86, width 1.84; labium light, length 0.62, width 0.58. Clypeus height 0.27, width 1.44. Anterior eye row straight, eye measurements in Table 1. Chelicerae unmodified; faces light with dark maculae distally; middle of promarginal teeth largest, three marginal teeth sub-equal in size, equidistant, all larger than promarginal teeth. Legs IV-II-I-III, ventral macrosetae pairs on tibiae are I-9, II-9, III-5, IV-1. Color of legs pale, marked only with very faint maculae. Abdomen length 4.2, with distinct, diffuse dorsal pattern. Palpus (Figs. 8, 9) tibia length less than cymbium, bulb tegulum and subtegulum prominent, ventral division of median apophysis acute distally with two points, guide of dorsal division acute, directed laterad, ectal division of retrolateral tibial apophysis prominent, projected somewhat laterally, outer edge with two points.

Female (holotype): Entire specimen blanched. Carapace length 3.0, width 3.0. Sternum length 1.70, width 1.70; labium length 0.58, width 0.60. Clypeus height 0.45, width 1.43. Anterior eye row straight, eye measurements in Table 1.

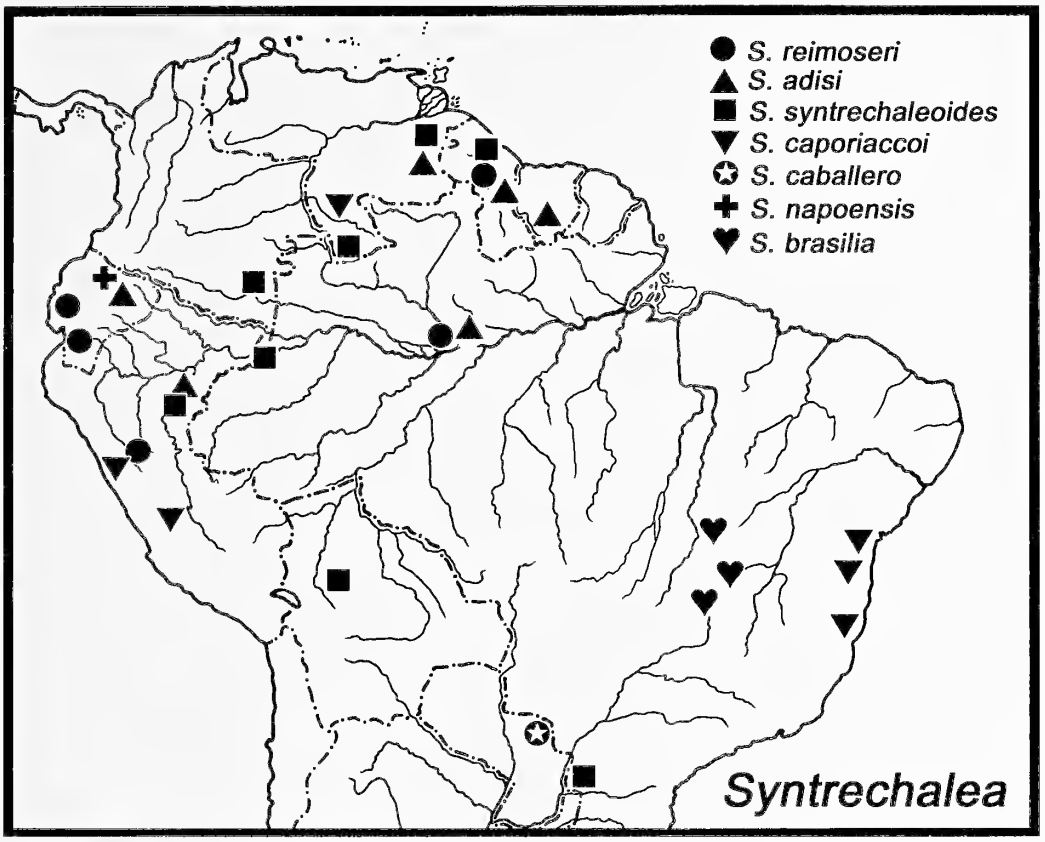


Figure 2.—Distribution of species of *Syntrechalea* in South America.

Cheliceral teeth as for male. Leg formula unavailable because of missing segments, ventral macrosetae pairs on tibiae are I-9, II-10, III-5, IV-0. Abdomen length 3.5. Middle field (*mf*) of epigynum (Figs. 10, 11) triangular, emerges from under a ridge, narrowing posteriorly; internal elements filling most of space inside epigynal plate.

Variation.—Carapace lengths of two males are 3.1 and 3.2 respectively. Average carapace length of females is 3.5 (3.0–4.1, $n = 6$).

Leg dimensions (mm).—*Male (Changuinola, Bocas del Toro, Panama):* Leg I: femur 7.2, tibia–patella 9.6, metatarsus 7.7, tarsus 4.9; total 29.4. Leg II: femur 7.3, tibia–patella 9.5, metatarsus 8.2, tarsus 4.8; total 29.8. Leg III: femur 6.7, tibia–patella 7.5, metatarsus 8.0, tarsus 5.2; total 27.4. Leg IV: femur 8.1, tibia–patella 9.5, metatarsus 11.5, tarsus 6.9; total 36.0.

Female (holotype): Leg I: femur 6.5, tibia–patella 8.7, metatarsus 6.2, tarsus missing; total -. Leg II: femur 6.8, tibia-patella 8.7, metatarsus 6.6, tarsus missing; total -. Leg III: femur 6.2, tibia–patella 6.8, metatarsus 6.8, tarsus 3.6; total 23.4. Leg IV: femur 7.6, tibia–patella 9.0, metatarsus 10.1, tarsus 5.8; total 32.5.

Natural history.—Collection notations such as "canopy sample," "tree trunks-open woods night," and "on dry wood" indicate that this is probably an arboreal species. An unidentified cricket with a female from Rincón de Osa, Costa Rica, may add further evidence that the species is not typically a streamside inhabitant. An opened egg-sac with attached spiderlings from Hamburg Farm collected 27 March 1930 has typical trechaleid structure as described previously for the family (Carico 1993).

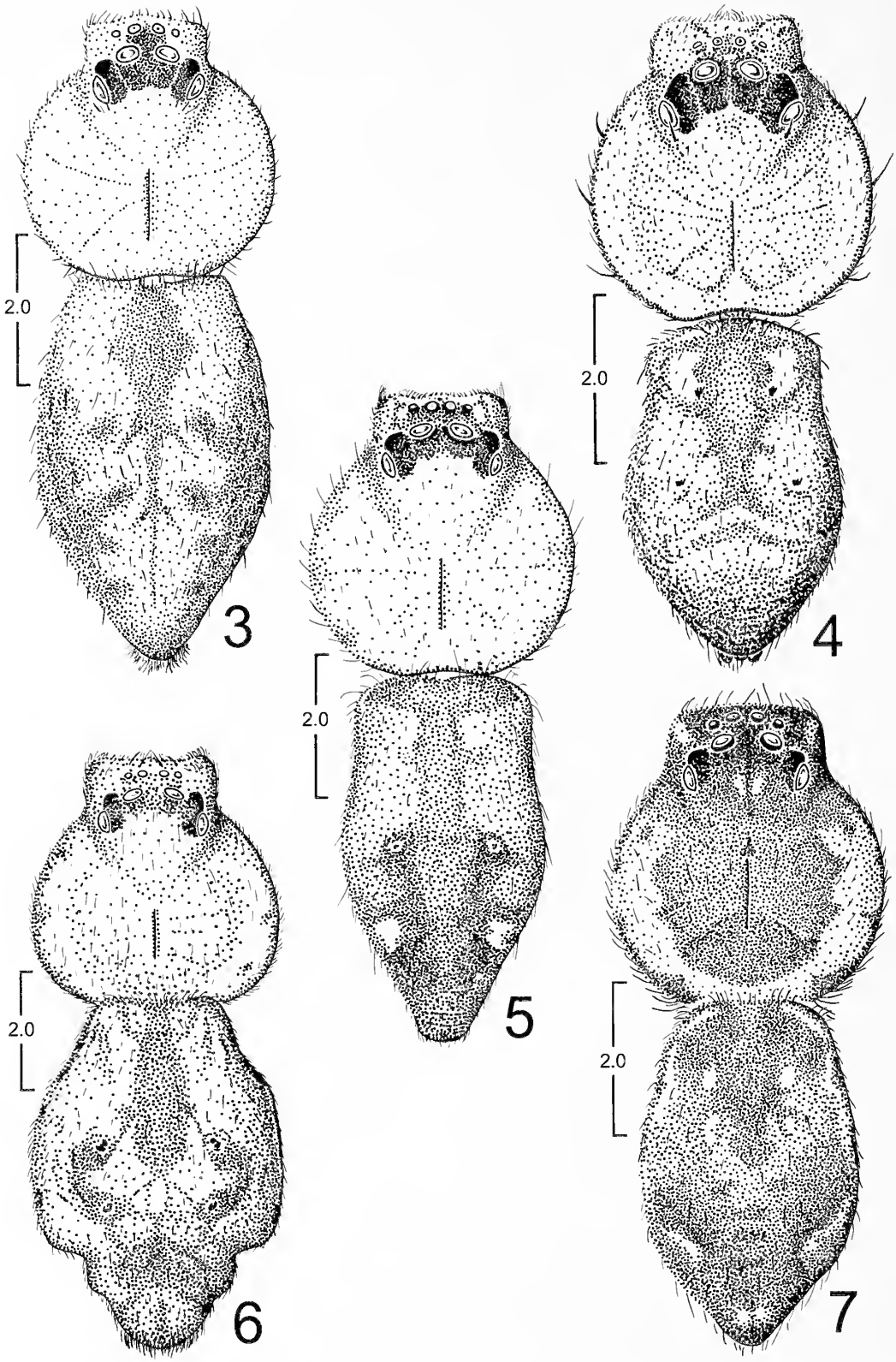
Distribution.—Most specimens are from Costa Rica and Panama. In addition, however, a single male with a locality label "15 kms NE Barrancas," is impossible to locate in Mexico where there are at least eight localities by that name. This locality is most likely in the southern tropical forested region of Mexico, which would be a similar habitat to that for other *Syntrechalea* species in South America. Therefore, it can be assumed that the distribution of this species is from southern Mexico throughout Central America (Fig. 1) where the appropriate habitat exists.

Syntrechalea reimoseri (Caporiacco)
Figs. 2, 3, 12, 13

Trechalea reimoseri Caporiacco 1947:22; Caporiacco 1948:634; Roewer 1954:143; Platnick 2008.
Syntrechalea reimoseri (Caporiacco): Carico 1993:237.

Material examined.—Female lectotype, present designation: GUYANA: *Potero-Siparuni*: Conwarook (Konawaruk), 05°15′N, 059°03′W, 18 March 1946, Romiti (MZUF).

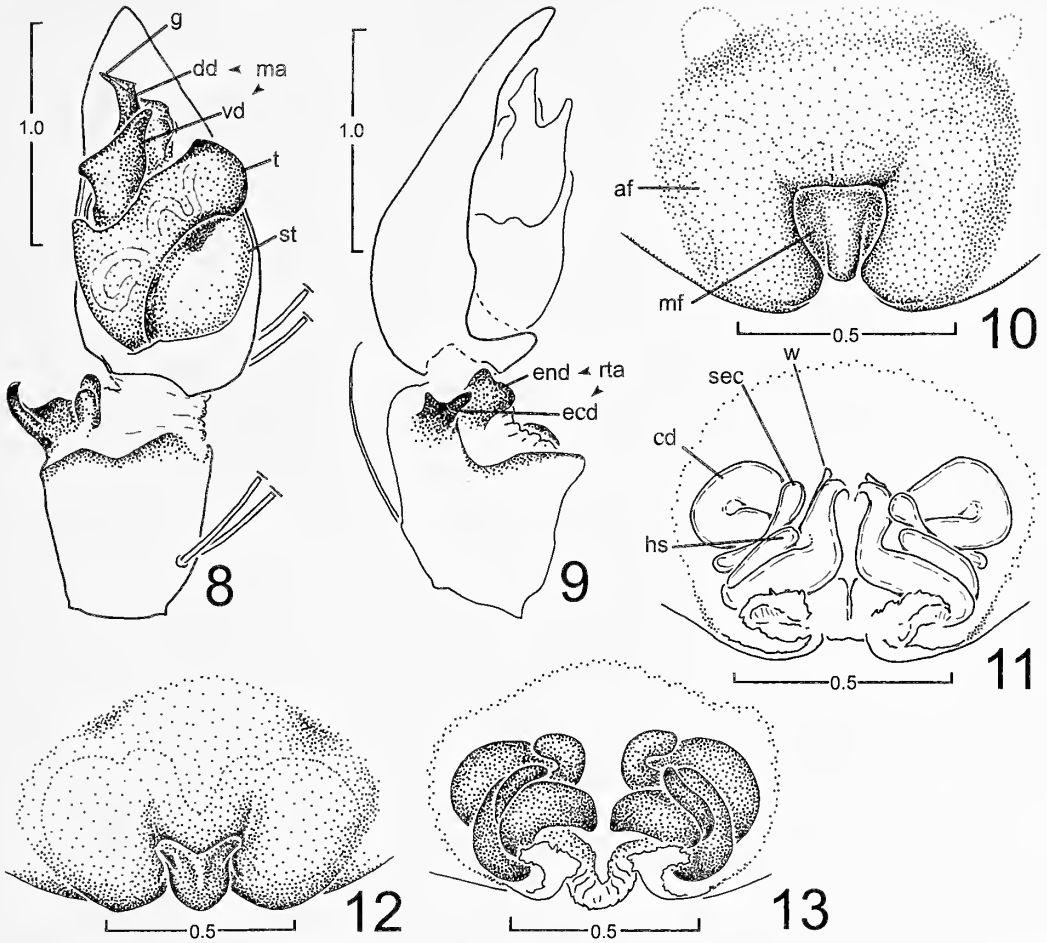
Other material: BRAZIL: *Amazonas*: 1 ♂, Reserva Ducke, 25 km N of Manaus, 03°06′48″S, 060°01′30″W, 24 March 1964, C.E. & E.S. Ross (CAS). ECUADOR: *El Oro*: 1 ♀, Boenavista, 20 km SE of Machala, 03°16′S, 079°58′W, 11 January 1942, E.L. Moore (CAS); *Los Rios*: 1 ♀, Pichilinque, 2 February 1955, collector unknown (CAS). PERU: *Huanuco*: 1 ♀, Tingo Maria, 09°18′S, 075°59′W, 21 November 1946, J.C. Pallister (AMNH).



Figures 3–7.—Dorsal patterns of species of *Syntrechalea*: 3. *S. reimoseri*, female; 4. *S. adis*, male; 5. *S. syntrechaleoides*, male; 6. *S. caballero*, female; 7. *S. brasilia*, male.

Diagnosis.—Females of *S. reimoseri* are distinguished from other species in the genus by details of the epigynum. Uniquely, the middle field is rugose ventrally and emerges from under a v-shaped margin of the anterior field. The internal structures are relatively large and occupy a large part of the area beneath the epigynal plate, a feature shared only with *S. tenuis* and *S. adis*.

Description.—*Female (Reserva Ducke, Amazonas, Brazil):* Carapace (Fig. 3) low, cephalic area elevated, light, unmarked, length 2.8, width 2.8; sternum light, unmarked, length 1.62,



Figures 8–13.—Genitalia of species of *Syntrechalea*. 8–11. *S. tenuis*: 8. Right palpus, ventral view; 9. Right palpus, retrolateral view; 10. Epigynum, ventral view; 11. Epigynum, dorsal view. 12, 13. *S. reimoseri*: 12. Epigynum, ventral view; 13. Epigynum, dorsal view. Abbreviations: a = anterior field, cd = copulatory duct, dd = dorsal division of median apophysis, ecd = ectal division of retrolateral tibial apophysis, end = ental division of retrolateral tibial apophysis, g = guide of median apophysis, ma = median apophysis, hs = head of true spermatheca, mf = middle field, sec = secondary spermatheea, st = subtegulum, t = tegulum, vd = ventral division of median apophysis, rta = retrolateral tibial apophysis, w = wing of copulatory duct.

width 1.60; labium light, length 0.51, width 0.55. Clypeus height 0.26, width 1.30. Anterior eye row straight, eye measurements in Table 1. Chelicera unmodified; faces light with dark maculae distally; middle of promarginal teeth largest, three marginal teeth sub-equal in size, equidistant, all larger than promarginal teeth. Legs II-I-III (IV missing); tarsi and distal part of metatarsi flexible, ventral macrosetae pairs on tibiae I-13, II-13, III-7; color generally light with distinct maculae on femora and faint dark maculae on other segments. Abdomen length 4.7, generally light with darker areas mainly on cardiac area and laterally in the posterior half, scattered small dark spots on lateral surfaces except for larger dark area near apex, light ventrally with a pair of dark spots centrally, a conspicuous patch of short, dark hairs at apex above anal tubercle.

Epigynum (Figs. 12, 13) with middle field white, acute posteriorly, arising from a v-shaped suture; internal structures large, filling most of the space beneath the epigynal plate.

Male: Unknown.

Leg dimensions (mm).—*Female (Reserva Ducke, Amazonas, Brazil):* Leg I: femur 5.7, tibia–patella 7.5, metatarsus 5.6, tarsus 3.6; total 22.4. Leg II: femur 5.8, tibia–patella 7.3, metatarsus 5.9, tarsus 4.0; total 23.0. Leg III: femur 5.3, tibia–patella 6.0, metatarsus 5.8, tarsus 3.8; total 21.0. Leg IV: missing.

Variation.—Average carapace length of females = 3.16 (2.8–3.5, n = 6).

Natural history.—A single egg sac from Tingo Maria, Peru, diameter = 7.3, has typical trechaleid features, i.e., flattened with spiderlings clearly visible inside.

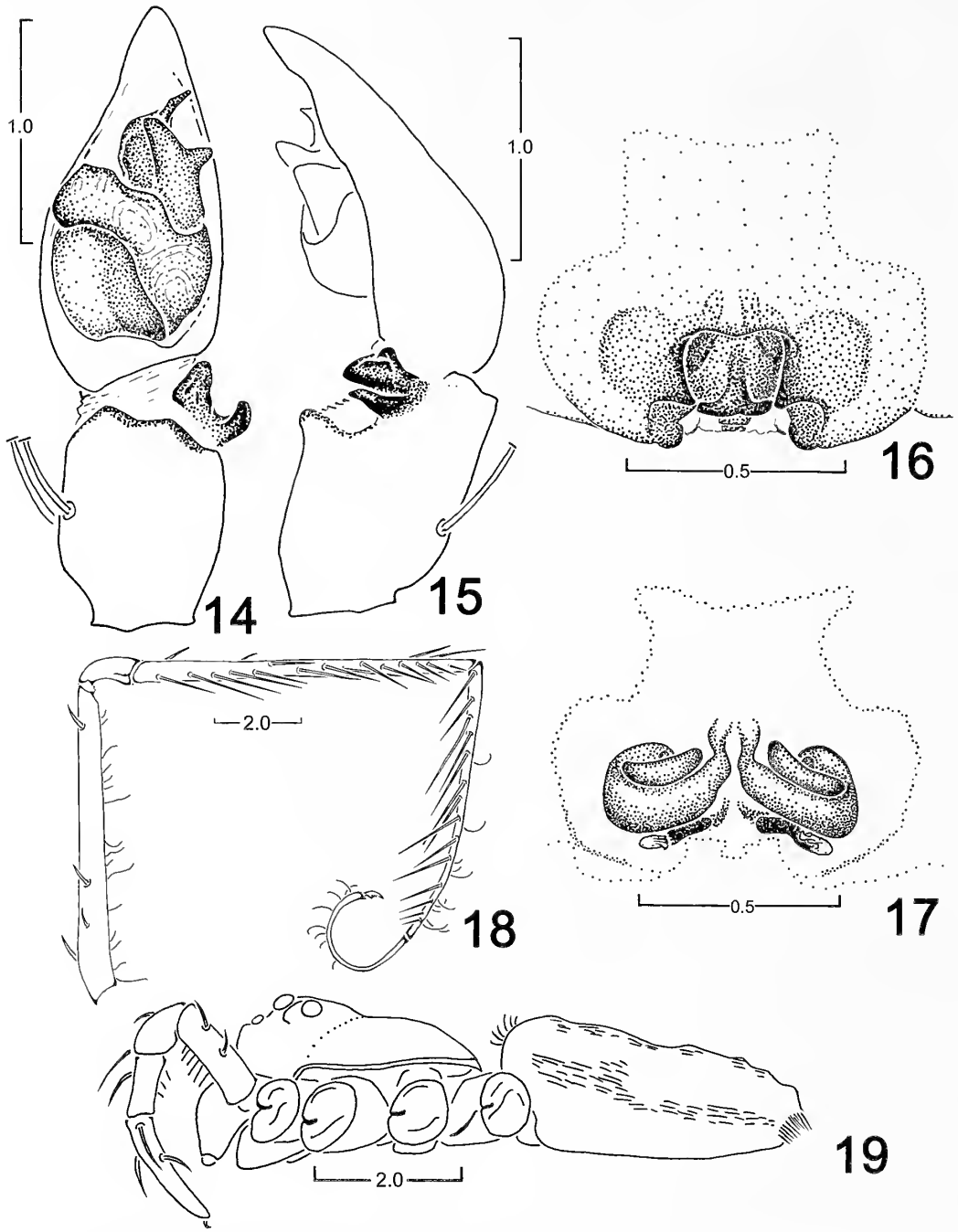
Distribution.—This species occurs from Guyana southwestward to Ecuador and south to the State of Amazonas, Brazil (Fig. 2).

Remarks.—The type collection contained both a male and a female, each belonging to a different species, neither of which was a member of the genus *Trechalea*. The female is designated here as the lectotype of *Trechalea reimoseri* and transferred to the genus *Syntrechalea*, while the male paralectotype, originally believed to belong to a third genus (Carico 1993), is described below as a new species, *Syntrechalea caporiacco*.

Syntrechalea adis new species
Figs. 2, 4, 14–19

Material examined.—Holotype male: BRAZIL: *Amazonas*: Igapó, Rio Tarumã Mirím, 2 March 1983, in trunk trap, J. Adis (INPA).

Other material: BRAZIL: *Amazonas*: 2 ♂, Manaus, 03°06′48″S, 060°01′31″W, Igapó, Rio Tarumã Mirím, 14



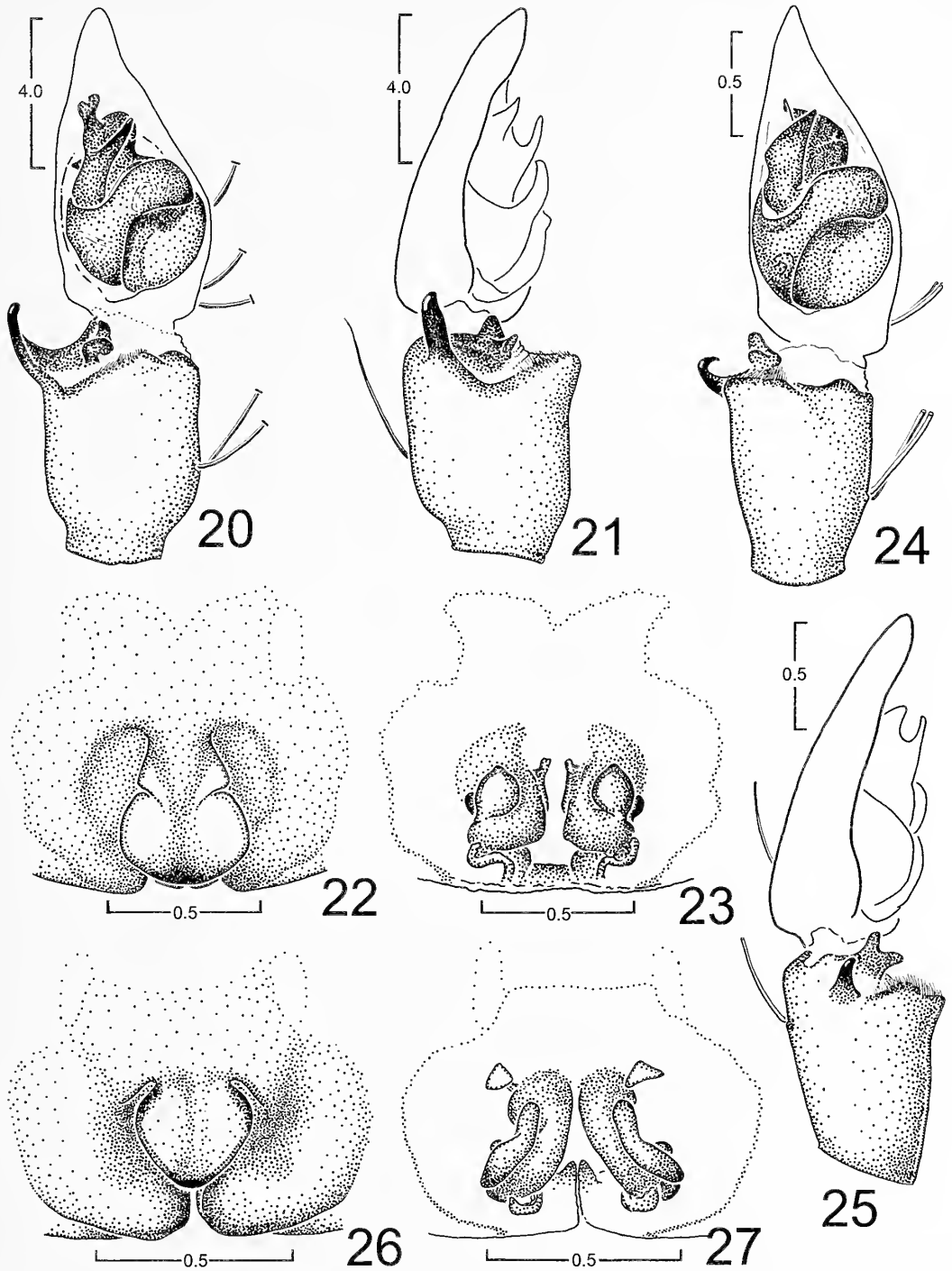
Figures 14–19.—Anatomical features of *S. adis*: 14. Left male palpus, ventral view; 15. Left male palpus, retrolateral view; 16. Epigynum, ventral view; 17. Epigynum, dorsal view; 18. Right leg I, retrolateral view; 19. Body, lateral view left side.

February 1983, J. Adis (INPA); 1 ♀, same data except 13 January 1988, H Höfer (INPA); 1 ♂, Reserva Florestal Adolfo Ducke, 30 July 1971, A.A. Lise (MCN 24980). SURINAM: *Province*?: 1 ♂, Kaiserberg Airstrip, Auid River, elev. 275 m, H.A. Beatty (FMNH). VENEZUELA: *Bolivar*: 1 ♀, Hato la Vergarena, 06°45′N, 063°30′W, elev. 122–152 m, 25 October 1954, J.J. Wurdack & N.G.L. Guppy (AMNH). PERU: *Loreto*: 1 ♀, Pitchecia, 05°11′S, 072°42′W, 5 June 1990, T. Erwin & D. Silva (MUSM).

Etymology.—The name is a noun in apposition after the name of the collector, the late Joachim Adis, and in honor of his work on the ecology of Amazonian inundation forests.

Diagnosis.—The number of ventral macrosetae pairs on femur I is 13 to 15 (Fig. 18) while there are none, or at most, only one, on femur IV. The ectal division of the retrolateral tibial apophysis is relatively small and curved distinctly distad, and the dorsal division of the median apophysis bears only the single-pointed, acute guide. The middle field of the epigynum is truncated distally and bears a t-shaped ridge.

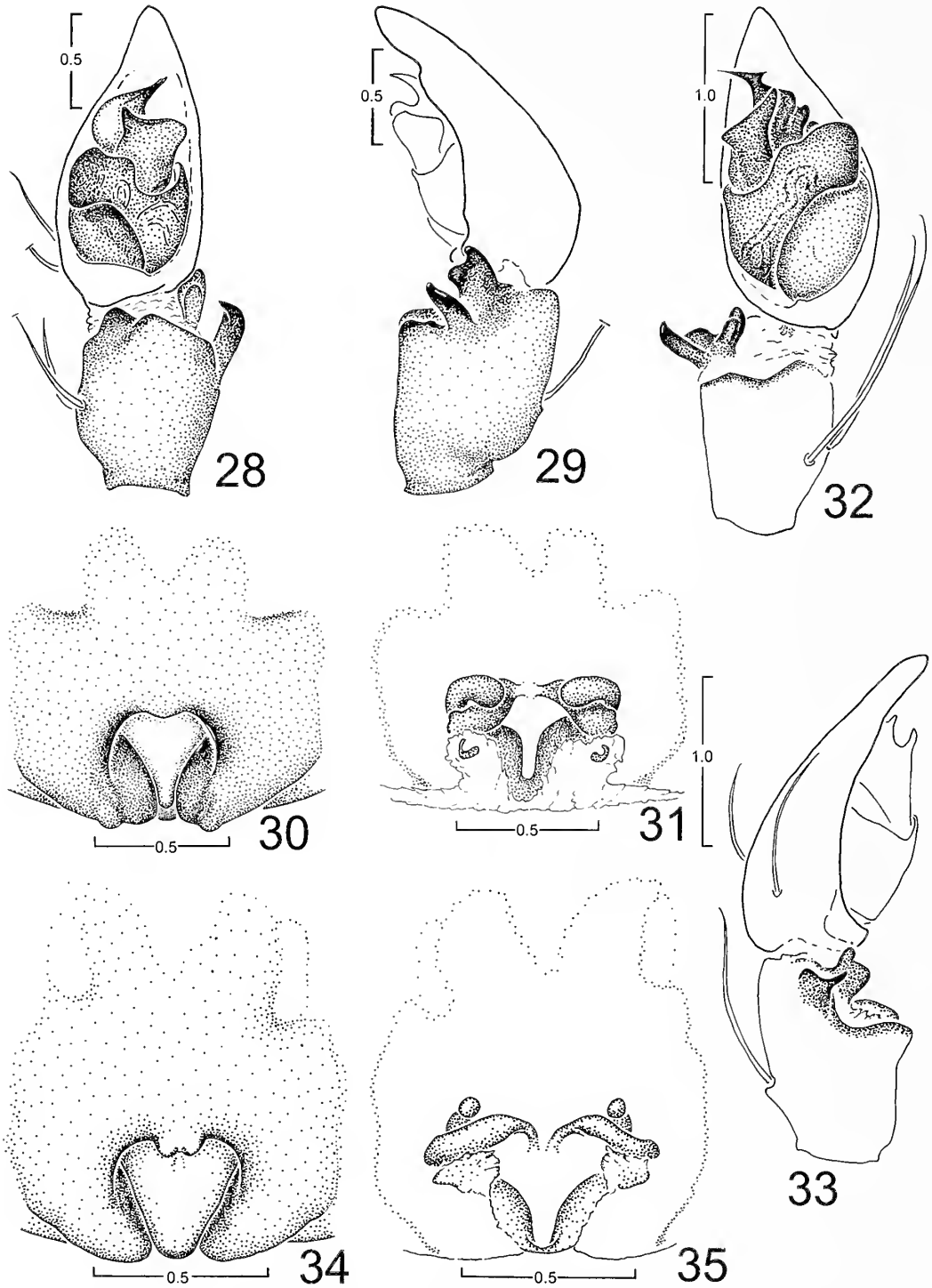
Description.—*Male (holotype):* Carapace low (Figs 4, 19), elevated in the cephalic area, black area surrounds PE, AME, length 3.3, width 3.3, generally light, narrow dark margins; sternum light, unmarked, length 1.70, width 2.0; labium medium light, lightest on anterior margin, length 0.65, width



Figures 20–27.—Genitalia of species of *Syntrechalea*. 20–23. *S. syntrechaleoides*: 20. Right palpus, ventral view; 21. Right palpus, retrolateral view; 22. Epigynum, ventral view; 21. Epigynum, dorsal view. 24–27. *S. caporiacco* 24. Right palpus, ventral view; 25. Right palpus, retrolateral view; 26. Epigynum, ventral view; 27. Epigynum, dorsal view.

0.70. Clypeus height 0.32, width 1.57. Anterior eye row straight, eye measurements in Table 1. Cheliceral face dark at anterior third, three promarginal teeth (middle largest), three retrolateral teeth sub-equal and equidistant. Legs IV-I-II-III, tarsi and distal part of metatarsi flexible, ventral macrosetae pairs on tibiae I-13, II-13, III-6, IV-2; color light with faint maculae dorsally on femora and patella. Abdomen length 4.2, dorsal pattern in Fig. 4, light ventrally and unmarked. Palpus (Figs. 14, 15) ventral division of median apophysis bifurcated, guide directed laterad; retrolateral tibial apophysis with ectal division a single curved point, ental division thickened, lobular.

Female (Igapó, Rio Tarumã Mirím, Amazonas, Brazil): Carapace shape and color as in male, length 3.0, width 2.8; sternum light, unmarked, length 1.8, width 1.8; labium light, length 0.64, width 0.64. Clypeus height 0.32, width 1.45. Anterior eye row straight, eye measurements in Table 1. Cheliceral face dark at anterior third, three promarginal teeth (middle largest), three retrolateral teeth sub-equal and



Figures 28–35.—Genitalia of species of *Syntrechalea*. 28–31. *S. brasilia*: 28. Left palpus, ventral view; 29. Left palpus, retrolateral view; 30. Epigynum, ventral view; 31. Epigynum, dorsal view. 32, 33. *S. napoensis*: 32. Right palpus, ventral view; 33. Right palpus, retrolateral view. 34, 35. *S. caballero*: 34. Epigynum, ventral view; 35. Epigynum, dorsal view.

equidistant. Legs IV-II-I-III, tarsi and distal part of metatarsi flexible, ventral macrosetae pairs on tibiae I-12, II-12, III-6, IV-0; color as in male. Abdomen length 3.5, color as in male. Epigynum (Figs. 16, 17) middle field truncated with t-shaped ridge and recessed in rounded space formed by median edges of anterior field; internal structures heavily sclerotized.

Leg dimensions (mm).—*Male (holotype):* Leg I: femur 8.7, tibia–patella 11.3, metatarsus 8.4, tarsus 5.7; total 34.1. Leg II: femur 8.7, tibia–patella 9.3, metatarsus 8.8, tarsus 5.8; total 32.6. Leg III: femur 7.7, tibia–patella 8.8, metatarsus 8.1, tarsus 5.4; total 30.0. Leg IV: femur 9.0, tibia–patella 10.8, metatarsus 12.2, tarsus 7.1; total 39.1.

Female (Igapó, Rio Tarumã Mirím, Amazonas, Brazil): Leg I: femur 6.9, tibia–patella 9.2, metatarsus 6.1, tarsus 4.0; total 26.2. Leg II: femur 7.0, tibia–patella 9.0, metatarsus 6.4, tarsus 4.2; total 26.6. Leg III: femur 6.5, tibia–patella 7.5, metatarsus

6.3, tarsus 4.2; total 24.5. Leg IV: femur 7.9, tibia–patella 9.4, metatarsus 9.1, tarsus 5.5; total 31.9.

Distribution.—Eastern Venezuela southward to the province of Bolivar, Peru and the state of Amazonas, Brazil (Fig. 2).

Remarks.—The specimens, collected by J. Adis and H. Höfer, were taken from arboreal traps probably in the blackwater inundation forest but never on the forest floor where spider collections also occurred (J. Adis, pers. comm.). Based on these observations, the arboreal characteristie of this species is assumed.

Syntrechalea syntrechaleoides (Mello-Leitão), new combination
Figs. 2, 5, 20–23

Trechalea syntrechaleoides Mello-Leitão 1941:246; Platnick 2008.

Material examined.—*Type:* BRAZIL: *Paraná*: Holotype female: Cachoeirinha, Bocaiúva do Sul, Brazil , no date, L. de Morrietes (MNRJ 41476).

Other material.—BOLIVIA: *Beni*: , 13 ♂, 22 ♀, Est. Biol. Beni, Zone 1, ca. 04°47′S, 066°15′W, elev. ~225 m, 8–14 November 1989, J. Coddington, S. Larcher, Penaranda, C.. Griswold, D. Silva (USNM); 1 ♂, 1 ♀, 1 juvenile, 27 km W of Yucumo, ca. 15°23′S, 066°59′W, elev. ~500 m, 15–19 November 1989, J. Coddington, C. Griswold, D. Silva, S. Larcher, Penaranda (USNM). COLOMBIA: *Amazonas*: 1 ♀, Leticia, February 1956, J. & N. Land (AMNH); 1..., Rio Pira and Apaporis, 00°25′S, 070°15′W, 7–16 February 1989, V. & B. Roth (CAS). GUYANA: *Bartica District*: 1 ♂, Kartabo, 1922 (AMNH). VENEZUELA: *Amazonas*: 1 ♂, Rio Yaeiba, 1.5 days above jct. w/ Rio Yatua, 01°29′02″N, 066°31′37″W, elev. 180 m, 6 December 1953 (AMNH); *Bolivar*: 1 ♂, 26 km N of Guasipati, 07°28′N, 061°54′W, 24 November–12 December 1987, S. & J. Peck (AMNH). PERU: *Loreto*: 1 ♂, Pithecia, 05°11′S, 072°42′W, 5 June 1990, T. Erwin & D. Silva (MUSM).

Diagnosis.—Both sexes are distinguished by details of their genitalia. The male has a twisted configuration and a truncated, notched tip to the terminal apophysis. The middle field of the female epigynum is expanded posteriorly, indented on the lateral margins, and not separated from the epigynal plate by an anterior suture.

Description.—*Male (Beni, Est. Biol. Beni, Dpto. Beni, Bolivia):* Carapace (Fig. 5) low, cephalic area elevated, length 3.9, width 3.7, generally light, darker at margins, dark pattern on clypeus, black in the eye region; sternum light, unmarked, length 2.25, width 2.1; labium medium light, lightest on anterior margin, length 0.78, width 0.78. Clypeus height 0.42, width 1.90. Anterior eye row straight, eye measurements in Table 1. Cheliceral face dark, clothed with light hair and a few larger, more erect light bristles medially, longitudinal carina on distal two-fifths of lateral margins; three promarginal teeth (middle largest), three retromarginal teeth equal in size with distal two closer together. Legs IV–(I-II)-III, tarsi and distal part of metatarsi flexible, ventral macrosetae pairs on tibiae are I-7, II-8, III-5, IV-5. Color on femora light ventrally with indistinct markings above, dark annuli on other segments. Abdomen length 5.2, dorsal pattern in Fig. 5, light ventrally. Palpus (Figs. 20, 21). Guide of median apophysis twisted, truncated and notched; retrolateral tibial apophysis with ental division with two lobes and ectal division curved medially at tip.

Female (loeality same as male above): Carapace shape and color as in male except dark areas not as distant, length 4.3, width 4.2; sternum light, unmarked, length 2.4, width 2.18; labium light with dark at center of lateral margins, length 0.85, width 0.79. Clypeus height 0.45, width 2.08. Anterior eye row straight, eye measurements in Table 1. Tarsi and distal part of metatarsi flexible, metatarsus slightly curved distally, ventral maerosetae pairs on tibiae I-7, II-7, III-5, IV-5; color as in male, Abdomen length 6.6, color as in male. Epigynum (Figs. 22, 23) with middle field white with a dark median band, adjacent margins of anterior field each with an indentation; internal structures bulbous.

Leg dimensions (mm).—*Male (Beni, Est. Biol. Beni, Dpto. Beni, Bolivia):* Leg I: femur 8.4, tibia–patella 10.9, metatarsus 8.7, tarsus 5.2; total 33.2. Leg II: femur 8.2, tibia–patella 10.4, metatarsus 9.0, tarsus 5.6; total 33.2. Leg III: femur 6.5, tibia–patella 7.3, metatarsus 7.0, tarsus 4.7; total 25.5. Leg IV: femur 8.5, tibia–patella 10.0, metatarsus 11.9, tarsus 6.9; total 37.3.

Female (Beni, Est. Biol. Beni, Dpto. Beni, Bolivia): Leg I: femur 8.1, tibia–patella 10.4, metatarsus 7.5, tarsus 5.1; total 31.1. Leg II: femur 8.2, tibia–patella 9.1, metatarsus 7.7, tarsus 5.3; total 30.3. Leg III: femur 6.9, tibia–patella 7.8, metatarsus 6.8, tarsus 4.9; total 26.4. Leg IV: femur 8.8, tibia–patella 10.1, metatarsus 10.9, tarsus 6.6; total 36.4.

Variation.—Average carapace length of males = 4.18 (n = 10) and average carapace length of females = 4.18 (n = 10).

Natural history.—One male from Guasipati, Venezuela was taken from a "sandy seasonal humid forest." Eight egg sacs, presumably of this species, were in the type collection and of typical construction; the average of the undamaged ones was 9.3 (9.2–10.0, n = 6) in diameter.

Distribution.—This species occurs from the Western Amazon basin from north central Bolivia northward to Southern Venezuela, and in the Cuyuni River basin of Coastal Guyana and Venezuela (Fig. 2).

Syntrechalea caporiacco new species
Figs. 2, 24–27

Trechalea reimoseri Caporiacco 1948:22 (in part).

Material examined.—Holotype male: VENEZUELA: *Amazonas*: SW. Base Cerro Yapacana 03°45′N, 066°48′W, 23 February 1978, C.W. Myers (AMNH).

Paralectotype of *Trechalea reimoseri*: 1 paralectotype male: GUYANA: *Potaro-Siparuni*: Conwarook (Konawaruk), 05°16′N, 059°00′W, 18 March 1946, Romiti (MZUF).

Other material: BRAZIL: *Bahia*: 1 ♂, Fazenda Almada Uruçuca, 14°35′S, 039°16′W, 26 November 1977, J.S. Santos (MCZ); 1 ♂, same data except 27 November 1977, J.S. Santos (MCN 10340); 1 ♂, Fazenda São Roque, Camacan (Camaçandi?, 13°12′S, 039°00′W), 3 December 1977, J.S. Santos (MCN 20223); 1 ♀, Fazenda Arizona, Juçari, 15°12′S, 039°32′W, CEPLEC-CEPLAC (possibly abbreviations of the collectors names) (MCN 25178); 1 ♂, 2 ♀, Fazenda Nossa Senhora das Neves, Itamarajú, no date, J.S. Santos (MCN 10296); 1 ♀, Itamarajú, 17°04′S, 039°32′W, February 1985, collector unknown (MNRJ); 1 ♀, Fazenda Jacarendá, Itamarajú,17°04′S, 039°32′W, 8 December 1977, J.S. Santos (MCN). PERU: *Huánuco*: 3 ♀, Monzón Valley, Tingo Maria, 09°08′S, 075°00′W, 23 September 1954, E.I. Schlinger & E.S. Ross

(CAS); 1 ♀, same data except 10 November 1954, E.I. Schlinger & E.S. Ross (CAS); *Junín*: 1 ♀, Colonia Perene, 10°53′S, 075°13′W, Rio Perene, 16.8 km NE. of La Merced, 3 January 1955, E.I. Schlinger & E.S. Ross (CAS); *Cashinari*: 1 ♂, no locality, J. Duarez & S. Córdova (MUSM).

Etymology.—The name is a noun in apposition in honor of Lodovico di Caporiacco, who originally included a male of this species as a syntype of *Trechalea reimoseri*.

Diagnosis.—The male is distinguished by the ectal division of the retrolateral tibial apophysis which is directed generally distad and distinctly curved. The middle field of the epigynum is not separated by a suture in its anterio-medial junction with the remainder of the epigynal plate.

Description.—*Male (holotype):* Carapace low, cephalic area elevated, length 4.2, width ~3.6, generally medium, lighter sub-marginally, darker at margins and eye region; sternum light, unmarked, length 2.1, width 1.9; labium dark, light on anterior margin, length 0.80, width 0.70. Clypeus height 0.35, width 0.92. Anterior eye row straight, eye measurements in Table 1. Cheliceral face dark distally, three promarginal teeth (middle largest), three retrolateral teeth equal in size with distal two closer together. Legs IV–II-III (I missing), tarsi and distal part of metatarsi flexible, ventral macrosetae pairs on tibiae are II-6, III-4, IV-5. Color on femora light with scattered darker markings, dark annuli on other segments. Abdomen length 5.0, dorsal pattern with distinct, scattered dark maeulae, light ventrally. Palpus (Figs. 24, 25), median apophysis with ventral division acute, guide of dorsal division acute and directed ventrad; retrolateral tibial apophysis ental division with two lobes, ectal division curved apically and directed medially.

Female (paratype, type locality): Carapace shape and color as in male, length 4.1, width 4.0; sternum light, unmarked, length 2.3, width 2.1; labium medium, lighter apically, length 0.80, width 0.78. Clypeus height 0.36, width 2.01. Anterior eye row straight, eye measurements in Table 1. Tarsi and distal part of metatarsi flexible, metatarsis slightly curved distally, ventral macrosetae pairs on tibiae I-6, II-6 (III & IV missing); color as in male, Abdomen length 5.3, color as in male. Epigynum (Figs. 26, 27) with pale middle field continuous and narrowly connected with anterior field; internally as illustrated.

Leg dimensions (mm).—*Male (holotype):* Leg I: missing. Leg II: femur 7.6, tibia–patella 8.4, metatarsus 9.7, tarsus 5.7; total 31.4. Leg III: femur 6.1, tibia–patella 6.9, metatarsus 6.5, tarsus 5.0; total 24.5. Leg IV: femur 8.9, tibia–patella 9.5, metatarsus 11.1, tarsus 7.2; total 36.7.

Female (Paratype, type locality): Leg I: femur 7.5, tibia–patella 10.2, metatarsus 7.4, tarsus 5.4; total 30.7. Leg II: femur 7.5, tibia–patella 9.6, metatarsus 7.2, tarsus 5.4; total 27.7. Leg III: missing. Leg IV: missing.

Variation.—Carapace lengths of two males are 4.1 and 4.2; average carapace length of females is 4.3 (3.8–4.8, $n = 8$).

Natural history.—A note with the type speeimens says: "tree trunks." Egg sacs of typical trechaleid construction were found; diameters were 7.5 (23 February, Venezuela), 7.2 (3 January, Peru), and 8.2 (10 November, Peru).

Distribution.—The limited material shows an apparent disjunct distribution (Fig. 2) which includes the Eastern slopes in Peru, the Orinoco River basin of Venezuela (holotype), uplands of Guyana, and the coastal areas of the Brazilian states of Junín and Bahia. This rather peripheral distribution in tropical South America suggests that the species is likely also found in the interior of the continent as well.

Remarks.—The male syntype of Caporiacco's (1948) *Trechalea reimoseri* is a member of this species; however, I reported (Carico 1993) that the male was a different species in an unnamed genus. I have instead determined that this male is a *Syntrechalea caporiacco*.

Syntrechalea brasilia new species
Figs. 2, 7, 28–31

Material examined.—Holotype male: BRAZIL: *Districto Federal*: Brasilia, cerrado near airport, 15°47′S, 047°55′W, November 2003, M. Prada (UBZ #2992).

Other material: BRAZIL: *Tocantins*: 1 ♂, Dianópolis, 11°42′S, 046°44′W, 25 September 2003, F.S.P. Godói (UBZ #2671); *Goiás*: 1 ♀, Fazenda Trijunção, 14°55′S, 045°56′W, 19 October 2003, Â.S. Zerbini (UBZ #2706).

Etymology.—The name is a noun in apposition taken from the name of the type locality.

Diagnosis.—This species is distinguished by details of the genitalia. The median apophysis of the palpal bulb is broad and roughly square but with the ental corner acute. The epigynum has the median field white and recessed into the anterior field which has the adjacent margins also recessed below the general height of the epigynal plate. The dark, sooty general color also distinguishes this species.

Description.—*Male (holotype):* Carapace (Fig. 7) very low, cephalic area elevated, length 3.8, width 3.5, generally dark, marginal black narrow band, submarginal light band extends from cephalic area to posterior margin, becoming lighter posteriorly, black in eye region dense black, prostrate, short setae in central dark area; sternum light, unmarked, with long light setae mostly anteriorly, length 2.0, width 2.0; labium dark reddish brown, light distal margin, length 0.70, width 0.72. Clypeus dark with two light spots laterally, height 0.46, width 1.56. Anterior eye row straight, eye measurements in Table 1. Chelicerae dark brown proximally with distal third bracketing a light area with long slender white setae, three promarginal teeth (middle largest), three retrolateral teeth equal in size with distal two closest. Legs IV-(I-II)-III, tarsi and distal one-half of metatarsi flexible, ventral macrosetae pairs on tibia, I-6, II-6, III-4, IV-4. Legs generally light, femora with dark bands prolaterally and lighter one retrolaterally, scattered spots and transverse bands dorsally, unmarked ventrally, other segments medium dark. Abdomen length 4.5, dorsum generally dark, covered with short, dark, prostrate seta mixed with iridescent ones, pair of distinct, circular spots anteriorly and pair of light spots posteriorly, sides with dark band separated from dorsum by light band, venter light and unmarked. Palpus (Figs. 28, 29) with broad, squarish median apophysis with ental corner acute, ventral division is rounded entally becoming acute and directed ectally; ectal division of retrolateral tibial apophysis flattened and somewhat hooked distally.

Female (Goiás, Fazenda Trijunção): Carapace very low, cephalic area elevated, length 4.3, width 4.2, generally dark, marginal black narrow band, submarginal light band extends from cephalic area to posterior margin, becoming lighter

posteriorly, black in eye region dense black, prostrate, short setae in central dark area; sternum light, unmarked, with scattered dark setae mostly medially and light setae at margins, length 2.15, width 2.15; labium dark reddish brown, light distal margin, length 0.75, width 0.80. Clypeus with patches of white setae at anterior-lateral clypeal area, height 0.45, width 2.04. Anterior eye row straight, eye measurements in Table 1. Chelicerae dark brown proximally and distal third bracketing a light area with long slender white setae; three promarginal teeth (middle largest), three retrolateral teeth equal in size and equidistant. Legs IV-(I-II)-III, tarsi and distal one-half of metatarsi flexible, ventral tibial macrosetae pairs on tibiae, I-6, II-6, III-4, IV-3. Legs generally light, femora with dark bands prolaterally and lighter one retrolaterally, scattered spots and transverse bands dorsally, unmarked ventrally, other segments medium dark. Abdomen length 6.7, dorsum covered with short, dark, prostrate seta mixed with iridescent ones, dark cardiac area, three pairs of light spots surrounded by black rings, lateral, longitudinal dark bands wider posteriorly, light and unmarked ventrally. Epigynum (Figs. 30, 31) with a depressed, white, triangular-shaped middle field.

Leg dimensions (mm).—*Male (holotype):* Leg I: femur 6.3, tibia–patella 8.0, metatarsus 6.4, tarsus 5.4; total 26.1. Leg II: femur 6.2, tibia–patella 7.7, metatarsus 6.6, tarsus 4.1; total 24.6. Leg III: femur 5.5, tibia–patella 6.0, metatarsus 5.7, tarsus 3.6; total 20.8. Leg IV: femur 6.9, tibia–patella 7.9, metatarsus 9.1, tarsus 5.3; total 29.2.

Female (Goiás, Fazenda Trijunção): Leg I: femur 6.5, tibia–patella 7.7, metatarsus 5.8, tarsus 4.1; total 24.1. Leg II: femur 6.5, tibia–patella 7.7, metatarsus 6.0, tarsus 4.0; total 24.2. Leg III: femur 5.9, tibia–patella 6.3, metatarsus 5.5, tarsus 3.9; total 21.6. Leg IV: femur 7.2, tibia–patella 7.9, metatarsus 8.6, tarsus 5.5; total 29.2.

Natural history.—Collection notes (P. Motta, pers. comm.) for this species indicates that it may not be arboreal: "underneath a termite mound" (#2706); "found in pit-fall traps" (#2671). However, the note, "cerrado near airport" (#2992), is ambiguous.

Distribution.—Found only in the Districto Federal and the adjaeent states of Tocantins and Goiás (Fig. 2).

Syntrechalea napoensis new species
Figs. 2, 32, 33

Material examined.—Holotype male: ECUADOR: *Napo*: Alianhui, 20 km E of Puerto Napo (01°00′S, 077°25′W), November 1996, E.S. Ross (CAS).

Etymology.—The name means from Napo, the type locality.

Diagnosis.—This species, along with only *S. tenuis*, has the two-pointed shape of the guide of the dorsal division of the median apophysis but differs from the latter by the shape of the retrolateral apophysis, which has only one acute point.

Description.—*Holotype male:* Carapace very low, cephalic area elevated, length 3.8, width 3.5, pale in color without pattern, conspicuously dark in the eye area with white hairs in the ocular quadrangle: sternum light, unmarked, with light setae mostly in anterior half, length 2.08, width 1.92; labium light except at proximal lateral edges, length 0.68, width 0.68. Clypeus light with dark, sub-median dark mark extending from ocular area to anterior margin, height 0.34, width 1.70. Anterior eye row straight, eye measurements in Table 1. Chelicerae light in proximal two-thirds with long light hairs and dark in anterior one-third with shorter dark hairs; three promarginal teeth (middle largest), three retrolateral teeth equal in size with distal two closest. Legs IV-(I-II)-III, tarsi and distal half of metatarsi flexible, ventral macrosetae pairs on tibiae, I-10, II-10, III-6, IV-5. Legs light with indistinct and scattered darker areas, bands of light setae on prolateral and retrolateral surfaces of all segments. Abdomen length 4.5, dorsal pattern irregular on dorsum and dorsal area on sides, light on venter with a median brown area anterior to epigastric furrow. Palpus (Figs. 32, 33) femur with several, shortened, ventral macrosetae; median apophysis acute distally and with a small, rounded sub-apical protuberance; retrolateral tibial apophysis acute with a basal, dorsal, rounded protuberance.

Female: Unknown.

Leg dimensions (mm).—*Male (holotype):* Leg I: femur 8.9, tibia–patella 11.5, metatarsus 9.6, tarsus 6.0; total 36.0. Leg II: femur 9.0, tibia–patella 11.4, metatarsus 10.2, tarsus 5.8; total 36.4. Leg III: femur 8.1, tibia–patella 9.7, metatarsus 10.0, tarsus 5.5; total 33.3. Leg IV: femur 9.7, tibia–patella 11.6, metatarsus 14.8, tarsus 8.0; total 44.1.

Natural History.—Unknown, however it is assumed to be arboreal as indieated by its anatomical features which are similar to those of other species of the genus.

Syntrechalea caballero new species
Figs. 2, 6, 34, 35

Material examined.—Holotype female: PARAGUAY: *Paraguarí*: near Pedro Juan Caballero (22°34′S, 55°37′W), 25–27 November 1956, C.J.D. Brown (MCZ).

Etymology.—The name is a noun in apposition taken from the name of the type locality.

Diagnosis.—This species is distinguished by the unique tufts of erect white hairs on the legs and chelicerae and also by details of the epigynum, which has a median node projecting posteriad from the anterior field over the triangular middle field.

Description.—*Female (holotype):* Carapace (Fig. 6) very low, cephalic area elevated, length 4.1, width 4.2, generally medium brown, dark margin, irregular submarginal band of white hairs interrupted by brown spots, dark in the eye area with white hairs in the ocular quadrangle: sternum light, unmarked, length 2.3, width 2.3; labium medium light, lightest at anterior margin, length 0.85, width 0.85. Clypeus height 0.47, width 2.17. Anterior eye row straight, eye measurements in Table 1. Chelicerae medium brown proximally, covered with long erect hairs medially and short prostrate hairs laterally, distal half glabrous and dark; three promarginal teeth (middle largest), three retrolateral teeth equal in size with distal two closest. Legs (I-II)-IV (III missing), tarsi and distal one-third of metatarsi flexible, ventral macrosetae pairs on tibiae, I-6, II-6, IV-3. Femora light ventrally, all other surfaces and all other segments with dark annular patterns, tufts of erect white hairs on prolateral and retrolateral surfaces of most segments. Abdomen length 6.0, dorsal pattern in Fig. 6, dark bands laterally and light ventrally. Epigynum (Figs. 34, 35) middle field triangular with a median node projecting posteriorly from the anterior field.

Male: Unknown.

Leg dimensions (mm).—*Female (holotype):* Leg I: femur 6.9, tibia–patella 8.4, metatarsus 6.2, tarsus 4.1; total 25.6. Leg II: femur 6.9, tibia–patella 8.0, metatarsus 6.5, tarsus 4.2; total 25.6. Leg III: missing. Leg IV: femur 7.5, tibia–patella 7.6, metatarsus 8.7, tarsus 5.2; total 29.0.

Natural history.—Unknown.

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The male of the orb-weaving spider *Cyrtophora unicolor* (Araneae, Araneidae)

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Abstract. Males of the araneid genus *Cyrtophora* Simon 1864 are comparatively rare in collections, possibly because they are much smaller and less conspicuous than their female counterparts and are expected to have a much shorter lifespan. Field work on Christmas Island (Indian Oeean) revealed a male of *Cyrtophora unicolor* (Doleschall 1857) copulating with a female. Both male and female are described here. The known distribution of *C. unicolor* is updated to include southern parts of China, Taiwan and Japan in the North, the Philippines and Papua New Guinea to the south-east, Indonesia and Christmas Island to the South, and Thailand, Myanmar, and Sri Lanka to the East. *Cyrtophora acrobalia* (Thorell 1895), described from a juvenile from Myanmar, is considered a *nomen dubium*.

Keywords: Cyrtophorinae, red tent spider, pedipalp morphology, Christmas Island, Australia

The araneid spider genus *Cyrtophora* Simon 1864 is known for the construction of large, tightly woven, horizontal orb-webs with a network of supporting threads above (e.g., Fig. 1). It currently includes 38 species and nine subspecies of which only ten species are known from both males and females. Thirty-one species or subspecies have been described based on females only and the remaining six from juveniles (Platnick 2007). *Cyrtophora* mainly occurs in the Indo-Australasian region, with some species described from Africa (Platnick 2007). The type species of the genus, *C. citricola* (Forsskål 1775), is the only representative of *Cyrtophora* that has been introduced to the New World (e.g., Levi 1997; Álvares & de Maria 2004).

The pronounced sexual dimorphism with males generally being much smaller and therefore less conspicuous than females and an expected shorter lifespan seems to be one reason for the rarity of males of *Cyrtophora* in museum collections. In addition, due to the pronounced sexual dimorphism, males present in collections may not have been correctly associated with conspecific females. However, systematic research in spiders relies heavily on an analysis of the morphology of the male pedipalp (e.g., in araneoids: Scharff and Coddington 1997; Griswold et al. 1998), and resolving the phylogenetic relationships in the diverse genus *Cyrtophora* remains difficult without knowledge of males. Here, I report on the male of the conspicuous *C. unicolor* (Doleschall 1857) (commonly known as "Red Tent Spider"), to date unknown. This male was collected during a recent trip to Christmas Island (Indian Ocean) courting a female which had left the curled leaf retreat in the center of its large web where she usually hides (Fig. 2).

Descriptions are based on specimens preserved in 70% ethanol. The epigynum of a female was prepared for examination by submersion in 10% KOH for 30 min. For clarity, the illustrations of the male pedipalp and female epigynum omit the setae. The morphological nomenclature follows Levi (1997). All measurements are given in millimeters (mm).

Images of a male and a female were taken with a digital camera (G6; Canon Inc., Japan) that was connected to the optical tube of a stereo microscope (MZ6; Leica Microsystems GmbH, Wetzlar, Germany) with an optical adapter set (MaxView^{TM} Plus; Scopetronix, Cape Coral, Florida, USA). Six to 10 photographs were taken in different focal planes and combined with the software package Helicon Focus 4.16 (Khmelik & Kozub 2007).

Abbreviations.—*Morphology:* TL, total length; CL, CW, CH cephalothorax length, width and height; AL, AW, abdomen length and width; AE, PE anterior and posterior eyes; AME, ALE, anterior median and lateral eyes; PME, PLE, posterior median and lateral eyes; MOQ, median ocular quadrangle. *Institutions*: BMNH, Natural History Museum, London, England; NHMV, Naturhistorisches Museum, Vienna, Austria; RMNH, National Museum of Natural History Naturalis, Leiden, The Netherlands; WAM, Western Australian Museum, Perth; ZMB, Museum für Naturkunde, Zentralinstitut der Humboldt-Universität, Berlin, Germany; ZMUC, Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark.

SYSTEMATICS

Family Araneidae Simon 1895
Subfamily Cyrtophorinae Simon 1895
Cyrtophora Simon 1864

Cyrtophora Simon 1864:261.
Euetria Thorell 1890:109 (synonymy established in Simon 1895).
Suzumia Nakatsudi 1943:184 (synonymy established in Yaginuma 1958).

Type species.—*Cyrtophora: Aranea citricola* Forsskål 1775, by subsequent designation of Simon (1895).

Cyrtophora unicolor (Doleschall 1857)
(Figs. 1–10)

Epeira unicolor Doleschall 1857:419; Doleschall 1859:plate 2, fig. 1; Workman & Workman 1894:20, plate 20.
Epeira stigmatisata Karsch 1878:326–327, plate 9, figs. 3, 3a–b.
Epeira stigmatisata var. *serrata* Hasselt 1882:21–22, plate 2, fig. 1, plate 4, fig. 5.- Thorell 1890:33 (synonymy established in Thorell 1895).
Epeira (*Cyrtophora*?) *unicolor* Doleschall: Thorell 1895:171.

Figures 1–2.—*Cyrtophora unicolor* female from Australia, Christmas Island (Indian Ocean): 1. Tent-web. The arrow points to the curled leaf that the spider places as a retreat in the center of the web; 2. Spider in her curled leaf retreat.

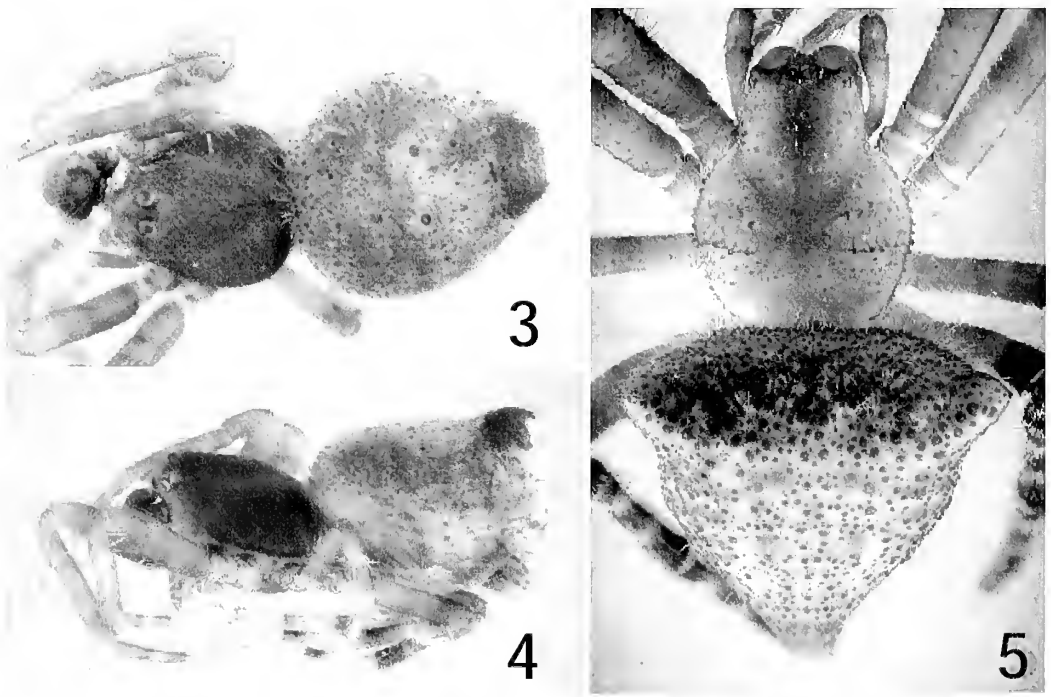
Araneus unicolor (Doleschall): Pocock 1897:600, plate 25, fig. 10; Pocock 1900:225.

Cyrtophora unicolor (Doleschall): Simon 1895:771; Roewer 1942:750; Bonnet 1956:1368–9; Chrysanthus 1959:201, figs. 3, 7, 26; Yaginuma 1968:36, figs. 8–9; Yaginuma 1986:117, fig. 32.4; Platnick 1989:335; Barrion & Litsinger 1995:587–590, figs. 366a–j; Yin et al. 1997:287, figs. 196a–c; Platnick 1998:499; Song et al. 1999:280, figs. 164m–n, 165g.

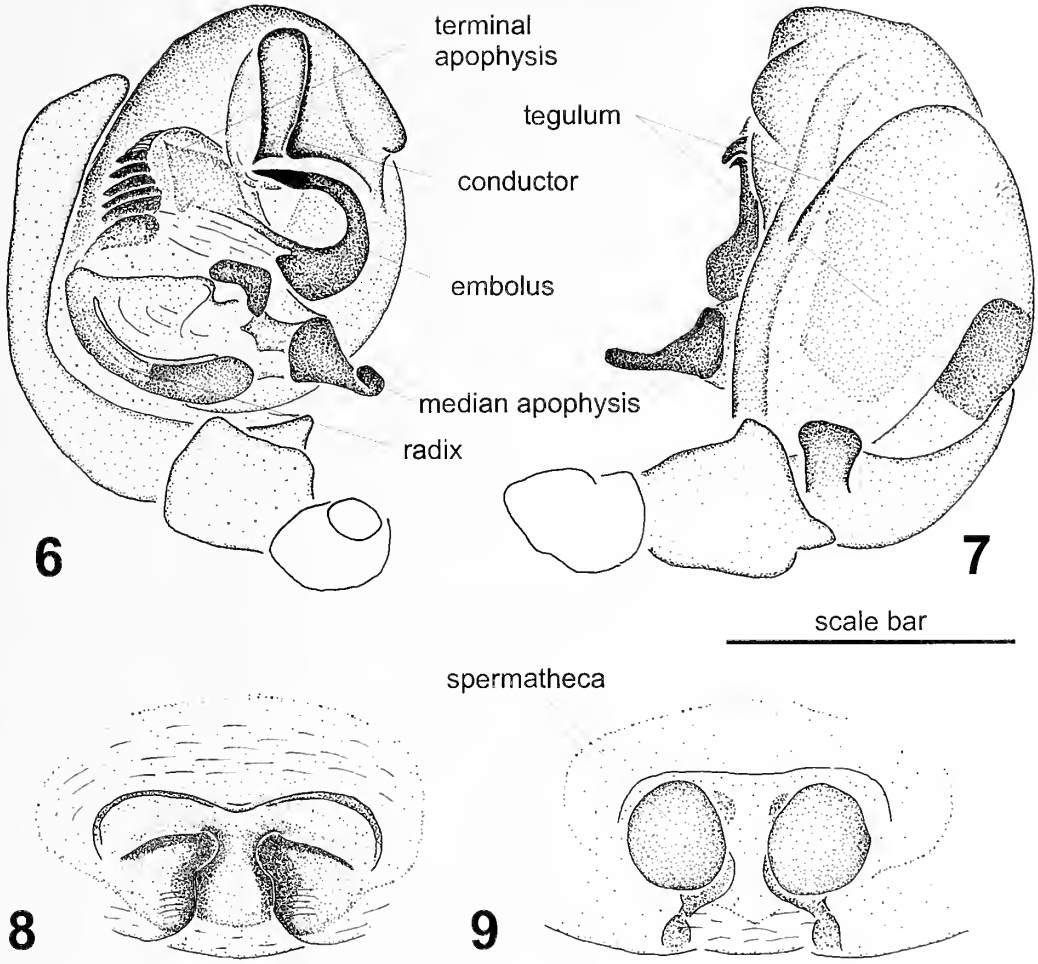
Types.—Syntypes of *Epeira unicolor* Doleschall: 1 female, Ambon, Indonesia, 3°42′S, 128°10′E (RMNH ARA05571); 1 immature, same locality (NHMV 20.596/1858.I.7) (not examined).

Holotype of *Epeira stigmatisata* Karsch: female, Thailand (no exact locality), F. Jagor (ZMB 2877) (not examined).

Holotype of *Epeira stigmatisata* var. *serrata* Hasselt: female, Agam district, Sumatra, Indonesia (no exact locality) (currently cannot be located in RMNH, where Hasselt's material is housed; E. v. Nieukerken, pers. comm.) (not examined).



Figures 3–5.—*Cyrtophora unicolor* (Doleschall). 3, 4. Male from Australia, Christmas Island (Indian Oeean) (WAM T65625): 3. Dorsal view; 4. Lateral view (total length 2.91 mm). 5. Female from Singapore (WAM 90/1964): dorsal view (total length 13.75 mm).



Figures 6–9.—*Cyrtophora unicolor* (Doleschall). Male and female from Australia, Christmas Island (Indian Ocean) (WAM T65625): 6. Left male pedipalp, mesal view; 7. Left male pedipalp, dorsal view; 8. Epigynum, postero-ventral view; 9 Epigynum, antero-dorsal view. Scale bar: (6, 7) 0.33 mm, (8, 9) 0.77 mm.

Material examined.—AUSTRALIA: *Western Australia:* 1 ♀, Christmas Island (Indian Ocean), 10°25′S, 105°40′E, 20 May 2005, V.W. Framenau (WAM T65699); 1 ♀, 1 juvenile, same locality, September 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 2 ♀, same locality, 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 1 ♀, Christmas Island (Indian Ocean), Central Plateau, 10°25′S, 105°40′E, 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 1 ♀, Christmas Island (Indian Ocean), east coast, 10°25′S, 105°40′E, October 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 4 ♀, 1 juvenile, Christmas Island (Indian Ocean), east of Flying Fish Cove, 10°25′S., 105°40′E., 12 August 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 1 ♂, 1 ♀, Christmas Island (Indian Ocean), N of Drumsite, 10°27′20″S, 105°40′10″E, 26 September 2005, V.W. Framenau, M.L. Thomas (WAM T65625); 1 ♀ with eggsac, Christmas Island (Indian Ocean), The Dales, 10°29′S, 105°33′E, 4–5 October 1969, Christmas Island Scouts (via S. Slack-Smith) (WAM T77421); 1 ♀, Christmas Island (Indian Ocean), 1 km W of Jane Up Cave (cave CI-6), 10°29′24″S, 105°37′54″E, 28 March 1998, W.F. Humphreys, in curled leaf (WAM T67960). INDIA: 1 ♀, eastern India (no exact locality), from dry collection (BMNH). INDONESIA: 1 ♀, 1 juvenile, Java (no exact locality), H.J. Jensen (ZMUC); 2 ♀, Bogor (Java), 6°35′S, 106°47′E, 1904, H.J. Jensen (ZMUC). MYANMAR (BURMA): 1 ♀, Tharawaddy, 17°19′N, 95°48′E, E.W. Oates (BMNH 1895.9.21.539). SINGAPORE: 1 ♀, Sungei Boleh, 1°18′N, 103°51′E, J.M. Waldock, J. Koh, swamp (WAM 90/1964); 1 ♀, Singapore, 1°18′N, 103°51′E,

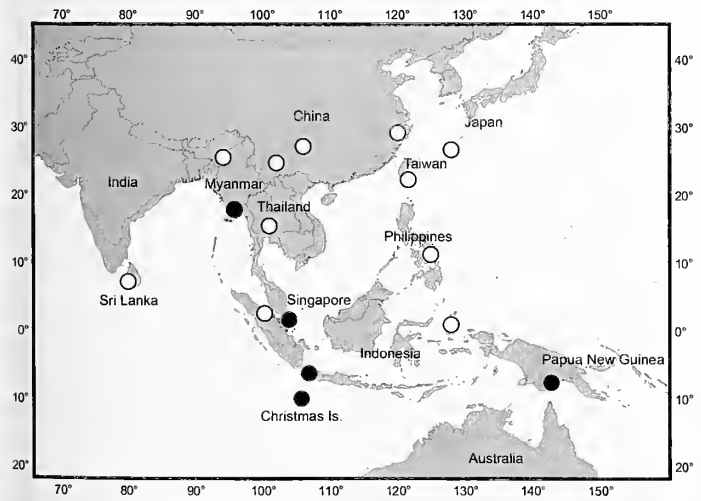


Figure 10.—Distribution records of *Cyrtophora unicolor* (Doleschall). (●) material examined, (○) records from the literature.

H.N. Ridley (BMNH 1894.12.22.12). PAPUA NEW GUINEA: 2 ♀, labelled "Pauneata, British New Guinea" (not listed in gazetteers) (QM S75510).

Diagnosis.—Male similar to *C. citricola* as illustrated in Levi (1997, figs. 154–156), but terminal apophysis with distinct longitudinal ridges instead of tubercles and median apophysis much stouter. Female, in contrast to other members of *Cyrtophora*, with numerous small sclerotized plates on the abdomen and numerous tubercles dorsally on cephalothorax (Fig. 5).

Description.—*Male (based on WAM T65625 from Christmas Island, Indian Ocean):* carapace: cephalic area protruding over clypeus (Fig. 4), its profile horizontal in lateral view; clypeus ca. twice as high as AME diameter; dark brown with some black pigmentation; fovea indistinct, longitudinal; sparse black setae, very few light setae posteriorly and silvery setae between eyes. Eyes: AE and PE rows recurved; row of AME wider than row PME; MOQ wider than long. Sternum: wider than long, orange-brown with dense black pigmentation; covered with few black macrosetae. Labium: ca. twice as wide as long, dark brown, front end rounded and with white rim. Chelicerae: orange-brown with black pigmentation some of which forms longitudinal stripes laterally; three very small retromarginal teeth, with the basal largest; four promarginal teeth, with the third (from apical) largest and the second smallest. Pedipalp (Figs. 6–7): median apophysis a mesally directed hook; embolus sickle-shaped with a very broad base; terminal apophysis with distinct sclerotized ridges. Abdomen: oval in dorsal view (Fig. 3), posterior end elevated above the spinnerets into a distinct tip (Fig. 4); milky-gray with light discoloration centrally, posterior tip very dark olive-gray; covered with few silverfish setae, setal sockets dark brown; venter milky-gray with two large lighter patches; spinnerets orange-brown with some dark pigmentation. Legs: leg length I > II > IV > III; orange-brown, with dark annulations.

Measurements. WAM T65625: TL 2.91, CL 1.39, CW 1.05, CH 0.61. Eyes: AME 0.12, ALE 0.08, PME 0.10, PLE 0.10. Row of eyes: AME 0.36, ALE 0.61, PME 0.28, PLE 0.63, MOQ length 0.26. Clypeus height 0.21. Sternum (length/width) 0.58/0.64. Labium (length/width) 0.13/0.25. AL 1.67, AW 1.42. Legs: lengths of segments (femur, patella, tibia, metatarsus, tarsus = total length): Pedipalp 0.97, 0.17, 0.17, - , 0.61 = 1.93; leg I 2.27, 1.15, 2.09, 1.91, 0.55 = 7.97; leg II 2.06, 1.18, 1.61, 1.48, 0.45 = 6.79; leg III 1.61, 0.70, 0.97, 0.88, 0.39 = 4.55; leg IV 1.94, 0.97, 1.48, 1.61, 0.42 = 6.42.

Female (based on WAM T65625 from Christmas Island, Indian Ocean): carapace: profile highest at fovea in lateral view; fovea a roundish pit; lateral and median eyes distinctly elevated from carapace; clypeus ca. as high as AME diameter; carapace laterally covered with large tubercles (Fig. 5); orange-brown; sparse black setae, few white setae in anterior half. Eyes: AE and PE rows recurved; row of AME wider than row PME; ME quadrangle wider than long. Sternum: wider than long, orange-brown with black pigmentation; covered with black macrosetae. Labium: ca. twice as wide as long; orange-brown; front end rounded and with white rim. Chelicerae: orange, apically somewhat darker; dentition as male. Epigynum (Figs. 8, 9): postero-ventral view: anterior rim sinuous, median sclerotized part pentagonal (Fig. 8); antero-dorsal view: large, round spermathecae (Fig. 9). Abdomen: longer than wide, with distinct and pointed humeral humps at anterior margin (Fig. 5); uniformly olive-brown with numerous small orange-brown sclerotized plates. Legs: leg length I > II > IV > III; femora orange-brown with indistinct dark annulations and very dark brown apically, patellae very dark brown, tibiae dark brown with light annulations which are accentuated by white setae, metatarsi and tarsi brown.

Measurements. WAM T65625: TL 18.75, CL 8.13, CW 6.75, CH 2.50 (without tubercles). Eyes: AME 0.30, ALE 0.21, PME 0.24, PLE 0.24. Row of eyes: AME 0.91, ALE 2.88, PME 0.79, PLE 2.94, MOQ length 0.76. Clypeus height 0.38. Sternum (length/width) 3.25/3.38. Labium (length/width) 1.00/1.45. AL 14.38, AW 12.75. Legs: Pedipalp 2.38, 1.13, 1.63, - , 2.63 = 7.75; leg I 7.63, 3.13, 5.38, 5.75, 2.13 = 24.00; leg II 7.38, 3.13, 4.75, 5.38, 2.13 = 22.75; leg III 4.50, 2.00, 2.50, 2.75, 1.88 = 13.63; leg IV 6.63, 2.88, 3.88, 4.88, 1.88 = 20.13).

Variation. ♀ (range, mean ± SD): TL 13.75–10.00, 17.00 ± 3.15; CL 6.25–8.13, 7.03 ± 0.79; CW 5.38–6.63, 5.78 ± 0.57; $n = 4$.

Remarks.—The embolus tip of the left pedipalp of the male described here was broken off and the illustration of the pedipalp (Fig. 6) shows a complete embolus reconstructed from the intact right pedipalp.

Pocock (1900, pg. 225) reported that *Cyrtophora acrobalia* (Thorell 1895), described based on a juvenile spider from Tonghoo (Myanmar), was "closely allied to this [= *C. unicolor*] species." Although the jar of the type specimen, originally described from the E.W. Oates collection (now housed in the BMNH), is present in London, it only contains the original label but no spider (pers. obs., 14 August 2007). Therefore the holotype must be regarded as lost. It remains impossible to ascertain the identity of this species based on Thorell's (1895) description alone and I consider *C. acrobalia* to be a *nomen dubium*. Thorell's (1895) original description of *C. acrobalia* includes a reference to the apparently similar *Cyrtophora diazoma* (Thorell 1890), described from a juvenile female from Sumatra. A synonymy of this species with *C. unicolor* remains possible pending an examination of the type material.

Distribution (Fig. 9).—*Cyrtophora unicolor* is known from China (Zhejiang, Yunnan, Guizhou) (Song et al. 1999), southern Taiwan (Chen & Tso 2004) and Japan (Miyashita 2002) in the north, the Philippines (Barrion & Litsinger 1995) and Papua New Guinea (this study) as its eastern border, Indonesia (Hasselt 1882; Pocock 1897; Chrysanthus 1959) and Christmas Island (this study) to the South, and Sri Lanka (Pocock 1900), Thailand (Karsch 1878), Myanmar (Thorell 1895; Pocock 1900) and northeastern India (Pocock 1900) in the East. However, the species was not listed for India by Tikader (1982). Roewer (1942) firstly catalogued Australia as part of the distribution of *C. unicolor* but, with the exception of the offshore territory of Christmas Island, I could not find an original record listing mainland Australia. The species is not present in the collection of the Queensland Museum whichholds large numbers of tropical araneids from Australia (O. Seeman, pers. comm.; pers, obs.).

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I am particularly grateful to the staff of Parks Australia North, Christmas Island for logistic support during my

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Cold temperature tolerance and distribution of the brown recluse spider *Loxosceles reclusa* (Araneae, Sicariidae) in Illinois

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Abstract. Although the temperatures at which the brown recluse spider (*Loxosceles reclusa*) is active have been described, no work has been done on lethal thermal limits that may influence the distribution of this medically important species. We tested the cold tolerance of *L. reclusa* at temperatures ranging from 3° C to −14° C. First, we tested spiders over brief 4-h exposures to a test temperature. Second, we tested spider tolerance to long-term, 30-da exposures to constant, low temperatures to simulate overwintering conditions. We also recorded temperatures beneath the plant litter layer and compared these to ambient surface air temperatures to estimate the effect of litter insulation. We then used the regression of ambient temperature to litter temperature to predict isotherms of litter retreats in Illinois during January, the month of lowest mean winter temperatures. Using the cold temperature lethal limits we found in the lab, we predicted a theoretical distribution of *L. reclusa* based solely on temperature that approximately matches its currently known distribution in Illinois.

Keywords: Biogeography, cold tolerance, lethal thermal limits, venomous spider, pest

The brown recluse spider, *Loxosceles reclusa* (Gertsch & Mulaik 1940), is distributed throughout the south-central United States (Gertsch & Ennik 1983; Vetter 2005). In its natural habitat, the brown recluse lives in dry, dark areas such as rocky overhangs, cliff ledges, bluffs, and under bark on dead trees. During winter months, *L. reclusa* can be found in silk retreats under stones on the ground (Hite et al. 1966). The brown recluse is also synanthropic, adapting to life in buildings as far north as Maine (McDaniel & Jennings 1983), though such outliers are rare and are the source of mueh misunderstanding (Vetter 2005). Because of the medical importance of the spider and confusion about its distribution in both the lay and medical communities (Vetter 2005), we investigated cold winter temperatures as one factor that could restrict the northern range of this species in Illinois, a state that spans the northern limits of its distribution.

Temperature acts as a barrier to the distribution of many animals but especially ectotherms such as spiders. Physiologieal and behavioral thermoregulation play a vital role in cold tolerance and, therefore, overwinter survival of spiders. Spiders vary greatly in resistance to cold temperatures with supercooling points (= SCP, the freezing point of hemolymph in an intact animal) ranging from −4° C to −34° C (Kirchner 1987). However, the temperature at which a spider can survive for periods of days is usually several degrees higher than the SCP. A variety of substances including proteins and polyhydric alcohols have been proposed as agents preventing ice-nucleation in the hemolymph (Husby & Zachariassen 1980; Zachariassen 1985; Kirchner 1987).

In winter, spiders regulate body temperature behaviorally by using leaf litter and accumulating snow as insulation from cold and variable ambient air temperatures. For instance, in Canada, a good snow cover can insulate the subnivean zone to temperatures no less than −9.5° C while the ambient air temperature plunges to −35° C, allowing for winter activity in several families of spiders (Aitchison 1978). In addition, many spiders, including brown recluses, are known to spin silk retreats (Hite et al. 1966) that may have insulating properties.

Only two species of *Loxosceles*, both from South America, have been tested for cold temperature tolerance. Fischer & Vasconcellos-Neto (2003) found an LT_{50} of −7° C for 1-h exposures in *L. laeta* (Nicolet 1849) and *L. intermedia* Mello-Leitão 1934. The brown recluse has never been tested for minimum lethal limits. We sought to determine the lethal minimum thermal limits of brown recluse spiders by exposing them to brief 4-hour or prolonged 30-da (= day) periods over a range of temperatures lower than 4° C, the point at which Hite et al. (1966) reported that they become inactive. We also recorded temperatures in the field in order to extrapolate temperatures beneath the leaf litter from ambient minimum air temperature isotherms for the state of Illinois. We chose Illinois as a model state to observe because its north-south axis straddles the northern boundaries of the range *of L. reclusa* reported in earlier literature (Gertseh & Ennik 1983; Vetter 2005). We then proposed a theoretical northern limit for the brown recluse based on their temperature tolerance and mean low winter temperatures beneath the litter layer.

METHODS

We collected brown recluses from a barn in the Little Creek Nature Preserve near St. Louis, Missouri (38.77419°N, 90.29150°W) and housed them individually in 5 × 5 × 3 cm clear plastic containers at room temperature (22° C) on a 12L:12D light cycle. Voucher specimens are deposited in the Biology Department at Monmouth College, Monmouth, IL. Spiders were acclimated to the lab environment for four weeks before testing began. We maintained spiders on house crickets (*Acheta domesticus* Linnaeus 1758) and did not initiate temperature tests until at least one week after their last feeding. From the sample population, we randomly designated

groups of 19–20 adult spiders to each treatment. We chose experimental temperatures based on information in Hite et al. (1966) and winter average low temperatures for 87 municipalities in Illinois having a continuous record from 1971–2000 available on the Illinois State Climatologist Office (2006) web site (http://www.sws.uiuc.edu/atmos/statecli/Summary/Illinois.htm).

Our first set of experiments tested *L. reclusa* at 4-h exposures. We placed each group of spiders in an incubator with relative humidity held constant at 30% (+/− 3%) and lowered the temperature by 4° C every 2 h from 22° C to the specified test temperature. Thus, spiders exposed to cooler temperatures underwent a longer cool-down period but all groups were cooled at the same rate. Humidity level was arbitrarily chosen but falls within the range of minimum humidity levels recorded in Illinois in winter months (Illinois State Climatologist Office, 2006). Spiders remained at the test temperature for 4 h and the temperature was then raised to 22° C in the same manner as it was lowered. We repeated this procedure for eight test temperatures: 3, 1.5, 0, −2, −5, −7, −10, and −14° C and recorded mortality rates.

In a second set of experiments we exposed spiders to low temperatures for 30 da to simulate overwintering conditions. Three different groups of spiders were gradually lowered as before in the 4-hour tests to 0, −2 and −5° C. After the 30-da period, the temperature was raised gradually, as in short-term experiments, to room temperature.

We analyzed the short-term temperature exposure mortality data using probit analysis (Minitab) to predict a lethal temperature for 50% of the test population (LT_{50}). Assuming a Weibull distribution gave the best fit of model to the data ($P > 0.10$, Hosmer-Lemeshow goodness-of-fit). The long-term temperature exposure data could not be analyzed by probit because, of the three temperatures tested, there were no mortalities at the highest temperature and no survivors at the lowest temperature. These zero values precluded the possibility of fitting a line with any accuracy.

Finally, in order to accurately predict microhabitat temperature in the leaf litter relative to ambient air temperature, we placed six Hobo temperature data loggers (Onset Computer Corporation) in LeSuer Nature Preserve near Monmouth, Illinois (40.921036°N, 90.63101°W). For 16 wk from November 2003 to March 2004 we recorded temperatures to the nearest 0.4° C at 5-min intervals beneath the litter (O horizon) at the boundary with the A horizon (partially decomposed organic matter) in three locations and nearby with the same exposure but at the ground surface ($n = 3$). We used mean daily values to calculate a regression between surface air and litter temperatures and used it in conjunction with mean minimum January air temperatures from the Illinois State Climatologist Office to produee a map of isotherms of litter temperatures across the state.

RESULTS

In the 4-h exposures to test temperatures ($n = 19$ each treatment), there were no mortalities in any of the five groups of spiders tested at 3, 1.5, 0, −2 and −5° C. The −7° C and −10° C test groups each experienced 47% mortality and at −14° C mortality was 100%. Probit analysis predicts a short-term exposure LT_{50} at −9° C (+/−1° C) (Figure 1).

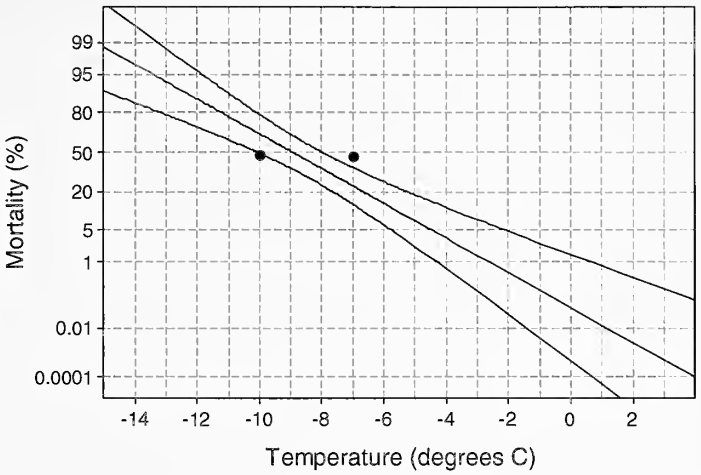

Figure 1.—Probability plot of mortality with 95% confidence intervals for 4-h exposures of brown recluse spiders at various temperatures. See text for details of data.

In the 30-da exposures ($n = 20$ each treatment) all spiders held at 0° C survived, 30% survived at −2° and none survived at −5° C. Because of the zero values for mortality and survivorship in the high and low temperatures, respectively, probit analysis was not appropriate for these data. As expected, the long-term survivorship was greatly reduced compared to short-term exposures. Though we cannot estimate an LT_{50} from these date, we can infer a long-term LT_{100} of at least −5° C, possibly higher.

Over a 16-wk winter period (2003–2004), leaf litter temperatures averaged 3.0° C warmer than air temperature. The range of temperature fluctuation in leaf litter and air over the entire period was similar, about 15° C. Litter temperatures fluctuated up to 13° C in a 24 h period with episodes in November when the temperature dropped as much as 12° C in a 4-h period. The regression equation of litter temperature (Y) on air temperature (X) was $Y = 1.87 + 0.65$ (X), with $r^2 = 0.72$ (Figure 2).

We used our regression equation to estimate litter temperatures from air temperatures aeross Illinois and superimposed these isotherms over confirmed *L. reclusa* records across the state. Records included citizen's submissions to the principal

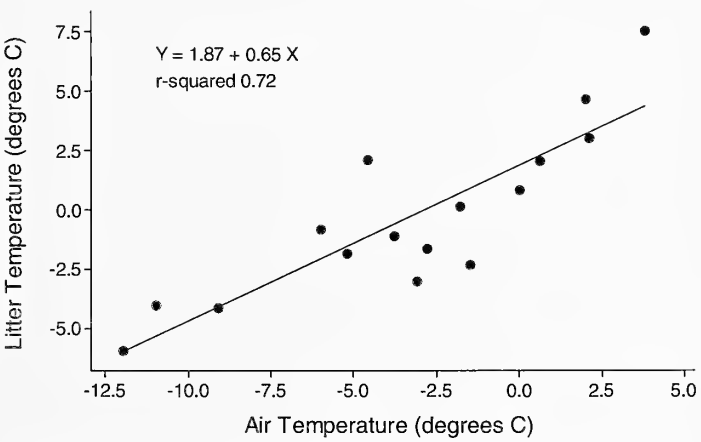

Figure 2.—Linear regression of ambient air vs. plant litter temperature (° C) in north-central Illinois, USA.

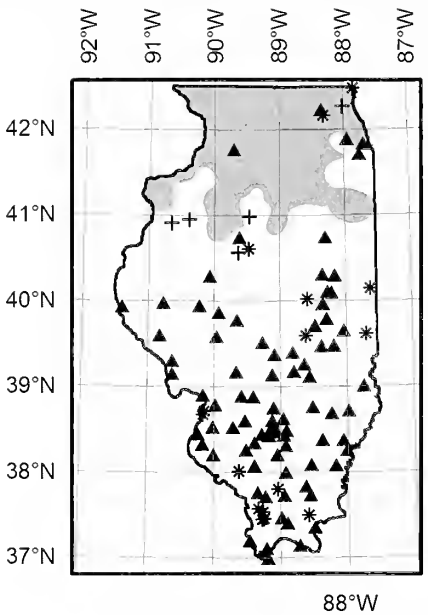

Figure 3.—Brown recluse spider records and estimated mean January litter temperature at or below the long-term minimum LD_{100} of −5° C indicated by shading for Illinois. Triangles denote records with voucher specimens from the Illinois Natural History Survey (INHS), other museums, and specimens submitted to the principal author's Bi-State Brown Recluse Project and to R. Vetter (2005 and personal communication). Asterisks are records of spiders without voucher specimens but recorded by arachnologists at the INHS. Crosses indicate known or probable human transport of spiders from within the known range of the brown recluse via two main routes: warehouses with daily shipments of materials or one-time transport to a residential area by moving stored materials.

author's Bi-State Brown Recluse Project (with collaboration from Rick Vetter, Univ. of California-Riverside), the Illinois Natural History Survey (INHS) and other museum sources, and records of Joe Beatty kept at the INHS (Fig. 3). Brown recluses are recorded primarily in the area of the state south of the −5° C litter temperature isotherm that correlates with the species long-term LT_{100}. At least five of the outlying records north of this isotherm (e.g., Chicago area, other north-central Illinois sites) are known to be due to transport by commerce or movement of stored household items from southern portions of USA well within the established distribution of the species.

DISCUSSION

With public concern over brown recluse bites elevated by dramatic photos and dubious stories on the internet, public perception that the spider occurs throughout the United States is widespread yet unfounded (Vetter 2005). Anecdotally, concerns about the northward movement of organisms due to global warming also contributes to exaggerated fears of the threat from a brown recluse bite far north of its usual range. Our study suggests that, given its cold temperature tolerance, the brown recluse is unlikely to become established north of its range in the wild.

The brown recluse has an LD_{50} of −9° C for 4-h exposures similar to those found by Fischer & Vasconcellos-Neto (2003) for the South American species *Loxosceles intermedia* and *L. laeta* whose LD_{50} is −7° C for shorter 1-h exposures. The brown recluse may be more tolerant of somewhat colder temperatures but the similarities are notable given the substantially different latitudes occupied by these three species (38°N for *L. reclusa* used in this study, and 24°S for *L. intermedia* and *L. laeta* from southern Brazil). Although Kirchner (1987) reported wide variability in supercooling points not only within genera but even within some species, based on these limited tests, the genus *Loxosceles* in the Americas may have relatively inflexible limits with respect to cold temperature tolerance.

Several limitations must be considered when extrapolating our lab data to field conditions. First, the rate of temperature change in the lab may be more rapid than what spiders are exposed to in the wild. Although our lab populations were dropped at a rate of 2° C/h, previous studies of lower critical temperatures in spiders have varied widely. Almquist (1970) acclimated various species at 4° C and then lowered temperatures by a more gradual 1° C/h. However, in studies on thomisids (Schmalhofer 1999) and *Loxosceles* (Fischer and Vasconcellos-Neto 2003) temperatures were lowered from room temperature to test temperatures at far faster rates than in our study (12 and 30° C/h, respectively). Which of these is a more accurate representation of the field situation is difficult to determine. In our study, litter temperatures dropped as much as 3° C/h even late in the fall (November). In the fall in Illinois, it is not uncommon for temperatures to drop more than 10° C in 1 h as a major cold front passes through an area (University of Illinois 2007). Although spiders may be exposed to very rapid temperature change, they may enter diapause before such temperature fluctuations occur by responding instead to changing photoperiods and avoiding the need for a sudden physiological response to rapidly dropping temperatures.

Second, because temperatures fluctuate among and within days over winter, the continuous exposure in our long-term laboratory tests may be more severe than actual conditions in the field that we represented by the isotherms of mean low January temperatures (Fig. 3). Such daily fluctuations above average minimum temperatures may be important to survival.

Third, the relatively low humidity we maintained in the incubators is probably also harsher than that experienced in overwintering microhabitats. However, *L. reclusa* is very tolerant of water loss and persists indefinitely in the lab with no access to water. Eskafi et al. (1977) report extremely low rates of water loss in brown recluses, the lowest of any spiders tested to that date.

Finally, extreme minimum temperatures might also be expected to increase brown recluse mortality and therefore limit brown recluse distribution. However, the mildest extreme low temperatures recorded in Illinois over the past 30 yr was −26° C in the southernmost portion of the state, a temperature that far exceeds the minimum short-term tolerance of *L. reclusa* in the lab. Yet brown recluses are common throughout southern Illinois. This suggests that at least some spiders must inhabit hibernacula sufficiently insulated to protect themselves from extreme lows for periods of several days.

We have shown a crude correlation of winter temperature with brown recluse temperature tolerance and distribution in Illinois but certainly other abiotic and biotic factors are limiting, especially in other portions of its range. For instance,

the brown recluse does not occur in most of Florida and the Atlantic coast where temperatures are mild enough for overwinter survival. Similarly, other factors must be in play limiting its westward expansion across the Great Plains. As a final caveat, much more needs to be known about the distribution of *L. reclusa* in natural habitats vs. buildings. Most records of brown recluses are of specimens collected in climate-controlled buildings, a factor that confounds attempts to relate ambient temperature to distribution. Where brown recluse records are more common and household infestation is not unusual we can infer that healthy wild recluse populations are probably a source of immigrants, and therefore must be adapted to ambient temperatures. However, records of brown recluses on the margin or outside of their normal range are often from buildings. It is rarely explored if wild populations exist in the immediate area of such records and these populations may only persist indoors in climate-controlled settings. Future collectors may wish to document more precisely the synanthropic distribution of brown recluses compared to their occurrence in natural habitats.

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Are brown recluse spiders, *Loxosceles reclusa* (Araneae, Sicariidae) scavengers? The influence of predator satiation, prey size, and prey quality

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Abstract. I examined prey choice of the brown recluse spider (*Loxosceles reclusa* Gertsch & Mulaik 1940) with reference to unusual scavenging behavior originally reported by Sandidge (2003). Because scavenging is an unexpected behavior in normally predatory spiders, I hypothesized that special circumstances must converge for the brown recluse to prefer dead prey over live prey. I offered crickets (*Acheta domesticus*) to brown recluses in several choice experiments. I varied predator satiation (spiders not fed for two or four weeks), prey size (small or large), and prey quality (live, fresh dead, dead 1–2 days, 1 week or 1 month). Overall, recluses preferred live prey over dead, but their choice was influenced by all three variables. Recluses were more likely to scavenge when presented with large live prey paired with dead prey of equal size than when presented with small live and dead prey. Spiders that had fed recently were more likely to scavenge. Finally, recluses preferred dead prey that were freshly killed or less than 24 hours old to items dead for longer periods. My results suggest that scavenging is an opportunistic behavior in recluses that requires specific circumstances that may rarely occur in nature.

Keywords: Brown spider, scavenger, foraging, prey choice

Spiders are generally regarded as obligate predators varying principally in their method of capturing live prey (Coddington & Levi 1991). Originally thought to be non-selective generalists, spiders have also been shown to choose prey in order to meet their current nutritional needs (Greenstone 1979; Mayntz et al. 2005). Such selection has been shown to be important in their growth and survival (Toft 1999; Toft & Wise 1999; Mayntz & Toft 2001). A few exceptions to feeding on active prey have been noted. Some spiders feed on insect eggs (Buschman et al. 1977; Jackson and Blest 1982), nectar (Pollard et al. 1995; Jackson et al. 2001), or pollen (Smith & Mommsen 1984).

Researchers have also observed scavenging by some spiders. Bristowe (1941) observed a gnaphosid feeding on pinned insects and Kullmann (1972) reported that spiderlings of several species would feed on their dead mother. Other researchers have supported lab populations of spiders, especially juveniles, on artificial diets of ground insects (Peck & Whitcomb 1968; Horner & Starks 1972). Knost & Rovner (1975), however, appear to have been the first to conduct experiments on scavenging in spiders. They reported that wolf spiders in the lab would readily consume dead prey and that movement was not a necessary stimulus to induce feeding. Wolf spiders would scavenge even when live prey were available, although the authors did not report on the relative numbers of prey chosen in each category. Although the term "prey" is normally used in reference to live organisms, for simplicity and consistency with earlier literature [e.g., Sandidge 2003], I use the term to refer to both live and dead organisms used for food.

While it may be more common than suspected, little is known about scavenging by spiders in the wild (Foelix 1996). Sandidge (2003) concluded that the brown recluse spider, *Loxosceles reclusa* Gertsch & Mulaik 1940 (Araneae, Sicariidae), was exceptional among wandering spiders because it preferred scavenging over predation and even actively avoided live prey. In the lab he observed that spiders starved for two weeks and offered both live and dead prey simultaneously tended to avoid live prey and instead scavenged on dead prey. He also observed scavenging *in situ* in spiders living in homes. In part because of their preference for scavenging, Sandidge & Hopwood (2005) suggested that brown recluses may be persistent and difficult to control in homes if abundant dead prey are available. Given the apparent rarity of scavenging in spiders and the medical importance of the brown recluse, whose bite can cause severe, necrotic wounds and even systemic reactions (Atkins et al. 1958; Anderson 1998; da Silva et al. 2004), I investigated variables that might promote scavenging in this species.

In the present study I examined three variables that could influence recluse prey choice: predator satiation, prey size and prey quality. I predicted that sated predators would be less likely than nutritionally deprived spiders to attack live prey when dead prey were available; that spiders would be more likely to attack small, rather than large live prey when paired with dead prey of similar size; and that spiders offered only dead prey would prefer more recently killed prey.

METHODS

I used a laboratory population of spiders that was captured from Little Creek Nature Area near Florissant, Missouri, USA (90.291°W; 38.774°N). Spiders were captured from a large pile of lumber in an unheated barn loft. Twenty-six adult male and 35 adult female spiders were housed individually in clear plastic containers (12 × 17 × 6 cm) kept at room temperature under a 12L:12D photoperiod and maintained on a diet of both live and dead domestic crickets (*Acheta domesticus*) offered weekly. Experiments were conducted over a 10-mo period in 2005.

Because brown recluse spiders are a relatively long-lived species (Hite et al. 1966; Eskafi et al. 1977), I was able to use spiders in multiple trials (n = number of trials). To control for possible effects of repeated testing, I randomly assigned spiders to a treatment order to avoid biasing spider choice based on prior experience in another testing situation. To further account for possible bias that could be introduced by

Table 1.—Overview of experimental designs with number of trials and response rates (% spiders feeding).

Treatment design			Sample sizes and response rates		
Starvation period (wk)	Prey size	Prey choice offered	Trials (#)	Spiders feeding (#)	Response rate (%)
2	Large	Live vs. Fresh dead	172	46	27
4	Large	Live vs. Fresh dead	100	61	61
4	Small	Live vs. Fresh dead	87	54	62
4	Small	Live vs. 1-Da dead	28	20	71
4	Small	Fresh dead vs. 1-Da dead	30	20	66
4	Small	7-Da dead vs. 1-Day dead	24	17	71
4	Small	8-Da dead vs. 2-Da dead	24	12	50

repeated testing of the same individual (influence of prior exposure, age, e.g.), I conducted statistical tests for independence of testing order. For spiders tested multiple times (up to 4 times) I used Cochran's Q tests and for spiders tested twice, I employed McNemar's test (Sokal & Rohlf 1969). Spider response was recorded as a categorical variable (choosing live or dead prey) with order of testing as the independent variable. Tests in which the spider did not attack or feed on prey were excluded from this analysis because level of satiation was controlled. I also tested for any influence of sex on choice of prey. If the results for effects of testing order and sex were not significant, I then pooled the data and tested various hypotheses concerning prey choice using a Chi-square test for goodness-of-fit or independence as appropriate. Voucher specimens are housed in the Biology department at Monmouth College, Monmouth, IL.

For prey choice tests I used crickets of two sizes: "large" crickets (4–6 wk old, 11–15 mm body length) and "small" crickets (2–3 wk old, 7–9 mm). Observations showed that the large crickets were well within the size range that the spider's venom could immobilize if they chose to attack. The small size class fell within the range of body lengths of *L. reclusa* used in this study. To kill crickets, I placed them in a freezer (−20° C) for approximately 24 h prior to testing and thawed them to room temperature before testing began. I also "aged" different groups of dead crickets by leaving them in ventilated containers at room temperature for 1, 2, 7, or 8 da (= day) and 4 wk. For all tests, I used forceps to place dead and live prey in the center of the plastic containers housing individual recluses.

I observed feeding behavior in a darkened room under low light beginning at roughly 18:00 h. During the first 15 min of testing, I observed spiders continuously and then checked every 15 min for the next 2 h for evidence of feeding. Because recluses will feed for ≥ 1 h on a given prey (Hite et al. 1966) this method ensured that no feeding in the first 2 h was missed. More than 90% of the spiders had made a choice of prey within the first 30 min. After 18 h of testing, I removed any uneaten prey. In the few instances when feeding occurred overnight after the initial 2-h observation period, I confirmed prey choice by examining prey remains under a dissecting scope. Feeding was easily confirmed by noting loss of volume and collapse of the exoskeleton due to fluids being withdrawn. I conduceted seven principal experiments in which I varied predator satiation, prey size and prey quality (Table 1). In all results where spiders were tested multiple times, the number of trials (n) is followed by the number spiders tested in parentheses.

Effect of satiation level.—I replicated portions of Sandidge's (2003) study by offering a choice of large live and large dead crickets to spiders that had been starved for 2 wk (n = 172 [51]). Due to the low rate of feeding in these tests, I modified Sandidge's (2003) design and starved spiders for 4 wk (n = 100 [47]), comparing the results of the two tests. Because the response rate increased dramatically, I starved spiders for four weeks in all other experiments.

Effect of prey size.—To compare with above experiments offering only large prey, I offered spiders small dead and small live prey (n = 87 [47]). In separate tests, I offered spiders either small live (n = 24) or large live prey (n = 23) alone rather than simultaneously to control for the possibility that spider avoidance of large crickets could cause them not to feed on small crickets placed in the same enclosure.

Effect of prey quality.—Spiders that had been starved for four weeks were offered the following choices of small crickets: live and 1-da dead (n = 28); fresh dead and 1-da dead (n = 30); 1-da dead and 7-da dead (n = 24); 2-da dead and 8-da dead (n = 24). Finally, prey that had been dead for 1 mo were offered alone to spiders (n = 23).

RESULTS

Spider choice was independent of testing sequence. For spiders feeding in at least two sequential experiments (n = 48), choice of prey was entirely independent of prior experience (Q = 0, P = 1.00). Likewise, prey choice was independent of prior exposure for spiders feeding in three sequential experiments (n = 27, Q = 0.15, P = 0.93) and four sequential experiments (n = 12, Q = 5.0, P = 0.17). Similarly, male and female spiders fed at the same rate and chose prey in the same proportions in all tests of live vs. dead prey (Chi-square test: $X^2_1 = 0.586$, P = 0.90) and in comparisons of dead prey of varying quality (Chi-square test: $X^2_1 = 3.515$, P = 0.32). Thus, the results are based on data pooled for both sexes.

Effect of predator satiation.—Spiders starved for 2 wk and offered large dead and large live crickets (as in Sandidge 2003) fed in only 27% of the 172 trials; the majority ignored both live and dead prey (Chi-square test: $X^2_1 = 45.06$, $P < 0.0001$). Only one spider fed on both prey. This individual was excluded from the choice comparisons as were spiders in other experiments that fed on both prey (exeept as noted). Of the spiders that fed on a single prey, 58% chose live prey but this preference was not significant (Fig. 1). An additional 12 spiders attacked and killed live prey but did not feed on the cricket.

After withholding food from spiders for 4 wk and offering large prey, 60% of the spiders fed and a clear majority (70%)

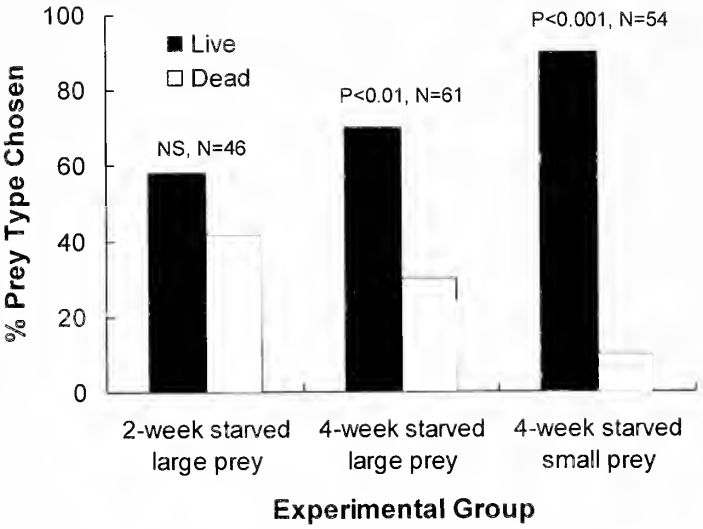

Figure 1.—Effects of satiation and prey size on scavenging by brown recluse spiders. Percentage of live vs. dead prey chosen by spiders deprived of food for 2 or 4 wk and offered large or small prey. NS = non-significant, $P > 0.05$. n = sample size.

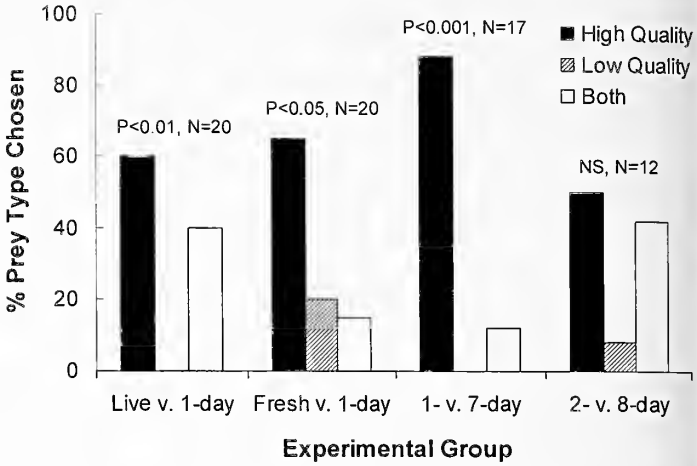

Figure 2.—Effects of prey quality on scavenging by brown recluse spiders. Percentage of high vs. low quality prey chosen by spiders deprived of food for 2 wk and offered small prey. NS = non-significant, $P > 0.05$. n = sample size.

preferred to feed on live prey (Chi-square test: $X^2_1 = 8.0$, $P = 0.005$; Fig. 1). A significant number of spiders (18% of those feeding) fed on both live and dead prey. In all tests below, spiders were not fed for 4 wk prior to testing to increase response rate.

Effect of prey size.—When offered small live and small dead crickets, 62% of the spiders fed; a response rate similar to when they were presented with large crickets. However, 90% chose the live prey exclusively, a highly significant preference (Fig. 1). This preference was significantly stronger than when spiders were offered large crickets (Chi-square test: $X^2_1 = 5.59$, $P = 0.018$). Many spiders (24%) fed on both live and dead prey, as they did when presented with large prey, but in every case they attacked and fed on live prey first. The percent feeding on both prey items was significantly greater in spiders that were not fed for 4 vs. 2 wk (Chi-square test: $X^2_1 = 8.756$, $P = 0.003$). Only two spiders (3.6% of spiders showing some response) attacked but did not feed on small live prey compared to 17% in the two tests with large crickets (Chi-square test: $X^2_1 = 6.21$, $P = 0.013$). Finally, when spiders were offered a single small or large cricket alone, far more spiders attacked and fed on small (74%) than large (17%) crickets (Chi-square test: $X^2_1 = 14.81$, $P = 0.0001$).

Effect of Prey Quality.—When spiders had a choice of live prey vs. prey dead for 1 day, none ate only the dead prey, showing a clear preference (100%) for live prey (Chi-square test: $X^2_1 = 12.0$, $P = 0.0005$; Fig. 2). Many spiders in this group fed on both live and dead prey, usually choosing the dead prey after feeding on the live specimen. Nonetheless, including spiders that chose both prey still results in a significant preference (71%) for live prey (Chi-square test: $X^2_1 = 5.14$, $P = 0.023$).

When offered two classes of dead prey, fresh and 1-da dead, 60% of the spiders fed and the majority (76%) preferred the fresher prey item (Chi-square test: $X^2_1 = 4.76$, $P = 0.029$; Fig. 2). Including spiders that chose both prey obscures this preference (Chi-square test: $X^2_1 = 3.52$, $P = 0.061$), but the fresher prey was almost always fed on first. Spiders also preferred to scavenge 1-da old prey vs. 7-da old prey (Chi-square test: $X^2_1 = 15.0$, $P = 0.0001$; Fig. 2). Once the prey had been dead for $\geq$ 2 da, spiders seemed less able to discern any difference in prey quality. Only 50% of the spiders fed when offered 2 or 8-da old dead prey. While most fed only on 2-da rather than 8-da old prey the difference was suggestive but not significant (Chi-square test: $X^2_1 = 3.57$, $P = 0.059$; Fig. 2). More spiders also fed on both prey rather than refusing one as they did in the 1- vs. 7-da comparison.

Finally, when 1-mo old dead crickets were offered to spiders, none of them fed on this item even though no other choice was available. Eighteen of the 23 spiders left their retreats and searched for food, but none fed, even after being starved for 4 wk.

Overall, spiders followed a hierarchy in prey selection by favoring live over dead, small over large, and fresh over more decayed dead prey. Further, less satiated spiders were more likely to feed on both live and dead prey, but fed on live prey first. More satiated spiders were more likely to attack, but not feed, on crickets, especially large ones.

DISCUSSION

Predator satiation.—Less than 30% of spiders starved for 2 wk fed when offered prey and even a 4-wk starvation period only produced an average 60% feeding response over all trials. Such low feeding rates may be a reflection of the low metabolic requirements of brown recluses, especially in laboratory situations. Recluses will remain motionless for extended periods and a recluse starved for 2 wk is probably not energetically stressed. Carrel & Heathcote (1976) found that *Loxosceles* and the closely related spitting spiders (*Scytodes*) had lower than expected heart rates for their size compared to the other spiders they studied. The remarkable ability of recluses to do without food or water for long periods and their impressive longevity for a small invertebrate also attest to their low metabolic requirements (Hite et al. 1966; Eskafi et al. 1977). Recluses live an average of 2 ys (with one female living nearly 5 yr) and can survive 2–3 mo without food (Eskafi et al. 1977). A recluse that is not energetically or nutritionally stressed may be less likely to attack large, live

prey because the risk of damage to itself outweighs the potential energy gain.

Prey size.—Recluses preferred live prey similar to their own body size even though their venom is capable of immobilizing much larger prey. Like Sandidge (2003), I also noted that recluses would often retreat from or ignore large, live crickets in their enclosures and would feed on dead crickets instead. Generalist predators with limited visual acuity, such as many wandering spiders, often use size as an initial screening device to determine the suitability of prey (Foelix 1996). Spiders may benefit by ignoring large, potentially dangerous prey if there are safer resources available like fresh, dead prey. Jackson et al. (2002) showed that the jumping spider *Portia* adjusts its attack strategy depending on prey vulnerability in order to reduce risk to itself. Wigger et al. (2002) found that the wandering spider *Cupiennus* injects more venom in prey that are difficult to subdue or dangerous, a behavior that Malli et al. (1999) demonstrated was dependent on the intensity and duration of the prey's struggle but independent of prey size. Sandidge's (2003) results are also consistent with the hypothesis that brown recluses avoid more dangerous prey. In his study, spiders were more likely to attack live over dead prey when offered slow-moving larval prey such as waxworms (*Achroia grisella*) and mealworms (*Tenebrio molitor*). Conversely, he observed the highest rates of scavenging when spiders were offered much more active and potentially more dangerous crickets as live prey.

Level of satiation is also likely to influence the size of prey a spider is willing to attack. Brown recluses may be more willing to take risks on large prey if they have not fed recently and have a lower response threshold to the stimulus of a moving prey. The fact that recluses more often attacked and bit, but did not feed on, large prey rather than small prey suggests that these behaviors may have been defensive rather than predatory and supports my interpretation that large prey are viewed as a threat rather than an opportunity. When spiders encountered small live prey, they were much more likely to attack even if relatively satiated.

Prey quality.—Quality of prey, defined here as a hierarchy based on age of the dead specimens (and live prey assumed to be of better quality than dead), also clearly influenced prey choice by recluses. Recluses preferred fresh dead prey rather than prey dead even for as little as 24 h. After 2 da of decay their ability to distinguish declining quality of dead prey appeared diminished. Wolf spiders showed a similar preference for fresher dead prey (Knost & Rovner 1975). My results suggest that unless fresh, dead prey is common in the natural habitat of recluses, scavenging is an unlikely option compared to predation. Prey choice will also depend on the relative availability of live and dead prey in their natural habitat, about which next to nothing is known.

I was unable to replicate the degree of scavenging observed by Sandidge (2003) in choice tests identical to his experimental design (2 wk starvation, relatively large dead and live crickets, same-sized enclosures, etc.). Whereas his spiders chose dead over live crickets 75% of the time, only 42% preferred dead prey in this study. Modifying Sandidge's (2003) design slightly by offering small crickets to less satiated spiders reduced rates of scavenging to only 10%. Thus, Sandidge's (2003) experimental design (large live prey, a fresh, dead alternative prey, and a relatively satiated spider) may have contributed to the high rates of scavenging he observed.

Another explanation for our differing results may be the origin of our test populations. Mine were collected from a semi-natural setting, a barn loft in a nature preserve in Missouri whereas Sandidge (2003) used spiders captured principally in homes in Kansas (personal communication). Synanthropic populations may have more opportunities for scavenging or there simply may be natural variation among populations in their tendency to scavenge. In particular, the high populations of recluses observed by Sandidge (2003) and reported by others (Vetter & Barger 2002) in some homes may make competition for live prey especially intense, increasing the profitability of scavenging. Lastly, in both studies, feeding on dead prey may not indicate that recluses necessarily scavenge in the wild. Spiders often return later to feed on prey they have killed earlier and this behavior could easily manifest itself in the lab where prey have been previously killed by the experimenter rather than the spider.

Brown recluses will scavenge under the right conditions. However, in this study brown recluses preferred live prey in nearly all circumstances. Larger live prey, greater satiation, and fresher dead prey all increased the likelihood of scavenging. We will need to learn more about quality and availability of prey to brown recluses *in situ* to determine if they are preferential or opportunistic scavengers.

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Taxonomic notes on Colombian *Cryptocellus* (Arachnida, Ricinulei)

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Abstract. A new species, *Cryptocellus florezi*, is described from a cave in Caquetá Department, Colombia, and may be most closely related to the Venezuelan species *C. lisbethae* González-Sponga 1998. The first known female of *C. peckorum* Platnick & Shadab 1977 is described, and new records of *C. narino* Platnick & Paz 1979 extend the known distribution of that species into Boyacá and Tolima Departments.

Keywords: Ricinuleids, systematics, Colombia

Arachnids of the order Ricinulei can be locally abundant, inside caves and in epigean habitats such as Amazonian forests, where densities as high as 36 individuals per square meter have been reported (Adis et al. 1989). Nevertheless, most of the described species are known from very few specimens, typically from only a single locality. All Recent ricinuleids are assigned to one family, Ricinoididae Ewing 1929, including three genera: *Ricinoides* Ewing 1929 from western and central Africa; *Pseudocellus* Platnick 1980 from Texas, Mexico, Central America, and Cuba; and *Cryptocellus* Westwood 1874 from Central America, South America, and Tobago. Some 30 species of *Cryptocellus* are currently recognized, including 28 cataloged by Harvey (2003) plus *C. abaporu* Bonaldo & Pinto-da-Rocha 2003 and *C. tarsilae* Pinto-da-Rocha & Bonaldo 2007, both from Brazil. Two of those putative species are not identifiable at present; however, *C. emarginatus* Ewing 1929 from Costa Rica and *C. leleupi* Cooreman 1977 from Ecuador were each based on juveniles and were therefore considered *nomina dubia* by Platnick & Shadab (1981) and Platnick & Paz (1979), respectively.

We report here on some recently collected ricinuleid specimens from Colombia. Only four currently valid ricinuleid species are known from that country: *C. magnus* Ewing 1929 from Magdalena Department, *C. glenoides* Cooke & Shadab 1973 from Valle del Cauca Department, *C. peckorum* Platnick & Shadab 1977 from Amazonas Department, and *C. narino* Platnick & Paz 1979 from Antioquia Department. Of these, *C. peckorum* has been known only from males, but both sexes are known for the other three species.

The new collections reported below provide significant range extensions for *C. narino*, the first known females of *C. peckorum*, and an interesting new species from Caquetá Department. All measurements are in mm. The specimens examined in this study are lodged in the Instituto de Ciencias Naturales, Universidad Nacional de Colombia (ICN) and the American Museum of Natural History, New York (AMNH).

Family Ricinoididae Ewing 1929
Genus *Cryptocellus* Westwood 1874

Cryptocellus Westwood 1874:201.
Heteroricinoides Dumitresco & Juvara-Balş 1977:148.

Type species.—*Cryptocellus: Cryptocellus foedus* Westwood 1874, by monotypy.

Heteroricinoides: Heteroricinoides bordoni Dumitresco & Juvara-Balş 1977, by original designation.

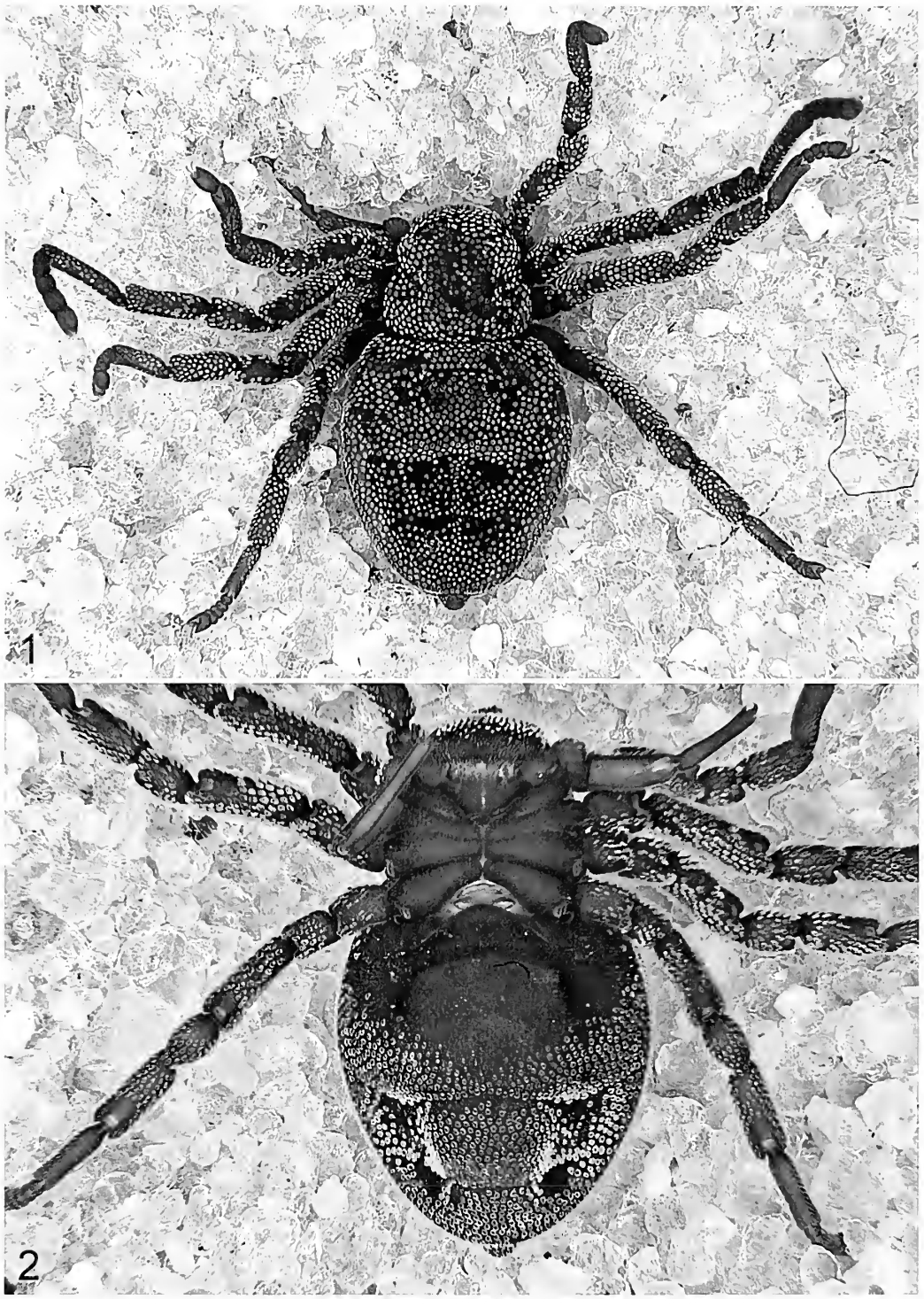
Cryptocellus florezi new species
(Figs. 1, 2, 5–9)

Material examined.—COLOMBIA: *Departamento del Caquetá*: Male holotype and female allotype, taken in association with bat guano in the dark zone, 3 m from the entrance of the sandy, highly humid Cueva "El Indio", elev. 1400 m, 2°44′41″N, 54°23′22″W, 2.7 km from Escuela de la Esperanza, Vereda Cristo Rey-Inspección de Policía Guayabal, Parque Nacional Los Picachos, Municipio San Vicente del Caguán, 2 December 1997, Y. Muñoz S. (ICN Ari-02).

Etymology.—The specific name is a patronym in honor of the Colombian arachnologist, Prof. Eduardo Flórez.

Diagnosis.—In having a body covered with white, scale-like setae (Figs. 1, 2), members of this species resemble those of the Colombian *C. uariuo*, but can easily be distinguished by the lack of deep pits on the cucullus and carapace, the absence of elevated tubercles on the distal half of the palpal tibia, and the unexpanded male metatarsus III. Outside of Colombia, similar white, scale-like setae occur in *C. albosquamatus* Cooke (1967) from Guyana (males of which are unknown, but females differ in having triangular spermathecae, see Platnick & Shadab 1977, fig. 52), *C. adisi* Platnick 1988 from Brazil (males of which have a longer, concave metatarsal process, and females of which have more rotund spermathecae, see Platnick 1988, figs. 1, 5), and *C. lisbethae* González-Sponga 1998 from Venezuela (males of which have a distally concave metatarsal process, see González-Sponga 1998, figs. 9, 11; females are unknown).

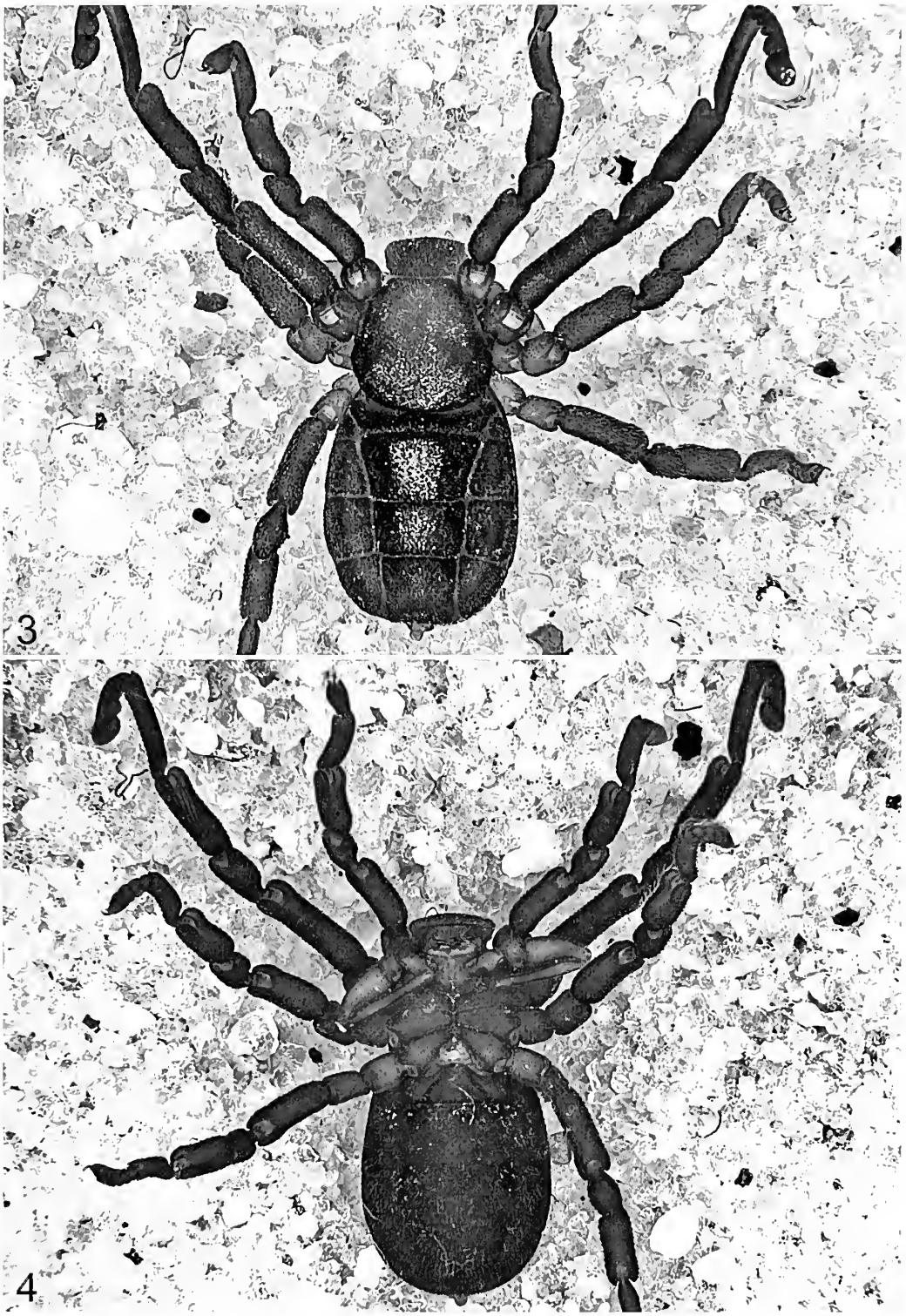
Description.—*Female:* Total length 4.37. Carapace 1.43 long, 1.65 wide near front of coxae III, where widest, reddish orange, darkest posterolaterally, without deep pits; pale ocellar areas obsolete, covered (like most of surface) with white, calyx-shaped, scale-like setae; tiny tubercles (about one-fifth size of scale-like setae) scattered over most of surface; with three depressions: one along midline, one on each side occupying middle one-third of length. Cucullus 0.70 long, 0.95 wide, reddish orange, proximal four-fifths covered with white, calyx-shaped, scale-like setae, distal one fifth with scattered long, white setae and few, subdistal tubercles; lateral lobes only slightly protuberant. Left chelicera: movable finger flattened posteriorly, not widened transversely, armed with nine teeth, fourth and fifth most proximal smaller than others; fixed finger armed with six teeth, most distal one much larger than others. Sternal region with coxae I not meeting tritosternum; coxae II meeting along their posterior halves, their suture line less than half as long as that of coxae III; coxae IV meeting anteriorly. Abdomen 3.04 long, 2.52 wide near rear of tergite 11, where widest, coloration and setation as in carapace except for narrow, dark orange articular membranes; ventral surface with white, calyx-shaped, scale-like setae covering posterior two-thirds of surface, densely packed except on deep, paramedian depressions on sternites 12 and 13; all surfaces with scattered, tiny tubercles; median plates of tergites wider than long, with submarginal depressions occupying middle half of length of



Figures 1, 2.—*Cryptocellus florezi* new species, female holotype: 1. Dorsal view; 2. Ventral view.

tergite 11, anterior two-thirds of length of tergite 12, anterior half of length of tergite 13, depressions with fewer scale-like setae than remainder of surface. Pygidium without notch in posterior dorsal or ventral margin of basal segment. Palpal coxae and trochanters reddish orange, more distal segments orange; second trochanters and femora with white, navicular setae, trochanters and femora with small tubercles, densest on posterior surfaces; coxae with long, white setae, without thickened white setae posteriorly; tibiae with short, stiff setae but without tubercles. Leg formula 2341. Legs reddish orange, tarsi lightest, all segments except coxae and tarsi with white, calyx-shaped, scale-like setae, densest laterally on femora and tibiae, with few, tiny tubercles, without enlargements. Second legs not widened, femur I about three times, femur II about five times as long as wide. Tarsal claws thin, evenly curved. Posterior surface of spermatheeae with ventrally situated duct (Fig. 9).

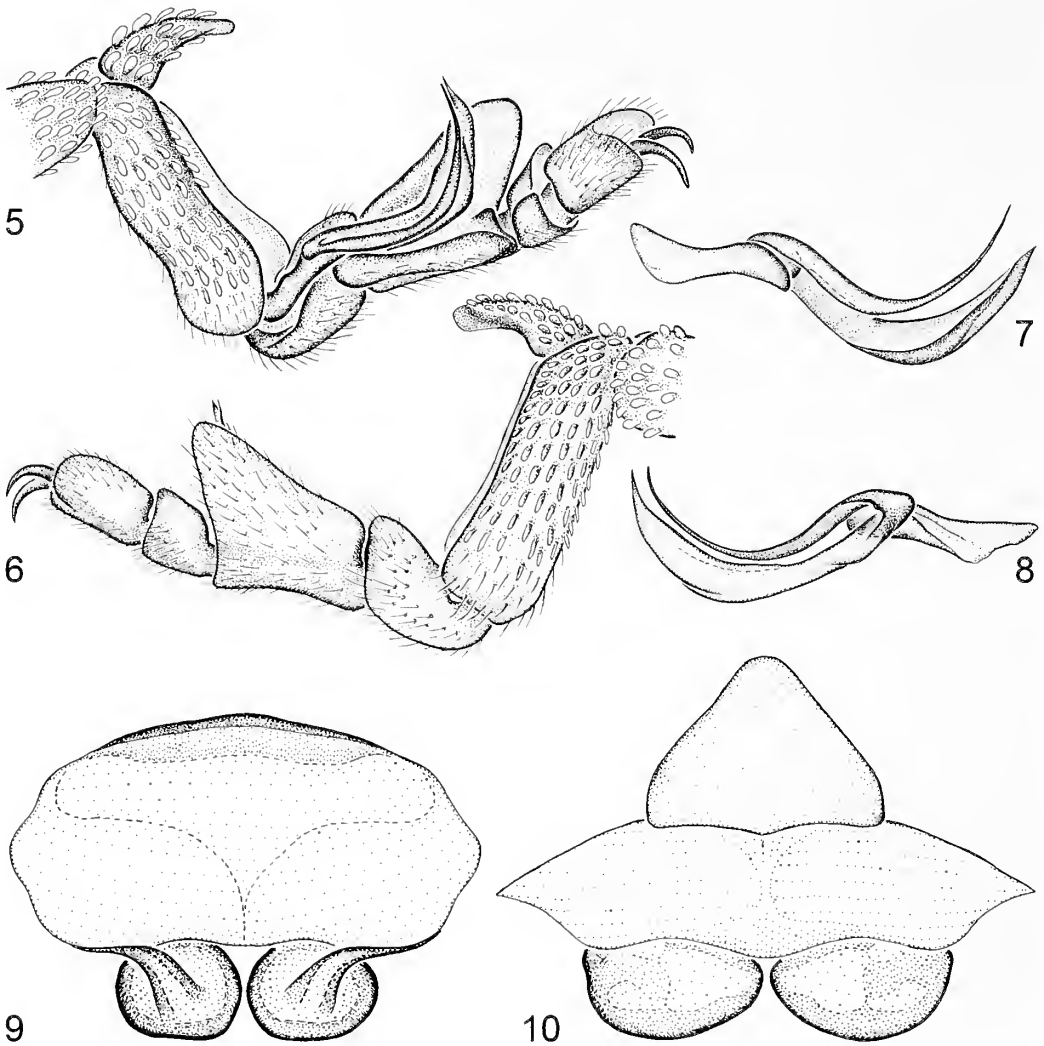
Male: As in female, except for the following. Total length 3.74. Carapace 1.32 long, 1.47 wide, with pale ocellar areas present but diffuse, those areas without scale-like setae. Cucullus 0.70 long, 0.94 wide. Left chelicera: movable finger with eight teeth, third most proximal smaller than others, fixed finger with five teeth. Suture line



Figures 3, 4.—*Cryptocellus peckorum* Platnick & Shadab, female: 3. Dorsal view; 4. Ventral view.

of coxae II as long as that of coxae III. Abdomen 2.44 long, 2.38 wide, depressions on sternites 12 and 13 much shallower than those on female. Leg III: metatarsus not expanded, metatarsal process short, convex (Figs. 5, 6); tarsal process boat-shaped, accessory piece filiform (Figs. 7, 8).

Relationships.—We suspect that this species is most closely related to *C. lisbethae*, rather than to *C. narino*, *C. adisi*, or *C. albosquamatus*, as the white, scale-like setae are typically calyx-shaped, arising from a stalk near the center of the scale, rather than canoe-shaped, arising from a stalk near one end of the scale. Similar scales were reported by Judson & Hardy (2001) on a protonymph from Tobago, and from only near the posterior margin of the carapace in *C. adisi* by Adis et al. (1999), who indicated that the scale-like setae help the animals survive inundations by using plastron respiration. The other white-



Figures 5–10.—*Cryptocellus* species. 5–9. *C. florezi* new species, holotype male, allotype female: 5. Male leg III, anterior view; 6. Male leg III, posterior view; 7. Male copulatory apparatus, anterior view; 8. Male copulatory apparatus, posterior view; 9. Female genital lip and spermathecae, posterior view. 10. *C. peckorum* Platnick & Shadab, female genital lip and spermathecae, posterior view.

scaled Colombian species, *C. narino*, belongs instead to the *C. magnus* group of species from northwestern South America (Platnick & Paz 1979).

Distribution.—Known only from the type locality.

Cryptocellus peckorum Platnick & Shadab
(Figs. 3, 4, 10)

Cryptocellus peckorum Platnick & Shadab 1977:13, figs. 54–57.

Material examined.—COLOMBIA: *Amazonas:* 1♀, Leticia, 7 km via Tarapacá, elev. 220 m, 30 October 2002, G. Amat and students from the Universidad Nacional (ICN Ari-07).

Diagnosis.—Females of this species, described here for the first time, differ from those of *C. florezi* and *C. narino* by lacking white, scale-like setae, from those of *C. narino* and *C. magnus* by lacking deep cuticular pits on the carapace, cucullus, and abdomen, and from those of *C. glenoides* by having shorter, wider spermathecae and a narrower genital lip (Fig. 10).

Description.—*Male:* Described by Platnick & Shadab (1977).

Female: Total length 4.36. Carapace 1.61 long, 1.69 wide near front of coxae III, where widest, reddish orange, darkest posteriorly, without deep pits (Figs. 3, 4); pale ocellar areas obvious, about half as long as coxae II; surface without scale-like setae but with numerous tubercles densely covering most of surface; with only slight depressions: one along midline, one on each side running from midline to rear of coxae II. Cucullus 1.03 long, 1.39 wide, reddish orange, without scale-like setae, surface almost entirely coated with tiny tubercles; lateral lobes only slightly protuberant, anterior margin densely set with long white setae. Left chelicera: movable finger flattened posteriorly, widened transversely, armed with 11 teeth, two most distal much enlarged, fused together for most of their length, fifth, seventh, and eleventh most distal much smaller than others; fixed finger armed with five teeth, most distal one much larger than others. Sternal region with coxae I not meeting tritosternum; coxae II meeting along their posterior three-quarters, their suture line as long as that of coxae III; coxae IV meeting anteriorly. Abdomen 2.95 long, 2.33 wide near middle of tergite II, where widest, coloration and setation as in carapace except for narrow, dark orange articular membranes; dorsal and ventral surfaces without scale-like setae, densely coated with tiny tubercles; median plates of tergites wider than long, with slight submarginal depressions, tergite II greatly elevated anteromedially. Pygidium without notch in posterior dorsal or ventral margin of basal segment. Palpal coxae and trochanters dark orange, more distal segments orange; coxae with few median and posterior tubercles, trochanters with few posterior tubercles; coxae with long, white setae anteriorly, without thickened white setae posteriorly; tibiae with short, stiff setae but without tubercles. Leg formula 2341. Legs reddish orange, tarsi lightest; without scale-like

setae, tiny tubercles scattered on all but ventral surfaces; without enlargements. Second legs slightly widened, femur I about three times, femur II about four times as long as wide. Tarsal claws thin, evenly curved. Spermathecae about twice as wide as long, almost meeting at midline (Fig. 10).

Distribution.—Known only from the area of Leticia in Amazonas, Colombia.

Cryptocellus narino Platnick & Paz

Cryptocellus nariño Platnick & Paz 1979:4, figs. 3–11.

Material examined.—COLOMBIA: *Antioquia*: holotype male, Nariño, Antioquia, Colombia, 23 September 1975, N. Paz (AMNH).

Other material examined: COLOMBIA: *Boyacá:* 1♀, Puerto Boyacá, Inspección Puerto Romero, elev. 650 m, 24 April 2001, R. Diaz, G. Amat (ICN Ari-05). *Tolima:* 1♂, 1♀, Ibagué, Barrio Piedra Pintada, elev. 1200 m, 26 December 1999, L. F. García (AMNH), 1♂, 2♀, same (ICN Ari-04), 1♂, 1♀, same locality, under rocks, 2 August 1999, L. F. García (ICN Ari-03),

Distribution.—This species is now known from three departments (Antioquia, Boyacá, and Tolima) in central Colombia.

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Spiders of the genus *Loxosceles* (Araneae, Sicariidae): a review of biological, medical and psychological aspects regarding envenomations

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Abstract. *Loxosceles* spiders are of concern outside of the arachnologieal world because their bites can cause occasional necrotic skin lesions and/or systemic complications; these manifestations are known as loxoscelism. Once these spiders became well associated as medical entities, much notoriety was attained through the publication of medical case histories as well as tales of horrific wounds in the general literature. Although most *Loxosceles* spider bites are unremarkable, require only general supportive care, and often result in excellent outcome, they are an occasional source of severe dermonecrotic injury with long healing times and significant scarring. In rare cases of systemic loxoscelism, serious intravascular, nephrological and/or multi-organ damage can occur, sometimes resulting in death. However, also of concern is that loxoscelism is diagnosed by medical personnel or presumed by the general public in highly improbable scenarios preventing or delaying proper remedy, which can lead to deleterious outcome. Herein, *Loxosceles* spider biology and medical aspects are reviewed. In particular, an extensive discussion of the distribution of the brown recluse spider, *L. reclusa* Gertsch & Mulaik 1940, is presented along with life history characteristics, which relate to the medical aspects of the genus. Also presented are manifestations and epidemiology of loxoscelism, misdiagnoses of bites by the medical community, alternative diagnoses confused with recluse spider bites and a discussion of the psychological basis for the proliferation of the myth of loxoscelism by both the general public and the medical community. North and South American species are reviewed because this is where the genus predominates and is the region where the most pertinent research has originated.

Keywords: Arachnida, brown recluse spider, dermonecrosis, distribution

There are very few spiders that are well known outside of the arachnological community. Almost all are large and conspicuous (tarantulas, orb weavers), medically important (black widows, Australian funnel web spiders) or medically implicated (hobo spiders). The spiders of the genus *Loxosceles* are ubiquitously infamous throughout the world because of their ability to occasionally cause significant skin necrosis also known as cutaneous loxoscelism.

Loxosceles spiders were not documented in the literature as medically important until the mid-20th century; previously, they were simply typical brown spiders that evoked little concern. In North America, once they were determined to be a public health threat, there was great interest in defining the distribution of the brown recluse spider, *L. reclusa* Gertsch & Mulaik 1940. This was followed by many reports of bites, verified and unverified, in both the medical and popular literature. Unfortunately, there was a parallel accompaniment of misinformation regarding the spider's distribution and its culpability as the etiology of skin lesions. Many advances have been made in medical areas in determining the treatment for loxoscelism, epidemiology of envenomations and the physiological mechanism of dermonecrosis. However, despite the infamy of the brown recluse spider, there was a surprising paucity of biological life history and distribution information after the initial efforts in the 1960s. In recent years, the genus has experienced more attention in biology and toxicology issues, particularly much excellent work by South American researchers with their native species.

The genus is known by the common names of violin, fiddleback, and recluse spiders in North America because of the darkly pigmented pattern on the anterior carapace (Fig. 1) and, in South America, by the rather non-specific name of brown spiders. Frequently, the term *brown recluse spider* is colloquially used for any *Loxosceles* specimen, especially in North America. The brown recluse spider actually refers specifically to one species, *L. reclusa*; here, the genus will be referred to as recluse spiders.

The typical reviews of *Loxosceles* spiders written by medical authors adequately cover the medical aspects of venomous insult to humans but are often understandably deficient in regard to the biology of this rather unique group of spiders. The goal of this review is to provide a biological summary as it relates to the medical aspects of *Loxosceles* spiders for a medical audience but also to assimilate new medical information that would be of value to the arachnological community. Although emphasis will be on the North American *Loxosceles* spiders, in particular *L. reclusa*, information is presented for other *Loxosceles* species found worldwide when relevant.

TAXONOMY

Heinecken and Lowe erected the genus *Loxosceles* for *L. citigrada* (now *rufescens*) from Madeira, Spain (Lowe 1835) although Dufour previously named the species as *Scytodes rufescens* in 1820. The name *Loxosceles* means *slanted legs* due to the way the spider holds its legs at rest (Cameron 2005) (Fig. 2) and is pronounced similar to *isosceles* as in the triangle of equal legs. The genus was originally placed in the family Sicariidae by Simon and has bounced around to the Scytodidae and Loxoscelidae. It was transferred back to the family Sicariidae based on spinneret morphology (Platnick et al. 1991) where it currently resides. The Sicariidae are currently comprised of spiders only from the genera *Loxosceles* (100 species) and *Sicarius* (21 species) (Platnick 2007).

Figure 1.—Brown recluse spider, *Loxosceles reclusa* Gertsch & Mulaik.

They are ecribellate, haplogyne spiders that are rather primitive as is evident by the simplistic genitalia, which makes differentiation among the many species somewhat challenging.

Much of the *Loxosceles* taxonomic activity occurred from 1958 through 1983, in the publication of the revisions by Gertsch (1958, 1967), Gertsch & Ennik (1983) and several of Gertsch's cave spider publications. Of the 100 *Loxosceles* species, 51 are native to North and Central America, 33 to South America with one (*L. rufipes* [Lucas 1834]) shared between the two continents. Gertsch named 70 of the 85 species that are native to the Western Hemisphere. Before Gertsch & Mulaik described *L. reclusa* in 1940, European or South American names were used for the North American fauna. Therefore, one finds a 1929 record of a *L. refescens* [sic] bite in Kansas for a probable *L. reclusa* specimen (Schmaus 1929) and the South American name, *L. unicolor* Keyserling 1887, used for the southwestern American desert dweller, *L. deserta* Gertsch 1973. Gertsch & Mulaik considered the genus name to be masculine and, hence, the brown recluse was initially described as *L. reclusus* (and is sometimes occasionally incorrectly referenced as such in medical journals); later, the species name was changed to the feminine form of *L. reclusa*. The genus name *Loxosceles* is ambiguous as to its gender but was meant to be feminine as used initially by Heinecken & Lowe (Lowe 1835).

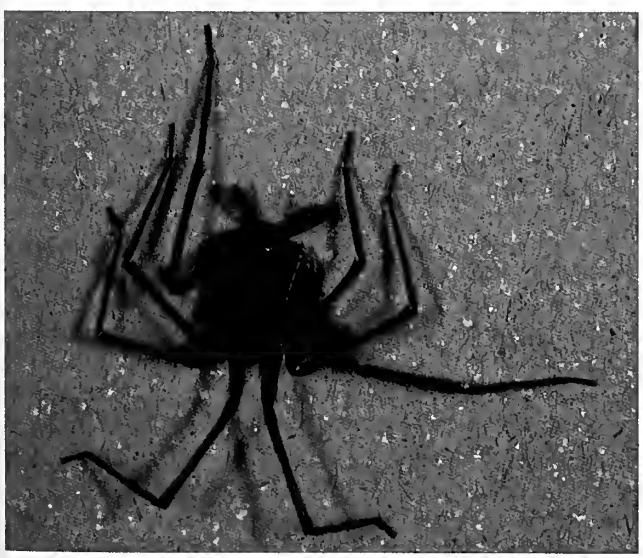

Figure 2.—Male *Loxosceles laeta* (Nicolet) showing the slanted leg position when resting. Note the palpal femora and tibia, which are exceptionally long compared to North American *Loxosceles* species.

DISTRIBUTION

Given the reputation of the brown recluse, it is quite surprising that the distribution information for this spider is so sporadic and poorly documented from state to state. The information that is presented here is a compilation of more than a decade's effort to ferret out the limits of brown recluse distribution in North America. This section will focus mainly on the distribution of *L. reclusa* in North America, as this is the species of greatest concern on the continent. Because *Loxosceles* spiders are synanthropic (i.e., its population increases in association with humans), the actual extent of its native range cannot be readily determined.

The most comprehensive source for North America *Loxosceles* distribution information is the genus revision of Gertsch & Ennik (1983). Their distribution map consists of dots representing collections of *L. reclusa* in North America. As such, a dot in New York may signify one itinerant, transported specimen found in a hotel while a map dot for a location in Kansas represents thousands to millions of *L. reclusa* in a widespread area where populations are consistent,

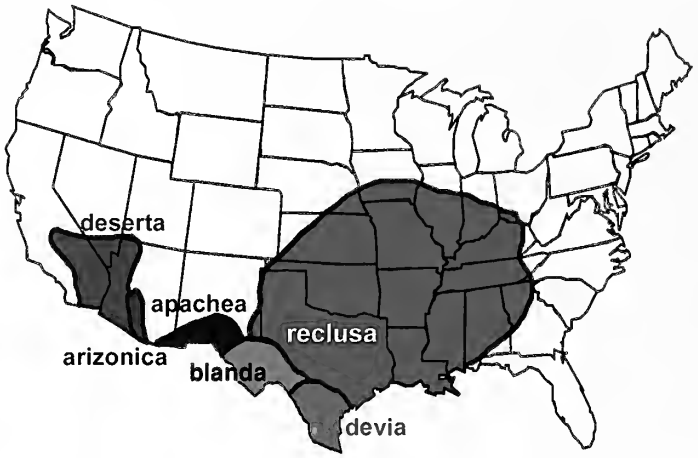

Figure 3.—Map of the distribution of the six *Loxosceles* species with widespread distribution in North America. Populations of *L. reclusa* in the middle of its range are commonly encountered, abundant in number, and reliable in their existence. As one reaches the margins of the distribution, *Loxosceles* spiders become less common and are more difficult to find. The other five species live in areas of the United States with sparse human population so their distribution is less reliable.

reliably found and spiders plentiful. Unfortunately, this non-specificity has been misinterpreted by non-arachnologists who overestimate *Loxosceles* distribution by considering the transported itinerants to define the boundaries of *Loxosceles* distribution. In addition, there are some areas on the map (e.g., the Texas Panhandle) where few collections are known. This could represent a valid scarcity of the spiders or sparse human population with few potential collectors or merely undersampling due to the spider's perceived commonness or some combination of the three factors. Nonetheless, if aware of obvious outliers, the map in Gertsch & Ennik (1983) is an accurate presentation of *L. reclusa* presence in North America. An additional study, which offered to identify any arachnid in the United States thought to be a recluse spider (Vetter 2005), corroborated the distribution as shown in Gertsch & Ennik (1983). However, both of these studies worked on the coarse-grained level of national distribution.

Information is presented below on a state-by-state basis for states on the periphery of *L. reclusa* distribution where populations diminish to non-existence. In the central area of the range (i.e., Arkansas, Missouri), it appears that entire states are infested although no actual publications are known to me that document the brown recluse spider in those states probably due to its ubiquity. The information for all the other states has been gathered from a wide and disparate number of sources including species lists by county, unpublished state maps, minor and arcane publications from state academies of science, agricultural experiment station bulletins, local and non-reviewed museum pamphlets, all corroborated with personal communications with arachnologists, entomologists, public and environmental health officials, poison control centers, and other authorities who might have decades-long oral history information. This is obviously a very mixed bag of resources; however, it is the best that could be assembled given the paucity of published information on such a well-known arachnid.

Starting in the northwestern corner of the *L. reclusa* distribution (Fig. 3), the spider is found in the southeastern corner of Nebraska (Rapp 1980); this information appears rather reliable considering the fine-grained listing by county for species in the state. For Iowa, the only sources known to me are a short publication (Stoaks 1980) and an unpublished map showing a few finds from the middle to southern portion of the state. Rapp (1980) mentions that Nebraska collections were only made in buildings, not in natural settings and Stoaks (1980) mentions the rarity of the spider in central Iowa, both statements of which would be consistent with the diminished density of an organism at the edge of its range. In Illinois, *L. reclusa* is common in the southern two-thirds of the state and found very rarely and unpredictably in the northern portion (north of Peoria) (Cramer & Mayright 2008). A similar story unfolds for Indiana with Indianapolis being about the northern limits. In Ohio, the brown recluse is rare (Oehler 1974; Bradley 2004) being found very sporadically and almost exclusively in the southwestern areas around Cincinnati to Dayton. In Kentucky, *L. reclusa* is common in the western region, decreasing in the central portions and is difficult to document in the eastern areas as one rises up into the Appalachian Mountains. Likewise, brown recluse spiders occur throughout Tennessee except in the extreme eastern counties, being very common in the western counties (Reed 1968; Vail & Watson 2002). There are scattered, isolated records of *Loxosceles* spiders in Virginia and North Carolina, which is indicative of the localized, spot-infestation establishment of transported specimens beyond the natural range of the spider. Similarly in South Carolina, the rarity of *Loxosceles* spiders has caused Frithsen et al. (2007) to posit that *L. reclusa* is non-native there. It is not common and restricted almost exclusively to the northwestern Piedmont geological province of Georgia (Vetter et al. unpubl. data), making this probably the only Atlantic coast state within the actual range of *L. reclusa*. Because of an interesting development, Louisiana, Mississippi, and Alabama will be discussed in the next paragraph. The brown recluse is very common throughout an extensive portion of Texas with other species (*L. devia* Gertsch & Mulaik 1940, *L. blanda* Gertsch & Ennik 1983, *L. apachea* Gertsch & Ennik 1983) replacing it further south and west (Fig. 3). Likewise, *L. reclusa* is extremely abundant in central to eastern Oklahoma and Kansas, however, there are no state publications known to me detailing this distribution. As the brown recluse is not native to Colorado (Vetter et al. 2003), the range terminates somewhere east of the Colorado border.

For Louisiana, Mississippi and Alabama, there are inconsistencies between the published Cooperative Economic Insect Report map of Gorham (1968) and other sources of information. Gorham (1968) shades every county in Mississippi indicating that brown recluses are found throughout the state. Neighboring states (Louisiana and Alabama) show only sporadic parishes or counties, respectively, as having recluses, mostly in the northern half of each state. Correspondence with R. Gorham in 2006 questioned the basis for the 1968 distribution in Mississippi. Simply, one phone call to the University of Mississippi resulted in the Biology chairman stating recluses were found in every county (R. Gorham, pers. comm.). This is no doubt based on the work of Dorris (1967)

who makes this same statement although examination of her field notes (copies provided by Pat Miller) and museum specimens indicates a very incomplete picture. The map of Gorham (1968) then became the basis for the inclusion of the entire Gulf coast area in recent maps in Vetter (2000), Swanson & Vetter (2005) and many publications citing these works. Because of discrepaneies, studies are currently underway to systematically examine the distribution of the brown recluse spider in Mississippi, Alabama and Louisiana. Preliminary data indicate an absence or dearth of *L. reclusa* in the coastal region of the Gulf Coast states, similar to Georgia. Corroborating this, a Texas entomologist communicated that in 25 years, he has had only one brown recluse submitted from the Houston area and to collect significant number of specimens one must travel about 150 km inland (J. Tucker, pers. comm.).

Of the other American *Loxosceles* species, only the five shown in Fig. 3 have significant widespread distributions. However, because these distributions are in the southwestern desert where human population is sparse, these species could have greater range than currently known. Another aspect that limits our knowledge is a behavioral difference: because *L. reclusa* is a synanthropic spider, it is an urban pest, is abundant in homes and, therefore, is frequently collected by non-arachnologists. In contrast, the southwestern *Loxosceles* species appear to be mueh less adapted to human environments and, in domestic situations, are only found in homes that are surrounded by native vegetation. For example, although *L. deserta* is found around Phoenix, AZ and Las Vegas, NV, it is not an urban pest in areas where office buildings, hotels, casinos, and green lawns have arisen in the desert environment. Because *L. reclusa* is a synanthrope, lives where human population density is comparatively greater and has a larger distribution, it is involved in more encounters with humans than other North American species.

Of the medically important *Loxosceles* species in South America, *L. laeta* (Nicolet 1849) has the greatest distribution, being found in Brazil, Uruguay, Argentina, Chile, Peru, and Ecuador (Gertsch 1967). Others include *L. intermedia* Mello-Leitão 1934 (Brazil, Argentina) and *L. gaucho* Gertsch 1967 (southern Brazil) (Gertsch 1967). From South Africa, *L. parrami* Newlands 1981 was reported as medically important (Newlands et al. 1982).

The Mediterranean recluse, *L. rufescens* (Dufour 1820), is a worldwide tramp, originating from the circum-Mediterranean region. It has been collected in many localities in the United States (e.g., Boston, MA; New York City, NY; Philadelphia, PA; Harrisburg, PA; Reading, PA; Washington DC; Ann Arbor, MI; Indianapolis, IN; Knoxville, TN; Jacksonville, FL; Baton Rouge, LA; several localities in Ohio and Georgia; Las Animas, CO; Los Angeles and Fresno, CA; Spokane, WA [Gertsch & Ennik 1983; Vetter unpubl. data]). In nonendemic *Loxosceles* areas in North America, it is more likely to find a spot infestation of the non-native *L. rufescens* than the native *L. reclusa*. The Mediterranean recluse has also become established in Australia (Southeott 1976). Gertsch (1967) states that there are no valid specimens of *L. rufescens* from South America. While others have described this species as cosmopolitan, Gertsch (1967) states that this is a misnomer. Although *L. rufescens* exists in many localities, in non-endemic areas it is typically found only indoors and in highly circumscribed distribution, heavily infesting one building or several if interconnected by conduits.

LIFE HISTORY AND BIOLOGY RELEVANT TO MEDICAL ISSUES

After *Loxosceles* spiders became a medical entity, they were the subjeets of biological and medical articles as researchers rushed to provide information on this new public health threat. Below is a review of the biological traits as they relate to the features that do or do not show a potential as a public health concern.

Longevity, fecundity and resistance to starvation.—*Loxosceles* spiders have long life spans compared to many seasonal entelegynes, which pass through a life cycle in < 1 yr. Hite et al. (1966) provide a longevity for *L. reclusa* of 1.5 yr for males and 1.7 yr for females with a maximum of 2.5 yr for one female when animals were maintained in the lab. They mention that life spans would probably have been longer had they been subjected to winter temperatures. Indeed, Horner & Stewart (1967) maintained their animals in winter refuges to provide a more natural scenario; their spiders survived over 5 seasons (spiders were still alive at the time of publication). Elzinga (1977) reports average life spans for *L. reclusa* males (897 da) and females (794 da) with 25% of the females living over 1,000 da, including one surviving 4.8 yr. Lowrie (1980) reared *L. laeta* under sporadic feeding conditions (initially weekly, then once every 3 to 10 mo, then starved to death); these spiders took an average of 2.1 yr to mature and lived another 4.8 yr as adults. Similarly, Fischer & Vasconcellos-Neto (2005a) report longevities of 1176 ± 478 da for *L. intermedia* females and 557 ± 87 da for males. However, these quantities are for captive animals confined to vials, not exposed to detrimental environmental factors, and, hence, might grossly overestimate the life span in natural or synanthropic settings.

Compared to many other common spiders, which produce hundreds to thousands of eggs per egg sac or over a lifetime, *Loxosceles* spiders have a more modest fecundity. Female *L. reclusa* average 50 eggs per egg sac (range 0 to 91, $n = 146$), and 2.7 egg sacs per female with a 48% hatch rate ($n = 55$) (Hite et al. 1966). For laboratory-reared *L. intermedia* restricted to one mating, egg sacs contained approximately 30 eggs where 70% hatched, however, the egg sacs of field-collected females of unknown mating history averaged around 50 eggs with 80% hatch (Fischer & Vasconcellos-Neto 2005b). When kept without access to additional matings, female *L. reclusa* (Horner & Stewart 1967) and lab-reared, singularly-mated *L. intermedia* females (Fischer & Vasconcellos-Neto 2005b) experience a decrease in fecundity per sac and/or egg viability with successive egg sacs throughout a season. For *L. reclusa* from figure 5 of Horner & Stewart (1967), from the 1st to 3rd egg sac, there is a drop in egg number per sac from about 27 to 18 and decrease of hatch rate from 66% to 37%. Field-collected *L. intermedia* females of unknown mating history did not show this decline (Fischer & Vasconcellos-Neto 2005b). Similar fecundity numbers are presented for other species: *L. laeta* – mean of 88.4 eggs per sac (range 22 to 138, $n = 81$) (Galiano 1967), *L. gaucho* – mean of 61.3 eggs per sac (range 25 to 117, $n = 78$) (Rinaldi et al. 1997) and *L.*

hirsuta Mello-Leitão 1931– mean of 33.7 eggs per sac with 93% hatch (n = 113) (Fischer & da Silva 2001).

Loxosceles are well known for surviving long periods of time without food. This is no doubt due in part to a slow metabolism; compared to similar-sized spiders, *L. reclusa* spiders have a low heart rate on the level of theraphosids (Carrel & Heathcote 1976). Eskafi et al. (1977) purposely starved field-collected *L. reclusa* at different temperatures and relative humidities. Spiders at 5° C survived 4 to 7 mo whereas this dropped to 1 to 2 mo at 30° C and less than 2 wk at 40° C. Lowrie (1980) starved mature *L. laeta,* which took an average of 1.2 yr to succumb.

Dispersal capability.—Recluse spiders do not have a great propensity for dispersal on their own accord. Ballooning is a well-known dispersal mechanism for small spiders, typically as early instars, allowing them to transport themselves miles from their take-off point, carried on uplifting air currents. However, recluse spiders are haplogynes; haplogynes do not balloon (Beatty 1970). In the infestation of *L. laeta* in southern California in the 1960s, although spiders were indeed found in many buildings, razing of an infested building eliminated the population, which did not reinfest the new building constructed on the site (Waldron 1969).

Tolerance of conspecifics and population size in human structures.—*Loxosceles* spiders can be found in very high density in synanthropic situations. A Kansas family collected 2,055 *L. reclusa* spiders in their home in 6 mo (Vetter & Barger 2002) and a survey in Kansas showed that 22 of 25 homes had *L. reclusa* with an average of 83.5 ± 114.9 spiders per home (range 1 to 526) (Sandidge 2004). In a Chilean survey, 29% of the homes were infested with *L. laeta* spiders with the five highest-infested rural homes averaging 163 ± 56 specimens (Schenone et al. 1970). In an Oklahoma barn, a team of arachnologists collected 1,150 brown recluses in three consecutive nights with little diminishing of the numbers although the size of the spiders decreased slightly as the collection progressed (C. Shillington, pers. comm.). Recluses are not social spiders in the sense of sharing webs, prey capture and defense such as *Metepeira* and other social or cooperative spiders (Uetz & Hieber 1997) but rather there is species-recognition that either reduces aggressive interactions and/or allows escape to a safe distance to avoid predation such as exists for *L. gaucho* in female-female (Stropa & Rinaldi 2001) and male-male interactions (Stropa 2007). Dozens of *Loxosceles* spiderlings of the same species can be reared in close quarters in a single jar with minimal cannibalism as long as there is adequate prey to eat and crevices in which to hide (Vetter & Rust 2008).

Heat and cold tolerance.—The upper and lower limits for temperature tolerance appear unremarkable. Hite et al. (1966) report that the activity limits of *L. reclusa* are 4.5° to 43° C. With 4-h exposures, there was 47% mortality for *L. reclusa* at −7° C and −10° C; with 30-da exposure all spiders survived at 0° C but none at −5° C (Cramer & Mayright 2008). With 1-h exposures at constant temperatures, Fischer & Vasconcellos-Neto (2003) report an upper LT_{50} (lethal temperatures for 50% of subjects) for *L. intermedia* (35° C) and *L. laeta* (32° C); the lower LT_{50} was −7° C for both species.

Hunting behavior and hiding places.—*Loxosceles* spiders are active hunters that do not make webs for prey capture in the typical spider sense. They will extend lines of silk from a retreat to opportunistieally alert them to the presence of entangled prey. Although recluse spiders are ecribellates, their silk is dry and shares several characteristics of cribellate silk (Knight & Vollrath 2002); hence, prey capture is via entanglement not adhesion.

Loxosceles spiders are reclusive as their name implies and have a predilection for crevices and other tight locations. In nature, *Loxosceles* spiders can be found under rocks and the loose bark of dead trees. In synanthropic environments, recluse spiders are found in cardboard boxes especially under folded flaps, in cupboards, behind bookcases and dressers, in trash, under broken concrete and asphalt and, of medical concern, in shoes and clothes left out on the floor or stored in closets and garages. In South America, *Loxosceles* spiders are known by the common names of *araña de detrás de los cuadros* (spider behind the picture) and *araña de los rincones* (spider in the corner) (Schenone et al. 1970). There is a propensity for *L. laeta* and *L. intermedia* to be found frequently in association with rough surfaces such as cardboard, construction material, wood and cloth and less so with smooth surfaces such as metal and ceramic (Fischer & Vasconcellos-Neto 2005c). Additionally, Fischer & Vasconcellos-Neto (2005c) remark that these spiders are almost absent from natural areas immediately surrounding the infested buildings where they were collected.

Summary of *Loxosceles* life history characters as they relate to public health.—Considering the biological information above, *Loxosceles* spiders present a mixed complement of characteristics that would both encourage and discourage their importance as a public health threat. The aspeets of long life, resistance to starvation and propensity to seek refuge in cardboard boxes would translate into a spider that could be well adapted to survival during accidental transport by humans allowing proliferation of a viable breeding population in a new area. However, this point is an overused bromide frequently espoused in the medical literature regarding the detrimental potential for *Loxosceles* dispersal throughout North America. Rarely do these authors provide corroborative evidence that this actually happens (Vetter & Bush 2002a). Although recluse spiders obviously can be found outside their endemic range, they still are quite rare and are not nearly as common as perceived by the medical community and general public (Vetter 2005).

Loxosceles spider fecundity is in the lower part of the spectrum compared to several spiders but definitely would cluster with other hunting spiders of similar size (J.F. Anderson 1990) so there is nothing remarkable about this life history characteristic. However, one aspect that reduces the potential for *Loxosceles* establishment outside endemic areas is that egg number and fecundity diminishes with successive egg sacs when re-mating is prevented. This is most likely explained by the difference of haplogyne and entelegyne reproductive biology. With entelegynes, the first male to mate fertilizes the majority of eggs and female spiders can store viable sperm for months (Elgar 1998). For example, the entelegyne western black widow spider, *Latrodectus hesperus* Chamberlin & Ivie 1935 produced 10+ egg sacs in captivity over a period of a year without re-mating, with many having > 300 eggs per sac and fertility reaching around 80 to 90% for the last egg sacs (Kaston 1970). In contrast, the haplogyne

recluses with last male sperm priority may require matings between egg sacs to maintain fertility. Therefore, unless a transported *Loxosceles* female has recently mated, her potential for producing viable egg sacs with high hatch rate is low.

Because of their inability to balloon, *Loxosceles* spiders are not well adapted to disperse from an infestation point. In nonendemic areas, they may develop large populations within one structure but they will not easily spread from that focal point as have many non-native, invasive entelegynes, which have established themselves over large portions of North America. In this respect, *Loxosceles* spiders are almost reliant upon humans for transport over large distances. Therefore, despite the dire concerns of some personal communications from the lay public to the author regarding the spread of *Loxosceles* spiders due to global warming, this does not appear to be a likely issue of immediate concern.

Loxosceles spiders develop large populations in synanthropic environments in endemic areas; if an infestation exists, multiple specimens of *Loxosceles* spiders should be available for collection. Therefore, outside of nonendemic *Loxosceles* areas, the finding of a single recluse specimen should be treated as a spot infestation of one, transported immigrant and, when preserved in alcohol, the threat of loxoscelism (and its typical requisite hyperbole and overreaction) should be a moot point. In northern climates, spiders would readily survive indoors but will perish outside with low winter temperatures. However, in structures infested with reeluse spiders, precautions can minimize the probability of envenomation (i.e., clean up clutter, move beds away from the wall, remove bed skirts or ruffles, do not use the underside of the bed for storage, shake out clothes and shoes before dressing).

MEDICAL ASPECTS OF LOXOSCELISM

The first North American associations of spiders with necrotic skin lesions occurred in the 19th century in Texas (Caveness 1872; Wilson 1893) then later in Kansas (Schmaus 1929). In South America, there were many circumstantial associations of skin lesions and *Loxosceles* spiders in the early part of the 20th century (Macchiavello 1947). In 1947, this association was proven in South America (Macchiavello 1947); in North America, this was confirmed a decade later (Atkins et al. 1957). After that, an explosion of reports spread the word about the newly implicated *Loxosceles* spiders as dermonecrotic agents.

The ability of *Loxosceles* spiders to cause signifieant skin injury has been and will continue to be reviewed extensively in the medical literature. Because this topic is more than well covered in medical and toxicology journals, only a brief review will be presented here; interested readers are encouraged to seek out da Silva et al. (2004), Hogan et al. (2004), Swanson & Vetter (2005, 2006), Wasserman & Lowry (2005), Pauli et al. (2006). Patel et al. (1994) and Wasserman & Lowry (2005) review the underlying physiological mechanisms of dermonecrosis. Pauli et al. (2006) review the many controversial aspects of *Loxosceles* antivenom application and present an extensive data-rich epidemiological comparison among studies.

There are four categories of *Loxosceles* bites:

- Unremarkable (very little damage, self-healing)
- Mild reaction (redness, itching, slight lesion but typically self-healing)
- Dermonecrotic (necrotic skin lesion considered by many the typical reaction)
- Systemic or viscerocutaneous (affect vascular system, very rare, potentially fatal)

One point that should be kept in mind is that most *Loxosceles* bites do not result in serious skin lesions, are typically self-healing without medical intervention and do not result in scarring; regular supportive care is typically sufficient with excellent outcome (Wright et al. 1997; Anderson 1998; Cacy & Mold 1999). Of patients developing necrotic lesions, about two-thirds heal without complications (Pauli et al. 2006). The more extreme manifestations of venom injury generate concern and publication of medical reports and, hence, skew the perception of the severity of the average loxoscelism event. Nonetheless, in the most severe manifestations, loxoseelism lesions can grow to 40 cm in size, healing can take several months and leave a disfiguring scar. Cutaneous loxoscelism damage is greater in obese victims (e.g., Masters 1998) because the venom enzymes readily destroy poorly vascularized adipose tissue. There can be gravitational spread of the lesion. Rare systemic manifestations can be serious and potentially life threatening (especially in children). Typically, *Loxosceles* spiders bite for defensive purposes and the resulting injury is a single focal lesion. Bites frequently occur when the spider is compressed against exposed flesh, typieally while a person is sleeping or getting dressed.

Most of the following paragraph is summarized from Wasserman & Lowry (2005) and comments made by Wasserman in reviewing this manuscript. In dermonecrotic lesions, *Loxosceles* venom causes an immediate vascular constriction at the bite site. Within 3 hours, polymorphonuclear leukocytes infiltrate the envenomation site. At 6 hours, dermal edema initiates. Itching develops along with inflammation and ischemia (local and temporary blood supply deficiency due to obstruction) at the bite site, which becomes painful and tender to the touch. For bites that become significant, there may be a characteristic bleb or blister, varying from flesh-colored to purple/black. Within a few hours to days, an eschar (hardened ulcer) may form, which eventually sloughs off, exposing soft tissue, which may take several months to heal. Within the first days, there also may be a characteristic bull's-eye lesion (blue center at the bite surrounded by a white ring of reduced blood circulation surrounded by a red ring of erythematous tissue although sometimes may exhibit more purplish hues or a necrotic center). Physicians consider this a classic sign of cutaneous loxoscelism but this also occurs in Lyme borreliosis (Osterhoudt et al. 2002) so hasty diagnosis in Lyme disease prevalent areas should be of concern. There is no current clinically available bioassay for loxoscelism detection (da Silva et al. 2004) although an experimental bioassay does exist (Gomez et al. 2002).

Necrosis is caused by a rare enzyme, sphingomyelinase D (SMD), ranging in molecular weight from 32 to 35 kDA depending upon the species and is found only in spiders (*Loxosceles*, *Sicarius*) and a few pathogenic bacteria (e.g., *Corynebacteria*) (Binford et al. 2005). It has been present in all *Loxosceles* spiders tested so far (Binford & Wells 2003). In *L.*

intermedia, SMD is absent in eggs and 1st and 2nd instar spiderlings, is first detectable in 3rd instars and increases in quantity as the spiders increase in size (Andrade et al. 1999). Of experimental interest, one must be careful in extrapolating from the response of test animals to that of humans. *Loxosceles* venom eauses dermonecrosis in humans, rabbits, and guinea pigs but not rats or mice (da Silva et al. 2004) Compared to humans, rabbits heal faster and do not develop chronic necrosis (Pauli et al. 2006). Recent research suggests that instead of one compound, the dermonecrotic factors may be a family of different toxin isoforms working synergistically (Ribeiro et al. 2007).

In rare systemic reactions (<1% of the cases of suspected *L. reclusa* bites [Anderson 1998] with higher incidence in South American loxoscelism), recluse venom may cause events such as hemolysis, disseminated intravascular coagulation (i.e., mini-clots throughout the vascular system) and sepsis, which can lead to serious injury and possibly death (Wasserman et al. 1999; Wasserman & Lowry 2005). Hemolysis is mediated by disruption of red blood cell membranes by SMD leading to free hemoglobin in the blood and the passing of dark urine; rhabdomyolysis from local tissue damage may also contribute to renal failure (Hogan et al. 2004). There is evidence for direct nephrotoxicity of *Loxosceles* venom components (Chaim et al. 2006). Renal damage typically is exhibited in small children. Anderson (1998) remarked, however, that with supportive hydration and dialysis, outcome was excellent.

Treatment for loxoscelism is controversial. Many remedies such as the anti-leprosy drug dapsone, hyperbaric oxygen, nitroglycerin patches, and even electroshock therapy have been proffered as effective eutaneous loxoscelism treatments (Swanson & Vetter 2005). However, the lack of a control group in all of these studies in concert with the self-healing nature of many loxoscelism lesions and the use of presumptive loxoscelism victims who may have had non-arachnid etiologies precludes definitive assessment of efficacy. Additionally, dapsone has detrimental side effects (Hogan et al. 2004; Swanson & Vetter 2005) and has recently been shown to be ineffective for experimental dermal loxoscelism (Elston et al. 2005). A common recommendation for most non-necrotic loxoscelism lesions is simple RICE (rest, ice, compression, elevation) therapy although alternate therapy recommends a relaxed neutral position instead of elevation and cool compresses instead of ice, the latter of which may cause its own detrimental effects. In the 1960s, early excision of damaged tissue was routinely advocated but now is only recommended for severely necrotic lesions and then, not until the borders of the wound have ceased spreading and are well defined; early excision can lead to delayed wound healing, increased infection, worsened scarring and disability (Anderson 1998; Wasserman & Lowry 2005). Also, with pyoderma gangrenosum, a condition sometimes misdiagnosed as cutaneous loxoscelism, removal of tissue increases injury via pathergy (Chow & Ho 1996); therefore, improper debridement in this case could be highly detrimental. In North America, antibiotics are often given to prevent secondary infection from the patient's endogenous bacterial fauna; recluse bites are generally aseptic for the first few days post-bite (Wasserman & Lowry 2005). In South America, antibiotics are not routinely given because secondary infeetion is uncommon; antivenom is frequently used to counter loxoscelism although its efficacy is controversial (Pauli et al. 2006). Antivenom is not commercially available in North America (Hogan et al. 2004). Some authors have argued that antivenom is most effective during the first 24 hour post-bite but most patients do not seek treatment until after the first day as the wound worsens. Nonetheless, Pauli et al. (2006) report that there is benefit to using it up to 72 h in that dermonecrosis may still develop but lesion size is smaller and healing time shorter. Barbaro et al. (2005) show high cross-reactivity among five *Loxosceles* venoms (three South American and two North American species) indicating the potential for a single global *Loxosceles* antivenom. A recent novel avenue of therapy involves topical application of tetracycline which reduced the progression of lesion formation in rabbits whereas oral administration was ineffective (Paixão-Cavalante et al. 2007); further research will be necessary to determine if this has therapeutic utility for envenomations in humans.

Wright et al. (1997) present information on 111 Tennessee patients with verified and presumed brown recluse spider bites; of these, 37% exhibited necrotic lesions and 2.7% required grafting. Cacy & Mold (1999) report the results of an Oklahoma physician survey with 149 presumptive loxoscelism patients; 40% exhibiting necrosis, 13% resulting in scarring and the average lesion healed in 2 wk. Sams et al. (2001) present 19 verified *L. reclusa* envenomations where 11 patients developed necrotic lesions (6 of which were larger than 1 cm^2) but none developed a chronic non-healing lesion. Eight, five and six patients had mild, moderate and severe lesions, respectively, with average healing times of 8, 22 and 74 da, respectively. No deaths were reported in these three studies.

In South America, Málaque et al. (2002) describe a Brazilian study of 359 presumptive and verified cases of loxoscelism with 53% of patients developing necrosis, 4% healed with scarring, 4% developed systemic loxoscelism and no deaths. Of the spiders brought in by patients that could be identified, most were *L. gaucho* with a few *L. laeta*. In Chile, Schenone et al. (1989) deseribe results of 216 loxoscelism events: 34 patients developed systemic loxoscelism with eight dying. The spider involved in Chile was *L. laeta*, eonsidered to have the most virulent bite of known recluse spiders (Wasserman & Lowry 2005); this may be due, in part, to it being the largest of all *Loxosceles* spiders.

Of other species, in the southwestern American deserts, *L. deserta* has been involved in verified envenomations with effect (Russell et al. 1969). In Israel, *L. rufescens* was blamed for an outbreak of skin lesions in orchard workers (Borkan et al. 1995) although association was mostly presumptive and some cases of persons with multiple episodes of lesions seem somewhat suspeet as valid loxoseelism.

Yet the risk of a *Loxosceles* spider bite is small even in heavily infested structures. Schenone et al. (1970) mentions collecting 5,449 *L. laeta* from 645 Chilean homes and "no cases of loxoscelism were registered." Similarly, in the Kansas home where 2,055 *L. reclusa* were collected in 6 mo, no one in the family of four had sustained a perceptible loxoscelism event in the 6 years of occupancy at the time of the study (Vetter & Barger 2002). However, at the 11-yr mark, the mother was bitten on the finger while reaching into laundry and shook a brown recluse from a shirt sleeve; the finger

turned red and swelled slightly but healed without incident (D. Barger, pers. comm.).

OVERDIAGNOSIS OF SPIDER BITES

In North America, once the brown recluse spider became known as a spider of medical importance, the medical aspeets were vigorously researched and reported. In the 1960s, case histories appeared in medical journals and new county and state records were documented in the USDA's weekly Cooperative Economic Insect Report as the brown recluse spider became well known outside of the arachnological community. Reports of brown recluse spider bites were common in the local media and in national magazines. As much as *Loxosceles* spiders are a legitimate public health threat, of equal concern is the overdiagnosis of loxoscelism as a common etiology for skin lesions.

Over the decades, the diagnoses of cutaneous loxoscelism became commonplace in the North Ameriean medical community. Although the majority of the reports emanated from endemic *Loxosceles* regions such as Tennessee and Oklahoma (Wright et al. 1997; Cacy & Mold 1999), additional reports of alleged bites (without evidence of a *Loxosceles* spider) were made in places such as Montana (Lee et al. 1969), Colorado (Mara & Myers 1977) and Canada (several references in Bennett & Vetter 2004). The belief of the existence of *Loxosceles* spiders as legitimate and common causes of dermonecrotic lesions was widespread and became deeply entrenched in the medical community, which diagnosed bites, the media which reported this unique and sound-bite friendly health threat, and the general public who readily believed both entities as trusted sources of knowledge. In contrast, then and now, arachnologists in non-endemic *Loxosceles* areas familiar with the local spider fauna and who were aware that *Loxosceles* spiders were either completely absent or extremely rare, tried to correct these misconceptions, but were often met with vehement resistance and unequivocal disbelief.

In the 1980s, Dr. Phillip Anderson (University of Missouri dermatologist specializing in loxoscelism treatment) and Dr. Findlay Russell (southern California physician, medical toxicologist, and one of the world's foremost authorities on animal venoms and plant toxins) attempted to alert the medical community to the errors of their ways in regard to jumping so vigorously on the brown recluse spider bite bandwagon (Anderson 1982; Russell & Gertsch 1983; Russell 1986). Russell & Gertsch (1983) state that of approximately 600 eases seen by them, 80% of the alleged spider bite eases were caused by other arthropods or other disease states. Russell (1986) further stated that 60% of his loxoscelism consultations emanated from areas lacking *Loxosceles* spiders. Other authors also chimed in (e.g., Kunkel 1985); however, by and large, this message was forgotten or trampled under as medical personnel continued to rely heavily on *Loxosceles* spiders as common etiologies to explain idiopathic lesions (i.e., lesions with unknown causative agents). This message was left idle until the early 21st century when editorials (e.g., Vetter 2000; Vetter & Bush 2002a,b; Bennett & Vetter 2004) and the research papers mentioned below were produced to counter the *Loxosceles* misinformation.

Because it is impossible to prove a negative (i.e., that no *Loxosceles* spiders live in the area), a different tack was taken. The belief in the ubiquity of *Loxosceles* spiders in an area was based almost solely on the number of incidents of skin lesions attributed to *Loxosceles* spiders. Therefore, a contradictory argument was presented: if the great number of skin lesions in a specific geographic area were truly caused by *Loxosceles* spiders, then the spiders should be readily collected and verified in the area, both historically and contemporaneously. Using as much taxonomic information as was available (museum and personal arachnological collections, correspondence with municipal agencies that receive spiders for identification [e.g., state diagnostic clinics, departments of public and environmental health, department of food and agriculture]) and comparing it to the number of alleged incidents of *Loxosceles* envenomation (e.g., published report or tallies of physician loxoscelism diagnoses, poison control center data bases, physician questionnaire responses), in nonendemic *Loxosceles* regions of North America, the number of loxoscelism diagnoses always outnumbered the verified number of *Loxosceles* spiders for such areas as Colorado and the Pacific coast states (Vetter et al. 2003), Florida (Vetter et al. 2004), Canada (Bennett & Vetter 2004), South Carolina (Frithsen et al. 2007) and Pennsylvania (Vetter et al. unpubl. data). The South Carolina paper was rather spectacular as it was based on two physician questionnaires in 1990 and 2004 where over 1,200 loxoscelism diagnoses were reported by primary care physicians in just those 2 years for the state which had, historically, only 6 disjunct localities producing a total of 45 *Loxosceles* spiders. When one considers that in endemic areas one can find great quantities of *Loxosceles* spiders in homes (Schenone et al. 1970; Vetter & Barger 2002; Sandidge 2004), mostly without loxoscelism in any occupant, it should be obvious that much misdiagnosis is occurring. These 1,216 diagnoses also represented a fraction of the actual number of South Carolina loxoscelism diagnoses because the survey response rate was only 42% in 1990 and 19% in 2004 and did not include dermatologists or emergency room physicians. These papers have been instrumental in helping to overturn the dogged resistance that the entrenched myths surrounding loxoscelism create, causing other dermonecrotic agents, which are far more likely, to be considered.

MISDIAGNOSES BY PHYSICIANS AND A LIST OF DIFFERENTIAL DIAGNOSES

Unfortunately, in the early years as well as now, physicians published unconfirmed bite cases, which confused and erroneously inflated the body of loxoscelism symptomology by reporting manifestations from a raft of non-arachnid medical conditions. Loxoscelism dermatologist Philip Anderson stated, "Because the well-accepted rules of evidence have been ignored, a large part of the total clinical literature on loxoscelism is invalid" (P. C. Anderson 1990). It has been suggested that editors require authors to distinguish between proven and presumptive loxoscelism reports in order to provide a more accurate basis for the information in the medical literature (such as found in de Souza et al. 2008) and that loxoscelism diagnoses without proof of an envenoming spider are best restricted to endemic *Loxosceles* regions (Anderson 1982; Vetter & Bush 2002a,b, 2004). Laack et al. (2007) provides a notable exception by documenting a verified bite by a *Loxosceles* spider transported to Minnesota.

Table 1.—A list of medical conditions that have been or could be misdiagnosed as cutaneous loxoscelism. Modified from Swanson & Vetter (2005).

Infections
Atypical mycobacteria
Bacterial
- *Streptococcus*
- *Staphylococcus* (especially MRSA)
- Lyme borreliosis
- Cutaneous anthrax
- Syphilis
- Gonococcemia
- Ricketsial disease
- Tularemia
Deep Fungal
- Sporotrichosis
- Aspergillosis
- Cryptococcosis
Ecthyma gangrenosum (*Pseudomonas aeruginosa*)
Parasitic (Leishmaniasis)
Viral (herpes simplex, herpes zoster (shingles))
Vascular occlusive or venous disease
Antiphospholipid-antibody syndrome
Livedoid vasculopathy
Small-vessel occlusive arterial disease
Venous statis ulcer
Necrotising vasculitis
Leukocytoclastic vaculitis
Polyarteritis nodosa
Takayasu's arteritis
Wegeners granulomatosis
Neoplastic disease
Leukemia cutis
Lymphoma (e.g., mycosis fungoides)
Primary skin neoplasms (basal cell carcinoma, malignant melanoma, squamous cell carcinoma)
Lymphomatoid papulosis
Topical and Exogenous Causes
Burns (chemical, thermal)
Toxic plant dermatitis (poison ivy, poison oak)
Factitious injury (i.e., self-induced)
Pressure ulcers (i.e., bed sores)
Other arthropod bites
Radiotherapy
Other Conditions
Calcific uremic arteriolopathy
Cryoglobulinemia
Diabetic ulcer
Langerhans'-cell histiocytosis
Pemphigus vegetans
Pyoderma gangrenosum
Septic embolism

There are many medical maladies that manifest in necrotic skin lesions but, unfortunately, the well-known deleterious effect of cutaneous loxoscelism causes this condition to be diagnosed far more often than it should. Russell & Gertsch (1983) initiated a list of dermonecrotic etiologies, which were or could be mistaken for cutaneous loxoscelism; additional authors are still adding to this list (Table 1). Some of the reported misdiagnoses include Lyme borreliosis (Osterhoudt et al. 2002), chemical burn (Vetter & Bush 2002c), anthrax (Roche et al. 2001), and *Staphylococcus* infection (Dominguez 2004).

One of the most important developments in medical arachnology in the last decade is the emergence of a bacterial infection (methicillin-resistant *Staphylococcus aureus* [MRSA]) as a major etiology of skin and soft tissue injury and the recognition of this infection as a frequent misdiagnosis for spider bite in general (Dominguez 2004; Miller & Spellberg 2004; Moran et al. 2006; Vetter et al. 2006; Cohen 2007) and brown recluse bite in particular (Dominguez 2004). This confusion is caused in part because the general public, who lack sufficient experience to accurately assess their injuries, use "spider bite" as the common explanation for idiopathic skin lesions (Miller & Spellberg 2004); of 248 patients who had MRSA, 29% presented to physicians with complaint of spider bites (Moran et al. 2006). MRSA awareness is receiving broad dissemination as it is reported routinely in the general media. It is a bacterial infection, which has developed genetic resistance to many broad-spectrum antibiotics. It is considered originally of nosocomial origin (i.e., from hospitals) and, due to its exposure to many antibiotics, it is quite pernicious. Common risk factors among patients with MRSA include histories of hospitalization or surgery or long-term care residence (Klevens et al. 2007). Another strain, community-acquired MRSA (CA-MRSA), manifests in people who do not have exposure to hospital settings but is common where people are housed in high density for long periods of time such as in prisons, nursing homes, long-term health care facilities, collegiate and professional sports locker rooms, and military barracks (Dominguez 2004; Vetter et al. 2006; Cohen 2007). MRSA is resistant to β-lactam antibiotics such as oral cephalexin; currently, MRSA is treated with antibiotics such as bactrim (trimethaprim-sulfamethoxazole), rifampin, doxycycline, and clindamycin (Benoit & Suchard 2006; Moran et al. 2006). CA-MRSA is susceptible to a larger range of antibiotics than nosocomial MRSA, possibly because the former has had less exposure to a wide spectrum of antibiotics. Reports of annual American death rate from invasive MRSA are estimated at 18,000+ per year (Klevens et al. 2007), which, if true, would exceed the annual death rate from AIDS virus (Bancroft 2007).

The continued awareness and education regarding MRSA and CA-MRSA has allowed for better health care as physicians are now correctly medicating a potentially deadly bacterial infection instead of treating alleged spider bites. Arachnologists who are aware of the communal epidemiological conditions that breed and spread CA-MRSA have contradicted medical personnel and correctly assessed alleged spider bite events as MRSA episodes, which allowed for proper remedy (Vetter et al. 2006; G.B. Edwards, pers. comm.). Epidemiological evidence that would suggest MRSA and would contraindicate spider involvement include 1) multiple contemporaneous lesions on one person, 2) sequential lesions on one person over time, and 3) multiple persons with lesions who live together or are in close contact (Vetter et al. 2006). Although Fagan et al. (2003) claim MRSA infection secondary to spider bites as a common association (with no case of definitive spider involvement), this faulty MRSA-spider bite connection has been summarily criticized (Miller & Spellberg 2004; Cohen 2007). Additionally, a study screening for MRSA in randomly-collected house spiders in Chicago showed no evidence of the bacterium on spider body parts

(Baxtrom et al. 2006) further supporting the lack of spider origin for a condition well established as a nosocomial infection.

HUMAN PSYCHOLOGY AND THE PROLIFERATION OF LOXOSCELISM DIAGNOSES

A large part of the basis for awareness of *Loxosceles* spiders throughout North American society is due to the dramatic, psychological nature surrounding the diagnosis of loxoscelism. Although the comments made here are more pertinent for nonendemic *Loxosceles* areas, there will be some relevance for endemic areas as well. The diagnosis of loxoscelism involves the psyehology of both the patient with a lesion and the physician making the diagnosis along with the interaction of the physician-patient relationship. Much of the information here has been developed over the last decade via conversations and correspondenees with medical colleagues, exposure to hundreds of emails from concerned North Americans attempting to discover the cause of their mysterious skin lesions as well as studies or treatises that delve into myth proliferation and the psychology of the cognitive medical diagnostic process. The points presented below are by no means exhaustive.

From the patient standpoint, there are many aspects that cause loxoscelism to retain a high profile in the general public's eye.

- Adverse reaction to spiders in western civilization ranges from mild dislike to intense arachnophobia (Isbister 2004). Entities perceived in a negative light are readily blamed as culprits for people's maladies and misfortunes despite the reality of the involvement (Difonzo & Bordia 2006); spiders qualify well as scapegoats. Physicians who likewise suffer from arachnophobia or spider disgust will be predisposed to inappropriately blame spiders as idiopathic skin lesion etiologies (Isbister 2004).
- Spiders are commonly encountered, readily recognizable organisms; therefore, they are embraced as causes of medical ills (Isbister 2004). It is difficult for most members of the non-medical world to visualize or conceptualize *Staphylococcus* or pyoderma gangrenosum.
- Patients appear to prefer accepting an exogenous cause rather than an endogenous response for a medical affliction (Benoit & Suchard 2006). Blaming a spider over which there is no control is more agreeable than admitting that some inherent physical weakness or detrimental life style choice is causing the illness.
- "Spider bite" is an oddly comforting diagnosis for patients with skin lesions (Benoit & Suchard 2006). It becomes a badge of courage that they "survived" an encounter with a beast of perceived danger. People who feel they have suffered loxoscelism recount their stories for years, which are then retold by others (Vetter, unpubl. data); this is one of the mechanisms for reinforcing myths in the general public (Difonzo & Bordia 2006). In contrast, one rarely recounts to friends and colleagues a personal bout with a bacterial infection, especially long after the incident.
- Patients often put blind faith in their physicians (Vetter, unpubl. data). If a physician diagnoses a brown recluse spider bite, this carries far more weight in the patient's eyes as to the probability of *Loxosceles* spiders in a local area than does the lifelong collecting experience of regional arachnologists (Vetter & Isbister 2008). Physicians knowingly work in an environment with accepted uncertainty (Montgomery 2006); however, patients feel that physicians work in a world of absolute knowledge.

For the physician, there are many aspects that maintain the persistence of loxoscelism as an etiology of idiopathic skin lesions.

- Patients understandably visit a physician because they seek answers for their illnesses. The physician wants to provide an answer because that is his/her job and, hence, this drives the desire for a diagnosis. There is an approximate overall 15% misdiagnosis rate in medicine (Elstein 1995). Although medicine is described as an art and a science, Montgomery (2006) advocates repeatedly that it should be considered neither but, rather, "a rational, science-using practice."
- Physicians may be reluctant to request the necessary tests to determine if a bacterial or viral agent might be the cause of a skin lesion (Isbister 2004; Benoit & Suchard 2006). This is caused in part by physicians not sufficiently pursuing the causative agent (Benoit & Suchard 2006) but also the desire to keep costs low in an era of spiraling medical expenses.
- Medical schools used to instruct their students that loxoscelism is a common cause of necrotic skin lesions. Colleagues have relayed that these lessons included truisms such as "if it is a necrotic wound, it is a brown recluse bite" and that brown recluse bites were "deadly" despite the rarity of such dire outcome. This appears to be changing as the medical textbooks are incorporating recent research (in particular, the distribution map of Swanson & Vetter [2005]) along with greater awareness of the differential diagnoses for dermonecrosis especially in regard to MRSA.
- The most common cause of cognitive error resulting in misdiagnosis is premature closure where, once a diagnosis is made, a physician fails to consider other likely differential diagnoses (Kuhn 2002; Graber et al. 2005). Senior physicians are just as likely to commit this error as junior physicians (Kuhn 2002). These mistakes arise as a manifestation of the heuristic diagnostic process, which when done correctly, results in the desired effects of reducing delay, cost and anxiety (Redelmeier 2005). Other cognitive errors, such as confirmational bias, prevent physicians from considering alternative diagnoses (Groopman 2007). Again, loxoscelism is a dramatic diagnosis and, once considered, a physician may lock on to this etiology to the exclusion of more probable causative agents.
- There is conflict in the medical field regarding improbable diagnoses (Montgomery 2006). The conservative-minded axiom of "when you hear hoof beats, think horses, not zebras" reinforces the need to first consider common etiologies with which a patient might present and, more importantly, the uncommon manifestation of a common etiology. The more dramatic zebra diagnoses are recalled more easily due to their novelty (Kuhn 2002) and, hence, are diagnosed too frequently. Nonetheless, even when knowingly faced with an improbable diagnosis of once-in-a-career probability, the physician does not want to overlook this rare condition out of professional duty to the patient (Montgomery 2006). Hence, the dynamic nature

of loxoscelism causes medical personnel to diagnose (and publish articles) where the evidential threads to *Loxosceles* spiders are extremely flimsy and sometimes obviously wrong (Anderson 1982; Vetter & Swanson 2007).

- Spider bites are prematurely embraced as etiologies for dermonecrosis without proper evidence-based medicine. This phenomenon is well demonstrated by an Australian episode with white-tailed spiders, *Lampona cylindrata* (L. Koch 1866) and *L. murina* L. Koch 1873 (Lamponidae) with speculation that they caused necrotic arachnidism (Sutherland 1983). This lead to a spate of publications documenting alleged effects of white-tailed spider bite based on presumptive diagnosis without spider involvement (Isbister & Gray 2003; White 2003; Isbister 2004). Verified bites with minor manifestation were brushed aside as aberrant; calls for funding to develop antivenom were made (White 2003). After 20 years of spider incrimination, Isbister & Gray (2003) definitively demonstrated with 130 verified *Lampona* bites with only minor, non-necrotic manifestation, that these spiders were not probable causes of necrotic arachnidism. Parallel features exist for loxoscelism in North America and blaming of dermonecrosis on wolf spiders in South America (Isbister 2004; Vetter & Isbister 2008).

CONCLUDING STATEMENT

The medical arachnological world encompassing *Loxosceles* spiders is an intriguing mixture of arachnology, toxicology, medicine, psychology, mythology, and even journalism. Without a doubt, *Loxosceles* spiders present a real envenomation threat for many regions of the world from a shy, reclusive spider. However, the exaggeration of this threat has given this genus a reputation that greatly extends past its actual physical presence. There are many facets to tease out of this situation as *Loxosceles* spiders' infamy has garnered concern outside the academic world. The facets are subject to human psychology and the checkered ability of non-scientists to properly interpret scientific data especially for a subject like loxoscelism, which lends itself so readily to exaggeration and myth. Although new research is providing the answers to the physiological mechanisms and treatment of the valid threat of loxoscelism, there is room for additional research in areas as simple as accurate distribution for states on the border of the currently known range of recluse spiders. *Loxosceles* spiders will continue to generate significant attention in the worlds of arachnology and medicine as well as interest and coneern from the general public.

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SHORT COMMUNICATION

Notes on the Amazonian species of the genus *Drymusa* Simon (Araneae, Drymusidae)

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Abstract. Males of *Drymusa spelunca* Bonaldo, Rheims & Brescovit 2006 and *D. colligata* Bonaldo, Rheims & Brescovit 2006 are described based on additional material collected in their type localities: the FLONA Carajás, Carajás and Juruti, both in the state of Pará, Brazil.

Keywords: Spiders, Amazonia, taxonomy

Until recently, the occurrence of the family Drymusidae in Brazil was unknown. The first Brazilian species of *Drymusa* was described by Brescovit et al. (2004) followed by the description of four additional species by Bonaldo et al. (2006), all occurring in Brazilian Oriental Amazonia. Among these species were *D. spelunca* and *D. colligata* deseribed by Bonaldo, Rheims & Brescovit (2006) both descriptions based on females collected in the state of Pará, at Carajás Mountains, Carajás National Forest (FLONA Carajás) and Juruti River Plateau, Juruti, respectively. Additional collecting in both type localities brought to light males of these species.

The material examined is deposited in Instituto Butantan, São Paulo (IBSP, A.D. Brescovit), Museu Paraense Emílio Goeldi, Belém (MPEG, A.B. Bonaldo) and Museu de Zoologia da Universidade de São Paulo, São Paulo (MZSP, R. Pinto da Rocha). Descriptions and terminology follow Bonaldo, Rheims & Brescovit (2006). All measurements are given in millimeters.

Family Drymusidae Simon 1893
Genus *Drymusa* Simon 1891
Drymusa spelunca Bonaldo, Rheims & Brescovit 2006
Figs. 1–3

Drymusa spelunca Bonaldo, Rheims & Brescovit 2006:456, figs 7–9, 13–18; Platnick 2007.

Type specimens.—Female holotype from Gruta N5S 20, FLONA Carajás (05°52′–06°33′S, 49°53′–50°45′W), Parauapebas, Pará, Brazil, 3–13 May 2005, Andrade & Arnoni, deposited in IBSP 51735 and three female paratypes from Gruta N5S 13 (MZSP 24996), Gruta N5S 07 (MPEG 2217), Gruta N5S 03 (IBSP 51733), all with the same data as holotype, examined).

Additional material examined.—BRAZIL. *Pará*: Parauapebas, FLONA Carajás (05°52′–06°33′S, 49°53′–50°45′W) (Gruta N4WS15), 1♂4♀ (IBSP 75977); 2♀ (MPEG 10010); 2♀ (MZSP 28327), 20 October–1 November 2006, R. Andrade et al.

Diagnosis.—Males of *Drymusa spelunca* resemble those of the Chilean *D. rengan* Labarque & Ramírez 2007 by the elongate palpal femora and tibiae and by the thin and elongate embolus (see Labarque & Ramírez 2007:figs. 3–6, 7–8). They are distinguished by the shorter embolus, slightly curved upwards (Figs. 2, 3), and by the lack of a small apophysis on the promargin of the palpal tarsi (see Labarque & Ramírez 2007:figs. 3–9).

Description.—Male (IBSP 75977): Carapace orange with brown pattern as shown in Fig. 1. Chelicerae orange, slightly darker than carapace. Sternum brown. Labium orange, distally cream colored. Endites pale yellow, distally cream colored. Legs orange, except metatarsi and tarsi pale orange. Pedipalps pale orange. Abdomen dorsally cream colored with 5–6 transversal brown bands (Fig. 1), ventrally cream colored with irregular brown pattern. Total length 3.00. Carapace flattened, 1.35 long, 1.10 wide. Eye diameters: PME 0.03, ALE 0.02, PLE 0.02. Lateral eyes on a tubercle. Chelicerae with two small retromarginal teeth, promarginal carina, and sub-apical hyaline keel. Labium: 0.25 long, 0.25 wide. Sternum: 0.70 long, 0.70 wide. Leg measurements: I: femur 2.85/ patella 0.40/ tibia 3.05/ metatarsus 2.80/ tarsus 0.70/ total 9.80; II: 2.50/ 0.40/ 2.60/ 2.40/ 0.70/ 8.60; III: 1.80/ 0.35/ 1.80/ 1.80/ 0.60/ 6.35; IV: 2.35/ 0.35/ 2.25/ 2.50/ 0.70/ 8.15. Palp with elongate femur and tibia, at least three times the length of the patella. Cymbium small and truncated, covered with long and strong setae. Bulb small and round with long and slender embolus, slightly curved upwards (Figs. 2, 3). Abdomen: 1.60 long, 1.10 wide.

Female described by Bonaldo, Rheims & Brescovit (2006:456, figs. 7–9, 13–18).

Variation.—Eight females. Total length 2.7–3.0; carapace 0.9–1.3; femur I 1.6–2.1.

Distribution.—Known only from the type locality.

Drymusa colligata Bonaldo, Rheims & Brescovit 2006
Figs. 4, 5

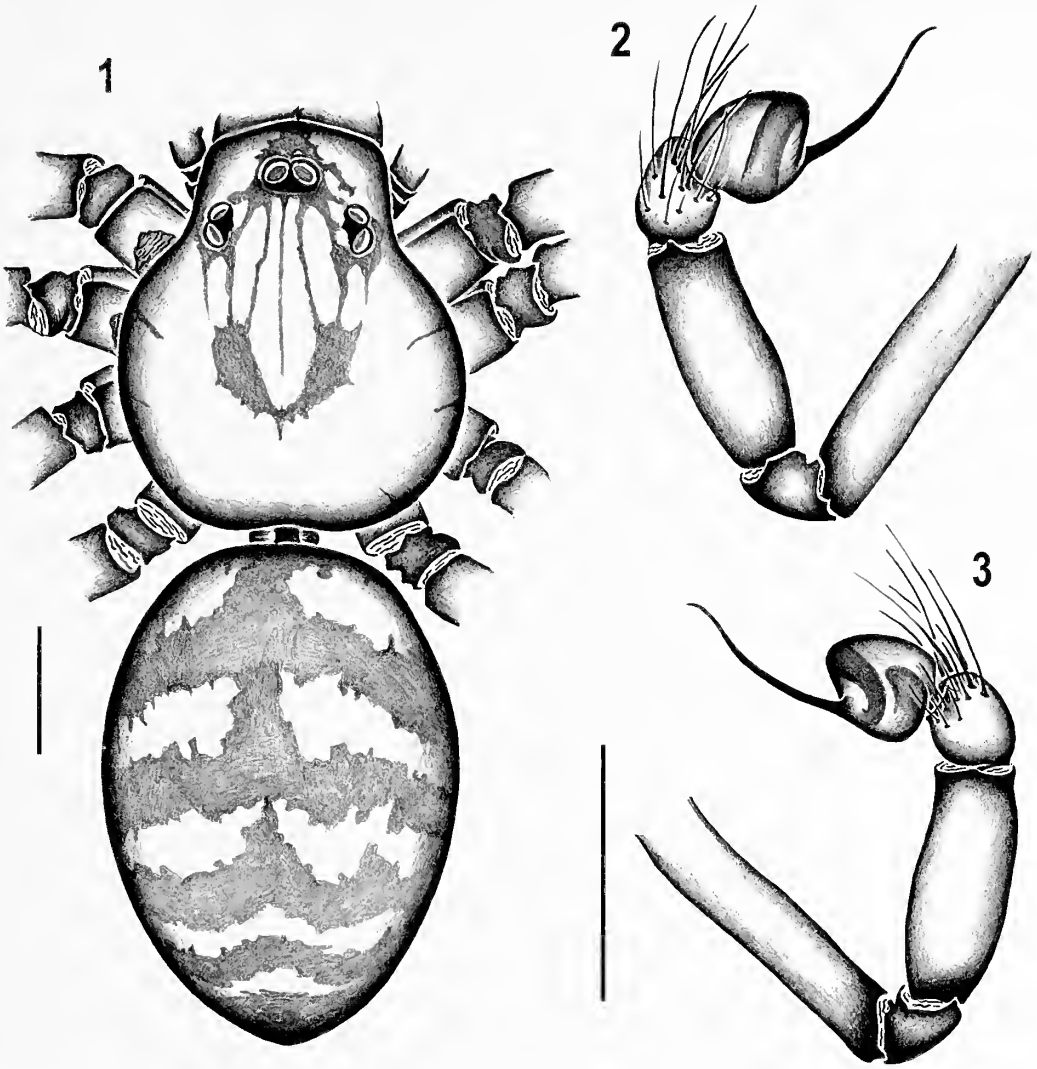
Drymusa colligata Bonaldo, Rheims & Brescovit 2006:456, figs. 4–6. Platnick 2007.

Type specimens.—Female holotype from Platô do Rio Juruti, Igarapé Mutum (02°36′10.6″S, 56°12′25.8″W), Juruti, Pará, Brazil, 6 November 2002, deposited in MPEG 2169.

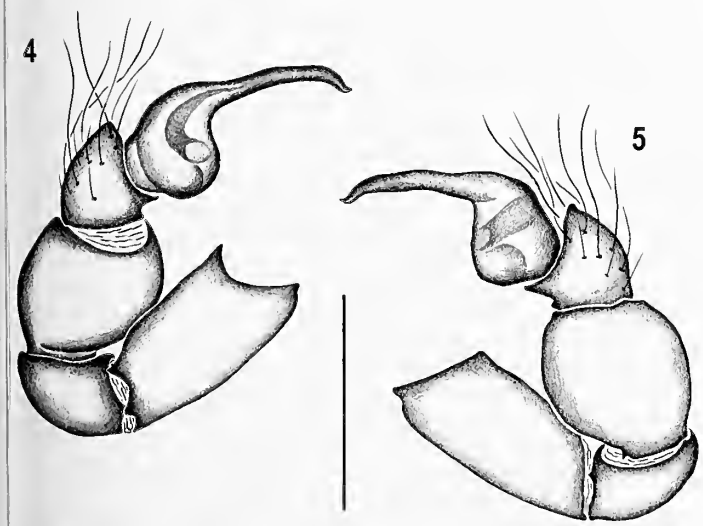
Additional material examined.—BRAZIL. Pará: Juruti (Fazenda Barroso, 02°27′41.7″S; 56°00′11.6″W), 1♂, 10 September 2006, D.F. Candiani & L.F. Lo Man Hung (MPEG 8589); 1♀, 15 September 2006, D.F. Candiani & N.F. Lo Man Hung (MPEG 8590); 1♀, 14 September 2006, D.F. Candiani (MPEG 8591).

Diagnosis.—Males of *Drymusa colligata* resembles those of *D. phylonatica* by the enlarged embolus (see Bonaldo et al. 2006:figs. 11, 12) but differs from this species by globose tibiae and truncated, not hook-shaped, apex of embolus (Figs. 4, 5).

Description.—Male (MPEG 8589). Carapace orange with brown margins and medial V-shaped pattern. Eye borders black. Chelicerae orange. Sternum brown with dark brown margins. Labium brown. Endites orange, distally light brown. Legs orange with faint black transversal stripes, except on tarsi. Pedipalps orange. Abdomen bluish gray with 6 W-shaped transversal black stripes. Total length 2.1. Carapace flattened, 1.0 long, 1.0 wide. Eye diameters: PME 0.12, ALE 0.12, PLE 0.12. Lateral eyes on a tubercle. Chelicerae with two small retromarginal teeth, promarginal carina and subapical hyaline



Figures 1–3.—*Drymusa spelunca* Bonaldo, Rheims & Brescovit: 1. Male, body, dorsal view; 2. Left palp, prolateral view; 3. Retrolateral view. Scale lines: 0.5 mm.



Figures 4–5.—*Drymusa colligata* Bonaldo, Rheims & Brescovit: 4. Male, left palp, prolateral view; 5. Retrolateral view. Scale lines: 0.5 mm.

keel. Labium: 0.3 long, 0.5 wide. Sternum: 1.3 long, 1.5 wide. Leg measurements: I: femur 2.2/ patella 0.4/ tibia 2.4/ metatarsus 2.2/ tarsus 0.75/ total 7.95; II: 2.2/ 0.4/ 2.60/ 2.1/ 0.6/ 7.4; III: 1.6/ 0.4/ 1.55/ 1.6/ 0.55/ 5.7; IV: 2.1/ 0.4/ 2.0/ 2.1/ 0.75/ 7.35. Male palp with small and truncated cymbium, covered with long and strong setae. Bulb long, globose, and curved upwards. Short palpal tibia (Figs. 4, 5). Abdomen: 1.1 long, 0.7 wide.

Female described by Bonaldo, Rheims & Brescovit (2006:456, figs. 4–6).

Variation.—Three females: total length 2.9–3.2; carapace 1.2–1.4; femur I 1.9–2.16.

Distribution.—Known only from the type locality.

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SHORT COMMUNICATION

On the tetragnathid genera *Alcimosphenus*, *Leucauge*, *Mecynometa* and *Opas* (Araneae, Tetragnathidae).

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Abstract. The genus *Mecynometa* contains one species, *M. globosa* O. Pickard-Cambridge 1889 that has three new synonyms. However, species belonging to two distinct genera, *Alcimosphenus* and *Opas*, had been included. *Opas* includes six known species. Two other *Mecynometa* species based on males, are synonyms of each other and appear to be the otherwise missing male of the common West Indian *Alcimosphenus licinus* Simon 1895. Male palpi of species of the three genera are illustrated for the first time. Three species of *Leucauge* are synonymized.

Keywords: Spiders, long-jawed, taxonomy, nomenclature, synonomy

Simon (1894) described *Mecynometa gemmata* and *Mecynometa scintillans* (both synonyms of *M. globosa*). A year later (1895) he gave a diagnosis for *Mecynometa* and a type species *M. globosa* O. Pickard-Cambridge 1889 (Figs. 1–10). In 1895 he also mentioned his previously described species, *M. gemmata* from Venezuela and *M. scintillans* from the Amazon. Petrunkevitch (1911) placed *Argyropeira flabilis* Keyserling 1893 (also a synonym of *M. globosa*) in *Mecynometa*.

Later Mello-Leitão added four more species to *Mecynometa*, which were unlike any previously named species in appearance: *M. paraensis* Mello-Leitão 1937, *M. trilineata* Mello-Leitão 1940, *M. caudata* Mello-Leitão 1944, and *M. melanoleuca* Mello-Leitão 1944. An additional species, *Epeira caudacuta* (Taczanowski 1873), was transferred to the genus (Levi 1991). All five belong to the previously described *Opas* O. Pickard-Cambridge 1896 for *O. lugens* of Central America (Figs. 11, 12) and which is at present misplaced in *Leucauge* (Levi 1980). A male *Opas* of unknown species was found in the available collections (Figs. 15–18).

All original species of *Mecynometa* were originally described from female specimens. Two additional species placed in the genus, *M. torrei* Archer 1958 and *M. montivaga* Archer 1958, were described from males, minute in size (Figs. 19–24; both probably the same species), from the Greater Antilles, from which females of neither *Mecynometa* or *Opas* have been reported. Unlike all others, they are described as crimson in color (the holotypes have since faded) and were presumably placed in *Mecynometa* because of the small size of *M. globosa*. Since, as recently reported (Levi 2005), the male of the common orange West Indian *Alcimosphenus licinus* Simon 1895 is unknown, I have to assume they are the missing males of *Alcimosphenus* and were overlooked because of their unusually small size, slightly more than 1.0 mm total length.

All four genera have a row of trichobothria on the fourth femur (Fig. 14). Males of *Alcimosphenus*, *Mecynometa*, and *Opas* are minute, less than 2 mm total length.

Abbreviations for museums holding specimens are given in the acknowledgements.

Mecynometa Simon 1894

Type species.—*Meta globosa* O. Pickard-Cambridge 1889, designated by Simon 1895. (This was not an included name when the name was first used, however Simon's two included species, *M. gemmata* and *M. scintillans*, are synonyms of *M. globosa*).

Diagnosis.—Posterior median eye row slightly procurved. *Leucauge*-like with unusually long legs; second patella plus tibia 3 times the length of the carapace; femur relatively short (Simon 1894 also described *Mecynometa* as having a slightly procurved posterior eye region and the posterior coxae farther apart than those of *Leucauge*).

The female epigynum is very lightly sclerotized with a rectangular depression (Figs. 1–3) leading anteriorly into an even less distinct oval (Fig. 3). On each side of the median depression may be a slightly darker area, showing the spermathecae and ducts through the transparent integument (Figs. 1, 2).

The male palpus differs from that of other genera by having a large attached paracymbium and a basal hook on the cymbium (Fig. 10).

Mecynometa globosa (O. Pickard-Cambridge 1889), Figures 1–10

Meta globosa O. Pickard-Cambridge 1889:2, figs. pl. 1, fig. 5, ♀. Female holotype from Teapa, Tabasco, Mexico in BMNH, examined.

Argyroepeira flabilis Keyserling 1893:355, pl. 18, fig. 262, ♀. Female holotype from Rio de Janeiro, Brazil in BMNH, examined. NEW SYNONYMY

Mecynometa globosa Simon 1895:737, fig. 810.

M. gemmata Simon 1895:737. Female holotype from Venezuela in MNHN, examined. 1895:152. NEW SYNONYMY.

M. scintillans Simon 1895:737. Immature holotype from Amazon in MNHN, examined. 1895:152. NEW SYNONYMY.

Species names were synonymized because their type specimens have similar genitalia and the immature *M. scintillans* has similar color pattern and proportions.

The lateral view of the male and the palpus are illustrated in Figures 7–10.

Opas O. Pickard-Cambridge 1896

Type species.—*Opas lugens* O. Pickard-Cambridge 1896, originally designated.

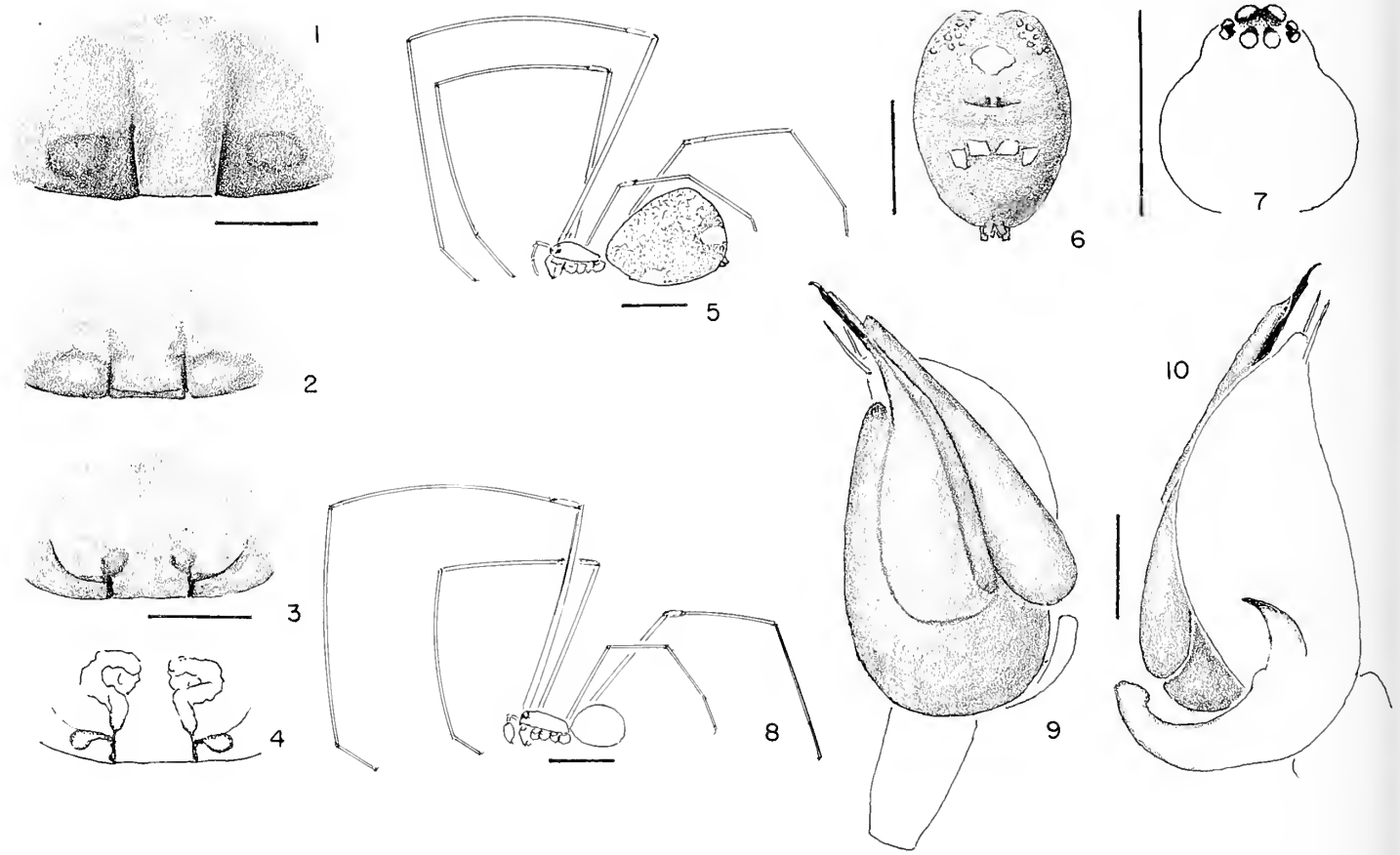
Diagnosis.—The abdomen has a posterior elongated tubercle with a striated base (Figs. 13, 14). Unlike *Leucauge* and *Mecynometa*, specimens are dark gray. The males are much smaller than females. Only one male has been found with females, among a collection from Madre de Dios, Peru (MUSM) (Figs. 15–18). There are undescribed species in various collections, all similar in appearance.

The female epigynum of all known species has a diagnostic wider than long, oval depression with a variable posterior lip (Fig. 11), sometimes enclosing a pair of depressions.

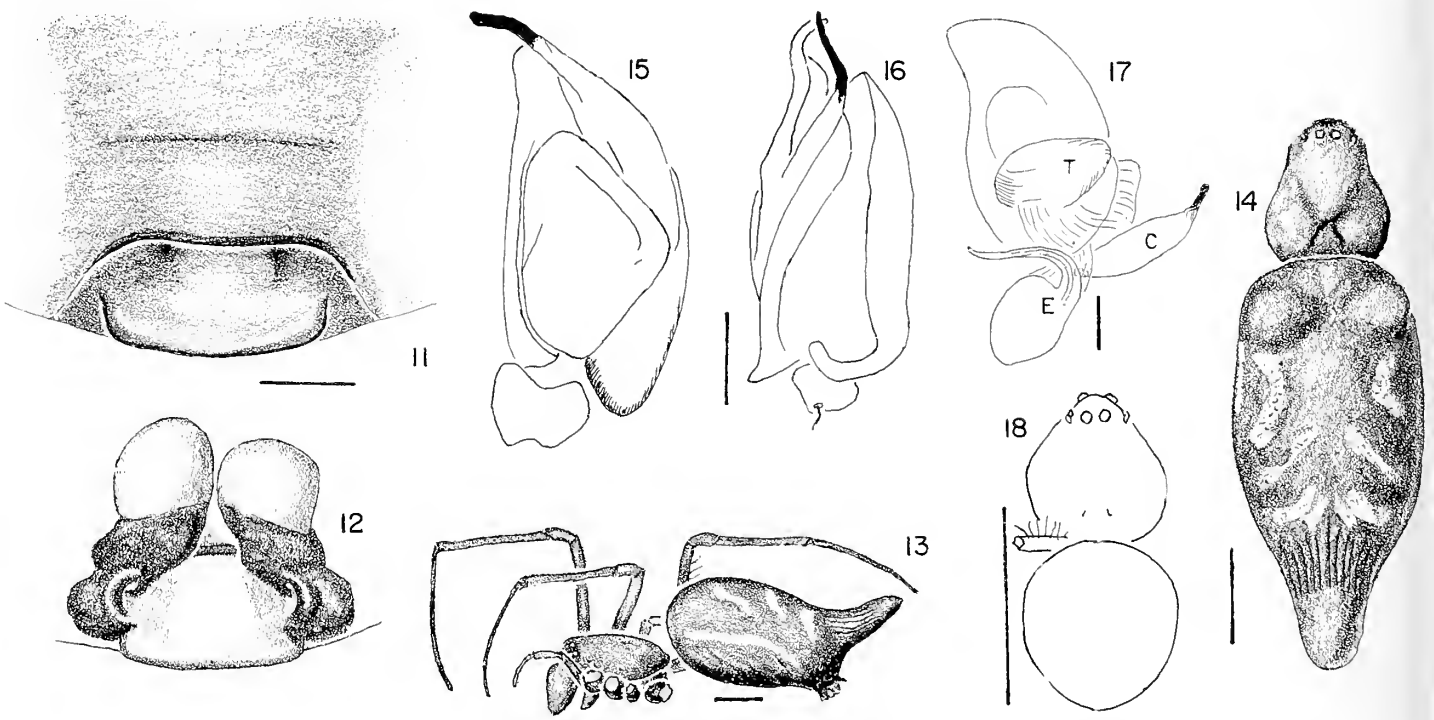
The male palpus has an attached paracymbium, relatively small tegulum with a projecting conductor enclosing the embolus (Figs. 15–17).

Opas lugens O. Pickard-Cambridge. Figures 11, 12

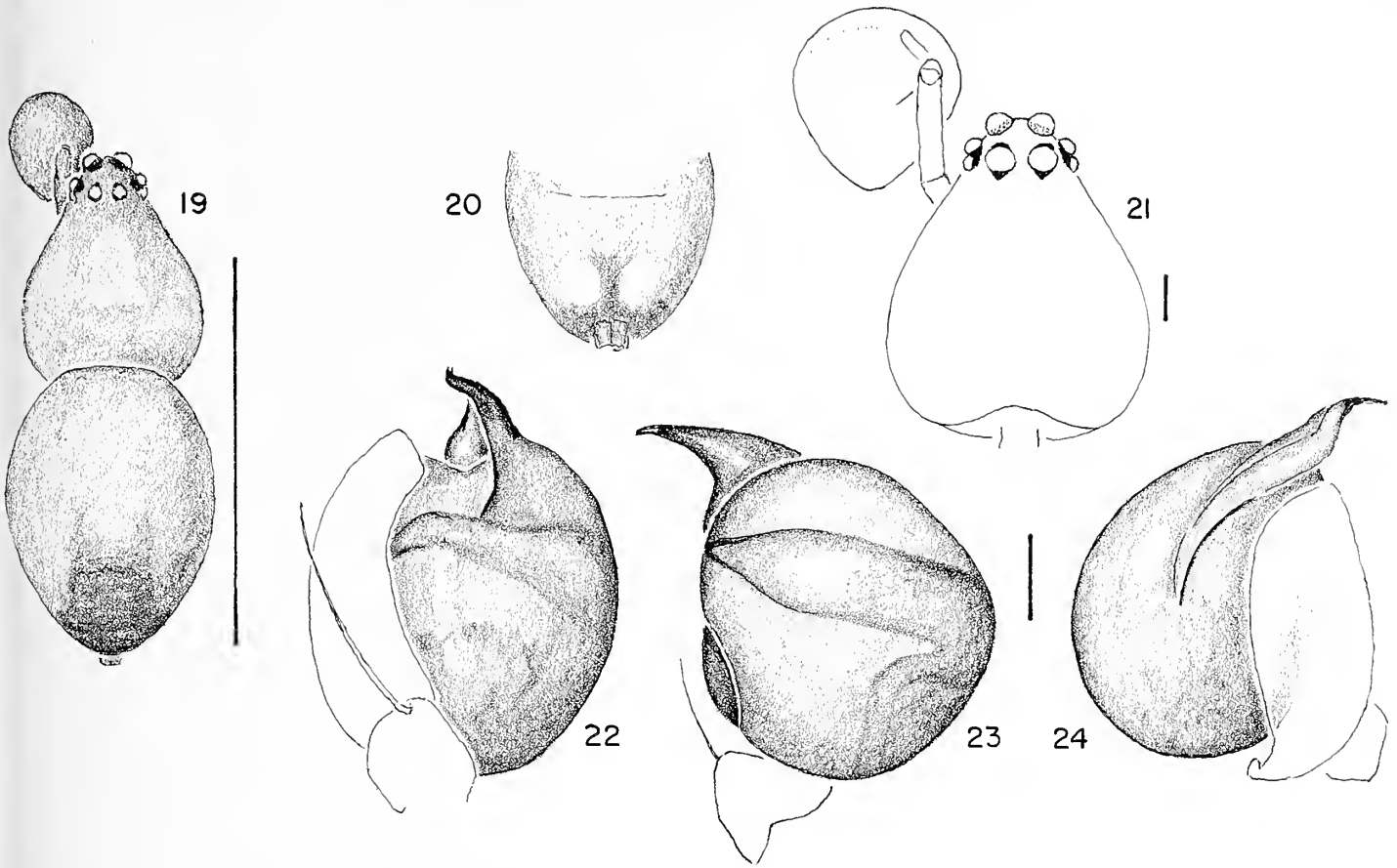
Opas lugens O. Pickard-Cambridge 1896:185, pl. 23, fig. 3, ♀. Female holotype from Teapa, Tabasco, Mexico in BMNH, examined.



Figures 1–10.—*Mecynometa globosa* (O. Pickard-Cambridge). 1–7. Female: 1. Epigynum (holotype); 2–4. Epigynum (Panama); 1–3, Ventral view; 4. Dorsal view, cleared; 5. Lateral view (Panama); 6. Abdomen, ventral view (holotype); 7. Carapace (Panama). 8–10. Male (Panama): 8. Lateral view; 9, 10. Left palpus; 9. Ventral view; 10. Lateral view. Scale lines = 1.0 mm, genitalia 0.1 mm.



Figures 11–18.—*Opas* species. 11, 12. *Opas lugens* O. Pickard-Cambridge, epigynum (holotype): 11. Ventral view; 12. Dorsal view, cleared. 13. *Opas* sp. (Panama); 14, *Opas caudacuta* (Taczanowski), carapace and abdomen; 15–18, *Opas*. sp., male from Madre de Dios, Peru (MUSM); 15–17, left palpus; 15, 17, ventral; 16, lateral; 17, expanded; 18, male, dorsal, without appendages, except fourth femur. Scale lines = 1.0 mm; genitalia, 0.1 mm. Abbrev.: C, conductor; E, embolus; T, tegulum.



Figures 19–24.—*Alcimosphenus licinus* Simon, male; 19, carapace, abdomen and left palpus; 20, abdomen, ventral; 21, carapace and left palpus; 22–24, left palpus; 22, mesal; 23, ventral; 24, lateral. (Figs. 19, 20. *M. torrei*, Cuba, others *M. montivaga*, Jamaica). Scale lines = Figs. 19, 20, 1.0 mm; Fig. 21; genitalia, 0.1 mm.

Argyropeira lugens: — O. Piekard-Cambridge 1897:234.
Leucauge lugens: — F.O. Piekard-Cambridge 1903; Levi 1980.

Natural History.—W. Eberhard (personal communication) reports the spider being "at the hub of an orb attached to low plants in a clearing. The orb was relatively planar, and inclined at 45° with horizontal. The maximum frame length was 62 cm, so it spanned a moderate space (not a huge span as in, for instance, *Gasteracantha*, not a small space as in, for instance, *Azilia*)" in Costa Rica.

The following species, previously placed in *Mecynometa* (Platnick 2007) should be placed in *Opas*. Their genitalia are illustrated in a file entitled "Illustrations of American *Eustala* (Araneidae), *Azilia*, *Leucauge*, *Opas* (Tetragnathidae) species and the type species of some genera of the two families" that is available online at: http://www.oeb.harvard.edu/faculty/levi/.

Epeira caudacuta Taczanowski 1873:136, pl. 5, fig. 16. Female holotype from Cayenne, French Guiana in PAN, examined. Peruvian specimens are misidentified. Now *Opas caudacuta*. NEW COMBINATION.
Mecynometa caudata Mello-Leitão 1944:9. Female holotype from Barra do Tapirapés, Amazonas [Mato Grosso], Brazil in MNRJ, examined. Now *Opas caudata*. NEW COMBINATION.
Mecynometa melanoleuca Mello-Leitão 1944:8. Female holotype from Barra do Tapirapés, Amazonas [Mato Grosso], Brazil in MNRJ, examined. Now *Opas melanoleuca*. NEW COMBINATION.
Mecynometa melanoleuca may be a synonym of *M. caudata*
Mecynometa paranensis Mello-Leitão 1937:7, fig. 7. Female holotype from Curitiba, Paraná, Brazil in MNRJ, examined. Now *Opas paraensis* NEW COMBINATION.
Mecynogea trilineata Mello-Leitão 1940:28, figs. 9, 10. Female holotype from Rio Xingo [Mato Grosso, Pará], Brazil in MNRJ, examined. Now *Opas trilineata* NEW COMBINATION.

Alcimosphenus Simon 1895

Diagnosis.—The male is minute in size and distinguished by its orange coloration. The oval abdomen has a dark posterior patch and ventrally a pair of white patches (Figs. 19, 20).

The palpus is distinguished by being subspherical and the conductor and embolus are short. As seen through the tegulum, the sperm duct is ventrally swollen (Figs. 22–24).

Alcimosphenus licinus Simon. Figs. 19–24

Alcimosphenus licinus Simon 1895:931. Female holotype from Jamaica, in MNHN, examined. Levi 2005:754, figs. 1–9, ♀.
Mecynometa torrei Archer 1958:5, figs. 7, 11, Male holotype from Sierra las Casas, Isle of Pines [I. do Pinos, Isla de la Juventud], Cuba, in AMNH, examined. NEW SYNONYMY.
Mecynometa montivaga Archer 1958:6, fig. 8. Male holotype from Hardwar Gap, Portland Par., Jamaica, in AMNH, examined. NEW SYNONYMY.

Leucauge White 1841

There are numerous species with similar genitalia that I am hesitant to synonymize since their size, the shape of the abdomen, or their coloration may differ. However the following groups have very distinct genitalia and can easily be shown to be the same. All American *Leucauge* species whose types were found are illustrated

in a file that is available online at: http://www.oeb.harvard.edu/faculty/levi/.

Leucauge funebris Mello-Leitão 1930,

Leucauge funebris Mello-Leitão 1930. Female holotype from Rio Cuminá [Rio Paru de Oesta, Pará], Brazil in MNRJ, examined.

Leucauge fagei Caporiacco 1954. Female holotype from Charvein, French Guiana in MZUF, examined. NEW SYNONYMY.

Leucauge mariana (Taczanowski)

Meta mariana Taczanowski 1881:560. Female holotype from Peru in PAN, examined.

Leucauge mandibulata F.O. Pickard-Cambridge 1903:440, pl. 41, figs. 12–18, ♀, Female holotype from Teapa, Tabasco, Mexico in BMNH, examined. NEW SYNONYMY.

Leucauge venustella Strand 1916. Female holotype from Hispaniola in SMF, examined. NEW SYNONYMY.

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I thank the various curators who thirty years ago and more recently loaned specimens from their institutions: AMNH, American Museum of Natural History, New York, W.J. Gertsch, J.A.L. Cooke, N. Platnick, L. Sorkin; BMNH, British Museum of Natural History, London, F.R. Wanless, J. Beccaloni; MNHN, Muséum national d'Histoire naturelle, Paris, M. Vachon, M. Hubert; MNRJ, Museu Nacional, Universidade Federal do Rio de Janeiro, A. Timotheo da Costa; MUSM, Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru, D. Silva; MZUF, Natural History Museum, Zoological Section "La Specola," University of Florence, Italy, S. Mascherini; PAN, Museum and Institute of Zoology, Polish Academy of Sciences, Warszawa, A. Riedel, W. Starega, J. Proszinski, A. Slojewska; and SMF, Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt, M. Grasshoff, P. Jäger.

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SHORT COMMUNICATION

The male of *Trechalea trinidadensis* (Araneae, Lycosoidea, Trechaleidae)

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Abstract. The male of the species, *Trechalea trinidadensis* Carico 1993, is described for the first time. The distributional range for this species is extended from Trinidad to Brazil.

Keywords: Amazonas Brazil, range extension, taxonomy, Neotropical

In a revision of the genus *Trechalea*, a total of eleven species were included, two of which were new (Carico 1993). Of the eleven, only one species was represented by a single specimen, a female of the new species *Trechalea trinidadensis* Carico 1993. Since the time that this work was published, new material has become available which includes additional specimens of the latter species, one male and three females. The male is described here for the first time. This new collection considerably extends the range of the species from the type location in Trinidad to central Brazil, which suggests that the species is considerably more widespread than originally thought.

Measurements are in millimeters. Specimens were loaned from the Invertebrate Collection of the National Institute for Amazonian Research, Manaus, Brazil (INPA). Abbreviations: AE = anterior eye row; PE = posterior eye row; OQA = length of ocular quadrangle, anterior; OQP = length of ocular quadrangle, posterior; OQH = height of ocular quadrangle; PLE = lateral eye of posterior row, diameter; PME = median eye of posterior row, diameter; ALE = lateral eye of anterior row, diameter; AME = median eye of anterior row, diameter; PLE–PME = length of row PLE and PME; PME–PME = length of row including both PME; ALE–AME = length of row ALE and AME; AME–AME = length of row including both AME.

TAXONOMY

Family Trechaleidae Simon 1890
Genus *Trechalea* Thorell 1869

Type species.—*Trechalea longitarsis* (C.L. Koch), by original designation.

Trechalea trinidadensis Carico 1993
Figs. 1, 2

Trechalea trinidadensis Carico 1993:255, figs. 73, 74.

Material examined.—BRAZIL: *Amazonas*: 1 ♂, 2 ♀, Rio Solimoes, left bank, 5 km above Tabatinga (4.240833°S, 69.942222°W), 19 March 1998, J. Adis, (INPA).

Diagnosis.—This species is best differentiated from all other species of the genus by details of the genitalia of both sexes but resembles most *Trechalea amazonica* F.O. Pickard-Cambridge. In the male, the median apophysis is distinguished by the shape of a portion of the ventral division, whieh is dark, scale-like and rounded in outline while this structure is not dark in *T. amazonica*. The ectal division of the retrolateral tibial apophysis is positioned about midway along the length of the tibia and is distinctly bulbous at the base with a small, apical, acute tip while the retrolateral apophysis is positioned higher on the tibia and is distinctly more slender. Species-distinctive characters of the abdominal pattern for the male are not available because it was damaged. The association of this male with the female of the species is based on syntopy and the similarity of color, shape and pattern of the prosoma and legs. Females in this collection have the distinctive dark, terminal scale on the middle field which is not found in *T. amazonica*.

Description.—*Male (Rio Solimoes)*: Carapace low, pale, unmarked except black in eye region, length 5.5, width 6.0. Sternum pale, unmarked, length 3.0, width 2.7; labium medium brown, darker laterally and lighter on distal margin, length 1.2, width 1.0. Clypeus somewhat distorted with dark macula on right side, height 0.60, width 2.70. Chelicerae dark brown, heavily clothed with light and dark setae; basal segment with groove near fang origin and lateral carina; 3 promarginal teeth with middle largest, 3 retromarginal teeth equal in size with distal two closer. Anterior eye row straight. Eyes: AE 1.5, PE 2.70, OQA 0.90, OQP 1.40, OQH 1.30, PLE 0.63, PME 0.63, ALE 0.23, AME 0.40, PLE–PME 0.45, PME–PME 0.15, ALE–AME 0.05, AME–AME 0.18. Legs pale with scattered dark maculae on each femur, pairs of dark annuli on each patella; segment lengths: femur, patella-tibia, metatarsus, tarsus, total: I-9.0, 11.1, 7.9, 4.5, 32.5; II-9.4, 11.5, 8.3, 5.0, 34.2; III-8.0, 8.8, 7.4, 5.4, 29.6; IV-10.3, 10.0, 11.6, 6.8, 38.7; tibial ventral macrosetae pairs: I-4, II-4, III-0, IV-3. Abdomen damaged, pattern not discernable. Median apophysis of palp with a portion of the ventral division dark, flattened, scale-like and rounded in outline; dorsal division with distinct curved and acute guide directed retrolaterally. Retrolateral tibial apophysis ectal division located centrally along length of palpal tibia, bulbous at base, narrowing distally to acute, curved point; ental division prominent (Figs. 1, 2).

Remarks.—A label with this collection indicates that the spiders were found on a tree trunk in the whitewater inundation forest when the forest was flooded. The three females have carapace lengths of 6.3, 6.3, and 6.8 respeetively.

ACKNOWLEDGMENTS

Appreciation is extended to the late J. Adis through whose assistance this collection was made available. I am grateful to M. Harvey, V. W. Framenau and P. Sierwald for editorial comments.

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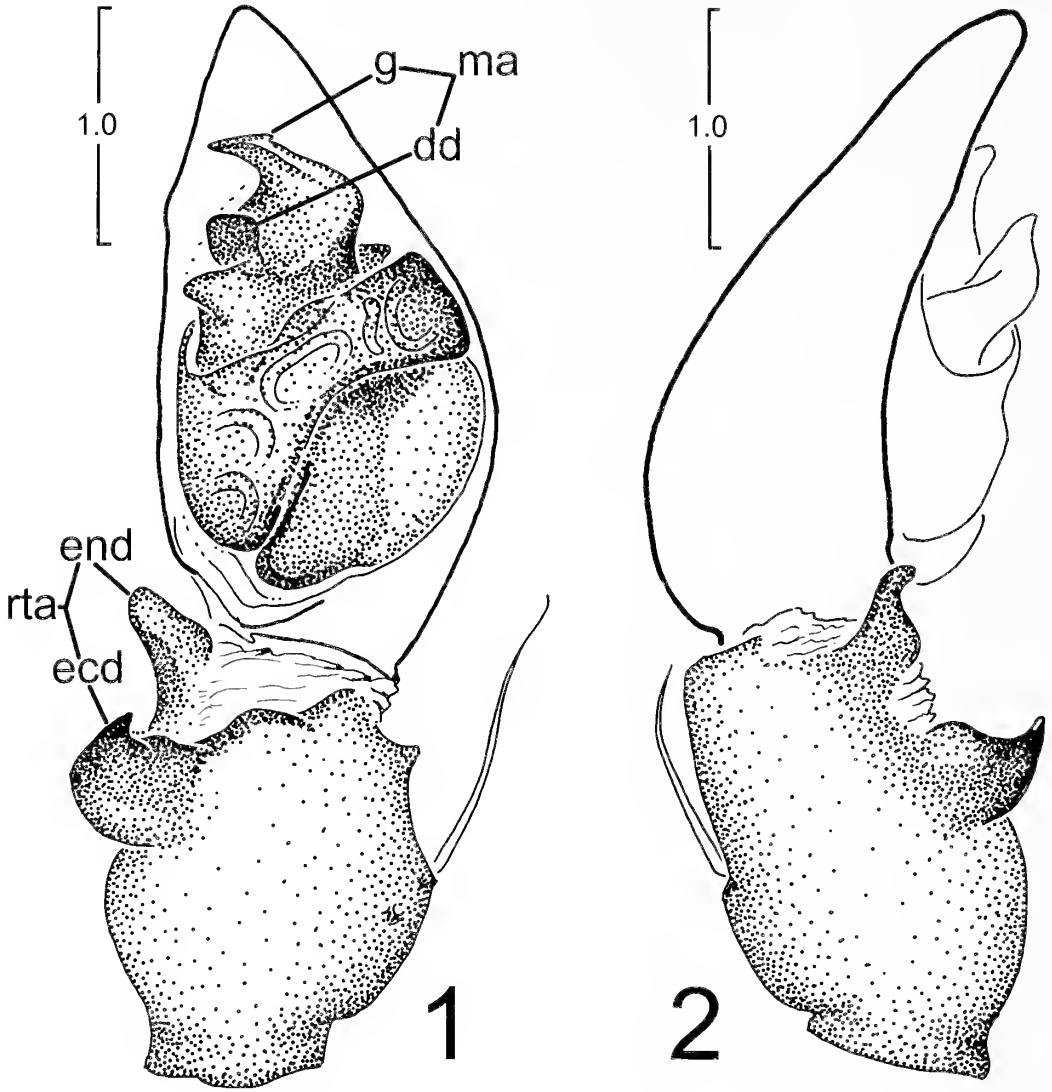

Figures 1, 2.—Left palpus of *Trechalea trinidadensis*: 1. Ventral view; 2. Retrolateral view. Abbreviations: ecd = ectal division, end = ental division, dd = dorsal division, ma = median apophysis, rta = retrolateral tibial apophysis, vd = ventral division. dd, vd, rta, ma, ecd, end.

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SHORT COMMUNICATION

A new species of *Tinus* (Araneae, Lycosoidea, Pisauridae) from Mexico

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Abstract. A single male from Oaxaca, Mexico is described as the new species, *Tinus oaxaca*, based on distinct features of the palpus including the shape of the retrolateral apophysis, the position of components of the palpal bulb, and the color pattern of the dorsum. Notes on the current taxonomic status of the genus *Tinus* are included.

Keywords: Taxonomy, morphology, spider

A male of the genus *Tinus* F.O. Pickard-Cambridge 1901 from Mexico was found among a collection of unidentified pisaurids borrowed from the California Academy of Science, San Francisco (CAS) that was clearly different from any of the currently known species in the western hemisphere based on the types of species included in a revision of the genus (Carico 1976) and *Tinus connexa* Bryant 1940. The objective of this paper is to describe this specimen and to include notes on the current status of the genus.

The genus *Tinus* is currently represented by 11 species (Platnick 2008). Seven species in the western hemisphere are found ranging from the southwestern USA to Panama (Carico 1976) and one is located in Cuba and Hispaniola (Bryant 1940, 1948). Types of the three Indian species (Tikader 1970; Reddy & Patel 1991; Biswas & Roy 2005) were not available at the time of this writing. The published descriptions of the latter, which are based only on females, are inconclusive regarding their generic affiliation with the species of the genus in the western hemisphere.

Gertsch (1940) implied that the Neotropical genus *Thaumasia* might be the closest relative to *Tinus* and could be a subgenus of the former. Sierwald (1989, 1990), who provided extensive analyses of the female (Sierwald 1989) and male (Sierwald 1990) genitalia of several pisaurid genera, detailed several similarities of these two genera and concluded that these "...features could be evidence for a closer relationship of both genera." The close affiliation of these two genera was recently confirmed by Santos (2007) who placed the two as sister taxa in his phylogeny of the Pisauridae.

In the western hemisphere the genus *Tinus* is distinguished by details of the male palpus: the large retrolateral tibial apophysis arises dorsally, may bifurcate and often curves ventrally; the conduetor is conspicuous and projects distad as a distinct, spatulate apophysis; the embolus in its pars pendula occurs in a series of distinct, often overlapping loops which are visible ventrally; part of the tegulum is a conspicuous, membranous sac which occurs in various, species-specific shapes when viewed ventrally.

Measurements are in millimeters. Abbreviations: AE = anterior eye row; PE = posterior eye row; OQA = length of ocular quadrangle, anterior; OQP = length of ocular quadrangle, posterior; OQH = height of ocular quadrangle; PLE = lateral eye of posterior row, diameter; PME = median eye of posterior row, diameter; ALE = lateral eye of anterior row, diameter; AME = median eye of anterior row, diameter; PLE–PME = length of row PLE and PME; PME–PME = length of row including both PME; ALE–AME = length of row ALE and AME; AME–AME = length of row including both AME. The names and abbreviations for structures of the male palpus used in this paper (Fig. 2) are based on the work of Sierwald (1990): bmt = basal membranous tube (= "tegulum" in Carico (1976), c = conductor, e = embolus, ma = median apophysis, pp = pars pendula, rta = retrolateral tibial apophysis, , st = subtegulum t = tegulum.

Family Pisauridae Simon 1890
Genus *Tinus* F.O. Pickard-Cambridge 1901

Type species.—*Tinus nigrinus* F.O. Pickard-Cambridge, 1901, by original designation.

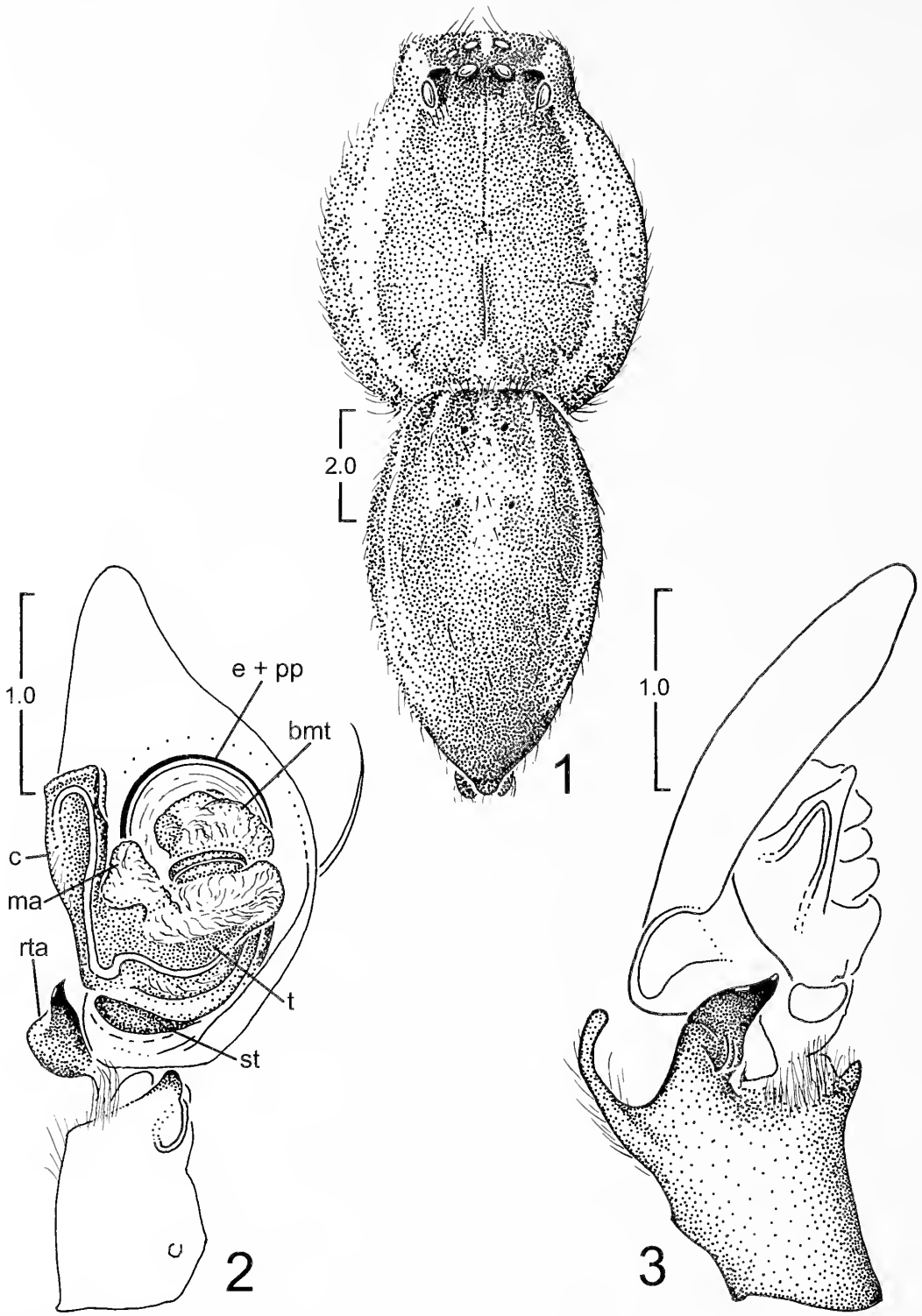
Tinus oaxaca new species
Figs. 1–3

Material examined.—Holotype male: MEXICO: *Oaxaca*: Rancho Carlos Minnas (coordinates not available), 1 April 1967, J. Nee (CAS).

Etymology.—The name is a noun in apposition derived from the name of the type locality.

Diagnosis.—The shape of the retrolateral tibial apophysis and the complex arrangement and shape of parts of the palpal bulb are distinguishable from other members of the genus. The large ectal division of the retrolateral tibial apophysis, which extends prominently away from the axis of the tibia along with the structural similarity of the acute ental division, resembles *Tinus palicthus* most. The latter is perhaps the closest congener but differs from it in the reduced number of visible loops of the embolus/pars pendula. The horseshoe-shaped indention on the retrolateral side of the cymbium (Fig. 2) is unique. The truncated distal end of the apophysis of the conductor and the reduced number of visible coils of the embolus are also unique, and these characters are not present in any other members of the genus (Carico 1976). Unlike other members of the genus, the dorsal pattern of the abdomen has the lateral margins of the median dark band straight for its full length.

Description.—*Male (holotype):* Carapace (Fig. 1) medium brown with distinct submarginal light brown bands, length 6.6, width 5.6. Sternum light brown, unmarked, length 3.20, width 3.08: labium length 1.20, width 1.12, light, unmarked. Clypeus narrow dark bands leading from PMEs to clypeus margin, dark band leading from anterior eye row to clypeus margin, with median light spot, height 0.65, width 2.80. Anterior eye row straight, diameters ALE 0.26, AME 0.32; interocular distances ALE–AME 0.08, AME–AME 0.15. Posterior eye row, diameters; PLE 0.38, PME 0.38; interocular distances PLE–PME 0.42, PME–PME 0.30. Chelicerae medium brown, each with a longitudinal, dark, reticulated band narrowing from clypeus to fang origin; three promarginal teeth, middle largest, proximal two closest; three retromarginal teeth, equal size, distal two closest. Only legs II and III remain attached; II femur 9.4, patella-tibia 12.3, metatarsus 9.0, tarsus 4.1; III femur 7.8, patella-tibia 9.5, metatarsus 7.3, tarsus 3.2. Color of legs light brown with indistinct pattern dorsally on femora and patella-tibiae. Abdominal dorsum with wide, dark brown band, lateral, straight, narrow white band distinct anteriorly and becoming diffuse posteriorly, sides mottled gray, venter light and unmarked, length 6.7. Palpus (Figs. 1, 2) with



Figures 1–3.—*Tinus oaxaca*: 1. Dorsum; 2. Right palpus, ventral view; 3. Right palpus, retrolateral view. Abbreviations: bmt = basal membranous tube, c = conductor, e = embolus, ma = median apophysis, pp = pars pendula, rta = retrolateral tibial apophysis, st = subtegulum t = tegulum.

conductor shaped as large, distally-projecting, blade-like and truncated apophysis; median apophysis distinct, white, and rounded distally, pars pendula, transparent along with dark, curved embolus inside presenting only two loops ventrally; ectal division of retrolateral tibial apophysis long, curved, arising dorsally; ental division large, flattened, curved, bent, acute; retrolateral surface of cymbium with a horseshoe-shaped indentation.

Natural history.—Unknown.

Distribution.—Known only from the type locality. The locality for this specimen is apparently a ranch, presumably in the state of

Oaxaca. This specific locality was not found in standard databases or gazetteers.

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SHORT COMMUNICATION

A new species of Monoscutinae (Arachnida, Opiliones, Monoscutidae) from New Zealand, with a redescription of *Monoscutum titirangiense*

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Abstract. *Templar incongruens* new genus and species (Monoscutidae) is described and assigned to the subfamily Monoscutinae (Opiliones). It is distinguished from other Monoscutinae by different ornamentation, relatively shorter legs, and enlarged chelicerae in the male. A redescription of *Monoscutum titirangiense* Forster 1948 is also given.

Keywords: Taxonomy, new species, new genus, morphology, Australasia

The subfamily Monoscutinae was established by R.R. Forster in 1948 for two new monotypic genera (*Monoscutum titirangiense* Forster 1948 and *Acihasta salebrosa* Forster 1948) of heavily sclerotized, dorsoventrally flattened harvestmen from northern New Zealand. Although Forster placed his new subfamily in the Phalangiidae, it was seemingly quite distinct from any other member of that family, with relatively short legs and almost the entire dorsum fused into a single scute (hence the name *Monoscutum*).

Since the original publication, no further species of Monoscutinae have been described, though undeseribed species have been recorded from eastern Australia (Hunt & Cokendolpher 1991). Šilhavý (1970) transferred *Monoscutum* to the Neopilionidae as part of the Megalopsalidinae. Megalopsalidinae was then raised to family rank by Martens (1976), and the subfamilies Monoscutinae and Megalopsalidinae were treated as distinct by Hunt (1990) and Hunt & Cokendolpher (1991). Crawford (1992) pointed out that the name Monoscutinae Forster 1948 has priority over Megalopsalidinae Forster 1949, and the correct name for the family uniting the two subfamilies is Monoscutidae.

The two subfamilies of Monoscutidae have been united solely by the structure of the penis (both possess paired bristle groups at the junction of shaft and glans), and have been regarded as quite distinct in external appearance. While Monoscutinae is described as dorsoventrally flattened and sexually monomorphic, Megalopsalidinae generally has a globular body, is less heavily sclerotized, and has greatly enlarged chelicerae in the male (Forster 1949). However, better-preserved specimens of Monoscutinae do not show the high degree of dorsoventral flattening previously regarded as characteristic of the subfamily, whieh therefore appears to be an artifaet of preservation. The new genus of Monoscutinae described below also possesses enlarged chelicerae in the male, though they are nowhere near the extraordinarily large appendages possessed by some Megalopsalidinae (Forster 1944; Taylor 2004). The greater sclerotization of Monoscutinae remains a distinguishing feature of the subfamily. Also notable are the ozopores, which are small and not easily visible from above in Monoscutinae, but large and readily visible in Megalopsalidinae.

The new genus and species *Templar incongruens* is here described from specimens collected near Christchurch, South Island, New Zealand, increasing the known range of Monoscutinae. The opportunity is also taken to present a redescription of *Monoscutum titirangiense*, the actual characteristics of which differ enough from the original published description that some confusion might otherwise be possible.

METHODS

Specimens were examined under alcohol using a Leica MZ6 microscope and drawings made using a camera lucida. Genitalia were examined under an Olympus BH-2 compound microscope using K-Y® Brand jelly as a mountant as described in Cokendolpher & Sissom (2000). Measurements were taken of all specimens using a graticule and are given below as averages in millimeters with standard deviations in parentheses. Prosoma and total body lengths were both taken down the midline, while width was measured at the widest part of the prosoma between the second and third legs. Leg measurements are given from leg I to IV. The specimens examined for this study are lodged in Auckland Museum (AMNZ), Te Papa Tongarewa, Wellington (MONZ) and Canterbury Museum, Christchurch (CMNZ), all in New Zealand. The system of approximately equal-sized areas within New Zealand designed by Crosby et al. (1998) for recording specimen localities was followed.

TAXONOMY

Family Monoscutidae Forster 1948
Templar new genus

Type species.—*Templar incongruens* new species.

Etymology.—Name given in recognition of the appearance of the female of the type species – heavily armored, and with a Cross marking.

Diagnosis.—Distinguished from *Acihasta* by absence of flanking spines on the dorsum of the opisthosoma and from *Monoscutum* by denticles on dorsum of body being simple and rounded, not complex, without large denticle on ocularium. Pedipalp patellar apophysis short, rounded. Legs short (e.g., femur II ca. one-third length of body versus three-quarters in *Monoscutum*).

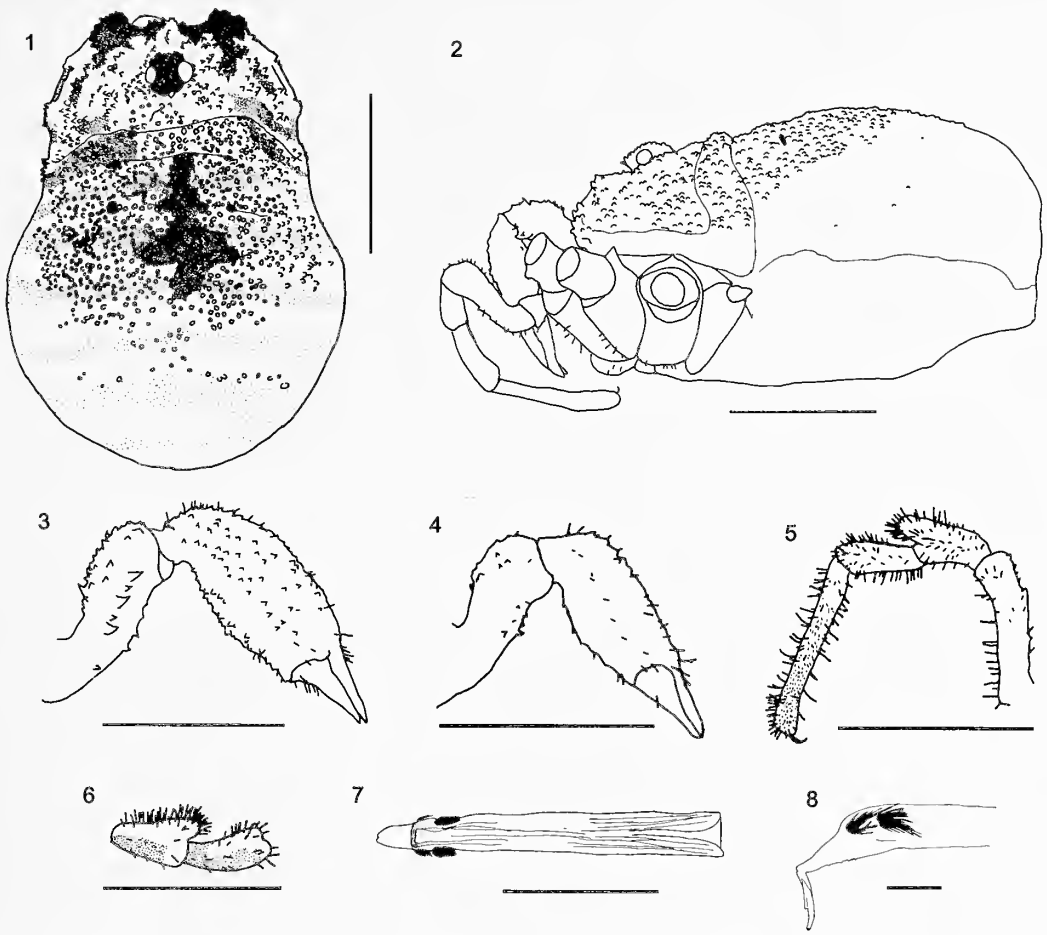
Description.—As for type and only known species.

Templar incongruens new species
(Figs. 1–8)

Material examined.—NEW ZEALAND: South Island: Mid Canterbury: Holotype male: Ahuriri Reserve, 43°41′S, 172°38′E, 22 January 2000, M.S. Harvey (CMNZ). Paratype: 1 female, collected with holotype (CMNZ).

Etymology.—Latin for "incongruent," to reflect the presence in this species of enlarged chelicerae in the male, a feature previously associated with the subfamily Megalopsalidinae, not Monoscutinae.

Description.—*Male:* Prosoma length 0.76, total body length, 2.3, width 1.52. Mottled medium and dark brown; carapace with lighter longitudinal stripes on either side of ocularium. Dorsum of prosoma



Figures 1–8.—*Templar incongruens* new species: 1. Dorsal view of body, female paratype; 2. Lateral view, female paratype; 3. Male chelicera, lateral view, male holotype; 4. Female chelicera, lateral view, female paratype; 5. Female pedipalp, medial view, female paratype; 6. Patella and tibia, male pedipalp, dorsal view, male holotype; 7. Penis, ventral view, male holotype; 8. Penis, lateral view, male holotype. Scale bars = 1 mm (Figs. 1–6), 0.05 mm (Fig. 7), 0.01 mm (Fig. 8).

and first five segments of opisthosoma except for lateral margins densely and evenly covered with simple, rounded denticles. Ocularium rugose. Ozopores small, not visible from above.

Chelicerae: Segment I 0.72, segment II 1.42. Both segments heavily denticulate. Segment I with ventral row of large denticles. Segment II enlarged relative to segment I. Outside of fingers smoothly convex.

Pedipalps: Femur 0.57, patella 0.29, tibia 0.35, tarsus 0.71. Femur without spines; setae in rows on sides and centerline of femur, with concentration of setae at inner distal end. Patella with rows of setae on sides and centerline. Patellar apophysis rounded, not extending far past patella-tibia junction, with scattered large setae. Tibia with rows of setae on sides, otherwise glabrous, and concentration of setae at inner distal end. Tarsus uniformly covered with small setae, with interspersed large setae.

Legs: Femora 0.88, 1.81, 0.86, 1.32; patellae 0.40, 0.70, 0.35, 0.53; tibiae 0.83, 1.68, 0.81, 1.09. Legs noticeably shorter than in other Monoscutidae. Femora, patellae and tibiae of all legs denticulate except leg II, which has only femur denticulate. Tibia II not divided into pseudosegments.

Penis: Glans bent dorsad to shaft, stylus slightly anteriad from vertical. Bristle groups on left smaller than right, with left anterior group very reduced.

Female: Prosoma length 1.0, total body length 2.94, width 1.84. Features as for male except for following. Mottled medium- and yellow-brown with darker median crucifix-shaped marking on opisthosoma from first to fourth segments, with "cross-bar" on third segment.

Chelicerae: Segment I 0.43, segment II 0.96. Chelicerae smaller than in male; no row of enlarged denticles on segment I.

Pedipalps: Femur 0.74, patella 0.33, tibia 0.40, tarsus 0.95.

Legs: Femora 0.95, 1.87, 0.84, 1.34; patellae 0.45, 0.76, 0.41, 0.54; tibiae 0.68, 1.97, 0.86, 1.18.

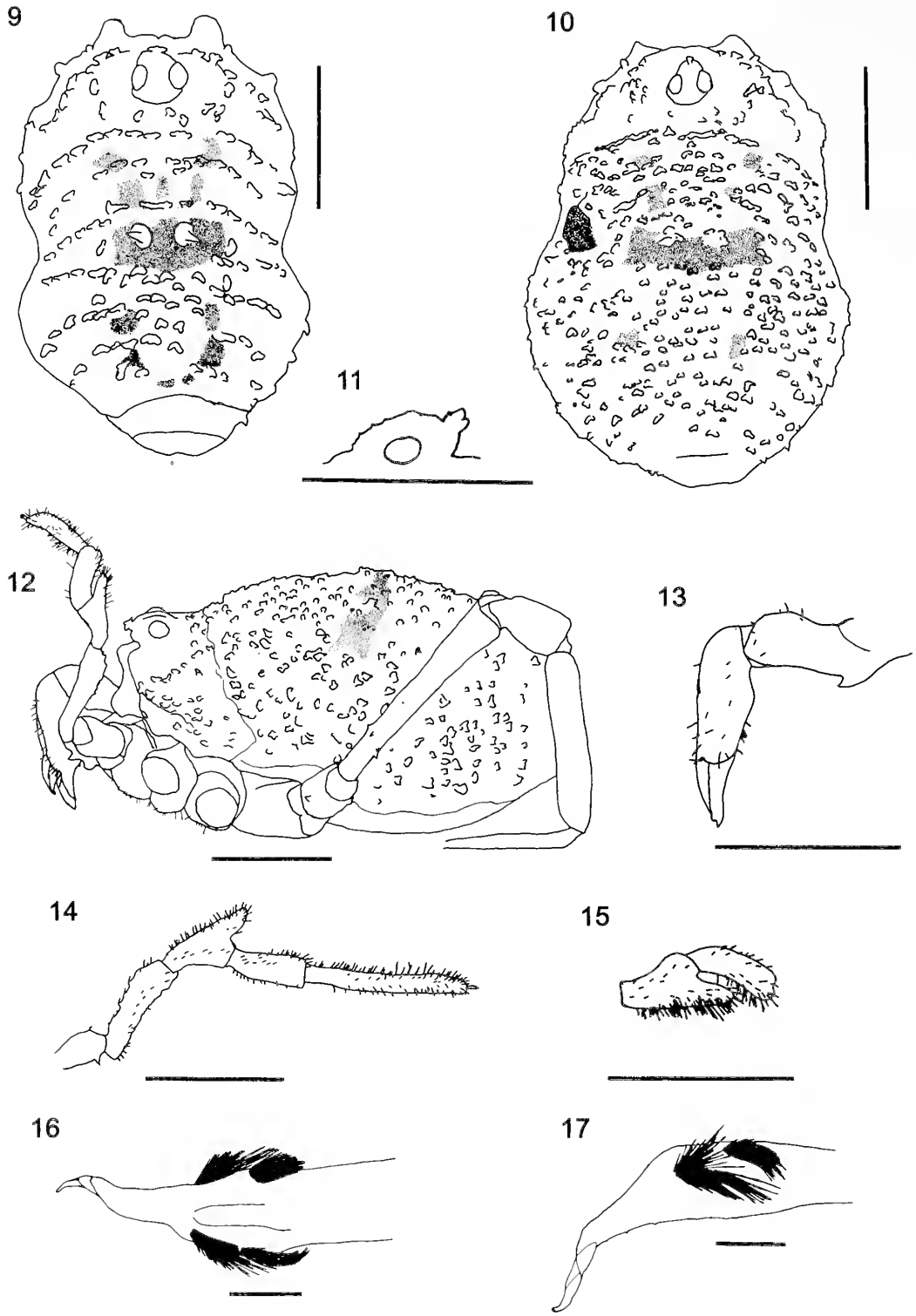
Remarks.—Though I was originally reluctant to establish a new genus for this species, and so leave Monoscutinae with three species in as many genera, *Templar incongruens* differs at least as much from either *Monoscutum titirangiense* and *Acihasta salebrosa* as they differ from each other, if not more so. As mentioned above, *Templar* is not entirely congruent with the original description of Monoscutinae by Forster (1948), but is placed in that subfamily pending a proper phylogenetic analysis of the Monoscutidae as a whole.

Due to insufficient specimens, it cannot be established at present whether the differences in color pattern described for the male and female represent differences between the sexes or simply differences between individuals. Unfortunately, the male genitalia were lost after examination.

Monoscutum Forster 1948

Monoscutum Forster 1948:314.

Type species.—*Monoscutum titirangiense* Forster 1948, by original designation.



Figures 9–17.—*Monoscutum titirangiense* Forster: 9. Dorsal view, male (AMNZ 60921). 10. Dorsal view, female (AMNZ 61458); 11. Female eye mound, lateral view (AMNZ 61459); 12. Lateral view, female (AMNZ 61458); 13. Female chelicera, lateral view (do.); 14. Female pedipalp, lateral view (AMNZ 61459); 15. Patella and tibia, female pedipalp, dorsal view (do.); 16. Penis, ventral view (AMNZ 61121); 17. Penis, lateral view (do.) Scale bars = 1 mm (Figs. 9–15), 0.01 mm (Figs. 16, 17).

Remarks.—No further species of *Monoscutum* have been described since *M. titirangiense*. *Monoscutum* is distinguished from both *Acihasta* and *Templar* by the complex ornamentation covering the dorsum, and also from *Acihasta* by the absence of flanking spines on the opisthosoma.

Monoscutum titirangiense Forster 1948
(Figs. 9–16)

Monoscutum titirangiensis [sic] Forster 1948:314–315, figs. 1–4.
Monoscutum titirangiense Forster: Šilhavý 1970:173.

Material examined.—NEW ZEALAND: North Island: Auckland: syntypes 1 ♂, 1 ♀: Titirangi, 36°56′S, 174°39′E, 12 December 1945, R. Forster (Tube 2/60) (MONZ AH.000076).

Other material examined: NEW ZEALAND: Auckland: 1 ♂, Atuanui, Mt Auckland, 36°27′S, 174°28′E, February 2002, A. Warren (AMNZ 60921); 6 ♂, 2 ♀, Atuanui, Mt Auckland, January 2002, A. Warren (AMNZ 61121); 1 ♀, Mataitai Forest S[outh?] A[uckland?], 39°59′S, 175°08′E, February 2002, A. Warren (AMNZ 61458); 1 ♀, Mataitai Forest S. A., February 2002, A. Warren (AMNZ 61459); ♂, Atuanui, Mt Auckland, February 2002, A. Warren (AMNZ 61795); 1 ♀, Atuanui, Mt Auckland, April 2002, A. Warren (AMNZ 61796); 1 ♂, 1 ♀, Atuanui, Mt Auckland, April 2002, A. Warren (AMNZ 61805); 1 ♂, Mataitai Forest S. A., March 2002, A. Warren (AMNZ 61960); 2 ♀, Mataitai Forest S. A., March 2002, A. Warren (AMNZ 61968); 1 ♀, Atuanui, Mt Auckland, April 2002, A. Warren (AMNZ 61997).

Description.—*Male:* Prosoma length 0.94 (0.07), total body length 3.13 (0.09), width 1.95 (0.09). Uniformly brown with dark brown saddle around central opisthosomal spines, small lateral darker patches in front of saddle and lighter median area behind saddle. Dorsum fused except for final two segments of opisthosoma; bearing multiple complex denticles, generally with short central column and two lateral projections, though individual denticles may be more or less irregular in form. Denticles on carapace roughly in rows along lateral and posterior margins of carapace, as well as directly behind and on either side of ocularium. Ocularium with single large anteromedian complex denticle with small lateral projections and enlarged central projection. Ozopores small, not obvious from above. Denticles on opisthosoma mostly in rows along segment boundaries. Two large median spines on third segment of opisthosoma. Extra denticles medially on two segments directly behind spines. Outermost denticle on three rows behind spines often shows reduction of medial branch and enlargement of lateral branch to form small laterally-projecting spine. Single such denticle on center of each side of first free segment.

Chelicerae: Segment I 0.40 (0.05), segment II 0.90 (0.03). No denticles on chelicerae. Second segment with anterior medial row of setae. Outer edges of fingers smoothly convex.

Pedipalps: Femur 0.74 (0.04), patella 0.38 (0.04), tibia 0.46 (0.03), tarsus 0.95 (0.03). Femur with row of spinose setae, bent distad, on inner dorsal edge; setae in rows on sides and centerline of femur, with concentration of setae at inner distal end. Patella with rows of setae on sides and centerline. Patellar apophysis triangular, about half as long as patella, directed at angle of about 45° from tibia, with scattered large setae. Tibia with rows of setae on sides, otherwise glabrous, and concentration of setae at inner distal end. Tarsus uniformly covered with small setae, with interspersed large setae.

Legs: Femora 1.35 (0.09), 3.26 (0.31), 1.28 (0.08), 2.15 (0.13); patellae 0.60 (0.07), 0.85 (0.09), 0.54 (0.12), 0.66 (0.03); tibiae 1.27 (0.12), 3.09 (0.19), 1.17 (0.09), 1.67 (0.10). Femora, patellae and tibiae of all legs with longitudinal rows of stout setae, no spines. Tibia II with four pseudosegments.

Penis: Glans bent dorsad to shaft, stylus directed anteriad from vertical. Left anterior bristle group not reduced.

Female: Prosoma length 1.13 (0.07), total body length 4.02 (0.26), width 2.14 (0.17). As for male, except for following. Generally more rugose, dentieles on opisthosoma more numerous and not arranged in any obvious pattern. Large median tubercles on third segment of opisthosoma irregular in form, rather than spines.

Chelicerae: Segment I 0.42 (0.07), segment II 1.01 (0.09).

Pedipalps: Femur 0.84 (0.06), patella 0.46 (0.04), tibia 0.53 (0.03), tarsus 1.09 (0.05). *Legs*: Femora 1.21 (0.05), 3.15 (0.26), 1.23 (0.15), 2.09 (0.12); patellae 0.60 (0.06), 0.89 (0.10), 0.60 (0.05), 0.71 (0.06); tibiae 1.20 (0.07), 3.00 (0.21), 1.08 (0.09), 1.63 (0.11).

Remarks.—The description given here differs somewhat from Forster's (1948) original. Despite the type vial containing specimens of both sexes, Forster's description is seemingly based on the male only (nevertheless, as the specimens are still conspecific, I do not designate a lectotype). Forster made no mention of the complex form of the denticles, and they appear rounded in his illustration. He also seems to have overlooked the distinct appearance of the female.

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SHORT COMMUNICATION

Notes on the distribution of *Berlandina nubivaga* with the description of the male (Araneae, Gnaphosidae)

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Abstract. Fourteen adult specimens of *Berlandina nubivaga* (Simon 1878) (two females and twelve males) were collected in Aosta Valley (NW Italy) by pitfall traps mostly placed in alpine pastures at about 2000 m elevation. The male is described and the palpal morphology is illustrated; a new drawing of the female internal genitalia is also given. The critical analysis of previous records suggests the distribution of *B. nubivaga* may be restricted to the Alps.

RIASSUNTO. Quattordici esemplari (due femmine e dodici maschi) di *Berlandina nubivaga* (Simon 1878) sono stati raccolti in Val d'Aosta (Italia nord-occidentale) con l'impiego di trappole a caduta collocate per lo più in pascoli intorno ai duemila metri di quota. Il maschio di questa specie risulta nuovo per la scienza: in questa sede viene quindi descritto illustrandone i caratteri sistematici salienti. Viene inoltre fornita una nuova illustrazione della vulva della femmina. L'analisi critica delle segnalazioni di *B. nubivaga* sembra suggerire che la distribuzione di questa specie sia ristretta alle Alpi.

Keywords: Ground spider, taxonomy, morphology, alpine spiders, Italy

During an ecological study focused on the impact of ski runs on alpine arthropod communities in Aosta Valley (NW Italy), fourteen specimens (two females and twelve males) of gnaphosids of the genus *Berlandina* Dalmas 1922 were found. Features of the female epigynum and internal genitalia identified the specimens as *Berlandina nubivaga* (Simon 1878), which is known from only few European localities. The male of this species is new to science; it is therefore described here for the first time and its palpal morphology is illustrated. A new drawing of the female internal genitalia is also given. Previous records from the Balkan Peninsula are doubtful; they are therefore analyzed critically in order determine the true distribution of this species.

METHODS

A stereoscopic binocular Wild M5 was used for the description. All measurements are in mm. The following abbreviations are used in the text: d = dorsal; v = ventral; pl = prolateral; rl = retrolateral; ALE = anterior lateral eyes; AME = anterior median eyes; PLE = posterior lateral eyes; PME = posterior median eyes.

Specimens are preserved in 75% ethanol and are lodged in Marco Isaia's collection at Turin University, Dipartimento di Biologia Animale e dell'Uomo (DBAU) and in the collection of Museo Civico di Storia Naturale "E. Caffi", Bergamo, Italy (MCSN).

TAXONOMY

Family Gnaphosidae Pocock 1898
Genus *Berlandina* Dalmas 1922

Type species.—*Gnaphosa plumalis* O. Pickard-Cambridge 1872, by original description.

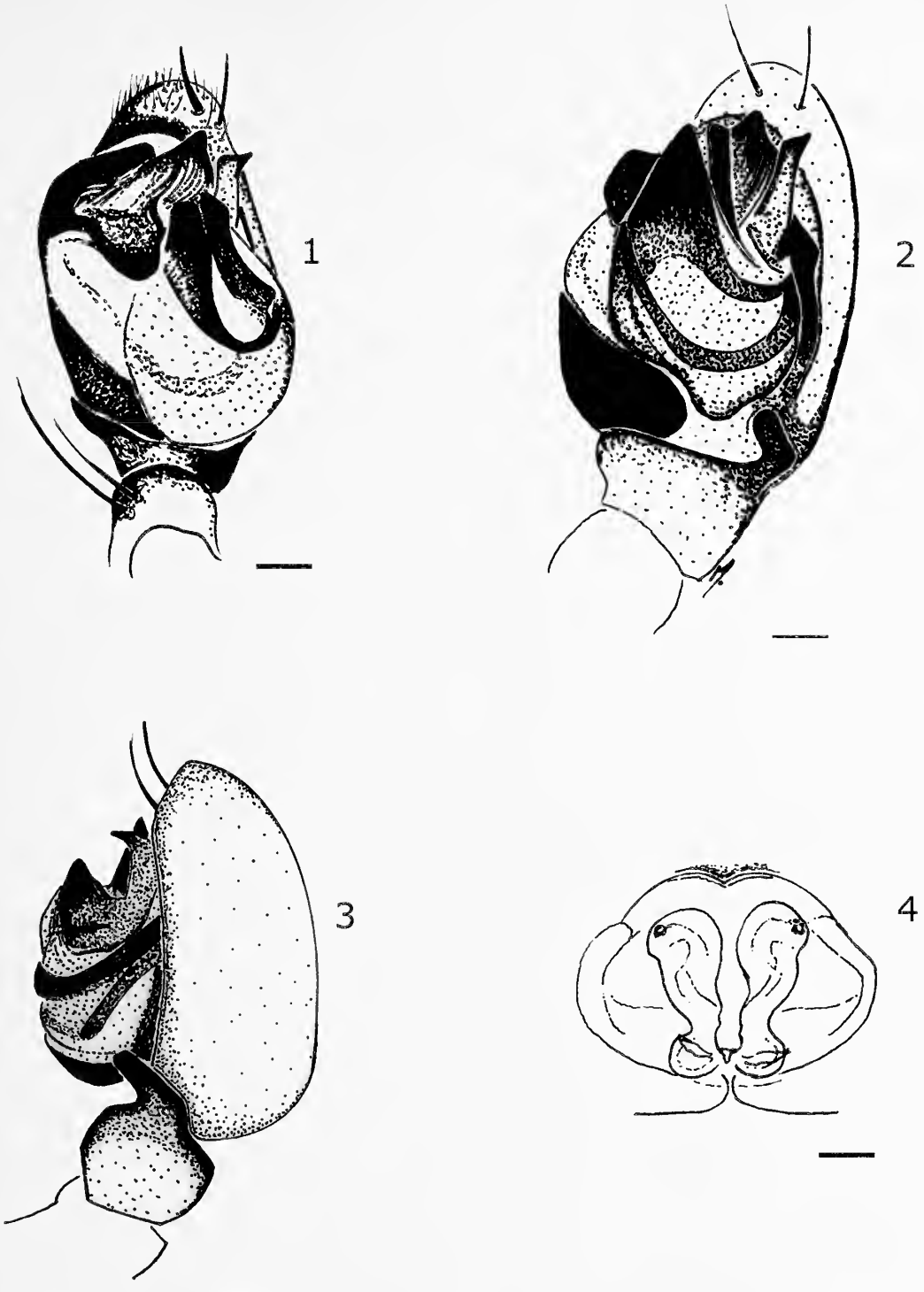
Berlandina nubivaga (Simon 1878)
Figs. 1–4

Pythonissa nubivaga Simon 1878:197.
Pterotricha nubivaga (Simon): Simon 1914:190, 222.
Berlandia nubivaga (Simon): Dalmas 1921:274, fig. 50.

Material examined.—ITALY: *Aosta Valley*: 12 ♂, 2 ♀, Torgnon, pitfall traps, 16–30 June 2006, M. Negro A. Rolando (10 ♂, 1 ♀ in DBAU; 2 ♂, 1 ♀ in MCSN).

Diagnosis.—Opisthosoma dark brown, dorsally and distally marked with blackish chevron-like stripes. Spinnerets blackish. Scutum small. Scopula of tarsus and metatarsus I and II slightly developed. Palpus with relatively small tibial apophysis, short and bent ventrally. Embolus distally triangular, bearing several sclerotized rims on its surface.

Description.—*Male:* Prosoma and opisthosoma dark brownish, dorsally with blackish chevron-like stripes. Opisthosoma laterally with two dark bands, starting below the middle and ending close to spinnerets. Spinnerets blackish, with three spigots. Scutum present, small. Anterior eyes in a procurved row (frontally), posterior row recurved (from above). AME smaller than ALE, PME very small. Chelicerae without lateral condyle. Inferior margin of chelicera with serrated keel, anteriorly with several strong bristles. Leg spination: tarsus I–IV: absent; metatarsus I–II: 4 v (in two longitudinal rows at side, with two spines each); metatarsus III: 6 d, 3 v, 3 rl, 2 pl; metatarsus IV: 5 d, 5 v, 5 pl, 4 rl; tibia I: 5 v (in two longitudinal rows at side, 2 prolaterally, 3 retrolaterally); tibia II: 4 v (in two longitudinal rows at side, 1 prolaterally, 3 retrolaterally); tibia III: 5 d; 6 v, 4 rl, 4 pl; tibia IV: 4 d, 6 v, 4 rl, 4 pl; patella I–II: absent; patella III: 2 d (nearly pl), 1 rl; patella IV: 1 d (nearly pl), 1 rl; femur I–II: 3 d, 1 pl (distal); femur III–IV: 3 d, 2 pl, 2 rl. Scopulae on tarsus and metatarsus I–II present, only slightly developed. Tarsal claws with seven teeth. Male palp (Figs. 1–3): cymbium oval, with mat of dense bristles dorsally and apically, tibial apophysis relatively small, short and bent ventrally, ending in a sub-rectangular blade-like process. Bulbus apically armed with three laminae (sensu Levy 1999): a retro-lateral one, slender and directed outward; median and ventral ones separated by transparent membranous lamella. Embolus distally triangular, bearing several sclerotized ridges on its surface. Measurements of illustrated male (in millimeters): total length (without spinnerets) 6.00; prosoma length 4.67; prosoma width 2.26; opisthosoma length 3.00; opisthosoma width 1.93; clypeus 0.23; chelicera 0.70; fangs 0.17; distance between eyes: AME–AME 0.14, AME–ALE 0.11, PME–PME 0.16, PME–PLE 0.13; ALE–ALE 0.30, PLE–PLE 0.47. Leg I: femur 1.61, patella 0.81, Tb 1.16, metatarsus 0.81, tarsus 0.84, total leg length 5.23; Leg II: femur 1.26, patella 0.71, Tb 0.81, metatarsus 0.84, tarsus 0.90, total leg length 4.52; Leg III: femur 1.35, patella 0.71, Tb 0.81, metatarsus 1.10, tarsus 0.97, total leg length 4.94; Leg IV: femur 1.81, patella 0.87, Tb 1.35, metatarsus 1.94, tarsus 1.13, total leg length 7.10.



Figures 1–4.—*Berlandina nubivaga* (Simon 1878) (hair omitted): 1. Left male palp, ventral view; 2. Left male palp, ventrolateral view; 3. Left male palp, lateral view; 4. Vulva of the female, *adnexae*, dorsal view. Scale lines = 0.1 mm for all illustrations.

Remarks.—The female was identified using the descriptions by Simon (1878, 1914) and the illustrations by Grimm (1985) and de Dalmas (1921). A new illustration of the vulva is given (Fig. 4). Considering the shape of the embolus in the drawings of the male palp by Grimm (1985) and de Dalmas (1921), the species could be considered close to *B. cinerea* (Menge 1872) (Europe to Kazakhstan - not UK - Italy and eastern Mediterranean) and to *B. punica* (Dalmas 1921) (Algeria, Tunisia, Libya) (distributions after Platnick 2007).

Habitat and distribution.—Specimens were collected by pitfall traps situated primarily in alpine pastures at an average elevation of 1950 m with prevalent southern and eastern aspect (see next section). The speeies is known from a few localities in the French Alps (holotype from Hautes Alpes, Col de l'Echelle: Musèe d'Histoire Naturelle, Paris) (Simon 1878), and in Switzerland (Wallis, Saas-Fee: coll. Wunderlich; Wallis, Fiesch: Naturhistorisches Museum, Berlin) (all information from Grimm 1985). *B. nubivaga* is recorded from Italy by

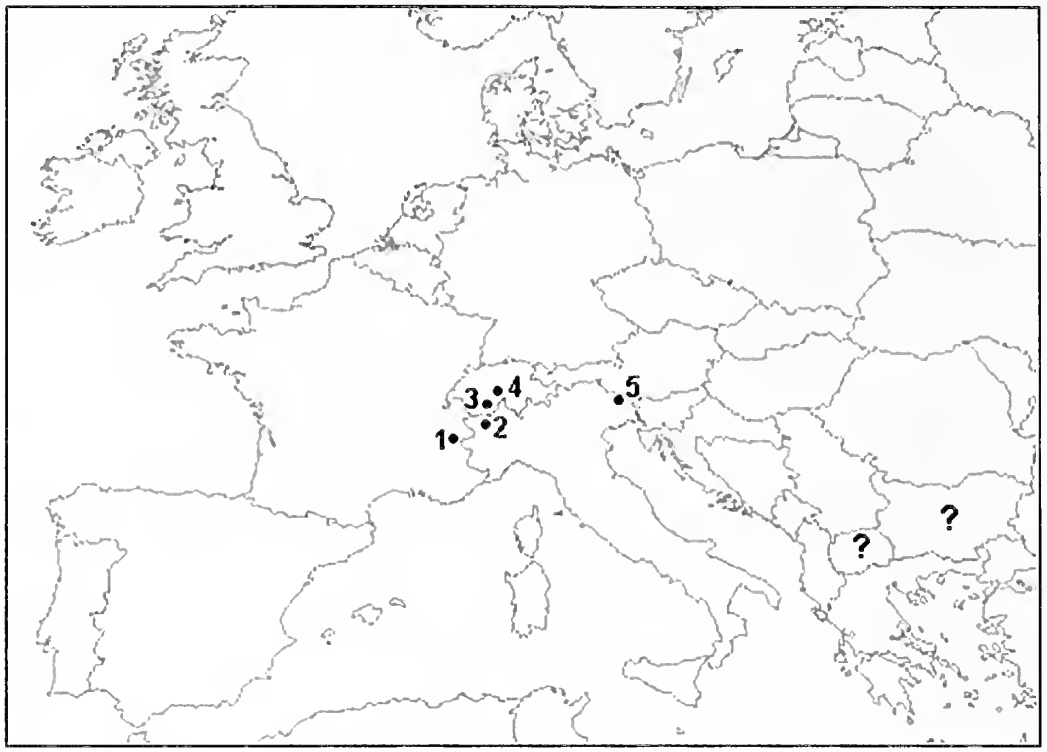


Figure 5.—Distribution—of *Berlandina nubivaga* (Simon 1878); dots refer to known localities. 1. F - Hautes Alpes, Col de l'Echelle; 2. I - Aosta Valley, Torgnon; 3. CH - Wallis, Saas- Fee; 4. CH - Wallis, Fiesch; 5. I – Province of Udine, Forno Avoltri; (1 after Simon 1878; 3, 4 after Grimm 1985; 5 after di Caporiacco 1926). Question marks refer to doubtful records in Macedonia and Bulgaria (see text). [Map taken from http://www.planiglobe.com accessed April 13, 2007, enhanced and elaborated with Photoshop 7.0 (Adobe Systems Incorporated)].

Pesarini (1995), di Franco (1997), and Trotta (2005) supposedly after the records published by Caporiacco (1926) who identified one female and one male (not described) from Carnic Alps (province of Udine, Forno Avoltri, ric. Marinelli, elev. 2122 m). This material was unfortunately not checked by us nor by Grimm (1985). The species is also recorded for Bulgaria (Drensky 1915, 1936 in Deltshev & Blagoev 2001) and Macedonia (Nikoliæ & Blagoev 2002, in Blagoev 2002). Literature records referring to *B. nubivaga* from Bulgaria (Drensky 1915, 1936; Nikoliæ & Polenec 1981) are unverifiable. A section of the Museum and a part of the Drensky's collection in which the assumed specimens of *B. nubivaga* were stored, were destroyed during the war (Deltshev 2007, pers. comm.). According to Deltshev (2007 pers. comm.), *B. nubivaga* does not occur in the Balkan Peninsula, and relevant misidentification is found in Drensky's collection. The same doubtful situation concerns *B. nubivaga* in Macedonia, for which no material is available. Deltshev's opinion is shared by T. Blick (2007, pers. comm.) who asserts that the only sure data are those from the western Alps. The record by Caporiacco (1926) from the eastern Alps seems to be plausible (Pantini 2007, pers. comm.) but needs confirmation. All in all, present reliable data seem to suggest that the distribution of *B. nubivaga* is restricted to the Alps. However, more records are needed to sustain this hypothesis.

Details of sampling stations.—(Number of specimens in parentheses); habitat; elevation; UTM coordinates; % soil cover of an area of 20m radius centered on the pitfall trap; additional species (number of specimens in parentheses). Sampling station 1: (1 ♂) Ski slope; 1956 m; UTM 32T3869155073792; S-SE; 80% grass, 10% stones, 10% bare ground; *Alopecosa aculeata* (Clerck 1757) (1); *Pardosa blanda* (C.L. Koch 1833) (72). Sampling station 2. (1 ♂) Larch wood; 2017 m; UTM 32T3868335074188; S; 80% shrubs, 20% grass; *Alopecosa aculeata* (Clerck 1757) (1), *Drassodes cuprens* (Blackwall 1834) (1), *Haplodrassus signifer* (C.L. Koch 1839) (2).

Sampling station 3: (1 ♂) Larch wood; 1995 m; UTM 32T3869205074160; S-SE; 50% grass, 50% shrubs; *Aelurillus v-insignitus* (Clerck 1757) (1), *Alopecosa aculeata* (Clerck 1757) (1), *Drassodes cuprens* (Blackwall 1834) (2), *Haplodrassus signifer* (C.L. Koch 1839) (2), *Haplodrassus umbratilis* (L. Koch 1866) (1), *Pardosa blanda* (C.L. Koch 1833) (1), *Xerolycosa nemoralis* (Westring 1861) (1), *Zelotes talpinus* (L. Koch 1872) (2). Sampling station 4: (2 ♂♂) Alpine pasture; 1912 m; UTM 32T3870345073985; SE; 100% grass; *Alopecosa accentuata* (Latreille 1817) (2), *A. cuneata* (Clerck 1757) (2), *Drassodes cuprens* (Blackwall 1834) (3), *Haplodrassus signifer* (C.L. Koch 1839) (2), *Pardosa bifasciata* (C.L. Koch 1834) (1), *P. blanda* (C.L. Koch 1833) (12), *P. mixta* (Kulczyn'ski 1887) (4), *P. palustris* (Linnaeus 1758) (8), *P. riparia* (C.L. Koch 1833) (1), *Xerolycosa nemoralis* (Westring 1861) (4). Sampling station 5: (1 ♂) Alpine pasture; 1937 m; UTM 32T3885185075228; N; 100% grass; *Alopecosa cuneata* (Clerck 1757) (1), *Arctosa figurata* (Simon 1876), *Drassodes cuprens* (Blackwall 1834) (3), *Pardosa bifasciata* (C.L. Koch 1834) (1), *P. mixta* (Kulczyn'ski 1887) (4), *Zelotes* sp. (2). Sampling station 6: (1 ♂) Edge wood-pasture; 1902 m; UTM 32T3871905074040; E; grass 100%; *Drassodes cuprens* (Blackwall 1834) (3), *Xysticus nimni* Thorell 1872 (1), *Haplodrassus signifer* (C.L. Koch 1839) (3), *Pardosa blanda* (C.L. Koch 1833) (10), *Alopecosa cuneata* (Clerck 1757) (1), *Zelotes electus* (C. L. Koch 1839) (1). Sampling station 7: (2 ♀, 5 ♂♂) Alpine pasture; 1915 m; UTM 32T3872275074229; E; 85% grass, 15% stones; *Alopecosa aculeata* (Clerck 1757) (3), *Arctosa renidescens* Buchar & Thaler 1995(1), *Drassodes cuprens* (Blackwall 1834) (2), *D. pubescens* (Thorell 1856) (1), *Haplodrassus signifer* (C.L. Koch 1839) (4), *Micaria fulgens* (Walckenaer 1802) (1), *Pardosa blanda* (C.L.

Koch 1833) (28), *P. palustris* (Linnaeus 1758) (1), *Steatoda phalerata* (Panzer 1801) (2), *Xysticus gallicus* (Simon 1875) (2), *X. ninni* Thorell 1872 (2).

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SHORT COMMUNICATION

Leiobunum nigripes is a junior synonym of *Leiobunum verrucosum* (Opiliones, Sclerosomatidae)

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Abstract. Two nominal species of harvestmen from eastern North America, *Leiobunum verrucosum* and *L. nigripes*, are generally distinguished by color patterns. However, laboratory-reared individuals and sequential sampling in the field clearly show that adult individuals change from the "*verrucosum*" pattern to the "*nigripes*" pattern during normal maturation. Specimens of the two nominal species were obtained from the original H. C. Wood and C. M. Weed collections and found to be effectively identical in all diagnostic details. *Leiobunum nigripes* is a junior synonym of *L. verrucosum*.

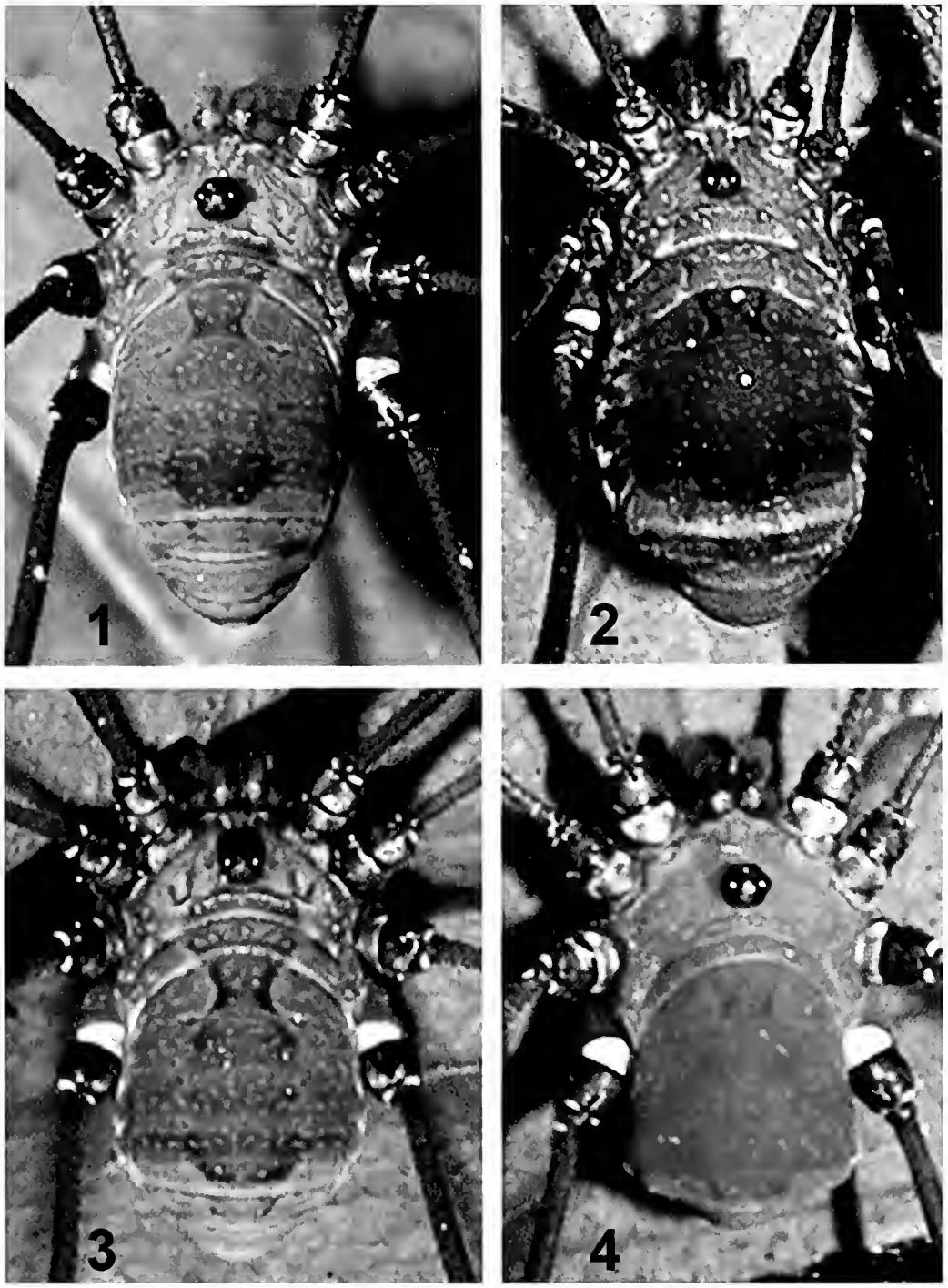
Keywords: North America, harvestmen, taxonomy

For several years, I have reared Maryland harvestmen in the laboratory and noted that newly molted adults of one species have a coloration that is considered typical of *Leiobunum verrucosum* (Wood 1868) and then gradually develop coloration typical of *Leiobunum nigripes* Weed 1892 (compare descriptions within Davis 1934; Bishop 1949; Edgar 1966, 1990). The color change is substantial in both sexes and is associated with cuticular hardening. Males and females are similar at first (Figs. 1, 3): the postocular carapace and scutum have a dark median figure with transverse rows of light spots, the remainder of the dorsum is a mottled golden brown, the venter is nearly white, and the pedal femur and tibia tend to have dark bands at their distal ends. As the males age, the golden-brown dorsum and white venter are replaced by a largely uniform orange to reddish-brown (somewhat lighter ventrally) color pattern, and the dorsal median figure is eliminated except for slight indications at its anterior and posterior extremes (Fig. 4). The legs also darken and thereby eliminate the banding. The dorsal surface of the females becomes a dark brown but the venter retains a light cream color and a light transverse band appears along the posterior margin of the scutum. The central figure is also reduced, but not as severely as in the males, and the legs also darken (Fig. 2). These observations prompted me to investigate the possibility that *L. nigripes* is actually a junior synonym of *L. verrucosum*.

Wood's (1868) original description of *Phalangium verrucosum* was based on male specimens of unknown origin. He described the specimens as having a sacculate ("alate") penis, black ocularium with two rows of stout denticles, evidence of a median dorsal figure behind the ocularium, a brown dorsum and light gray venter, dark trochanters and reddish-brown legs. The fate of Wood's type specimens is unknown, but my inspection of his surviving material maintained at the Academy of Natural Sciences in Philadelphia revealed a vial of four poorly preserved specimens labeled by Wood as *P. verrucosum* collected in Washington, D.C. All evidence of original coloration is now absent in these specimens, but the cuticle is well-enough preserved to show those features characteristic of the species now most commonly called *L. nigripes*, including 1) sacculate penis; 2) labrum with arrowhead-shaped terminus; 3) ocularium with two rows of short, stout denticles; and 4) pedal coxae I and IV with strong anterior rows of denticles (absent or weak in coxae II and III) and coxa I–IV with strong posterior rows of denticles.

Weed (1892) recorded specimens from Illinois and Ohio, which he originally identified as *L. verrucosum* (Weed 1887, 1889a, 1889b, 1890; see also Cokendolpher & Zeiders 2004). However, he also obtained two specimens from Queens County, New York from the eminent entomologist Nathan Banks, who had apparently identified the specimens as *L. verrucosum*. Significantly, Weed followed Banks (e.g., Banks 1901) in characterizing *L. verrucosum* as having a tapered abdomen, although Woods' specimens have truncated abdomens. The differences between Banks's specimens and those from Illinois and Ohio led Weed (1890) to propose a new species, *L. nigripes,* for the midwestern material. However, it is likely that the New York specimens were actually immatures of a now-unidentifiable species. This conclusion is based on the facts that Weed (1) simply quoted Wood's genitalic description of *L. verrucosum*, (2) assigned sexes to the two specimens based on relative body size rather than details of genitalia or palpal morphology, and (3) illustrated the palp with a pronounced patellar apophysis (Weed 1890, pl. VI, fig. 2k), a feature typical of immature *Leiobunum* and adult females of a few New York species (e.g., *L. calcar*, *L. nigropalpi*, *L. vittatum*). Thus, it is likely that misidentification by Banks led Weed to change an initially correct identification of the midwestern specimens and to propose a new species. My examination of the male lectotype and four male paralectotypes of *L. nigripes* from Weed's original collection revealed no significant differences with specimens of *Phalangium verrucosum* from the Wood collection. I conclude that *Leiobunum nigripes* and *L. verrucosum* are the same species.

Workers following Weed continued to recognize two species and to cite coloration as the key diagnostic character. For example, Davis (1934) acknowledged the substantial similarity of *L. verrucosum* and *L. nigripes*, noting that "Young adults of [*L. nigripes*] have a brown dorsum and a yellowish white venter which makes them readily confused with *L. verrucosum*. The legs, however, are not shaded distally in *L. nigripes*" (Davis 1934:682). The last statement is patently ineorrect and is, in any case, a rather trivial difference on which to base separation of species. Bishop (1949) did not compare the two species directly but cited no significant differences other than color and perhaps a more southerly distribution for *L. verrucosum*. Interestingly, a southeastern species, *L. formosum* (Wood 1868), may have contributed to confusion, because its somatic morphology and coloration are remarkably similar to those of *L. verrucosum* and even changes color during the adult stage. Specimens obtained from pitfall traps in southeastern Virginia, where ranges of *L. verrucosum* and *L. formosum* overlap, show that *L. verrucosum* passes through the "*verrucosum*-to-*nigripes*" color change during May and that *L. formosum* passes through a very similar color series during mid- to late July, although it retains the distally shaded leg segments.



Figures 1–4.—Comparison of typical coloration of early adult and late adult *Leiobunum verrucosum* from Maryland. 1. Early adult female. 2. Mature adult female. 3. Early adult male. 4. Mature adult male.

Misidentification of immature *L. formosum* as *L. verrucosum* may have contributed to Bishop's supposition that *L. verrucosum* is a southern species.

In summary, the name *L. nigripes* Weed 1889 should be regarded as a junior synonym of *L. verrucosum* (Wood 1868). Males of *L. verrucosum* are readily separated from other *Leiobunum* species of eastern North America by the following combination of characters: (1) sacculate penis; (2) labrum with arrowhead-shaped tip; (3) dark ocularium and pedal trochanters, which contrast with the dorsum and coxae; and (4) absence of terminal white banding on all leg segments. Females of *L. verrucosum* may be distinguished from those of most other *Leiobunum* species in that the femur of leg I is shorter than the length of the body and the troehanters and ocularium are dark and contrast with dorsum and pedal coxae. However, these features alone cannot be regarded as diagnostic, and this highlights the persistent need for a more thorough study of female characters in the genus.

Material examined for this study are lodged in the following institutions: Academy of Natural Sciences, Philadelphia (ANS); Illinois Natural History Survey, Champaign (INHS); National Museum of Natural History, Smithsonian Institution, Washington

D.C. (NMNH); Shultz Collection, University of Maryland, College Park (UMD); Virginia Museum of Natural History, Martinsville (VMNH).

Family Sclerosomatidae Simon 1879
Genus *Leiobunum* C. Koch 1839

Type species.—*Phalangium rotundum* Latreille 1798, by subsequent designation of Simon (1879:172)

Leiobunum verrucosum (Wood 1868)
Figs. 1–4

Phalangium verrucosum Wood 1868:29, 1 fig.
Liobunum verrucosum (Wood): Weed 1887:935; Weed 1889:88; Weed 1892:189–190, pl. VI.
Leiobunum verrucosum (Wood): Roewer 1910:217; Roewer 1923:898–899; Davis 1934:695–696, fig. 9; Bishop 1948:209–211, pl. 7, figs. 97–100; Edgar 1966:355, 364.
Liobunum nigripes Weed 1892:190–191, pl. VII, figs. 1, 2. **New synonymy.**
Leiobunum nigripes Weed: Roewer 1910:220–221; Roewer 1923:900; Davis 1934:681–682, fig. 26; Bishop 1949:198–199, pl. 5, figs. 65–68; Edgar 1966:355, 362; Katayama & Post 1974:18.

Type material examined.—*Leiobunum nigripes*: USA: *Illinois*: Champaign County: male lectotype, woods near Urbana, 40.1°N, 88.2°W, 8 July 1887 (INHS: #00882). Paralectotypes: 1 female, Urbana, 40.1°N, 88.2°W, 21 June 1887 (INHS: #00883); 1 male, woods near Urbana, 40.1°N, 88.2°W, 8 July 1887 (INHS: #00884); 1 female (INHS: #00885), Urbana, 40.1°N, 88.2°W, University Farm, among boards about farm, 23 June 1887; *Ohio*: Clermont County: 2 males: ca. 39°N, 84°W, August 1890 (NMNH).

Other material examined.—USA: *Maryland*: many specimens, Howard County, Columbia, Gorman Park, 39.165°N, 76.875°W, May–August 2004–2006, J.W. Shultz (UMD); many specimens, Montgomery County, Patapsco State Park, 39.253°N, 77.080°W, May–August 2004–2006, J.W. Shultz (UMD); many specimens, Prince Georges County, College Park, University System of Maryland Building, 39.004°N, 76.953°W, May–August 2004–2006, J.W. Shultz. *Mississippi*: 1 ♂, 2 ♀, Noxubee County, Noxubee NWR, Check Station, 33.2747°N, 88.7948°W, 2 August 2007, P. Miller, G. Stratton; 2 ♂, 1 ♀, Layfayette County, 1 mi [1.65 km] SW Abbeville, 34.489°N, 89.510°W, 4 August 2007, P. Miller, G. Stratton (UMD). *Ohio*: many males and females, Summit County, Bath Nature Preserve, 41.177°N, 81.642°W, 30 June 2005, J.W. Shultz (UMD). *Pennsylvania*: Bucks County: 5 ♀, Rushland, Coyne Farm, malaise trap, 40.250°N, 75.044°W, 31 May–5 June 1998, H.O'Connor (ANS); 4 ♂, 4 ♀, same data except 6–14 June 1998 (ANS); 4 ♀, same data except 24 June–10 July 1998 (ANS); many males and females, Bucks County, same data except 21 July–5 August 1998. *Virginia*: 6 ♂, 9 ♀, Clarke County, Blandy Experimental Farm, ca. 3 mi [4.8 km] S. of Boyce (39.06°N, 79.06°W), malaise trap, 2 July 1991, D.R. Smith (VMNH); 5 ♂, 4 ♀, same data except 25 April 1999 (VMNH); many males and females, Accomack County, Assateague Island, Chincoteague NWR, White Hills, 0.64 km N. of toll booths, 37.93°N, 75.33°W, 24 July–11 August 1998, VDNH survey (VMNH): 3 ♀, Northampton County, Savage Neck Natural Area Preserve, 37.33°N, 76.00°W, interdunal pond, 24 June–28 July 1999, A. Chazal, A. Foster (VMNH); 1 ♂, 5 ♀, Fluvanna County, Kents Store, 37.879°N, 78.129°W, Bell drift fence site, 24 July 1996, Molly Bell (VMNH). *District of Columbia*: 3 ♂, Washington, D.C., "District of Columbia," 39°N 77°W, no date or collector (ANS).

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SHORT COMMUNICATION

Relevance of collected juveniles to the analysis of spider communities

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Abstract. Spider field collections often consist of a high percentage of immature specimens that are not identifiable to species; in many studies these juveniles are discarded and not used in analyses. To evaluate if this practice affects the results of a community study, we sampled foliage-dwelling spiders in two habitats, reared the collected immature spiders until maturity, and identified them to species. We tested if measurements of species richness, evenness, and assemblage composition changed with the exclusion of data from immature specimens by analyzing two datasets: one including mature spiders only, the other including both mature and immature spiders (complete dataset). Nine of the total 49 spider species were collected only as juveniles, but only one of these nine species, *Philodromus praelustris* Keyserling 1880, was common (≥ 10% of collection). The distribution of individuals among species was more even in the complete dataset than the mature-only dataset, which could either indicate differences in composition or reflect sampling effort. However, species richness estimates were similar regardless of dataset, and there were only small changes in species composition of the samples between datasets, suggesting that there were not important compositional differences between the samples in each dataset. The inclusion of immature spiders in the data in this study yielded the same results that would occur with increased sampling effort.

Keywords: Immature spiders, rearing, biodiversity

In community studies, field collections of spiders often have a high proportion of immature spiders as compared to mature spiders: the percentage of juveniles may reach over 80% of the individuals collected (Brierton et al. 2003; Samu et al. 1997). As a result, the number of spiders that are identified to genus or species level varies; in some studies 70–80% of all specimens are identified (Bostanian et al. 1984; Olszak et al. 1992a, 1992b; Brierton et al. 2003), whereas in others the number is as low as 20% (Mason et al. 1997; Samu et al. 1997). The accuracy to which an immature spider is identified to genus or species often depends on its family: Linyphiidae, Dictynidae, Clubionidae, and some Salticidae are more rarely identified to species when collected as juveniles in foliage studies (Bostanian et al. 1984; Olszak et al. 1992b; Mason et al. 1997), while Araneidae and Thomisidae juveniles can be identified more easily because of distinct physical markings (Jiménez-Valverde & Lobo 2006).

The composition of the mature spiders in an assemblage may differ from the composition of the assemblage that includes both immature and mature individuals owing, for instance, to differential phenologies (time of maturity) or mortality rates across species. Thus the exclusion of unidentified immature spiders may affect the results of analyses, both within one habitat (Jiménez-Valverde & Lobo 2006) and when comparing assemblages between habitats.

We used a study comparing spiders in orchards and adjacent deciduous forest (Sackett et al. In press) to test if the results of analyses change with the inelusion or exclusion of immature spider specimens in the data. After the collection of foliage-dwelling spiders, we reared the juveniles until maturity to allow species level identification. We analyzed two datasets: one with only spiders colleeted as mature individuals ("mature-only" dataset), and the other also containing the extra data obtained from the rearing and identification of immature spiders ("complete" dataset). The parameters of species richness, evenness, and community composition were calculated using each dataset and the results from the analyses were compared.

The collections of foliage-dwelling spiders were from four apple orchards and adjacent deciduous forests, sampled on three to five occasions from May to August 2004. Three orchards (A, B, and C) were in Frelighsburg (45°03′N, 72°50′W), Québec, on an Agriculture and Agri-Food Canada experimental farm. These orchards and their adjacent forests were sampled on 17–19 May, 7–8 June, 30 June–3 July, 19–22 July, and 9–11 August. Orchard D was an organic commercial orchard in Mt. St. Hilaire (45°31′N, 73° 09′W), Québec, and this orchard and its adjacent forest were sampled during the last three sampling periods listed above. No insecticides had been used in any of the orchards for at least nine years. Apple trees and forest foliage were sampled by beating branches over a 1-m^2 collecting sheet. In the Frelighsburg orchards we sampled trees from the two outer rows: 16 apple trees, 5 branches per tree, whilst in the Mt. St. Hilaire orchard we sampled interior trees, not edge trees, due to constraints from other research projects. In the adjacent forest, we sampled the foliage of two 5-m blocks along the edge (1 m into the forest).

To include as many immature specimens as possible in the complete dataset, we used two strategies to identify these individuals. Some species were identified even when immature from non-reproductive characteristics: *Araniella displicata* (Hentz 1847), *Enoplognatha ovata* (Clerck 1757), *Philodromus rufus vibrans* Dondale 1964, *Misumena vatia* (Clerck 1757) and *Tmarus angulatus* (Walckenaer 1837). Other immature spiders were reared individually in the laboratory on a diet of live *Drosophila* until reproductively mature and then identified. To inerease rearing success during the latter portion of the study, the *Drosophila* were fed diet supplemented with ground dog food (Nutro: Natural Choice, Nutro Products Inc., California); the spiders were also fed various insects collected from outdoors. Spider nomenclature followed that of Platnick (2007), and vouchers were deposited in the Lyman Entomological Museum of McGill University (Ste.-Anne-de-Bellevue, Québec).

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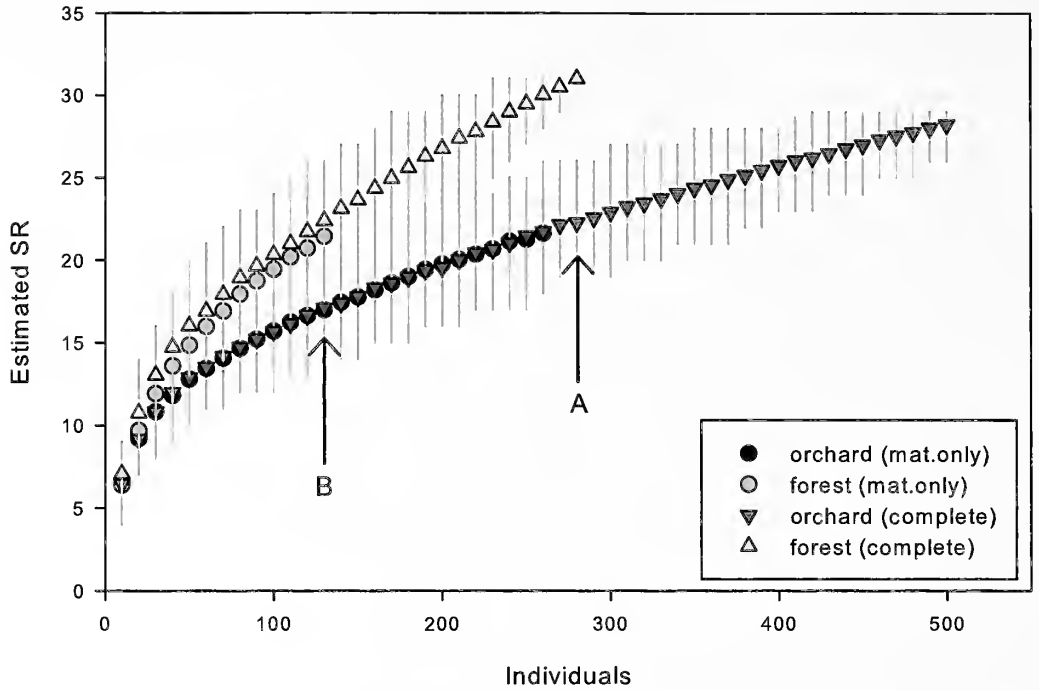

Figure 1.—Individual-based rarefaction curves depicting estimated spider species richness (SR) (± 95% confidence intervals) for orchard and forest habitats in southern Québec using complete and mature-only ("mat.only") datasets. Arrows indicated species richness at which orchard and forest was compared for complete dataset (A) and mature-only dataset (B).

To estimate species richness in each habitat and with each dataset, we calculated individual-based rarefaction curves using Ecosim version 7, with an independent algorithm and 1000 iterations per abundance level (Gotelli & Entsminger 2004). First, we compared the rarefied species richness of each habitat from each dataset. Then we assessed whether comparisons of species richness between habitats would differ depending on which dataset was used.

We compared the evenness of the individuals among species in the two datasets with Whittaker rank-abundance plots, separating the data by habitat and dataset and expressing the relative abundance (log transformed) of each species as a percent of the total abundance (Magurran 2004).

We assessed differences between the species composition of the samples based on location (A, B, C, or D), habitat (orchard or forest), and dataset (complete or mature-only). To compare samples we used non-metric multidimensional scaling (NMDS), a non-parametric ordination method that does not require linear relationships between variables (McCune & Grace 2002). We log transformed the abundance data to reduce the influence of common species. To eliminate the effect of different total abundances in each dataset, we expressed species abundance values as a percent of total abundance in each dataset. Both transformations and standardizations of data are acceptable before analysis using NMDS (McCune and Grace 2002). Using PCORD v. 4 (McCune & Mefford 1999), we did an initial six-dimensional analysis (parameters: Sørensen distance measure, random starting configuration, 100 iterations, 50 runs with real data, and 100 runs with randomized data (Monte Carlo test)). For the second run we altered the number of dimensions to that recommended by the preliminary run and used the graph coordinates from this preliminary run as the starting coordinates (McCune & Grace 2002).

Forty percent of the immature spiders were successfully reared. Mortality of juveniles occurred mainly during the early rearing period, when spiders were fed fruit flies without a supplemented diet (i.e., added dog food). The success rate of rearing was over 80% when spiders were fed fruit flies reared with supplemented diet.

Identifying immature spiders doubled the number of identified individuals included in the analyses from 402 to 809, and the number of species identified increased from 35 to 43. Of these eight species not represented by mature specimens, six were singletons, one species, *Emblyna maxima* (Banks 1892), was only found occasionally (12 specimens), but another species, *Philodromus praelustris* Keyserling 1880, was one of the most common species found in the study (129 specimens). A complete species list is available in Sackett et al. (in press).

Despite the increase in raw species richness when the complete dataset was used, rarefied estimations of species richness in each habitat (orchard and forest) were the same when calculated using either dataset (Figure 1). The inclusion of data obtained from rearing and identifying immature specimens produced the same results as an increase in sampling effort would have done. When the rarefied species richness of orchard and forest were compared using the complete dataset, the forest had significantly more species than the orchard because the 95% confidence intervals calculated by EcoSim did not overlap (Fig. 1, point A). This significant difference between the species richness of the two habitats was not found from the rarefaction of data from the mature-only dataset (Fig. 1, point B); this was due to fewer individuals (lower sampling effort) in the dataset rather than changes in the rarefaction curves. Jiménez-Valverde & Lobo (2006) also found that low sample sizes from the exclusion of juveniles negatively affected the precision of species richness estimators, but in contrast to our study, the value of species richness estimators differed between datasets that included or excluded juveniles.

There was a more even distribution of individuals among species (rank abundance) in both orchard and forest habitats in the complete dataset as compared to the mature-only dataset (Fig. 2). These differences could either reflect compositional differences in the assemblages or lower sampling effort.

The NMDS comparing samples from each location, habitat, and dataset produced a two-dimensional ordination (final stress = 6.48) explaining 93.5% of the variation (axis 1: $R^2 = 0.796$; axis 2: $R^2 =$

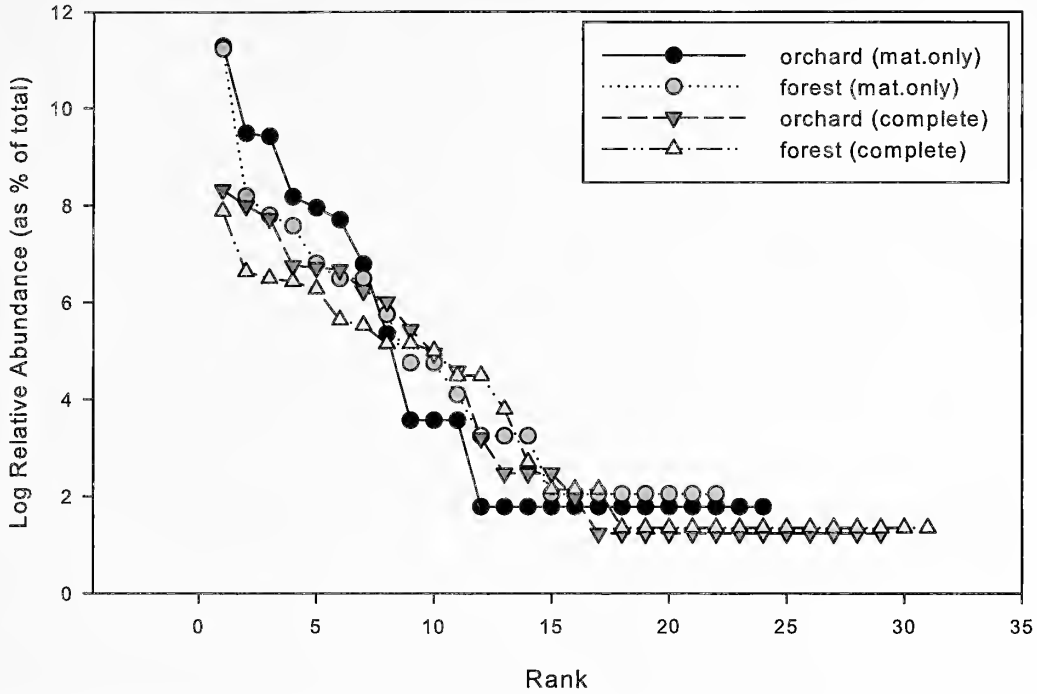

Figure 2.—Rank-abundance (Whittaker) plot of relative abundance of spider species ($\log_{10}$ abundance, expressed as pereent of total) in orehard and deciduous forest in Southern Québec and from complete and mature only ("mat.only") datasets.

0.139). In general, the two points from each particular habitat and location were close, indicating that the composition of the assemblages was similar regardless of dataset (Fig. 3).

Sample points from the mature-only dataset tended to be below and to the left of all sample points from the complete dataset. This consistent shift in space suggests that there is also a consistent change in the sample composition between datasets. Since samples were standardized so that there was no difference in abundance between datasets, the main difference between the samples was the number of species and evenness, both of whieh were higher in samples in the complete dataset. Again, the different results from the two datasets appear to be because of a relative difference in sampling effort, rather than variations in species composition resulting from the exclusion of immature specimens.

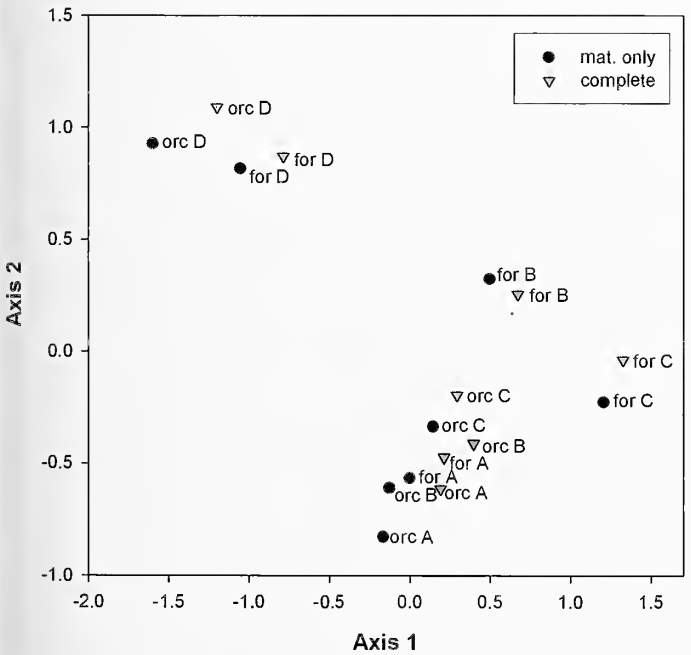

Figure 3.—Sample unit (orchard or forest for each site, collection dates pooled) non-metric multidimensional scaling (NMDS) analysis of southern Québec spider collections from complete and mature-only ("mat.only") datasets. Labels following symbols indicate habitat (orchard: "orc", forest: "for") and site (A to D) of sample.

In our study the results of community analyses were the same when data from immature specimens was included or excluded, and an increase in sampling effort would produce a comparable increased precision of the analyses. The similarity of assemblages between habitats was largely determined by the dominant species within the habitats, and these species were collected as mature individuals. Rearing immature spiders also required considerable time, space, and effort. Jiménez-Valverde & Lobo (2006) showed that species richness estimates of a spider community in central Spain were altered by the exclusion of juveniles. These different results could be due to biological differences between the communities, or statistical differences between datasets. For example, the inclusion of juveniles increased the number of individuals by about ten-fold in the data of Jiménez-Valverde & Lobo (2006), but only doubled the number of individuals in our study. Although in our system the inclusion of immature spiders was unnecessary for accurate comparisons of community parameters between habitats, this may not be true for all spider communities.

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SHORT COMMUNICATION

Araneus expletus (Araneae, Araneidae): another stabilimentum that does not function to attract prey

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Abstract. Juvenile *Araneus expletus* often place a visually conspicuous, disc-like white silk stabilimentum on one side of the retreat where the spider rests during the day away from its orb. Placement of the stabilimentum at this site rules out a prey attraction function and argues instead that it may function to defend the spider from visually orienting enemies.

Keywords: Orb weaver, orb web, silk, defense, camouflage

The function of the visually conspicuous white silk "decorations" or "stabilimenta" that many orb weavers add to their webs has a long history of controversy (summary, Herberstein et al. 2000). Silk stabilimenta are described by Herberstein et al. (2000) as "conspicuous silk designs on the surface of the web" (p.650). They have various forms, including straight and curved lines, tufts, and more or less circular, flat discs of white silk (Herberstein et al. 2000). All known discs and most other silk stabilimenta are placed at or near the hub of the orb where the spider rests during the day. Disc stabilimenta occur in the webs of the araneids *Argiope argentata* (Fabricius 1775) (Nentwig & Heimer 1987) and *Allocyclosa bifurca* (McCook 1887) (Eberhard 2003), and the uloborid genera *Philoponella, Uloborus*, and *Zosis* (Lubin 1986).

Herberstein et al. (2000) concluded that silk stabilimenta evolved convergently at least nine times among orb weaving spiders. They argued that the prey attraction ("foraging") hypothesis for the function of stabilimenta "has received most supporting evidence." They noted that the independent derivations of stabilimenta may imply different functions, although this is surely not a logical necessity (Eberhard 2003). Blackledge & Wenzel (2001) argued, in contrast, that silk stabilimenta may function in roles similar to retreats in reducing predation pressure. Subsequent reports have added two additional apparently independent origins, in the genera *Molinaranea* (Levi 2001) and *Metepeira* (Piel 2001). This note presents still another apparent convergence, in *Araneus expletus* (O. Pickard-Cambridge 1889). The stabilimenta of this species are especially interesting because the site where they are placed in the spider's web rules out the prey attraction hypothesis.

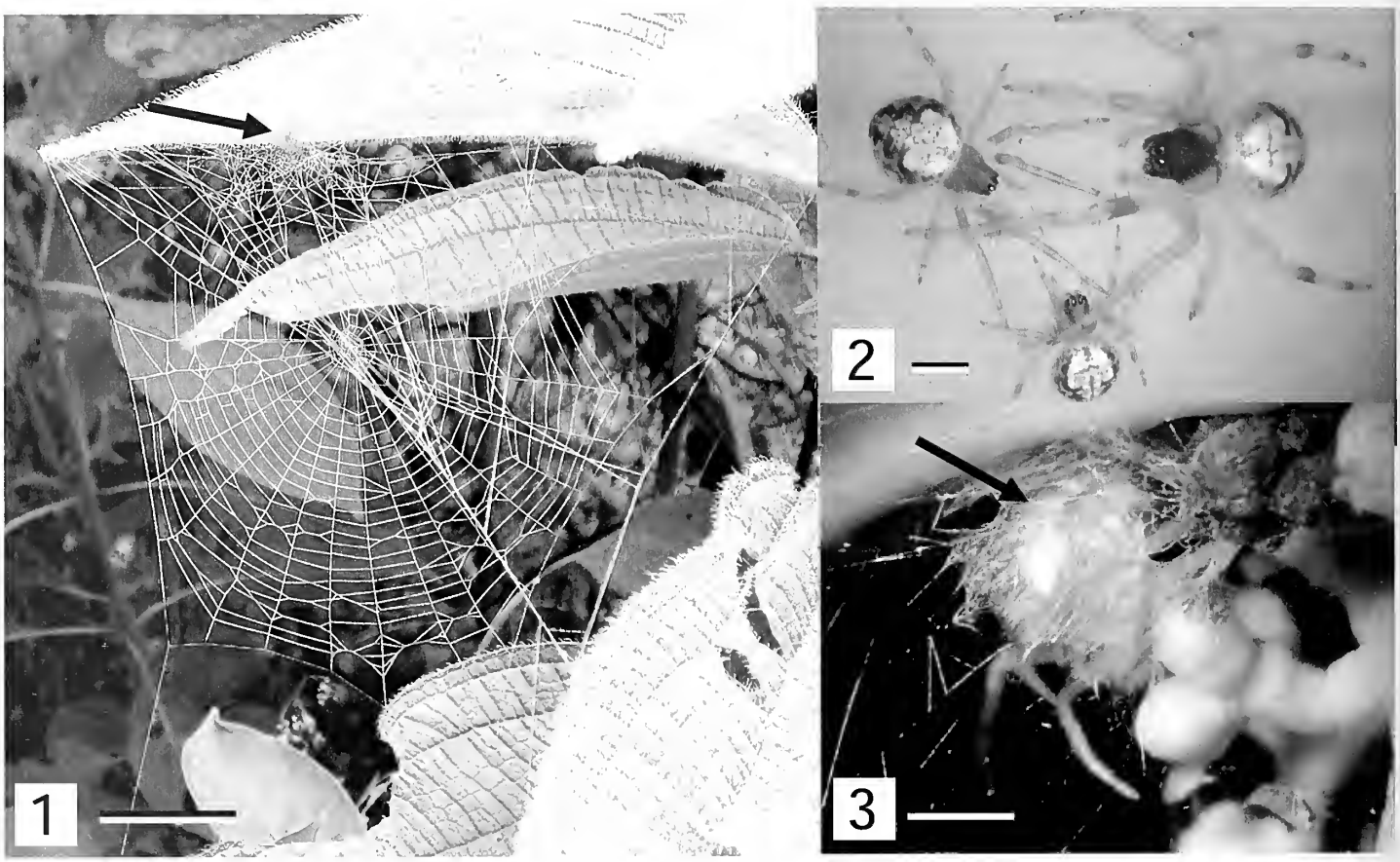
The sites in the web where the spider rests during the day and where the stabilimentum is placed can have important implications for the possible functions of stabilimenta. One general pattern in the distribution of stabilimenta among orb weavers is that among the many species of orb weavers in which the spider rests during the day at the edge of the web rather than the hub, not a single species builds a stabilimentum (Eberhard 2003). This pattern argues against a prey attraction function, because if the function of stabilimenta is to attract prey to the web, there is no obvious reason why stabilimenta should be lacking in these webs. If anything, these spiders would seem to have more rather than less need to attract prey to the web, because their attacks are necessarily slower; they must first move from the retreat to the hub before going to the prey. This association between resting away from the hub and lack of stabilimenta is, on the other hand, easily explained by the camouflage hypothesis.

This note shows that juveniles of *A. expletus* constitute the first exception to this pattern: these spiders build disc stabilimenta, despite the fact that they consistently rest off of the web in a retreat during the day. This exception supports the camouflage argument, however, because these spiders place their stabilimenta on the walls of their retreats, rather than on their orbs.

Araneus expletus is an orb-weaving spider that ranges from Mexico to Panama in second growth at intermediate elevations (Levi 1991). Previous observations (W. Eberhard, unpublished) indicate that in the Valle Central of Costa Rica *A. expletus* is relatively common and apparently univoltine, with young instars appearing early in the wet season (late April or early May); mature females are present late in the wet season and early in the dry season (Dec–March). Spiders of all ages build orb webs with a silk retreat in a small tangle of lines away from the orb (Fig. 1); the retreat is connected to the hub with a signal line that the spider holds with one leg. The spider rests in the retreat during the day, and rushes to the hub along the signal line to attack prey entangled in the orb. Adults and older juveniles often fold or roll green leaves to form a more or less conical retreat, while younger juveniles generally fold leaves only partially or not at all. The lines in the orbs of adults are distinctly yellow in color, and are faintly yellow in those of young juveniles. The silk in the dense walls of the retreats of older juveniles and adults is white. The orb is rebuilt in the early morning more or less daily, and is apparently used mostly during the day. Only one of 30 young juveniles checked between 8–10 PM had an apparently newly built orb; the others had removed the orb, and there were only a few radial lines in the area where the orb had been. The eggs are not laid in the retreat, and egg sacs have not been found.

Young juvenile spiders (estimated to be second and third instars) were observed near San Antonio de Escazú, San José Province, Costa Rica (elev. 1320–1400 m; ~10°20′N, 84°15′W) during the second half of May 2007 They were identified as *A. expletus* on the basis of color patterns (a distinctive central white patch and lateral brown on the anterior dorsum of the abdomen) (Fig. 2), their relative abundance, their size and the season when they were encountered, the early second growth habitat in which they occurred, the green leaves and stems to which their webs and retreats were attached (only one of 53 had a retreat in a curled dry leaf), and their web design (a more or less vertical orb with a hub that lacked a central hole and a retreat away from the orb) (Fig. 1). More than 20 years' field experience at this site leaves little doubt about this species identification. Voucher specimens have been deposited in the Museo de Zoología of the Universidad de Costa Rica.

Of 53 young juveniles (maximum width cephalothorax ranged from 0.80 to 1.38 mm), 51% had a patch of bright white silk on the wall of the retreat; in no case was there any white patch on the orb itself (all spiders were checked in the morning, and had orbs). These patches fit



Figures 1–3.—Orb weaver *Araneus expletus* and its web: 1. Orb and retreat of a juvenile *A. expletus*; the arrow indicates the spider, which was resting on the underside of a leaf near its lateral edge. A disk stabilimentum was on the near wall of the retreat (the retreat is nearer to the viewer than the orb). Scale line = 3 cm. 2. Juvenile *A. expletus* illustrating their color patterns. Scale line = 1 mm. 3. Spider's abdomen (arrow) is obscured by stabilimentum, while its legs, which extend beyond the stabilimentum, are easily visible through the wall of the retreat. Scale line = 1 mm.

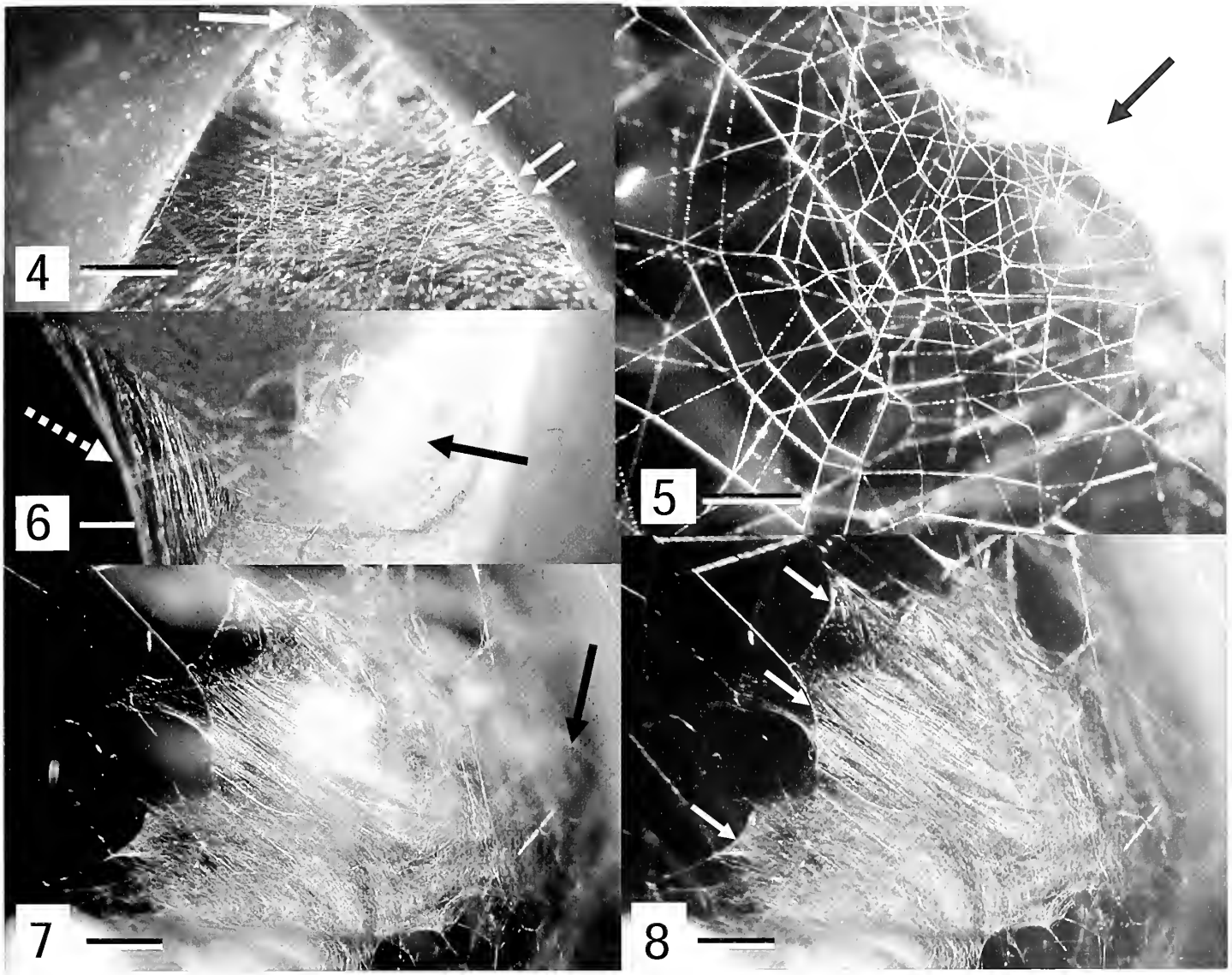
the definitions of silk stabilimenta of other orb weavers (Herberstein et al. 2000; Blackledge & Wenzel 2001) in being visually conspicuous white objects composed of a dense mat of many fine white silk lines that were apparently added to another structure (the retreat wall) (Figs. 3, 6–8). The retreat wall was thimble-shaped or conical, and some were formed when the spider pulled the edges of a leaf partly together with silk lines (Figs. 4, 6). When the leaf was not bent (as in Figs. 1, 5), the retreat consisted of an approximately conical wall of non-sticky lines, in some cases with recognizably radial and spiral orientations that resembled the hub of an orb (Fig. 5). The stabilimentum lines ran in many directions, were attached to the retreat lines (Figs. 7, 8), rather than to the leaf (Fig. 4), and occurred on retreats in which the leaf was not curled, so they did not have the mechanical function of applying tension to the leaf edges. The stabilimentum lines were whiter than the lines in the wall of the retreat, and their density was great enough to largely obscure the outline of the spider from view when it was in the retreat (Figs. 6–8). In contrast, even relatively thick retreat walls of the lines that were used to curl the leaf were relatively transparent, and left the spider more visible (compare Figs. 3, 4 and 6).

Retreats of young juveniles were found under the leaves of at least six families of plants, and the leaf was at least partly folded by the spider in 88.7% of the retreats. Of the 27 stabilimenta, 48.2% were on the wall of lines that folded the leaf, 40.7% were on the retreat wall opposite the lines that folded the leaf (Fig. 6), and 11.1% were on the wall of a retreat under an unfolded leaf (Figs. 1, 7, 8).

The fact that the silk stabilimenta of *A. expletus* juveniles are placed on their retreats demonstrates that these stabilimenta do not function to attract prey, because the structure that captures prey is the orb, not the retreat, and the retreat was always sited away from the orb (Fig. 1). The possibility that the stabilimentum functions to camouflage or hide the spider as it rests in its retreat from visually orienting enemies is supported by the placement of the stabilimentum near the spider's resting place in the innermost portion of the retreat and on retreat walls that were relatively exposed (Figs. 1, 6–8), and by the effectiveness with which the stabilimenta obscured the outlines of the spiders (Figs. 6–8). One cannot rule out, however, the possibility that stabilimenta in this species function as physical barriers to protect the spider from predators or parasites.

These arguments are of course based on correlations rather than experiments. Data from experimental manipulations, however, do not necessarily provide more reliable information. In fact, for hypotheses such as camouflage and prey attraction, that necessarily involve so many different possible predators, parasites, and prey in a variety of habitats, experiments that achieve appropriate balances in quantifying different effects, and whose interpretations are not open to other criticisms (Eberhard 1990; Herberstein et al. 2000; Craig et al. 2001) are very difficult if not impossible to design (Eberhard 2003). On the other hand, some correlations (e.g., stabilimenta on webs or parts of webs that do not function to capture prey) can provide powerful reasons to reject particular hypotheses.

For those of us who are counting, this makes four different spider genera with independently derived silk stabilimenta in which the prey attraction hypothesis is strongly contradicted: *Philoponella* (Eberhard 2006); *Gasteracantha* (Jaffé et al. 2006; Eberhard 2006); *Allocyclosa* (Eberhard 2003); and now *A. expletus*.



Figures 4–8.—Orb weaver *Araneus expletus* and its web: 4. The thick wall of lines that folded a leaf into a cone and that lacks a stabilimentum does not obscure the abdomen of the spider resting inside (large arrow). In places where the lighting and focus on the lines are favorable, it can be seen that the numerous fine lines were all attached to the edges of the leaf (small arrows). Scale line = 1 mm. 5. Lateral wall of a retreat without a stabilimentum in which the leaf was only slightly folded, illustrating a hub-like pattern of lines; arrow indicates the spider (out of focus) in the retreat. Scale line = 0.5 mm. 6. A spider that faces outward from a folded leaf retreat is partially obscured by the retreat wall (black arrow) that has a stabilimentum (out of focus). The strong lines that bent the leaf into a cone (dotted white arrow) are on the opposite side of the retreat. Scale line = 1 mm. 7. Inner end of a retreat that is largely covered with a stabilimentum; the spider, resting in the retreat facing away from the camera, is largely obscured (black arrow indicates posterior tip of the spider's abdomen) (contrast with the relatively transparent retreat wall that lacks a stabilimentum in Fig. 4, and the wall beyond the stabilimentum in Fig. 3). 8. The same retreat as in Fig. 6 but without the spider. The similarity with Fig. 6 illustrates how well the stabilimentum hid the spider in Fig. 6. The fine white lines of the stabilimentum are attached to the tangle of lines that form the retreat wall (small white arrows). Scale lines in 6 and 7 = 0.5 mm.

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SHORT COMMUNICATION

Assessing the dispersal of spiders within agricultural fields and an adjacent mature forest

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Abstract. A manipulative experiment was done in corn fields and their adjacent forests using enclosures that restricted access to ground-dwelling spiders. Enclosures were either closed from the adjacent habitat but open to ballooning and ground-dwelling spiders (using holes cut in the side of enclosures) or were open plots (controls). This allowed us to test the role of ballooning compared to cursorial dispersal of ground-dwelling spiders within these habitats. A reciprocal substrate treatment was included in which leaf-litter was added to cornfields and removed from forests to test the interaction between mode of dispersal and habitat use. Ninety species were collected using visual surveys and with pitfall traps. More species were collected in cornfields, and more individuals were collected in litter-addition plots, but we uncovered no interaction between substrate treatment and enclosure type. However, enclosures that excluded cursorial spiders had fewer mature and immature spiders, suggesting that cursorial activity (at a small spatial scale) is an important mode of dispersal within both types of habitats.

Keywords: Agroecosystems, ballooning, dispersal, substrate manipulation

Understanding how spiders (Araneae) colonize agroecosystems is important since sustaining viable populations of generalist predators is a key attribute of effective integrated pest management (e.g., Snyder & Wise 1994; Schmidt et al. 2004). Spiders (Araneae) are ideal for such research sinee they have distinct methods of dispersal (i.e., cursorial or ballooning) that allow for experimental manipulation. Manipulative experiments to quantify their mode of dispersal and to assess their need for surrounding habitats as permanent refuge are required.

It has been suggested that spiders normally found in agroecosystems take refuge in surrounding natural landscapes during periods of cultivation and disturbance (e.g., Halley et al. 1996; Wissinger 1997), and the colonization of spiders from natural habitat to agroecosystems is thought to be significant. For example, spiders common to agroecosystems have been found to move from weed strips to cereal fields in the spring (Lemke & Poehing 2002) and the proportion of spider webs in cereal fields correlates with the proportion of surrounding non-crop habitat (Schmidt & Tscharntke 2005a). There is some evidence for differences in spider assemblage patterns in natural landscapes such as woodland and old-fields adjacent to cultivated land (Riechert & Bishop 1990; Samu & Szinetar 2002) bringing the importance of such landscapes as spider reservoirs in doubt. Assemblage differences, however, can fluctuate depending on the time of year. For instance, dominant arable species have been found to be more abundant in permanent grassland in early spring indicating a dependence on natural habitat (Schmidt & Tscharntke 2005b).

Spider colonization of agroecosystems may occur more commonly via long distance colonization events (i.e., ballooning) rather than short distance methods (cursorial) (Bishop & Riechert 1990; Schmidt & Tscharntke 2005b). Conservation biological control has also been promoted as a method for increasing populations of spiders in agroecosystems (e.g., by providing artificial habitat refuges, see Halaj et al. 2000). However, whether movement of spiders into agroecosystems is via ballooning compared to cursorial activity requires further study. It is therefore of interest to understand the interaction between habitat refugia and dispersal mode within agroecosystems, and to test if dispersal differs in natural habitats compared to agricultural fields.

We studied the modes of dispersal by spiders and their effects on community structure and abundance within cornfields and adjacent mature deciduous forests in SW Quebec. We tested whether spider assemblages used cursorial or ballooning as a main method for dispersal within these habitat types. We also included a reciprocal substrate treatment to establish whether an interaction occurred between substrate type and mode of dispersal. This treatment is included in light of the use of habitat refugia to promote spiders in agroecosystems (e.g., Halaj et al. 2000), and since some spider species in agroecosystems show affinities to such refugia (Buddle & Rypstra 2003).

METHODS

Our study area is located adjacent to the Morgan Arboretum (Ste-Anne-de-Bellevue, QC Canada, approximately 45.42°N, 73.95°W). The experiment used three mature deciduous forest sites (approximately 50 years old, dominated by *Acer saccharum, A. rubrum*, and *Fagus grandifolia*; sites were greater than 300 m apart) bordering operational cornfields (operated by the Macdonald Campus Farm, McGill University). The cornfields were subject to early and mid-season herbicide applications and conventional tillage in the spring and fall.

To assess mode of dispersal, we used circular aluminium enclosures (30 cm height, diameter of 0.70 m, 0.38 m^2 in area) dug into the ground so 25 cm remained aboveground. The upper ring (a band 3 cm wide) was treated with TangleFoot®. We had three levels of this treatment: no holes (to prevent cursorial dispersal but allow ballooning spiders), holes (triangles with 5 cm sides were cut at ground level to allow for cursorial dispersal in addition to ballooning; six of these were cut, meaning about 18% of the perimeter was open to cursorial spiders), and control (no enclosures). These treatments were replicated twice within the forest and field and at three different sites. The enclosures were placed between rows of corn just after planting. The above treatment was nested with two substrate treatments to test the effect of substrate type on the overall assemblage, and to test for potential interactions between dispersal mode and substrate type. Therefore, each set of three enclosures was placed within an area of 8.1 × 3.7 m. The substrate treatment was

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reciprocal, and had two levels: Litter addition (leaf litter was moved from the forest and added to the field), and litter removal (litter was removed from the forest, by raking away all detritus, LFH layer). Litter was sifted and kept overnight before addition to the field. Some spiders, therefore, may have been accidentally introduced in the field but observations suggest these were minimal. Thus, there were 72 enclosures in total: three enclosure treatments × two substrate treatments × two replicates × three sites × two habitat types. Vertical structure increased over the growing season due to corn and weed growth, and this structure likely interfered with dispersal of spiders into enclosures. Therefore, ballooning and cursorial spider activity may have been underestimated in the field compared to the forest as vertical structure in the forest varied less over time.

Spiders were sampled using pitfall traps and with visual surveys. One pitfall trap (circular, transparent plastic: 7 cm diameter, 9.5 cm height, filled with 2–3 cm of propylene glycol diluted 3:1 with water) was placed in the center of each enclosure. Traps were accommodated with a circular shelter 10 cm in diameter, held above the traps using nails. The traps were installed on 4 June 2004, and collected on a bi-weekly basis from 16 June–25 August 2004 (i.e., 71 days of continual trapping). Visual collections were done weekly (10 min per enclosure) using an aspirator, and we attempted to perform all visual surveys between 06:00–12:00 h. Samples were sorted and stored in 70% ethanol. All adult spiders were identified to species (nomenclature followed Platnick 2007) and immature spiders were identified to family, primarily using the key by Paquin & Dupérré (2003). Voucher specimens have been deposited in McGill University's Lyman Entomological Museum (Ste-Anne-de-Bellevue, Quebec, Canada).

We used a 3-Factor nested ANOVA (i.e., enclosure treatments nested within substrate treatment and substrate treatment nested within habitat) to test our response variables (total abundance, immature abundance and mature abundance). Fixed factors were habitat (forest or corn field), substrate type (litter addition/removal or control) and enclosure type (holes, no-holes, control), and all possible interaction terms were tested. Data were tested for normality, and log-transformed when necessary. SAS for Windows (Version 5.1, SAS Institute, Cary, North Carolina) was used for ANOVA analyses, and post-hoc comparisons of means was done using Tukey's test (P = 0.05). Rarefied estimates of species richness were compiled to compare the influence of the treatments on species richness standardized to sampling effort (number of individuals) (Gotelli & Colwell 2001; Buddle et al. 2005); ECOSIM (Gotelli & Entsminger 2004) was used to calculate rarefaction curves. Ordination analysis (non-metric multidimensional scaling, NMS) was completed on species presence-absence data, to determine patterns of similarity in community composition in relation to treatment types. This was done with the software program PCOrd (McCune & Mefford 1999).

RESULTS

A total of 1891 individual spiders representing 90 species was collected (A.C. Hibbert & C.M. Buddle. 2007. List of spider species collected at the Morgan Arboretum, available online at http://insectecology.mcgill.ca/spider_list.pdf). Visual surveys aecounted for over half of the spiders collected compared to pitfall traps (1230 and 661 individuals, respectively). Of the total number of individuals, 70% were immature spiders. Immature spiders represented approximately 70% of the total abundance in enclosures with no holes, indicating immature spiders were the most common ballooning colonizers, an inference supported in the literature (Greenstone et al. 1987). Most species were rarely collected, given that an average of 6 specimens per species was found.

ANOVA results indicated non-significant interaction terms for both immature and mature spider catch rates. Habitat type (forest versus corn field) had no effect on catch rates of immature or adult spiders (P = 0.684 and P = 0.968, respectively), but substrate treatment and enclosure type had significant main effects on catch rates. Immature spiders were most commonly collected in substrate treatments with leaf litter compared to no-litter treatments (mean ± SE: litter, 25.5 ± 6.03 spiders; no litter, 11.42 ± 2.58 spiders; $F_{1,8}$ = 7.92; P = 0.023, n = 36). There was no effect of substrate type on adult spiders (litter, 9.11 ± 0.78 spiders; no litter, 6.5 ± 0.87 spiders; $F_{1,8}$ = 4.69; P = 0.062, n = 36). Fewer immature and adult spiders were collected in enclosures without holes compared to holes and control (Fig. 1).

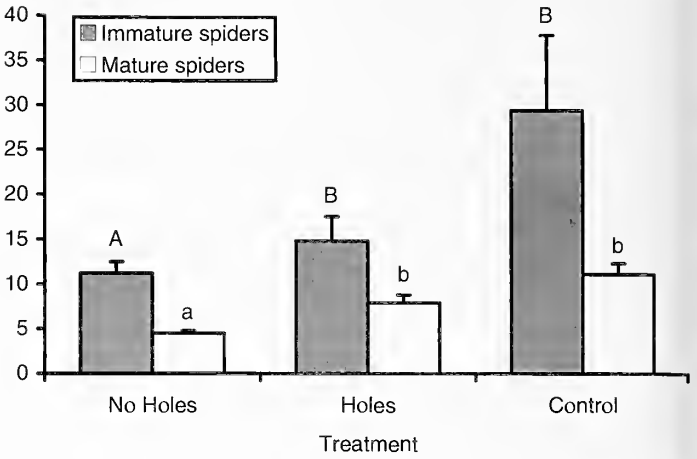

Figure 1.—Mean (± SE n = 24) number of spiders collected by pitfall traps and visual surveys (pooled by collection time), by enclosure type (control: no enclosure; holes: enclosure in place but accommodated with holes for access from ground-dwelling spiders; no-holes: enclosures in place but no access for ground-dwelling spiders). Significant difference of means (Tukey's post-hoc test) indicated by different letters for comparisons between treatments for each response variable (immature or mature spiders) analyzed separately. In this Figure, data from field compared to forest samples and substrate treatments are pooled since non-significant interactions were uncovered.

Rarefied estimates of species richness demonstrated that the number of species was not affected by substrate type (mean ± S.D: litter, 63.02 ± 2.34 species; no litter, 61.57 ± 0.61 species, sample effort of 230 individuals) or enclosure treatment (control, 41.70 ± 2.84; holes, 37.39 ± 2.32; no holes, 46.34 ± 1.12, sample effort of 100 individuals). The number of species (observed) was affected by habitat type, as more species were collected in the cornfield (64 species) compared to the forest (57 species), a pattern supported by rarefied estimates of species richness (cornfield, 62.74 ± 1.60 species; forest, 56.10 ± 0.92, sample effort of 270 individuals). The NMS ordination analysis found a weak pattern (i.e., high final stress, only 59% variance explained by three axes) demonstrating that species assemblages within the forest and cornfield differ from each other (Fig. 2); when coded according to treatment types, no structure to the species data was discovered (not shown).

DISCUSSION

Catch rates of mature and immature spiders were lowest in enclosed treatments, where arrival only by ballooning was allowed to occur. This indicates that ground dispersal contributed significantly to the arrival of spiders in both habitats in this study (i.e., the same effect was uncovered in the forests as within the corn field). This is in contrast to what has been found in small garden plots (Bishop & Riechert 1990) and on Sagebrush (Ehmann 1994) where ballooning was found to be the most important means of arrival.

If cursorial activity is assumed to be an important type of short distance travel, adjacent mature forest edges have the potential to act

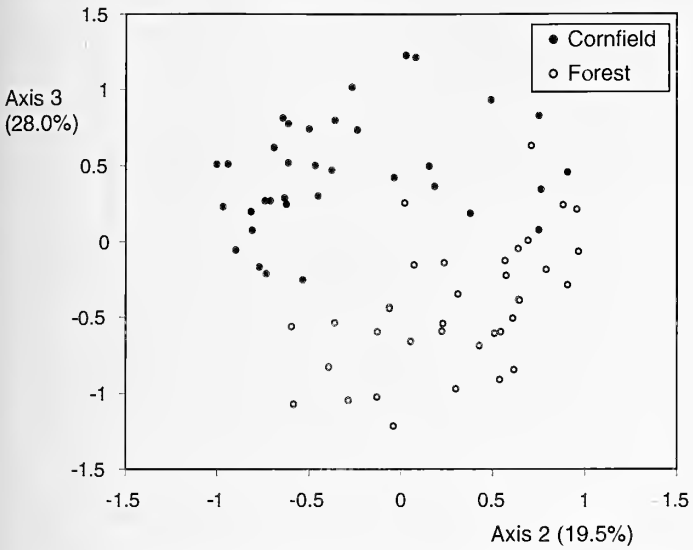

Figure 2.—Non-metric multidimensional scaling (NMS) ordination depicting samples (i.e., individual enclosures) coded by habitat (forest compared to cornfield) based on presence absence data for 90 spider species. A three dimensional NMS ordination was deemed optimal, but axis one represented 11.5% of the variation and depicting the 3-dimensional solution did not change the pattern; therefore, only axes 2 and 3 are depicted. Fifty-nine percent of the total variance is explained by the ordination; solution is based on 20 iterations with real data, 44 iterations total and final stress was 21.2. Monte-Carlo permutations (n = 100) indicated each axis was significantly different ($P < 0.01$) than would be expected by chance. The solution from a detrended correspondence analysis (DCA) was used as the starting coordinates for the final NMS solution.

as important "reservoirs" for spider dispersal within agroecosytems, at least at small spatial scales, and at this scale such reservoirs may be as critical as more distant and/or permanent refuges. This does, however, depend on the size of potential reservoirs and on the area of cultivated land. Although the ordination did reveal community composition differences between the forest and corn field, this multivariate analysis explained little of the total variation in the species by sample matrix (Fig. 2). Adjacent mature forests may therefore share enough in common with cornfields to maintain or retain populations of spiders throughout the growing season. Species data by habitat type are available as an online appendix (http://insectecology.mcgill.ca/spider_list.pdf).

Immature spiders responded positively to leaf-litter additional treatments. Leaf litter presumably provides optimal conditions for young spiders, and adding it to agroecosystems may promote their numbers, a finding consistent with Halaj et al. (2000). It is possible, however, that the abundance of immature spiders was overestimated if egg sacs had been transferred with the litter to the cornfield. Due to the difficulty in identifying immature spiders to species, assemblage differences were not fully determined, and community composition may overlap more between forests and agroecosystems if immature spiders are taken into account.

Our results indicate that dispersal by mature and immature spiders within corn fields and within mature forests bordering these fields occurred often via cursorial activity. Even though the spider assemblage of our forests was different than the corn fields, it is possible that some of the species move from the adjacent habitat to the agroecosystem and adjacent forests may play a role in facilitating short-distance faunal recolonization of agroecosystems.

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SHORT COMMUNICATION

On the identity of *Pettalus cimiciformis* and *P. brevicauda* (Opiliones, Pettalidae) from Sri Lanka

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Abstract. Among the most enigmatie Cyphophthalmi are members of the genus *Pettalus*, a monophyletic group endemic to Sri Lanka. To date three species have been named, *Pettalus cimiciformis* (O. Pickard-Cambridge 1875), *P. brevicauda* Pocock 1897, and *P. lampetides* Sharma & Giribet 2006. However, the identity of the two XIX Century species remains eonfusing. Here the identity of the three original *Pettalus* specimens is revised based on their re-examination and comparison to the original descriptions, which do not match the redescriptions of these species published in the monograph of Hansen & Sorensen (1904).

Keywords: Holotypes, male, arachnid, taxonomy

Among the most enigmatic Cyphophthalmi are the members of the genus *Pettalus*, a monophyletic group endemic to Sri Lanka (Boyer et al. 2007). To date, three species have been named, *Pettalus cimiciformis* (O. Pickard-Cambridge 1875) [described as *Cyphophthalmus cimiciformis*], *P. brevicauda* Pocock 1897, and *P. lampetides* Sharma & Giribet 2006 (Pickard-Cambridge 1875; Pocock 1897; Sharma & Giribet 2006) with ca. 10 additional speeies known but still undescribed (Sharma & Giribet 2006). Both nineteenth century species were redescribed by Hansen & Sørensen (1904) and specimens are deposited at The Natural History Museum, London (NHM). However, confusion still remains in the literature with respect to the identity of the types of *P. cimiciformis* and *P. brevicauda*. The original descriptions of *P. cimiciformis* and *P. brevicauda* do not match the redescriptions of Hansen & Sorensen (1904), and a loan of the supposed two holotypes from The Natural History Museum did not immediately resolve this controversy since both were labelled as *P. brevicauda*.

According to the original description by O. Pickard-Cambridge (1875), the single specimen of *Pettalus cimiciformis* is an adult male (based on the original illustrations) "...received from Mr. G. H. K. Thwaites, by whom it was sent to me from Ceylon." G.H.K. Thwaites was then the director of the Peradeniya Botanical Gardens, and I had originally suggested that *P. cimiciformis* may have originated from there (the type locality was listed as "Ceylon"). These gardens were visited by G. Giribet, S.L. Boyer, I. Kuranarthna, and P. Sharma in June 2004 and 52 specimens of a *Pettalus* species were obtained during the visit. However, the species from Peradeniya differs considerably from *P. cimiciformis*. These specimens have appeared in recent publieations as *Pettalus* cf. *brevicauda* (Boyer et al. 2007; Boyer & Giribet 2007; Pinto-da-Roeha et al. 2007). *Pettalus cimiciformis* was reported to have dimensions of "length of $1^3/_4$ line, breadth nearly 1 line," and a scale bar reported to be shown at real size in his (O. P.-C.) plate XIII, figure 3f measures almost 4 mm. The second species, described by R.I. Pocock (1897), was based on two specimens from Pundaluoya (spelt Punduloya), in the Central Province, Sri Lanka, collected by E.E. Green. The largest specimen, upon which the description was based, measured 3.8 mm in length and 2.5 mm width according to the original description and was said to differ from *P. cimiciformis* "in its relatively weakly lobate 'tail' and much smaller process on the fourth tarsus [the adenostyle]" (Pocock 1897:290). He also stated that "A second smaller specimen, obtained by Mr. Green, has no process on the fourth tarsus, and the last tergite scarcely lobate and not grooved. This specimen is probably either young or of a different sex from the type." The illustration of the prosomal ventral complex seems to indicate a closed gonostome,

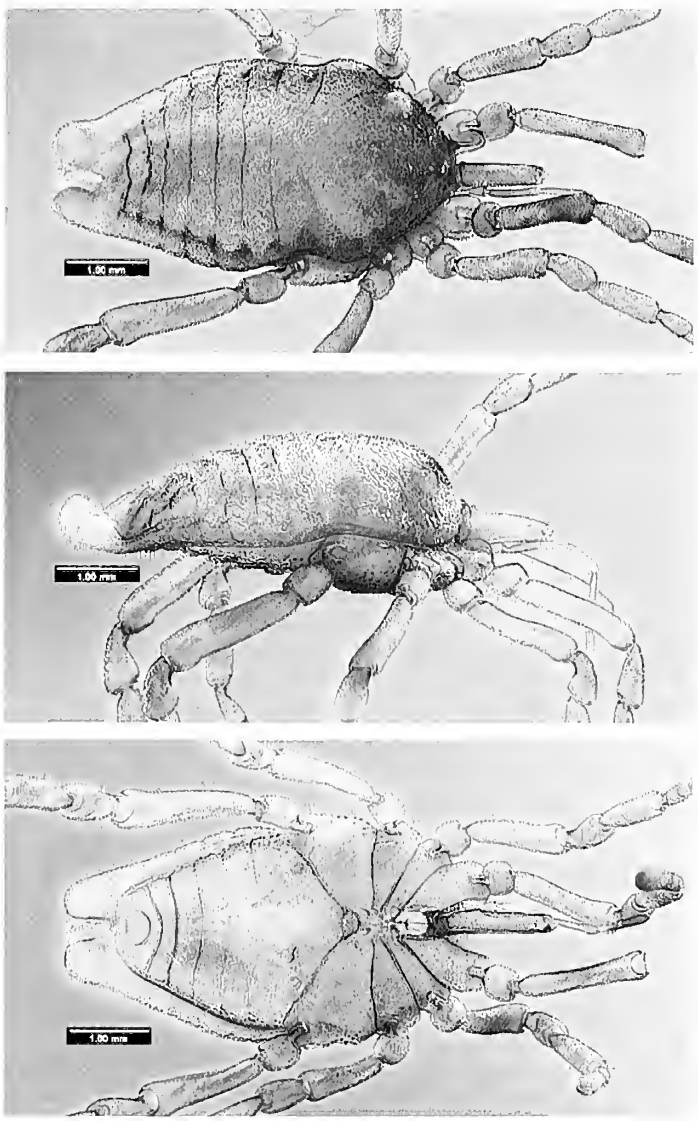

Figure 1.—Holotype of *Pettalus cimiciformis* in dorsal (top), lateral (center) and ventral (bottom) views. Scale bar = 1 mm. Specimens were photographed under a Leica MZ 12.5 dissecting microscope using a mounted JVC KY-F70B digital camera. Digital images captured at different focal planes were assembled using the application Auto-Montage Pro Version 5.00.0271 by Syncroscopy.

Figure 2.—Holotype of *Pettalus brevicauda* in dorsal (top), and ventral (bottom) views. Scale bar = 0.5 mm.

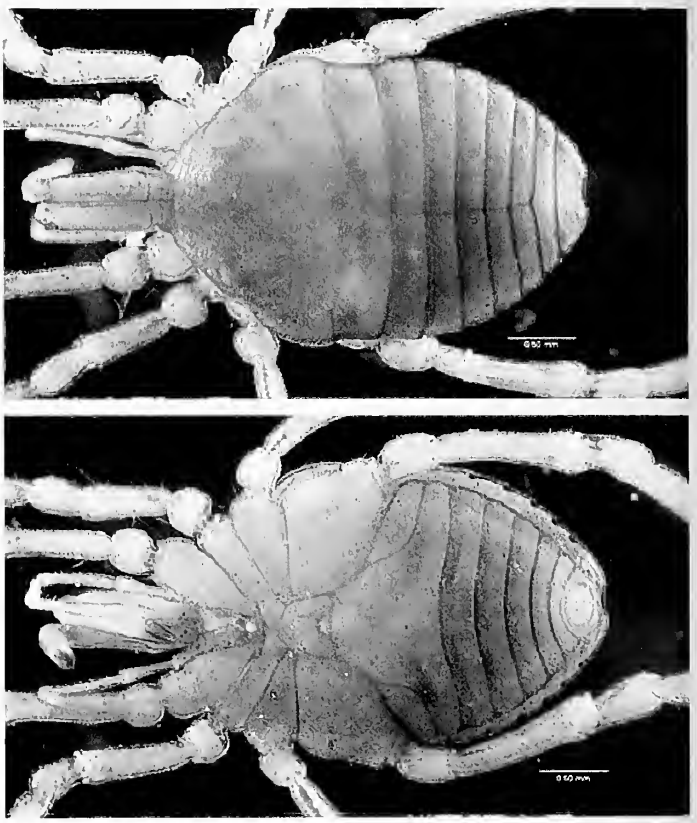

Figure 3.—Specimen of *Pettalus* sp. from Pundaluoya in dorsal (top), and ventral (bottom) views. Scale bar = 0.5 mm.

typical of immature specimens. Although we visited Pundaluoya in June 2004, we were not able to locate primary forest, and we did not locate specimens of *Pettalus* in the tea plantations. In 2001 I received a loan from NHM supposedly containing the types of both species. However, both specimens, a large male and a much smaller subadult male, were labelled in pencil and using the same font as "*Pettalus brevicauda*" from "Punduloya" collected by E.E. Green.

Consultation of Hansen & Sorensen (1904) did not resolve this issue even though it supposedly provided detailed illustrations of both species. Their Plate III, figure 3a, labelled "P. brevicauda Poc." [italics missing in the original] (see also figure legends on their page 168) and description—the largest specimen reported to measure 4.6 mm; the smallest reported to measure 3 mm—corresponded to the larger specimen borrowed from NHM. In contrast, *P. ciuiciformis* was reported to measure 3.6 mm, considerably smaller than the other specimen (Hansen & Sørensen 1904: 103). Furthermore, the illustrations of this species (their Plate III, fig. 2) do not seem to correspond to either specimen described by Pocock (1897; see discussion below).

After a second visit to the collections of the NHM in June 2007, I was able to examine a third *Pettalus* specimen, also labelled as "*Pettalus brevicauda*, Poc. (young), Punduloya (Ceylon), E.E. Green coll." and solve the mystery about the identity of the two oldest *Pettalus* species. In total, the NHM collection included three specimens of *Pettalus* illustrated in Figs. 1–3. The largest specimen (5 mm measured in dorsal view from anteriormost carapace border to end of the "tail," as is currently the standard for measuring Cyphophthalmi), an adult male, is unmistakably the holotype of *P. cimiciformis* (Fig. 1). This species was coded correctly in a cladistic analysis of cyphophthalmid relationships (Giribet & Boyer 2002), but subsequently erroneously "corrected" in a series of later analyses and papers (Giribet 2003; Sharma & Giribet 2006). The specimen was studied and dissected by C. Juberthie.

The second specimen (3 mm; Fig. 2), a subadult male with an incipient tail and adenostyle, but still with a closed gonostome aperture, is the type specimen of *P. brevicauda*, as evidenced by the description and original illustrations by Pocock (1897).

The third specimen (3.1 mm; Fig. 3) is a juvenile from the same collection as *P. brevicauda* although due to its size (larger than the subadult type of *P. brevicauda*), it may correspond to a second species from Pundaluoya. This specimen does not have a type status and should be referred to as *Pettalus* sp.

Hansen & Sørensen (1904) redescribed both species but unfortunately got the specimens mixed up, and since then there has been great confusion with respect to the identity of the species. Furthermore they illustrated a specimen of *P. cimiciformis* (their plate III, figure 2a) that does not seem to have existed, or at least that does not correspond to any specimen deposited at the NHM or illustrated in the original descriptions. Their illustrations from plate III, figure 3, labelled *P. brevicauda* correspond to the type of *P. ciuiciformis*.

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SHORT COMMUNICATION

Subterrestrial life of *Arctosa lutetiana* (Araneae, Lycosidae)

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Abstract. *Arctosa lutetiana* (syn. *Tricca lutetiana*) (Simon 1876) (Lycosidae) is found in many European countries; however, the biology of the species is still unknown because it lives hidden under ground and is difficult to find. The objective of this study was to fill in basic information about the biology of this species. The specimens were obtained between 2005–2006. This species lives in primitive underground burrows that are not lined with silk. Herein we describe, for the first time, the burrows and the prey capture method of this species.

Abstrakt. *Arctosa lutetiana* (syn. *Tricca lutetiana*) (Simon, 1876), slídák lesostepní (Lycosidae) je druh žijící v mnoha evropských zemích, nicméně jeho biologie je dosud neznámá. Žije totiž skrytým způsobem života pod zemí a je velice obtížné ho v přírodě nalézt. Cílem této práce je doplnit základní data o biologii tohoto druhu. Jedinci byli získáváni převážně ručním sběrem v letech 2005–2006. Díky vhodně zvolené metodě chovu byly u tohoto druhu poprvé popsány jeho podzemní komůrky nevystlané pavučinou a způsob lovu kořisti.

Keywords: Spiders, life history, underground burrow, prey capture, Czech Republic

Arctosa lutetiana (Simon 1876) is an extra-mediterranean (including Ural) wolf spider that dwells in xerothermic forest-grassland habitats (Buchar & Růžička 2002). Unfortunately, it is very difficult to find because of its subterranean lifestyle. Until pitfall trapping was used in the 1950s, only a few specimens were known from collections and little was known about the biology of this species (Dahl 1908; Wiebes 1956). The taxonomic classification is also problematic (Buchar 1981; Dondale & Redner 1983; Buchar & Thaler 1995; Platnick 2007).

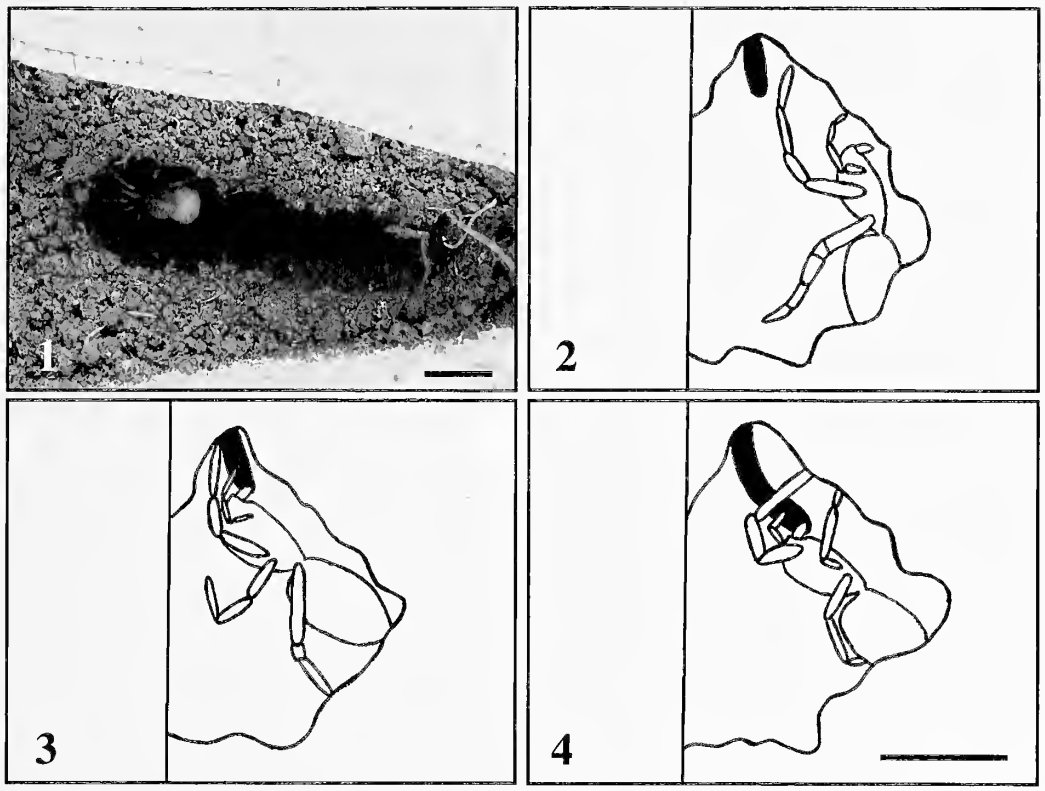
In order to obtain more information about the biology of *A. lutetiana*, we used dry pitfall trap sampling (n = 48) to obtain living specimens. Adult spiders (mostly males) were obtained using this method. We also used the "lookdown" technique to collect additional specimens. The spiders were collected from crannies under stones. Variously aged juveniles and females were obtained using the latter method. The study took place in localities Dřínová hora (elev. 345 m, 14°09′E, 49°56′N) and Koda (elev. 380 m, 14°07′E, 49°56′N) in Český kras (Bohemian Karst) PLA in central Bohemia (Czech Republic). The specimens collected included 80 adult males, 20 females, five subadult males, and 25 juveniles. Voucher specimens are deposited in the National Museum (Václavské náměstí 68, 115 79 Prague 1, Czech Rep.).

Aspects of the biology of *A. lutetiana* were studied in the laboratory. The spiders (adult females and juveniles) were kept in individual glass terraria (14 x 11 x 8 cm) with either 2–2.5 or 5 cm of soil from the collecting localities in each. This height of soil was sufficient as the spider's body length is 7–8 mm. Small stones were placed on the soil surface in the corners of each terrarium. Rearing temperature was 23° C, and the photoperiod was 14L:10D. A digital Olympus C-7070 WZ camera and a Panasonic NV-GS400 video camera were used to record the spider's activity.

Immediately upon being placed in the terraria, females and juveniles typically begin digging. Females move through the ground in an oblique or vertical position with their prosoma oriented down (n = 20). They push the soil laterally using their legs, but they do not otherwise move the soil outside the burrow. The resulting underground burrows have various sizes, shapes, and positions. In nature, they are either under a stone or under a surface without vegetation. The burrows take a variety of forms. They can be simple bowl-like burrows with a diameter 1.5–2 cm (n = 16), have a deeper and shallower part (similar to the letter L or Γ), have one deeper part with two more shallow parts (similar to the letter J or U), or be oblong up to 3 cm (Fig. 1), but never with an entrance or exit. The burrows of gravid females are bigger and deeper–up to 2.5 cm (n = 11), although three of them were housed in a terrarium with 5 cm of soil depth as a control to determine whether the spiders would build deeper burrows in an alternative depth of soil. On the other hand, burrows with a depth of 7 mm (made under a stone) were also observed (n = 6). Females push the residual material from the burrow up forming a small "molehill" above the underground burrow (n = 11); however, this is not done if the burrow is situated under a stone. When we picked up the stone situated above the burrow, the spiders (mainly juveniles) tended to clog the open entrance that resulted, with material (soil, detritus) from the surroundings (n = 17). Because the soil depth in the terraria was 2–2.5 cm, the majority of females (n = 14) made their burrows on the bottom of the terrarium and thus it was possible to observe what was happening inside the burrows.

It is remarkable that the walls of the burrows were not silk-lined. Only several silk fibers reinforcing the roof of the burrow were sometimes observed, mainly in the burrows of hibernating females (n = 16). These fibers create a fragile "dome." Similar fibers were observed in two burrows situated under the stone. These burrows did not have a "roof" (the stone constituted the roof) but they were reinforced with several fibers in the area of contact with the stone. So these fibers created a "ring beam." The lower part of these burrows was not reinforced by any fibers. Therefore, *A. lutetiana* differs from the other species from the genus *Arctosa*, which live in silk-lined burrows (Dondale & Redner 1983).

We also wanted to determine how *A. lutetiana* captures prey when it spends most of its time underground. Several females built their burrows in the corner of the terrarium and thus it was possible to observe prey capture from the side of the terrarium. A *Tribolium* larva was put above the burrow and the female's behavior was recorded. When the larva moved through the ground (above the burrow) in the space of the female's burrow, the female immediately moved to the larva (Fig. 2) and caught it using her legs I and chelicerae (Fig. 3) and pulled the prey inside her burrow using her pedipalps and chelicerae (Fig. 4). Sometimes, the female damaged a part of the roof of the burrow during this action. This is further evidence that the burrow is



Figures 1–4.—*Arctosa lutetiana* females in earthen burrows. 1. Uncovered burrow (stone was removed) revealing resident female with an egg sac. 2–4. *A. lutetiana* female catching a prey. Lateral view (vertical line is the wall of a terrarium): 2. Female moves towards *Tribolium* larva (black); 3. Female bites the larva; 4. Female pulls the prey inside the burrow. Schematized – not all legs are shown, for clarity. Scale = 5.0 mm.

not reinforced by silk. The observations were successfully repeated many times (with all spiders living in the terraria). This method of prey capture in which spiders wait in burrows passively until a small soil animal comes inside, is likely to be the reason why the burrows are not silk-lined.

Generally, wolf spiders' burrows are usually longer vertical tubular holes in the ground. They are not used for catching prey but as a shelter (Shook 1978). Exceptionally, burrows can be small and entirely closed, typically for Central European *Trochosa* C.L. Koch 1848 speeies (Engelhardt 1964). In all cases mentioned so far, the burrows are silk lined, e.g., *Arctosa cinerea* (Fabricius 1777) (see Nielsen 1932), *Hogna carolinensis* (Walckenaer 1805) (see Shook 1978), *Donacosa merlini* Alderweireldt & Jocqué 1991, etc. On the contrary, the closed, non-silk lined burrows and the peculiar lifestyle of *A. lutetiana*, described here for the first time, may contribute to a better understanding of the taxonomy and phylogenetic relationship of the genus. Nevertheless, further investigation of life history traits is necessary.

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SHORT COMMUNICATION

Silk release by copulating *Schizocosa malitiosa* males (Araneae, Lycosidae): a bridal veil?

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Abstract. We report release of silk threads by males of *Schizocosa malitiosa* (Tullgren 1905) during copulation. The silk is deposited over the female's front legs and near her mouthparts. Possible functions for this behavior could be inhibiting female aggressiveness through chemicals deposited on the silk, inducing female catalepsy during copulation or repelling other males. We propose future studies manipulating male silk release to test these hypotheses.

Keywords: Wolf spider, tying-behavior, female aggression, cannibalism

Many spiders release draglines when walking, anchored to the substrate at intervals by attachment discs (Foelix 1996). In some cases, males can release silk threads over females during courtship or copulation. This was first reported by Bristowe (1958) in the thomisid *Xysticus cristatus* (Clerck 1757). He defined the bridal veil as the silk lines deposited by males over females during courtship or copulation. Species from at least 7 families of spiders have demonstrated male silk release during copulation (Table 1).

Schizocosa malitiosa (Tullgren 1905) is a medium-sized wolf spider (average body length: 17 mm in males and 23 mm in females) that is very common in Southern Uruguay. Males follow female silk draglines and perform an elaborate courtship that includes visual and vibratory signals (Costa 1975). Males also release draglines while they walk, but silk release during courtship has not been observed (F.G. Costa and A. Aisenberg, pers. obs.). Copulation takes place in the typieal lycosid mating position, with the male on top of the female facing opposite her (Costa 1979). Duration of copulation is approximately 90 min, averaging 300 palpal insertions distributed in two consecutive patterns (Costa 1979). The first copulatory pattern eonsists of multiple insertions with the same palp, side shift, multiple insertions with the other palp, and so on, during approximately 40 min. The number of insertions gradually diminishes until they transform into alternate use of palps after a single insertion, which constitute the second copulatory pattern, persisting until dismount. After males dismount, females can remain motionless in a cataleptic state for varying periods (several sec up to 40 min) (Costa 1979). This cataleptic state is not correlated with copulation duration, number of palpal insertions, or side shifts (Aisenberg & Costa 2005).

Occasional observations had revealed that males could deposit silk lines over the females' legs (F.G. Costa and A. Aisenberg, pers. obs.). In spite of many years working on *S. malitiosa*, this behavior had never been described before and such behavior had also not been reported previously in Lycosidae. Therefore, we decided to quantify the occurrence of male "tying" behavior in *S. malitiosa* under laboratory conditions.

Adult males and subadult individuals of *S. malitiosa* were collected in Marindia, Canclones, Uruguay (34°46′49.9″S, 55°49′34.1″W), from March to July 2006. Spiders were individually housed in culture dishes (9.5 cm diam. × 1.5 cm height), each with cotton moistened with water. Individuals were fed ad libitum with juvenile cockroaches (*Blaptica dubia*, Blattaria, Blaberidae) and mealworms (larval *Tenebrio* sp., Coleoptera, Tenebrionidae). Room temperature during the breeding period averaged 19.8 ± 1.8° C (Mean ± SD, range = 14.0–26.0° C). Juveniles were maintained in a warmed room (22.7° ± 0.7° C, range = 21.5–24.5° C) as a way to accelerate their development. The average temperature during the trails was 21.7 ± 1.9° C (range = 19.5–26.0° C).

We performed 20 trials under laboratory conditions. Spiders were randomly assigned to each sexual encounter. In all the cases, we used virgin females and adults of at least 11 da of adult age, or 10 da after their capture in the field. We did not reuse individuals in the trials. The test arenas were square glass containers (29.5 cm × 29.5 cm × 9.5 cm) with sand and small pebbles as substrate. We provided four wooden blocks (each 6 cm × 1 cm × 1 cm) to enrich the area and provide potential refuges. Females were placed in the arena 48 h prior to the trial, allowing the deposition of contact pheromones with the draglines. Males were carefully introduced into the arena and removed after 20 min without courtship, 30 min when males courted but did not copulate, or after the end of copulation. The course of sexual behavior was followed by direct observation by two observers: one registered the number of insertions and side shifts and the second observer registered the durations and the occurrence of silk release. Voucher specimens were deposited in the arachnological collection of Sección Entomología, Facultad de Ciencias, Montevideo, Uruguay.

We obtained 15 copulations from the 20 pairings and in all the cases males were observed spinning silk over the female during copulation. Copulatory characteristics coincided with those reported by Costa (1979). Each male bent his abdomen downward and actively attached silk lines to the substrate (small pebbles or wooden chops), on top of female legs I and II, or close to her mouthparts (Fig. 1). The silk thread and movements of spinnerets were continuously observed during both copulatory patterns and until the end of the copulation. In 10 cases, the female remained cataleptic after copulation.

We conclude that *S. malitiosa* males regularly release silk during copulation. Possibly, two facts explain why this behavior had not been reported before. First, the inclusion of pebbles and wooden chops on the substrate for the first time allowed the attachment of male silk strands during the side shift movements, making the silk more visible. Current studies confirm the occurrence of male silk release during copulation using diverse substrates and experimental cages (A. Aisenberg, pers. obs.). Second, the observations were performed by two observers, one on each side of the test arena, which resulted in more detailed observations. Apparently, the copulating males continue releasing draglines and attachments during copulation similar to their behavior when they walk (F.G. Costa and A. Aisenberg, pers. obs.).

Various hypotheses have been proposed to explain the possible functions of male "tying" behavior, including inhibition of female

Table 1.—Spider species showing male silk release during copulation according to published studies.

Family	Speeies	Reference
Ctenidae	*Cupiennius coccineus* F.O. Pickard-Cambridge 1901	Schmitt (1992)
Dictynidae	*Dictyna volucripes* Keyserling 1881	Starr (1988)
Homalonychidae	*Homalonychus theologus* Chamberlin 1924	Domínguez & Jiménez (2005)
Nephilidae	*Nephila pilipes* (Fabricius 1793) (formerly *N. maculata*)	Farr (1977); Robinson & Robinson (1980)
Pisauridae	*Ancylometes bogotensis* (Keyserling 1877)	Merrett (1988)
Pisauridae	*Pisaurina mira* (Walckenaer 1837)	Bruce & Carico (1988)
Theridiidae	*Latrodectus hesperus* Chamberlin & Ivie 1935	Ross & Smith (1979)
Theridiidae	*Latrodectus tredecimguttatus* (Rossi 1790)	Stern & Kullmann (1981)
Thomisidae	*Xysticus cristatus* (Clerck 1757)	Bristowe (1958)

aggressiveness (Schmitt 1992; Domínguez & Jiménez 2005), or bridal veiling as a displacement activity arising from the conflict of mating a potentially predatory partner (Schmitt 1992). Additionally, it has been proposed that bridal veils are involved in female identification of mating partners by male pheromones deposited in the silk (Ross & Smith 1979). In *S. malitiosa*, the silk lines are deposited over or near the dorsal side of the female's front legs, which are known to present numerous chemoreceptors in spiders (Foelix 1996; Barth 2002).

Ayyagari & Tietjen (1987) suggested male pheromones function as repellents for other males in the wolf spider *Schizocosa ocreata* (Hentz 1844). According to this hypothesis, bridal veils could function as porters of male pheromones. Becker et al. (2005) reported the use of male chemical signals as elicitors of female quiescence (catalepsy) during copulation in the agelenid *Agelenopsis aperta* (Gertsch 1934). In *S. malitiosa*, this hypothesis could not be tested because all males released silk but some females remained cataleptic and others did not. The determinants and functions of female catalepsy in this species remain obscure.

Nevertheless, studies on these topics are scarce and hypotheses require further testing. Peretti & Córdoba-Aguilar (2007) have stressed the importance of fine-scaled behavioral observations for studies on sexual selection. Possibly, more detailed observations of spider courtship and copulation will contribute new cases of males that "tie" females during courtship or copulation, suggesting that this could be a widespread behavior in spiders. Future experiments sealing male spinnerets and investigating variations on the mating pattern and female agonistic behavior, as well as studying male-male competition with and without copulatory silk lines, will help elucidate the possible functions of this behavior.

Figure 1.—Copulation of *Schizocosa malitiosa*, with the male lying on top of the female. Note the white spot of silk on the pebble located under the male spinnerets.

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SHORT COMMUNICATION

Some notes on rearing *Poltys* (Araneae, Araneidae) in captivity

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Abstract. Spiders of sexually dimorphic and nocturnal species, *Poltys grayi* Smith 2006 and *P. laciniosus* Keyserling 1886, were reared from egg sacs. Spiders were kept in small containers and were fed on a non-living food mix based on houseflies, pollen, egg, and moths. Despite setbacks while developing the method, 41% of *P. grayi* spiderlings matured (all males) and 24% of *P. laciniosus* matured (both males and females). Details of the food mix and conditions of rearing are presented. This method of rearing spiders may be useful for taxonomic purposes and for studies of variation, but is probably unsuitable for behavioral studies.

Keywords: Orb-web spiders, captive rearing, pollen, houseflies, moths, variation

The majority of studies that involve rearing orb-web spiders aim to examine web-building behavior, therefore spiders are reared in large cages where they can spin webs and live food is usually placed into the webs. Indeed, a recent publication provides invaluable advice for laboratory rearing (Zschokke & Herberstein 2005). Of studies involving the rearing of spiders for other purposes, many minimize the space and facilities required by enclosing spiders in small vials, at least for younger stages (e.g. Schaefer 1977), and some have successfully used artificial food mixes (Peck & Whitcomb 1968, cited in Nentwig 1987; Amalin et al. 1999, 2001). That spiders will accept non-living food is not surprising as a number of instances of spiders scavenging dead prey or accepting unlikely food items offered in a captive situation can be found in the literature (Nentwig 1987 provides examples). As far as I am aware, however, no studies have reported rearing orb-web species (e.g., Araneidae) to maturity using small containers and entirely fed on non-living food.

The present study involved rearing araneid spiders in the genus *Poltys* C.L. Koch 1843. This was carried out to: 1) confirm the matching of sexes by obtaining males from egg sacs laid by known females; 2) study the development of abdominal shape in females. These results have been previously reported (Smith 2006a, 2003 respectively), but the method of rearing has not. Additional data from this rearing method on clutch sizes and growth rates will be reported in a future publieation. The spiders were reared as efficiently as possible in small vials and on non-living food. The rearing methods were developed by trial and error during the course of raising the specimens; hence this work is not presented as a rigorous scientific study. Rather, this short communication is intended to provide some guidance to others who wish to raise spiders in similar conditions, and is focused on methodology rather than results.

Female and juvenile male spiders in the genus *Poltys* catch nocturnal insects, primarily moths, using an orb web snare. During daylight the spiders sit motionless on a dead twig and the females especially are cryptically camouflaged, with irregular abdominal shape and coloration (Smith 2006a). Males mature after 2–4 molts, females after 8–12 molts (Smith 2003, 2006b). Males of several *Poltys* species were reared successfully but the results reported here concentrate on two species for which females were also targeted, *P. grayi* Smith 2006 and *P. laciniosus* Keyserling 1886. *Poltys grayi* is restricted to Lord Howe Island, where the climate is similar to the northern coast of New South Wales; *P. laciniosus* is found over much of mainland Australia, but mostly away from the humid east coast. Eighty spiderlings of *P. grayi* were set up as described below, 40 from each of two egg sacs laid in December 2000 by wild-caught females. The *P. laciniosus* spiderlings were from egg sacs laid by females caught in western New South Wales and South Australia in March 2002. A total of 374 spiderlings from 12 egg sacs were set up. All the females that laid egg sacs (Table 1) and the majority of their offspring are deposited in the collections of the Australian Museum, Sydney, New South Wales. Some reared specimens were distributed to other Australian museums (Smith 2006a).

A few days after their emergence, spiderlings were placed in separate glass vials approximately 1.5 cm diameter × 5 cm high. Males were reared through to maturity in these, females until about the 5th molt when they were transferred into the next vial size (2.5 × 5 cm). Large females were again transferred into larger containers, usually plastic specimen pots (4.4 × 5.8 cm). Plastic caps supplied with the vials were used as stoppers for *P. grayi*; several small holes were punched in each cap. These stoppers were initially used also for *P. laciniosus*, but the spiderlings did not thrive in the humid conditions these lids produced. These were subsequently swapped for caps made of a thin cotton cloth secured with an elastic band. All spiders were provided with an appropriately sized twig with broken side twigs or leaf scars to sit on. The twig was stuck onto the base of the vial in a small ball of "Blu Tack" to keep it in position during cleaning and so help minimize disturbance.

Water was provided by wetting a small twist of cotton wool stuck on the side of the vial. *Poltys laciniosus* with cloth caps were provided with additional humidity at night in dry weather by the placement of a damp cloth over each tray of specimens. This cloth was removed in the morning. *Poltys grayi* spiderlings were alternately fed freshly squashed flies (*Drosophila* Fallén or houseflies, *Musca domestica* L.) and a few crushed and dried pollen "granules" (Table 2), which were sprinkled onto their lines. Spiderlings did not thrive beyond the first two or three molts on this diet (similar results were reported for a lycosid species fed on a monotypic diet by Uetz et al. 1992) and so a food mix was developed (Table 2). The ingredients were mashed and mixed thoroughly to a sticky consistency using a pestle and mortar. Batches sufficient for one or two weeks were mixed at one time: portions were placed in small vial lids, wrapped in twists of plastic wrap and stored in a freezer until required. Lumps of freshly thawed food mix approximately the size of the spider were stuck to the inside of the vial lid (for those with plastic lids) or to the side of the vial (for *P. laciniosus*). The correct consistency ensured that the food stayed in place high in the vial, as food that fell was not eaten. Food and water were provided every two to three days, the frequency depending on the number of specimens to be fed, their growth rate/voracity and the time of year. In hot weather it was necessary to remove food remains from high-humidity vials on the following day. Spiders were fed shortly before dark and specimens

Table 1.—Specimen data for the female spiders that made egg sacs used in this study.

Australian Museum registration number	Species Locality and date
	Poltys grayi
KS90968, KS90953	New South Wales: Lord Howe Island, along Lagoon Rd, 31°31′S 159°04′E, 6–15 Dec. 2000
	Poltys laciniosus
KS78296	New South Wales: Cocoparra NP, The Woolshed Flat campsite, 34°04′46″S 146°13′23″E, 15 Mar. 2002
KS78300, KS78301	South Australia: Ngarkat Conservation Park, Pertendi Hut campsite, 35°38′17″S 140°46′50″E, 17 Mar. 2002
KS78303, KS78304	South Australia: Millbrook Reservoir, 34°50′S 138°49′E, 19 Mar. 2002
KS78307	South Australia: Mt Remarkable NP, Mambray Creek, 32°50′45″S 138°01′41″E, 20 Mar. 2002
KS78310	South Australia: near entrance to Coffin Bay NP, 34°37′26″S 135°27′04″E, 22 Mar. 2002
KS78311	South Australia: Lincoln NP, Woodcutters Beach camping area., 34°47′11″S 135°55′04″E, 23 Mar. 2002
KS78313	South Australia: Lincoln Hwy, 41km N of Cowell, 33°21′28″S 137°03′58″E, 24 Mar. 2002
KS78314, KS78315, KS78318	South Australia: Arden Vale Rd, 5.1km from outskirts of Quorn, 32°18′08″S 138°00′49″E, 24 Mar. 2002

were kept well lit until feeding was complete to inhibit the onset of nightly activity. This regime minimized stress through disturbance while making fresh food mix available during the nightly active period.

Spiders were reared in a deeply shaded room and supplementary light was provided using a lamp on a timer. Day lengths were maintained as appropriate for the time of year, but were often shifted slightly later during winter to facilitate the late afternoon-early evening feeding regime. Additional heating was used to boost daytime temperatures during the cooler months, when thermal inertia caused indoor temperatures to lag significantly behind those outside. When many specimens were involved, i.e. during the early stages of rearing *P. laciniosus*, the whole room was heated using an electric oil-filled radiator. For fewer specimens the heated area was localized by using pet heating pads and enclosing the specimens in an inverted clear plastic tank.

The date of each molt was recorded on a label. Cast exoskeletons and the label were kept in a separate adjacent vial. On death or maturity, the spider and alcohol were added into the same vial as the exuviae and data. All hatched egg sacs were retained, and later opened and the exuviae counted.

A summary of the spiders raised by this method follows. The *Poltys grayi* spiderlings emerged in mid summer 2001 (early–mid January). Of the 80 spiderlings, sixteen males matured from one egg sac, 17 from the second. No females matured from either, but many grew far enough to establish the abdominal shape (Smith 2003). This is an overall success rate of 41%, or 82% for males if the sex ratio was 1:1 at hatching (Smith 2003). The *Poltys laciniosus* spiderlings hatched in late autumn and early winter 2002. There was high initial mortality over winter and until plastic lids were replaced with porous cloth caps. Few molts occurred until spring. Sixty-three males from these 374 spiderlings matured in total. Twenty-five females were reared through to maturity, five in their first year, and 20 in the second. A further three penultimate females were euthanized at the start of the third winter; these would have matured within the next 6 months. Other juvenile females also grew large enough to develop indicative abdominal shape. This is an overall success rate of 24%, or 34% for males and 15% for females if the sex ratio is 1:1 at hatching. The success rate from individual egg sacs ranged from 0% to 51%. The low percentage of spiders of *P. laciniosus* reared from egg sacs was primarily due to the unsuitable initial rearing conditions of high humidity, combined with the winter emergence, which extended the time until most growth started. Variability of fitness of the spiderlings from different egg sacs may also have been a factor. Some females of *P. grayi* might have survived to maturity using the improved techniques later developed for *P. laciniosus*.

Several rearing studies have reported that specimens reared in restrictive containers were smaller at maturity than wild-caught counterparts, at least for normally active hunting species (Schaefer 1977; Miyashita 1988). All specimens that matured in this study, *P. grayi* males and *P. laciniosus* males and females, were within the carapace-length range of wild-caught specimens (Smith 2006a, b).

Table 2.—Ingredients and preparation of food mix used to raise *Poltys* spiders.

Ingredient	Quantity	Availability	Preparation	Notes
Houseflies (*Musca domestica*)	c. 50	As pupae from specialist pet food suppliers	Frozen after eclosion.	Nutritional value low, but provides structure for the mix.
Moths (various species, not identified; those suspected to be distasteful were discarded)	1–5, depending upon size	Caught wild at lights and other sites	Frozen prior to use; prepared by removal of wings, body hairs rubbed off in water.	Moths probably not necessary, especially for non moth-specialist species.
Mealworms (tenebrionid beetle larvae)	2–3	From pet stores or fishing shops; easy to maintain a colony	Frozen to kill; cut into short sections.	Used more when moths not as available. May not be necessary.
Pollen	2–3 'granules'	"Pollen granules" available from health food outlets	Ground into mix. This honeybee product is slightly sticky; if needed as a powder, dried in oven at low temperature and crushed.	Important nutritionally for spiderlings of web-recycling species (Smith & Mommsen 1984)
Egg yolk	2–3 drops	Food stores	Used in small quantity to avoid decay of food mix.	Use demonstrated by Amalin et al. 2001.
Soy 'milk'	A few drops as necessary	Food stores	Used to adjust mix to a sticky consistency.	Use demonstrated by Amalin et al. 2001.

Poltys laciniosus, in particular, mostly fell in the middle of the size range; *P. grayi* males were at the lower end because most matured at the second molt, i.e., at the earliest opportunity. Although some *P. laciniosus* were stunted, it was found that these individuals, which were not responding well to rearing conditions, did not reach maturity. It was previously reported that *P. grayi* juvenile females appeared to be stunted (Smith 2003). Although some of these were distinctly small, comparison with *P. laciniosus* suggests that the size increases typical of the final one to two molts were underestimated, and those *P. grayi* that responded well to rearing conditions were on track to reaehing normal sizes.

The method of rearing spiders deseribed above, like others, has advantages and drawbacks. The primary advantage is the relatively small amount of space required. An additional plus is the possibility of feeding spiders through winter when it might be difficult to find natural prey, making it appropriate for species that do not overwinter in the egg stage. The high success rate for males makes it particularly useful for matching sexes for sexually dimorphic species. The primary drawback is the labor-intensive care regime, although for fast growing species (or micro males) this problem is less important. The application of the method is also largely limited to raising spiders for non-experimental purposes, as there is potential for behavioral changes due to lack of mobility and learning cues in a simplified environment. This has been demonstrated for active hunters such as salticids (Carducci & Jakob 2000) but may well apply equally to sedentary web builders. Although *Poltys* species are the only spiders raised all the way through from an egg sac during this study, individuals of other nocturnal araneids, in particular species of *Dolophones* Walckenaer 1837 and *Carepalxis* L. Koch 1872, have been brought to maturity through several molts using the same technique. Undoubtedly this method will not work for all araneid spiders; for instance I was unable to persuade newly hatched spiderlings of *Heurodes* Keyserling 1886 to start feeding and part-grown spiders caught in the wild do not always thrive. Adaptations of the method would be required to match the activity cycle or primary food group of the spiders being raised. Here, due to doubts as to the completeness of the nutrients in the food mix, moths were included because they are the primary prey item of *Poltys* in the wild (Stowe 1986; Smith 2006a) and the importance of a varied diet was stressed by Uetz et al. (1992).

Spiders in natural populations may show marked variation in the development of secondary sexual characters, such as cheliceral parameters (e.g., Levi 1981), and examples of genitalic polymorphisms are occasionally reported (Jocqué 2002). If the occurrence of such variation in spiders is even partially mediated by environmental factors such as space or nutrient intake, it would be likely that polymorphisms might be evident in laboratory reared specimens. Such environmentally controlled variation (or polyphenism) has been studied in some insect species. For instance, the male horn allometry in a scarab beetle (Coleoptera: Scarabaeidae) was shown to be dependent on diet quality (Emlen 1997) and several environmental cues, including crowding, have been shown to influence the behavioral and physical changes in taxa such as aphids (Heteroptera: Aphidae), which switch between dispersive and sedentary adult forms (Braendle et al. 2006). Far from being an undesirable source of error, this exploratory aspect of laboratory rearing of spiders should be viewed as an opportunity. At present it is likely that many variable taxa have been described under multiple species names (Jocqué 2002). These current shortfalls in our understanding and recognition of species boundaries are unlikely to be resolved without the sometimes accidental insights brought by captive rearing.

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SHORT COMMUNICATION

The costs of male courtship and potential benefits of male choice for large mates in *Phidippus clarus* (Araneae, Salticidae)

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Abstract. Despite a wealth of research on the benefits of mate choice, empirical evidence for the costs of courtship is scarce. Understanding the interplay between the costs and benefits of reproductive behaviors is critical to our understanding of sexual selection. I present a study designed to explore the potential reproductive benefits of male choosiness for large mates as well as the costs of courtship in the jumping spider *Phidippus clarus* (Keyserling 1885). My findings suggest that a positive relationship between female tibia length and the number of emerging spiderlings may underlie male choice for large females. However, this benefit may be mitigated by the longevity costs of courtship. Further investigation of the potential trade-offs between the benefits of male preferences for large females and the costs of courtship in this species is required.

Keywords: Sexual selection, survivorship, fitness, jumping spider

The costs and benefits of courtship and mate choice are of critical importance to our understanding of sexual selection, and it has been widely accepted that sexual traits associated with courtship increase fitness. However, currently favored viability indicator (good genes) and Fisherian self-reinforcing models of sexual selection require that courtship behaviors and associated morphological traits have evolutionary costs that balance their benefit (Fisher 1958; Zahavi 1975; Kirkpatrick 1982; Andersson 1986). Although significant research effort has been directed towards the fitness benefits that individuals derive from courtship and mate choice (Petrie 1992; Johnstone 1995; Rypstra et al. 2003), quantification of costs has been rare (Kotiaho 2001).

I report an investigation designed to explore some of the fitness costs of male courtship and mating as well as the potential benefits of male choice for large mates in the jumping spider *Phidippus clarus* (Keyserling 1885). *P. clarus* is a widespread, sexually dimorphic jumping spider that inhabits old fields throughout North America. Adult females build silken nests that are used when mating, ovipositing, and guarding young (Hoefler & Jakob 2006). In Massachusetts as well as other parts of the USA (e.g., Roach 1988), *P. clarus* has a relatively restricted reproductive cycle compared to other congeners mating in early to mid July and ovipositing in August (pers. obs.). Hoefler (2007) discovered that cohabiting pairs (= adult male guarding penultimate instar female) of *P. clarus* were size-assortatively matched for tibia length (front legs). Adult males are choosy: in outdoor simultaneous choice tests, small and large adult males preferentially courted and cohabited with females that had longer tibias, a trait that was inversely correlated with female maturation. Further, adult males demonstrated preferences for large adult females (that mature early) when only female silk and associated cues were present (Hoefler 2007). This might suggest that males discriminate between females on the basis of pheromones or other cues associated with silk, which indicate closeness to maturity as well as overall body size. However, because female tibia length appeared to be important for male discrimination (and highly correlated with other traits potentially used for discrimination) (Hoefler 2007), my specific aims in the current study were to (1) explore the potential benefits of male preferences for large females by examining the relationship between maternal tibia length and the number of offspring that emerged from egg sacs and to (2) investigate the potential costs of male courtship and mating by quantifying the effect that these behaviors had on the survivorship of males. Voucher specimens were deposited in the University of Massachusetts, Amherst insect collection.

P. clarus readily use artificial nest tubes in the field to build silken retreats, which are important sites for reproduction among other things (Hoefler & Jakob 2006). During the first two weeks of June 2003, I haphazardly placed 90 cm tall surveyors flags (Ben Meadows, Janesville, Wisconsin, USA) made of wire poles with 7.5 × 6.5 cm plastic flags in old fields in Amherst (42.3736°N, 72.5208°W) and Hadley (42.3606°N, 72.5714°W), Massachusetts, USA. I made artificial nest tubes (3.8 cm long, 1.5 cm diameter) of plastic plumber's tubing, painted them black with spray paint (Krylon flat black, Sherwin-Williams, Cleveland, Ohio, USA), and tied them to the wire pole of surveyor flags such that they were positioned horizontally. I returned to the fields in mid September 2003 and collected nest tubes with egg sacs and guarding adult females and maintained them in the laboratory individually in plastic cages (18 cm × 13 cm × 11 cm) on a 13:11 h L:D cycle at approximately 26° C until spiderlings emerged. I offered females approximately five early-instar crickets (*Acheta domestica*, Top Hat Cricket Farm, Kalamazoo, Michigan, USA) per week, and provided water ad libitum in test tubes plugged with cotton. I recorded the right front tibia length of each adult female using dial calipers under a dissecting microscope and measured them to the nearest 0.01 mm. Adult females were immobilized briefly with carbon dioxide gas before measurements were recorded. As spiderlings emerged, they were separated into individual Petri dishes (3.5 cm diameter, 1 cm high) to minimize potential counting error. Petri dishes were labeled according to identification numbers assigned to mothers. After all spiderlings emerged, I regressed female tibia length against the number of hatched spiderlings and discovered that tibia length significantly predicted the number of spiderlings ($F_{1,35} = 156.23$, $n = 37$, $r^2 = .817$, $P < 0.0001$, Fig. 1).

Concurrently, I examined the effects of male courtship and mating on male longevity. In early June 2003, I collected 47 penultimate males (= instar not associated with females), raised them to adulthood in the laboratory as described above, and recorded the

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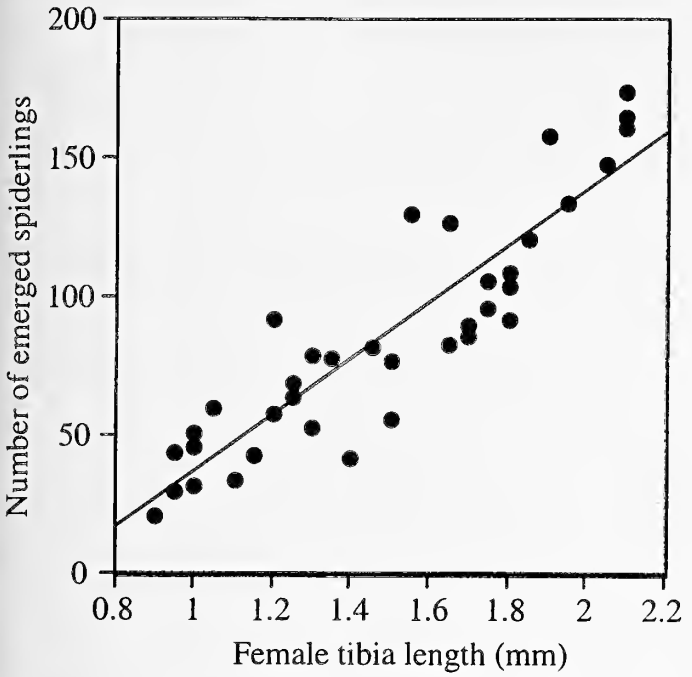

Figure 1.—The number of emerged *P. clarus* spiderlings regressed against the length of the mother's tibia.

date of their final molt. Antepenultimate females (n = 227) were also collected and maintained as previously described through their penultimate and adult instars. Construction paper blinders were placed between cages housing males to prevent them from seeing each other; all male cages were placed away from female cages in the laboratory.

After all males matured, I randomly divided them into two treatment groups and one control group: courtship experience (n = 16), courtship and mating experience (n = 17), and naïve (n = 14). In early July 2003, individual males assigned to the courtship experience treatment were placed in the cage of a randomly selected penultimate female for 1 h daily over a period of 5 consecutive days. Males were placed with a different, randomly selected female each day. All males courted penultimate females by vigorously waving their front legs and abdomens while moving from one side of the cage to the other. On day 6, males were placed into empty cages for 1 h. After trials, males were returned to their cages, where they were offered up to 5 crickets (depending upon how many were currently in the male's cage). I followed this same protocol for males assigned to the courtship and mating experience treatment; however, on day 6, males were placed in

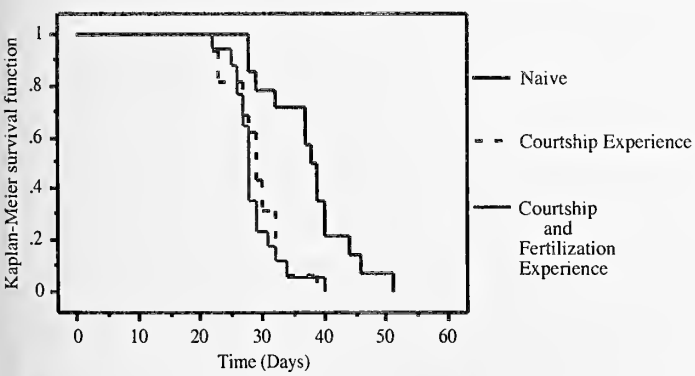

Figure 2.—Survival distributions of adult *P. clarus* males from naïve, courtship experience, and courtship and mating experience groups as a function of the number of days after their final molt.

a randomly selected cage housing an adult female, and the pair was allowed to mate. All males attempted to insert their pedipalps into the female's epigynum, but I did not determine whether sperm were transferred. Males assigned to the naïve group were placed in different empty cages for 1 hour a day over a period of 6 consecutive days (crickets were offered as described above). Following the 6-day treatment period, males were maintained in the laboratory as described above until they died. Date of death was recorded for all males. I compared the survival distributions (date of final molt to date of death) using Kaplan-Meier survival analysis (Kaplan & Meier 1958). I used the non-parametric Kaplan-Meier product limit estimator to test for a significant treatment effect on the median survival distribution. Additional pairwise comparisons were made via the logrank (Mantel-Cox) test.

Male courtship and mating had a significant effect on the longevity of males (Mantel-Cox logrank test: χ^2 = 16.48, n = 47, P = 0.0003, Fig. 2). Males assigned to the naïve treatment lived significantly longer than males assigned to the courtship experience treatment (P = 0.0002) as well as males assigned to the courtship and mating experience treatment ($P < 0.0001$). Male longevity did not differ between the courtship experience treatment and courtship and mating experience treatment (P = 0.972).

Results from my study are consistent with the widely accepted paradigm that male arthropods can maximize fitness by mating with large females. This may explain male choice in *P. clarus* (Hoefler 2007): if a male is unable to mate with all reproductive females in a population, he should benefit by selecting females capable of producing more offspring. Male mate choice decisions would be expected to be based on female features that are correlated with potential reproductive success, such as body size (Gwynne 1991; Owens & Thompson 1994; Altmann 1997). However, costs incurred during courtship may mitigate the benefit.

In the current study, I discovered that adult female tibia length significantly predicted the number of spiderlings that emerged from egg sacs. This finding is consistent with and may underlie Hoefler's (2007) discovery that male *P. clarus* prefer females with long tibias. Generally, clutch size increases with female body size in many arthropods, including spiders (Marshall & Gittleman 1994; Simpson 1995; Jann & Ward 1999; Fox & Czesak 2000; Skow & Jakob 2003). For example, tibia-patella length was highly correlated with egg clutch size in the pholcid spider *Holocnemus pluchei* (Scopoli 1763) (Skow & Jakob 2003). This common pattern in arthropods may implicate male choice as something that may be more widespread than presently apparent (Bonduriansky 2001).

Combined with previous studies of mating behaviors in *P. clarus*, the advantage of male choice for large females would appear to be twofold: (1) female size and number of progeny are positively correlated, and (2) larger females mature before smaller females creating opportunities for polygynous mating (Hoefler 2007). It is important to acknowledge that I did not monitor female mating behavior in the field. Therefore, I am unaware if females mated multiply and if polyandry affects the number of eggs produced, as has been found in other arthropods (Moya-Larano & Fox 2006). Evidence from other salticids suggests that these spiders do sometimes mate again, but are much less prone to mating after their first copulation (Jackson 1981).

I discovered that courting (and mating) male *P. clarus* had significantly reduced survivorship than males who had no experience with females. This may have been a consequence of the energetic costs of courtship. Interestingly, in between trials with females, males were maintained individually in cages with cricket prey available. Although I did not quantify prey consumption, males appeared to feed very rarely. Thus, they may not have been able to recoup the loss of energy spent on courtship.

A trade-off between the fitness benefit of courting, discriminating between females, mating with large females, and the reduced lifespan

associated with courtship may play a vital role in male reproductive success. Reproductive behaviors have been shown to reduce lifespan in other species. For instance, courtship significantly decreases longevity in male vinegar flies (Cordts & Partridge 1996), tsetse flies (Clutton-Brock & Langley 1997), and the drumming wolf spider *Hygrolycosa rubrofasciata* (Ohlert 1865) (Kotiaho 2000). However, it is currently unknown if male courtship is integral to male discrimination. If courtship is evolutionarily costly and discrimination can be achieved without courtship, it would be advantageous for males to avoid courtship with unprofitable potential mates. Interestingly all males in the courtship treatment and courtship and fertilization treatment courted all females, which varied in size. Although only one female was present with a male at a given time, it would appear that male courtship is very common when females are present.

In addition to energetic costs, male *P. clarus* courtship may have other costs. Predators and parasitoids often exploit the sexual displays of their prey in order to locate them (Cade 1975; Wagner 1996; Zuk et al. 1998). Pompilid wasps have been observed attacking and subduing *P. clarus* in the field (Hoefler, pers. obs.); courting males may be more susceptible than females due to their overt courtship displays and because they often guard females outside of the silken retreat where they are exposed. Socially imposed costs, which may take the form of increased male aggression towards displaying males (Borgia 1995; Candolin 1997; Kotiaho 2001), may also reduce male fitness via energetic costs and/or injury.

To ascertain with greater certainty the value of spider males mating with larger females, researchers conducting future studies should consider experimental control over female mating opportunity as well as measures of fitness other than offspring number. Similarly, future studies of how reduced lifespan from courtship affects lifetime reproductive success will improve our understanding of the trade-off between sexual behaviors and their underlying costs.

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SHORT COMMUNICATION

Cold-hardiness in the wolf spider *Pardosa groenlandica* (Thorell) with respect to thermal limits and dehydration

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Abstract. The super-cooling point (SCP) of *Pardosa groenlandica* was found to be −10.54° C, which is lower than for species from warmer climates, in agreement with predictions. There was no significant difference found between sexes. There were also no significant differences between the seasons, although there was a slight trend towards lower SCP temperatures in the winter months. Dehydration lowered SCP in *P. groenlandica*, with a mean depression of over 3° C in desiccated individuals. Specimens of *P. groenlandica* were able to move at temperatures as low as −2.3° C. These data allow for comparisons with samples from other climatic regions, and reinforce predictions based on previous studies with a variety of arthropods, regarding the effects of hunger and desiccation on the SCP.

Keywords: Arachnida, cold tolerance, Lycosidae, sub-arctic, super-cooling

Arthropods that live in sub-zero temperatures for at least part of the year survive by one of two physiological and biochemical responses. At least for insects (Bale 2002), one way is tolerance of ice crystal formation in their bodies (freeze tolerance), and the other is avoidance of ice crystal formation (freeze avoidance). Ice crystal formation is avoided by super-cooling, which depresses the freezing point (Sinclair 1997; Renault et al. 2002). The super-cooling temperature depression is often used to determine cold-hardiness in invertebrates, and the temperature at which ice crystals form is called the super-cooling point SCP (Renault et al. 2002). Several physiological processes are known to cause super-cooling and SCP depression. These include accumulation of poly-ol compounds in the hemolymph (thus increasing the osmotic pressure), dehydration (also increasing osmotic pressure), synthesis of thermal-hysteresis protein, or evacuation or masking of ice-nucleation factors in the gut (Duman 1979; Sømme 1982; Zachariassen 1982; Aunaas et al. 1983; Cannon & Block 1988; Danks 2005). Cold hardiness is particularly important in spiders as they are not known to be freeze-tolerant (Kirchner 1987). Among spiders there are a variety of strategies for surviving sub-zero temperatures (Schaefer 1977; Kirchner 1973, 1987). There are two main strategies to survive freezing temperatures by super-cooling temperature depression according to Kirchner (1987). One physiological strategy is to maintain a relatively constant SCP throughout the year. This strategy is found in species that have low (SCP = −3° – −7° C) or medium (SCP = −7° – −15° C) cold hardiness, by Kirchner's categories (Kirchner 1987). According to this idea, only species with high cold hardiness (SCP < −17° C) decrease their SCP as seasons proceed. The second physiological strategy is a lowering of the SCP as the temperature decreases through seasons. This strategy is found in species that have high cold hardiness.

In this study we used a common wolf spider (Lycosidae) *Pardosa groenlandica* (Thorell 1872) to test four research goals regarding the nature of cold hardiness in spiders. The species is found across northern Canada, Alaska, and Siberia, in terrain that ranges from exposed mountain slopes, to open plains, to stony coastlines (Dondale 1999). All the habitats share one feature: all experience several months at sub-zero temperatures, so that the species must be adapted for cold hardiness to remain active below 0° C. However, it is known that species of *Pardosa* from different regions, with differences in mean monthly temperatures, vary in their SCP. For example, *Pardosa* species from Newcastle-upon-Tyne (UK) had higher SCP than a variety of Lycosidae from cooler climates (Kirchner 1987; Bayram & Luff 1993). Therefore, our first goal was to test whether *P. groenlandica* has a lower SCP than reported for the *Pardosa* species from warmer climates. We also determined the thermal limit of locomotion, at which temperature individuals are still active. The habitat of *P. groenlandica* would classify it as a species of medium cold hardiness (Kirchner 1987). Our second goal was to test whether *P. groenlandica* maintains the same SCP through seasons, as would be predicted by Kirchner (1987). Controlled dehydration is known to be one physiological response to decreasing the SCP in insects (Danks 2005) and in wolf spiders (DeVito & Formanowicz 2003). Since an increase in poly-ol concentration was proposed to be physiologically demanding in winter-active species (Duman 1979), dehydration would be a plausible alternative to increasing the osmotic pressure. Therefore, our third goal was to test whether dehydration contributes to cold hardiness and SCP depression in *P. groenlandica.* Finally, a difference in the SCP between sexes is known in some arthropods but is rare in spiders (Kirchner 1987; Salin et al. 2000). Our fourth goal was to test whether the SCP was different between male and female individuals of *P. groenlandica.*

METHODS

Study site.—Spiders were collected from Fisherman's Cove in Eastern Passage, Nova Scotia (44°36′N, 63°29′W, elev. 5.18–6.09 m above sea level), with a mean annual temperature of 6° C. Seasonal temperature data were obtained from the nearby weather station at Shearwater, Eastern Passage, Nova Scotia. Mean over-wintering temperatures are December −1° C, January −4° C, February −4° C, March 0° C, and April 4° C. The terrain was a rocky shore, with most rocks ranging from 10–30 cm in diameter. The sediment beneath the rocks was sandy and wet and acted as a barrier to the spiders. Spiders were located in and among the rocks from the water line up to and on the boardwalk. The rocks are covered in snow and ice through the over wintering period until April.

Collecting spiders.—Adult spiders were collected as needed between June and December 2005 with no specific time interval between samplings. This period covers the warmest months and extends through the cooling months to winter. Individual spiders were captured and placed into 14 ml glass vials. In favorable weather (see below) about 20 spiders could be collected in 30 min by 3 or 4 people. No biases were made towards size or sex. Collected spiders

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Table 1.—Seasonal variation in super-cooling points (SCP) of *Pardosa groenlandica*.

Time period	Mean field temperature range (° C)	SCP (° C) (mean ± SD)	*n*	SCP range (° C) Max.	SCP range (° C) Min.	*P*
June–July	9–22	−9.8 ± 2.29	20	−6.6	−12.8	0.164
August–September	10–22	−10.8 ± 1.77	21	−7.5	−15.0	0.618
October–December	−5–13	−11.7 ± 2.9	9	−7.5	−15.3	0.265
Overall		−10.54 ± 2.43	50	−6.6	−15.3	

were maintained at 22° C without food, and experiments were performed within two hours of collection. Voucher specimens have been deposited in the Natural History Museum, Department of Biology, Dalhousie University.

Determination of super-cooling point.—Spiders were placed in a 2 ml tube and held in place using a 4 cm^2 piece of paper towel. A thermocouple (Virtual Instruments Atlantic Low Temperature Systems, Austin, Texas) was fed through a small hole in the lid of the tube and was attached to the spider via a minute amount of petroleum jelly. The thermocouple led to a digital reader which stored temperature data. Spiders were frozen one at a time in an Endocal Refrigerated Cooling Bath (NESLAB, Newington, New Hampshire) set at 20 ± 0.05° C. The bath temperature was then decreased at a rate of 1° C per minute while an electronic graph was made of the temperature. The SCP was defined by a sharp increase in temperature recorded. Readings were ceased once the temperature recorded returned to a point lower than the SCP. After each trial, the temperature of the cooling bath was returned to 20° C for the next trial. SCP means were compared across seasons. SCP were analyzed using ANOVA (Zar 1984) and significance tested at 95% confidence. Throughout this paper, means are reported ± SD.

Effect of dehydration on super-cooling point.—In September 2005, 29 spiders were randomly selected regardless of life stage, size, or sex and placed into one of two groups: The 14 spiders in the control group were individually contained in 22.1 cm^3 vials with the lid on, but the lid was temporarily removed once per day to allow air renewal. The 15 spiders in the treatment group were also contained in the same size vial, but instead of a lid each vial was covered with cheesecloth held in place with an elastic band. All spiders were individually weighed using an electronic balance accurate to 0.001 g and again after 3 days. The SCP experiment was then performed as described above. Comparison of weight lost and SCP between the control and experimental groups were carried out using ANOVA (Zar 1984) and significance tested at 95% confidence.

Thermal limit of locomotion.—In October 2005, 20 spiders were individually placed in 14 ml vials. A hole was made in the top of the vial with a scalpel through which a thermocouple was fed. The vials were placed in a programmable temperature-controlled cooling bath which cooled at a rate of 1 ± 0.2° C per 3 min. The starting temperature was set at 0° C. At each −1° C interval, measured by a thermocouple thermometer (Hanna Instruments Model HI 93530, Laval, Québec, Canada) the spiders were observed and qualitative notes were taken on the spider's ability to move. The experiments were ended at the temperature the spider was no longer observed to move, and this temperature was recorded as the thermal limit of locomotion for that individual.

RESULTS

General observations.—Spiders were about 1 cm in body length not including the legs. Spiders were present in abundance regardless of temperature during the collection period with the exception of rainy and/or windy days. Specimens were collected mostly between and under rocks, with more being found on the boardwalk on colder days. Spiders were only found in high numbers on sunny days, with fewer being found as cloud cover and/or wind intensity increased.

Determination of super-cooling point (SCP).—A total of 50 spiders was tested between June 6th and December 5th 2005. The average SCP was −10.5 ± 2.4° C, range = −15.3 – −6.6° C (Table 1). None of the individuals survived, indicating that this species was not tolerant of ice crystal formation below the SCP. There was no significant difference in the mean between seasons ($P > 0.05$). A random sample of 12 female and 12 male spiders collected in September 2005 were sexed for comparison of their SCP. The SCPs of males and females were −11.4 ± 2.7° C and −10.5 ± 1.3° C, respectively. Analysis with ANOVA showed no significant difference between SCP by sex ($P = 0.322$).

Effect of dehydration on SCP.—Twenty eight spiders were randomly assigned to either the control group or the dehydration group. As shown in Table 2, the dehydration group lost more mass than did the control group (−0.015 ± 0.011 g versus −0.002 ± 0.003 g). Analysis using a t-test showed that the mean SCP of the control group was not different from the mean SCP of the species (−10.5° C) ($P = 0.957$). The dehydration treatment resulted in a SCP 3.3° C lower than the control group. Analysis with ANOVA shows this to be a significant difference ($P = 0.001$).

Thermal limit of locomotion.—The mean temperature at which the randomly chosen spiders ($n = 20$) could no longer move was −2.4° ± 0.9° C, range = −1.0° C – −4.0° C. All spiders slowed down at 0° C and regained mobility after the experiment when 1 min after their body temperatures returned to normal. There did not appear to be any immediate detrimental effect on their health.

DISCUSSION

Super-cooling point and thermal limit of locomotion.—The wolf spiders *P. pullata* (Clerck 1757) and *P. amentata* (Clerck 1757) from Newcastle-upon-Tyne (UK) were shown to have a higher super-cooling point (SCP) (Bayram & Luff 1993) than spiders that lived in cooler climates (Kirchner 1973; Schaefer 1977). Our results show that *P. groenlandica* from a cooler climate had lower SCP. Overall these results support the idea that SCP is lower in spider species from colder habitats as proposed by Kirchner (1987). At least, our results confirm this trend within the genus *Pardosa*. With a mean SCP of −10.54° C, *P. groenlandica* falls into the medium range of cold-hardiness predicted by its habitat (Kirchner 1987). This finding is comparable to other species of lycosids, for example, *Arctosa perita* (Latreille 1799) and *Pirata piraticus* (Clerck 1757) with SCP of −11.0° C and −14.5° C, respectively.

The mean thermal limit of locomotion found in *Pardosa groenlandica* was −2.4° C. This is not an unusual value, as there are many species of spiders capable of locomotion below 0° C. At temperatures below 0° C it is less likely to find spiders in the open because they move more slowly and they would become more vulnerable to predation. It is likely that the SCP is lower than the thermal limit of locomotion because spiders can still become active during brief warm spells, especially in more sheltered spaces among the rocks. While the protocol used to determine the thermal limit of locomotion is relatively standard, it places the spiders in an artificial setting where they do not have much space to move. Wolf spiders are known to exhibit thermoregulatory behavior in addition to their resistance to cold by super-cooling (DeVito & Formanowicz 2003). It

Table 2.—Effect of dehydration on super-cooling point (SCP) in *Pardosa groenlandica*.

Treatment	Start weight (g, mean ± SD)	End weight (g, mean ± SD)	Weight loss (g, mean ± SD)	SCP (° C, mean ± SD)	*n*	*P*
Control	0.152 ± 0.055	0.151 ± 0.057	0.001 ± 0.007	10.6 ± 1.9	14	0.001
Dehydrated	0.142 ± 0.175	0.129 ± 0.178	0.013 ± 0.0116	13.9 ± 2.5	14	

may be that, under these conditions, heat that would have been generated by moving was not possible.

SCP change with seasons.—As *P. groenlandica* is a species with medium cold-hardiness, we predicted that the SCP of this species would not differ signifieantly from season to season (Kirchner 1987). The results (Table 1) support the hypothesis, although a trend was observed in the data. During the October to December period of sampling there was a noticeable, but statistically insignificant, tendency towards lower SCP in the spiders, with points reaching as low as −15.3° C and with only three findings below −12.0° C. The results indicate that *P. groenlandica* demonstrates aspects of both of Kirchner's (1987) cold-hardiness strategies. However, there are probably intermediate species that do not fit into these categories. For example *Pirata piraticus*, with a SCP of −14.5° C, does not meet the criterion of the high-cold-resistance category (i.e., SCP < −17° C), but shows a depressed SCP during the winter compared to summer months (Kirchner 1987).

Effect of dehydration on super-cooling point.—Wolf spiders are known to control evaporative water loss and are capable of water uptake directly from the soil (DeVito & Formanowicz 2003). This is not unusual in soil-dwelling organisms (Adl 2003), and it was recently observed in the oribatid mite *Phauloppia* sp. (Sjursen & Sømme 2000). Moisture from the sand below the stones on this coastline is probably an important source of water for *P. groenlandica*. The results support our hypothesis that dehydration decreased the SCP and therefore increased cold hardiness in this species by −3.3° C (Table 2). Since the spiders in the dehydration experiment were not fed for three days, it is possible, but unlikely, that hunger altered the SCP of either the control or the dehydration groups. However, the mean SCP of the control group in this experiment (−10.6° C) was not significantly different than the mean SCP determined in the previous experiment (−10.5° C) by two tailed t-test with $P = 0.0296$ at 95% confidence (Tables 1, 2).

SCP between males and females.—Wolf spiders do not usually show a difference in SCP between sexes (Kirchner 1987). Results from a related wolf spider *Pardosa pullata* also determined that the SCP did not differ between the sexes (Bayram & Luff 1993). However, it is not known how generalized this statement is for wolf spiders, especially when there are morphological differences between sexes, as in *P. groenlandica*. Other arthropod species with marked morphological differences between sexes sometimes show differences in SCP, as in the lesser mealworm (Salin et al. 2000). The results obtained from this study support the hypothesis that there is no significant difference among the sexes in *P. groenlandica* with regards to SCP, and this is consistent with data available to date on wolf spiders.

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SHORT COMMUNICATION

The South American genus *Spintharidius* (Araneae, Araneidae)

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Abstract. The name *Madrepeira anazonica* Levi 1995 is a synonym of *Spintharidius rhomboidalis* Simon 1893. *Spintharidius* is currently monospecific.

Keywords: Spiders, orb-weavers, taxonomy, synonomy

Thirty years ago, while revising South American araneid spiders, I requested the holotypes of the two species of *Spintharidius* Simon 1893, *S. cerinus* Simon 1893, and *S. rhomboidalis* Simon 1893, from the Muséum Nationale d'Histoire Naturelle, Paris. I was told that both species were listed in the catalog but the specimens were lost and remain so. The identity of the generic name was an enigma and I feared erroneously it would be a senior synonym of *Alpaida* O. Pickard-Cambridge 1889 (Levi 2002:562).

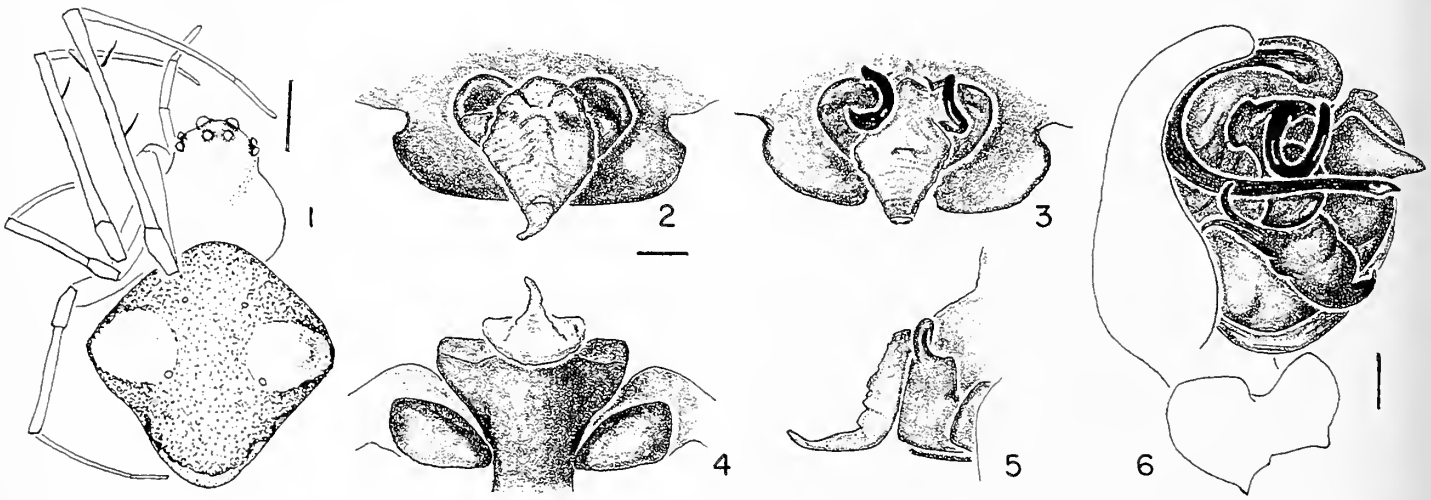
While reviewing illustrations of the lost specimens in Paris in 1958 when examining theridiids, I found notes and illustrations of *S. cerinus* and *S. rhomboidalis*. Both species had a similar epigynum: *cerinus* is a synonym of *rhomboidalis*, which I examined at that time. The diagonal abdomen, the long legs with the first patella and tibia twice the length of the carapace, and the unusual epigynum with a pointed scape having a pair of basal "ears" and lateral lobes, leave no doubt that it is an older name for the widespread but rare *Madrepeira anazonica* Levi 1995.

Spintharidius Simon

Spintharidius Simon 1893. Type species. *S. rhomboidalis* Simon 1893. *Madrepeira* Levi 1995. Type species *M. anazonica*. NEW SYNONYMY

Diagnosis.—The female differs from other araneid genera by having a diamond- shaped abdomen with lateral humps (Fig. 1), thin legs with only a few long setae, and the epigynum with lateral and median plates fused on a base (Fig. 3) and on each side of the attachment of the annulate scape, a scale formed from the posterior median plate (Fig. 2).

The male palpus has a median apophysis with a pair of flagellate spines, and differs from others with a similar median apophysis by



Figures 1–6.—*Spintharidius rhomboidalis* Simon. 1. Female, dorsal view. 2–5. Epigynum: 2. Ventral view; 3. Ventral view, with broken emboli; 4. Posterior view; 5. Lateral view. 6. Left male palpus, mesal view. Scale lines: Fig. 1, 1.0 mm; Figs. 2–5, 0.1 mm. (From Levi 1995, with permission).

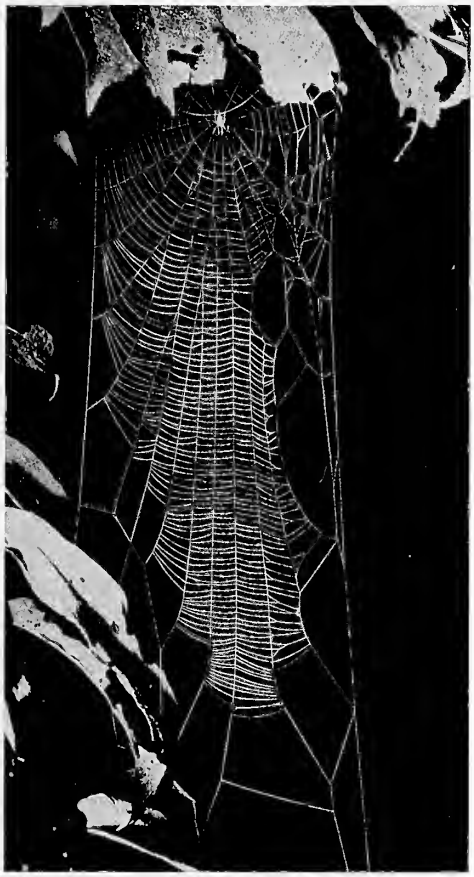


Figure 7.—Ladder orb-web of *Spintharidius rhomboidalis* resembles that of *Scoloderus* (Levi 1995, plate 5; reproduced with permission of the author).

having a U-shaped embolus and a long curved prong as terminal apophysis (Fig. 6).

The spiders make a ladder web resembling that of *Scoloderus* (Fig. 7).

Spintharidius rhomboidalis Simon (Figs. 1–6)

Spintharidius rhomboidalis Simon 1893. Female holotype from Paraguay in the Muséum Nationale d'Histoire Naturelle, Paris, examined.

S. cerinus Simon 1893. Female holotype from southern Brazil, examined. NEW SYNONYMY.

Madrepeira amazonica Levi 1995. Female holotype from Albergue "Cuzco Amazonica," [12°33′S, 69°03W, elev. 200 m]. Departmento de Madre de Dios, Peru in the Museo Univarsitaria San Marco, Lima. NEW SYNONYMY.

Another name listed in the genus, *S. viridis* Franganillo 1926 from Cuba, remains unidentified.

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INSTRUCTIONS TO AUTHORS SUBMITTING ARTICLES TO THE JOURNAL OF ARACHNOLOGY

(instructions last revised 13 March 2008)

General: Manuscripts must be in English and should be prepared in general accordance with the current edition of the *Council of Biological Editors Style Manual* unless instructed otherwise below. Authors should consult a recent issue of the *Journal of Arachnology* for additional points of style. Manuscripts longer than three printed journal pages should be prepared as Feature Articles, shorter papers as Short Communications. One invited Review Article will be published in the first issue of each year at the discretion of the editors. Suggestions for review articles may be sent to the Managing Editor. Unsolicited review articles are welcomed and will be subject to the same review process as all other submissions.

Submission: Send one electronic version of the entire manuscript in Microsoft Word format to the Managing Editor of the *Journal of Arachnology*: **Paula E. Cushing, *Managing Editor*, Denver Museum of Nature and Science, Zoology Department, 2001 Colorado Blvd., Denver, CO 80205-5798 USA** [*Telephone:* (303) 370-6442; *FAX:* (303) 331-6492; *E-mail:* Paula.Cushing@dmns.org or PECushing@juno.com]

The Managing Editor will acknowledge receipt of the manuscript, assign it a manuscript number and forward it to an Associate Editor for the review process. Correspondence relating to manuscripts should be directed to the Associate Editor and should include the manuscript number. If the manuscript is accepted, the author will be asked to submit the final copy electronically to the Associate Editor. Submission of final illustrations is detailed below. Authors are expected to return revisions promptly. Revised manuscripts that are not returned in a reasonable time period will be considered new submissions.

Voucher Specimens: Specimens of species used in your research should be deposited in a recognized scientific institution. All type material must be deposited in a recognized collection/institution.

FEATURE ARTICLES

Title page.—The title page includes the complete name, address, and telephone number of the corresponding author; a FAX number and electronic mail address if available; the title in upper and lower case (first word and all proper nouns should be capitalized), with no more than 65 characters and spaces per line in the title; each author's name and address; and the running head.

Running head.—The author's surname(s) and an abbreviated title should be typed in capital letters and must not exceed 60 characters and spaces. The running head should be placed near the top of the title page.

Abstract.—The heading should be placed at the beginning of the first paragraph set off by a period. A second abstract, in a language appropriate to the nationality of the author(s) or geographic region(s) emphasized, may be included.

Keywords.—Give 3–5 appropriate keywords following the abstract. Keywords should not duplicate words in the title.

Text.—Double-space text, tables, legends, etc. throughout. Three levels of heads are used.

- The first level (METHODS, RESULTS, etc.) is typed in capitals and on a separate line.
- The second level head begins a paragraph with an indent and is separated from the text by a period and a dash.
- The third level may or may not begin a paragraph but is italicized and separated from the text by a colon.

Use only the metric system unless quoting text or referencing collection data. If English measurements are used when referencing collection data, then metric equivalents should also be included parenthetically. All decimal fractions are indicated by a period (e.g., −0.123). Include geographic coordinates for collecting locales if possible.

Citation of references in the text: Cite only papers already published or in press. Include within parentheses the surname of the author followed by the date of publication. A comma separates multiple citations by the same author(s) and a semicolon separates citations by different authors, e.g., (Smith 1970), (Jones 1988; Smith 1993), (Smith & Jones 1986, 1987; Jones et al. 1989). Include a letter of permission from any person who is cited as providing unpublished data in the form of a personal communication.

Citation of taxa in the text: Include the complete taxonomic citation for each arachnid taxon when it first appears in the manuscript. For Araneae, this information can be found online at http://research.amnh.org/entomology/spiders/catalog/INTRO2.html. For example, *Araneus diadematus* Clerck 1757.

Literature Cited section.—Use the following style and include the full unabbreviated journal title. Personal web pages should not be included in Literature Cited. These can be cited within the text as (John Doe, pers. website) without the URL. Institutional websites can be included in Literature Cited.

Huber, B.A. & W.G. Eberhard. 1997. Courtship, copulation, and genital mechanics in *Physocyclus globosus* (Araneae, Pholcidae). Canadian Journal of Zoology 74:905–918.

Krafft, B. 1982. The significance and complexity of communication in spiders. Pp. 15–66. *In* Spider Communications: Mechanisms and Ecological Significance. (P.N. Witt & J.S. Rovner, eds.). Princeton University Press, Princeton, New Jersey.

Platnick, N.I. 2008. The World Spider Catalog, Version 8.5. American Museum of Natural History, New York. Online at http://research.amnh.org/entomology/spiders/catalog/INTR01.html

Footnotes.—Footnotes are permitted only on the first printed page to indicate current address or other information concerning the author. All footnotes are placed together on a separate manuscript page. Tables and figures may not have footnotes.

Taxonomic articles.—Consult a recent taxonomic article in the *Journal of Arachnology* for style or contact the Subject Editor for Taxonomy and Systematics. Papers containing original descriptions of focal arachnid taxa should be listed in the Literature Cited section.

Tables.—Each table, with the legend above, should be placed on a separate manuscript page. Only horizontal lines (no more than three) should be included. Tables may not have footnotes; instead, include all information in the legend.

Illustrations.—Original illustrations (hard copy) should not be sent until the article is accepted for publication. Electronic submission of final illustrations is acceptable if the author strictly adheres to the Digital Art Spec guidelines posted at the following website: http://www2.allenpress.com/allen_press/apguides/Digital_Art_Spec.pdf. Hard copies of final illustrations must still be submitted to the Editor-in-Chief to ensure that the electronic version matches the printed copy. To determine if your electronic figures adhere to the Allen Press specifications, you can also go to http://verifig.allenpress.com, type in the password, allenpresscmy, and follow the instructions. Address all questions concerning illustrations to the Editor-in-Chief of the *Journal of Arachnology*: **James E. Carrel, *Editor-In-Chief*, Division of Biological Sciences, 209 Tucker Hall, University of Missouri-Columbia, Columbia, MO 65211-7400, USA** [*Telephone:* 573-882-3037; *FAX:* 573-882-0123; *E-mail:* carrelj@missouri.edu]. All hard-copy art work must be camera-

ready – i.e., mounted and labeled – for reproduction. Figures should be arranged to fit (vertically and horizontally) the printed journal page, either one column or two columns, with a minimum of wasted space. When reductions are to be made by the printer, pay particular attention to width of lines and size of lettering in line drawings. Multiple photos assembled on a single plate should be mounted with a minimum of space separating them. Distribution maps should be considered figures and numbered consecutively with figures. Written on the back should be the name(s) of author(s) and an indication of top edge. The overall dimensions should be no more than 11 inches (28 cm) × 14 inches (36 cm). Larger drawings present greater difficulty in shipping and greater risks of damage for which the *Journal of Arachnology* assumes no responsibility. On the hard copies of illustrations sent by the author (upon acceptance), indicate whether the illustration should be one column or two columns in width and indicate the preferred position of illustrations within the text. Make notations in the text margins of a hard copy of the final manuseript or provide this information in electronic mail posted to the Editor-in-Chief. Color plates can be printed, but the author must assume the full cost, currently about $600 US per color plate.

Legends for illustrations should be placed together on the same page(s) and separate from the illustrations. Eaeh plate must have only one legend, as indicated below:

Figures 1–4. *A-us x-us*, male from Timbuktu. 1, Left leg; 2, Right chelicera; 3, Dorsal aspect of genitalia; 4, Ventral aspect of abdomen. Scale = 1.0 mm.

The following alternate Figure numbering is now acceptable:

Figures 1a–e. *A-us x-us*, male from Timbuktu. a. Left leg; b. Right chelicerae; c. Dorsal aspect of genitalia; d. Ventral aspect of abdomen. Scale = 1.0 mm.

Assemble manuscript.—The manuscript should appear in separate sections or pages in the following sequence; title page, abstract, text, footnotes, tables with legends, figure legends, figures. If possible, send entire manuscript, including figures, as one Microsoft Word document.

Page charges, proofs and reprints.—Page charges are voluntary, but non-members of AAS are strongly encouraged to pay in full or in part for their article ($75/journal page). The author will be charged for changes made in the proof pages. Hard copy or pdf reprints are available only from Allen Press and should be ordered when the author receives the proof pages. Allen Press will not accept reprint orders after the paper is published. The *Journal of Arachnology* also is published by BioOne and JStor. Therefore, you can download the PDF version of your article from one of these sites if you or your institution is a member. PDFs of articles older than one year will be made freely available from the AAS website.

SHORT COMMUNICATIONS

Short Communications are usually limited to three journal pages, including tables and figures. The format is open, but internal headings (Methods, Results, etc.) are omitted. An abstract is required.

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