ZooKeys 52: 1–8 (2010)
doi: 10.3897/zookeys.52.496
www.pensoftonline.net/zookeys

RESEARCH ARTICLE

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ZooKeys
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Ambengana Millidge & Russell-Smith, 1992, a synonym of *Neriene* Blackwall, 1833 (Araneae, Linyphiidae)

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Academic editor: *Dmitry Logunov* | Received 8 June 2010 | Accepted 26 June 2010 | Published 30 July 2010

Citation: Xu X, Liu J, Chen J (2010) *Ambengana* Millidge & Russell-Smith, 1992, a synonym of the genus *Neriene* Blackwall, 1833 (Araneae, Linyphiidae). ZooKeys 52: 1–8. doi: 10.3897/zookeys.52.496

Abstract

The taxonomic status of the genus *Ambengana* Millidge & Russell-Smith, 1992, is revised on the basis of its original description, illustrations and re-examination of the type species. A new synonymy is proposed: *Ambengana complexipalpis* Millidge & Russell-Smith, 1992 (the type species of *Ambengana*) **syn. n.** with *Neriene birmanica* (Thorell, 1887). Therefore, the genus *Ambengana* Millidge & Russell-Smith, 1992 **syn. n.** is synonymized with *Neriene* Blackwall, 1833. A morphological re-description, diagnosis and comparative illustrations are provided for *N. birmanica* as well.

Keywords

Taxonomy, Linyphiidae, *Neriene*, *Ambengana*, new synonymy

Introduction

The monotypic genus *Ambengana* Millidge & Russell-Smith, 1992, was erected for *Ambengana complexipalpis* Millidge & Russell-Smith, 1992, from Bali (Millidge & Russell-Smith 1992). There has been no further report on this genus since its original description (Platnick 2010). Recently, the authors examined the linyphiid specimens collected from Yunnan Province in the southwestern China and found that some of them seemed to be *A. complexipalpis*. However, the structure of the copulatory organs of this species clearly indicated that this species should be considered a junior synonym of *Neriene birmanica* (Thorell, 1887). The spermathecae with spirally coiled grooves in the female, the spirally coiled terminal apophysis, and the curved and narrow embolus in the male, all indicate that this species should probably belong to the genus *Neriene*. Thus, the genus *Ambengana* should be considered a junior synonym of the genus *Neriene* Blackwall, 1833.

Neriene birmanica was first described as *Linyphia birmanica* from the female (Thorell, 1887). Since then several studies have been made (Caporiacco 1935; van Helsdingen 1969; Chen et al. 1989; Chen and Gao 1990; Song et al. 1999). Among these, Caporiacco (1935) first reported the male as *Bathyphantes kashmiricus* in Kashmir; van Helsdingen (1969) redescribed the male as *Neriene kashmirica* when he reclassified the species of *Linyphia latreille*; Chen et al. (1989) first reported on this species from China and synonymized *N. kashmirica* with *N. birmanica*. The aim of the current paper is to re-describe *N. birmanica*, and to illustrate with digital photos, and to propose a new synonymy.

Material and methods

Specimens were examined with an Olympus SZX16 stereomicroscope; details were studied with an Olympus BX51 compound microscope. Male palps and female epigyne were examined and illustrated after being dissected from the spider bodies. Spermathecae were cleared in boiling KOH solution to dissolve soft tissues, and the embolic divisions of male palps were excised by breaking the column (the membranous connection between the suprategulum and the radix). Photos were made with Cannon G10 digital camera (14.7 megapixels) mounted on an Olympus SZX16 dissecting microscope. The digital images depicting the general appearance and genital morphology are a composite of multiple images taken at different focal lengths along the Z axis and assembled using the software package Helifocus 3.10. Left structures (e.g., palps, legs, etc.) are depicted unless otherwise stated. Most hairs and macrosetae are usually not depicted in the final palp and epigynum images.

All measurements were obtained using an Olympus SZX16 stereomicroscope and are given in millimeters. Eye diameters are taken at the widest point. The total body length does not include the length of the chelicerae or spinnerets. The leg measurements are given in the following sequence: total (femur, patella +tibia, metatarsus, tarsus). The terminology used in text and figure legends follows van Helsdingen (1969).

The following abbreviations are used in the text and figures. Male palp: ALP- anterior projection of lamella; DLP- dorsal projection of lamella; E- Embolus; MM- median membrane; MA- median apophysis; L- lamella; LLP- lateral projection of lamella; P- paracymbium; PLP- posterior projection of lamella; ST- subtegulum; T- tegulum; TA- terminal apophysis. Epigynum: FG- fertilization groove; S- spermatheca; SC- "scape"; SG- spiral groove; TP- turning point. Somatic characters: AER- anterior eye row; ALE- anterior lateral eye; AME- anterior median eye; AME-ALE- distance between AME and ALE; AME-AME- distance between AMEs; AMEd- diameter of AME; PER- posterior eye row; PLE- posterior lateral eye; PME- posterior median eye; PMEd- diameter of PME; PME-PLE- distance between PME and PLE; PME-PME- distance between PMEs.

All the specimens examined are deposited in the College of Life Sciences, Hubei University, China.

Taxonomy

Neriene Blackwall, 1833

Type species. *Linyphia clathrata* Sundevall, 1830.

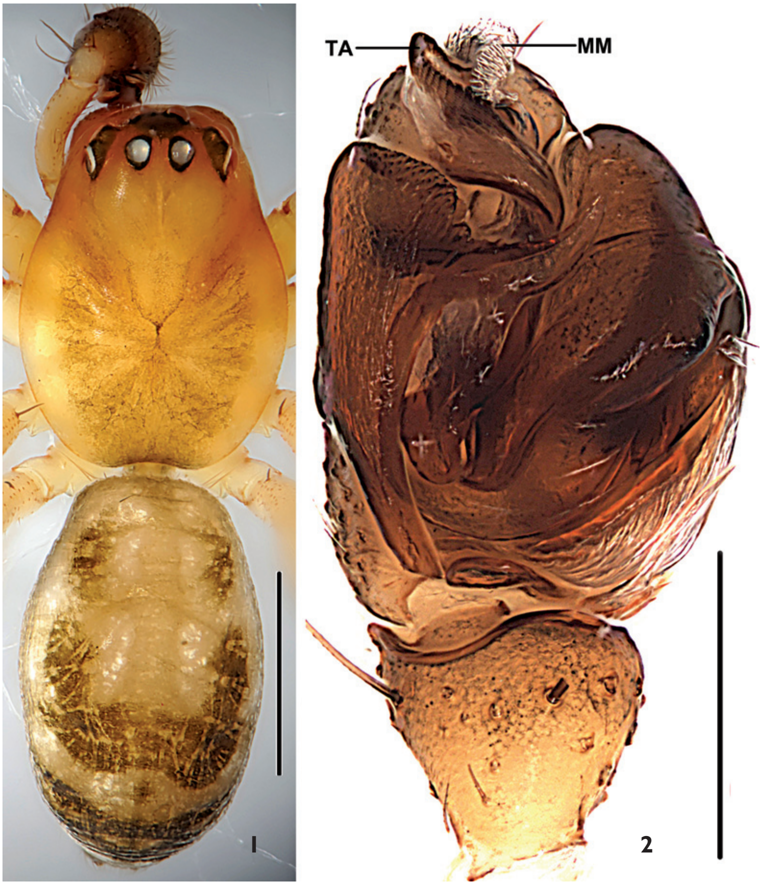
Neriene birmanica (Thorell, 1887)

Figs 1–12

Linyphia birmanica Thorell, 1887: 99 (f).
Bathyphantes kashmiricus Caporiacco, 1935: 167, pl. 2, fig. 12 (m).
N. kashmirica van Helsdingen, 1969: 261, figs 359–360 (m).
N. birmanica van Helsdingen, 1969: 265, figs 361–363 (f).
N. birmanica Chen, Zhu & Chen, 1989: 1, figs 1–10 (mf).
N. birmanica Chen & Gao, 1990: 99, figs 124a–j (mf).
N. birmanica Song, Zhu & Chen, 1999: 188, figs 108G–H, Q (mf).
Ambengana complexipalpis Millidge & Russell-Smith, 1992: 1387, figs 52–55 (mf), **syn. n.**

Material examined. CHINA: 1 ♂, 3 ♀, Sichuan Province, Panzhihua City, Miyi County, 10.07.1981 Gao J.C.; 1 ♂, 1 ♀, same locality, Chen X.E.; 2 ♂, 3 ♀, Yunnan Province, Dehong DaiJingpo Autonomous Prefecture, Ruili City, 16.09.2000, Chen, W. H. & Liu, F. X.; 2 ♂, 6 ♀, Yunnan Province, Lincang City, Zhenkang County, Nansan Town, 14.09.2000, Chen, W. H. & Liu, F. X.; 1 ♀, Yunnan Province, Honghe Hani and Yi Prefecture, Luchun County, 2.09.2000, Chen, W. H. & Liu, F. X.; 3 ♂, 7 ♀, Yunnan Province, Xishuangbanna Dai Autonomous Prefecture, Menghai County, Daluo Town, 9.09.2000, Chen, W. H. & Liu, F. X.; 1 ♂, same province and prefercture, Menghai County, 10.09.2000, Chen, W. H. & Liu, F. X.; 1 ♀, Yunnan Province, Honghe Hani and Yi Prefecture, Jinping Miao, Yao and Dai Autonomous County, 30.08.2000, Chen, W. H. & Liu, F. X.; 1 ♀, Yunnan Province, Pu'er Prefecture, Jiangcheng Hani and Yi Autonomous County, 25.09.2000, Chen, W. H. & Liu, F. X..

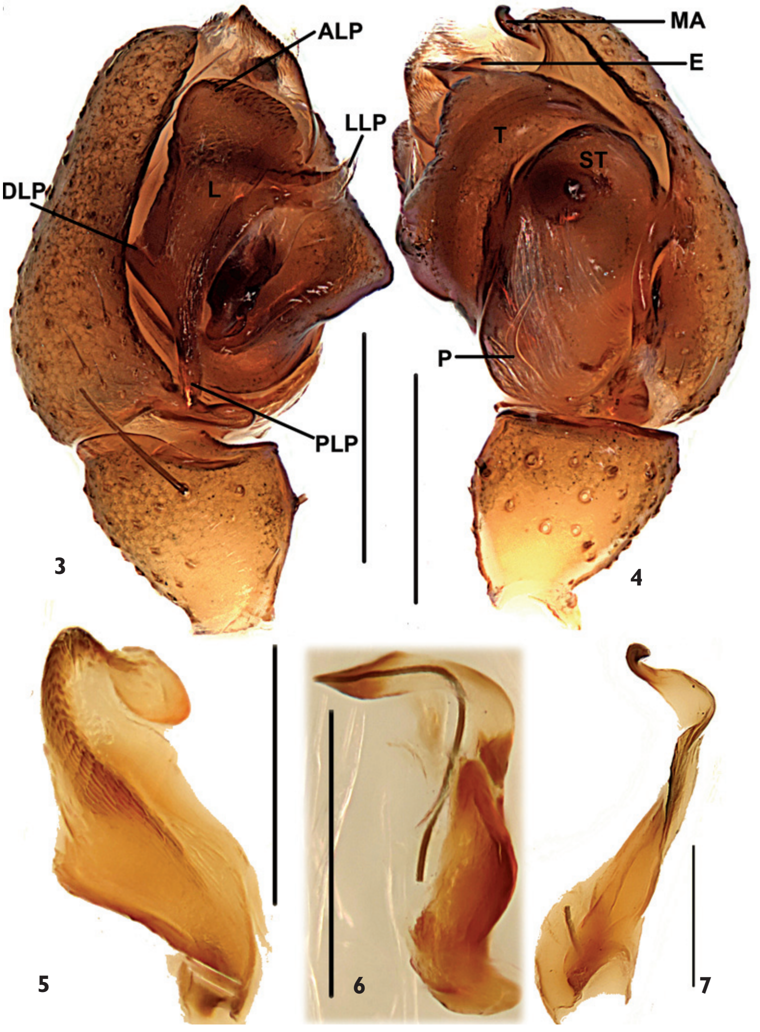
Diagnosis. Tibia not fusiform, with few spines; paracymbium with narrow distal arm tapering to a sharp tip; hook-shaped tip of distal part of median apophysis curved in ventral direction; transversal and terminal sclerites never present; lateral depressions of the epigyne small and superficial, this species belongs to the *peltata*-species group



Figures 1–2. *Neriene birmanica* (Thorell, 1887), male from Nansan Town (Yunnan Province, China). **1** male habitus, dorsal view **2** left palp, ventral view. Scale bars =1 mm (**1**), scale = 0.2 mm (**2**).

(van Helsdingen 1969). It can be distinguished from other members of the *peltata*-group species by the tiny paracymbium (Fig. 4), the sword-shaped embolic tip (Figs 4, 6), the broad and short terminal apophysis with about one coil (Figs 2, 5), the translucent spot at either side of the uniquely trapeziform atrium opening, the superficially depressed area at either side next to lateral translucent spots (Fig. 9), and the scape forming a rounded mesal projection and spiral grooves of about two coils in the female (Figs 10, 11).

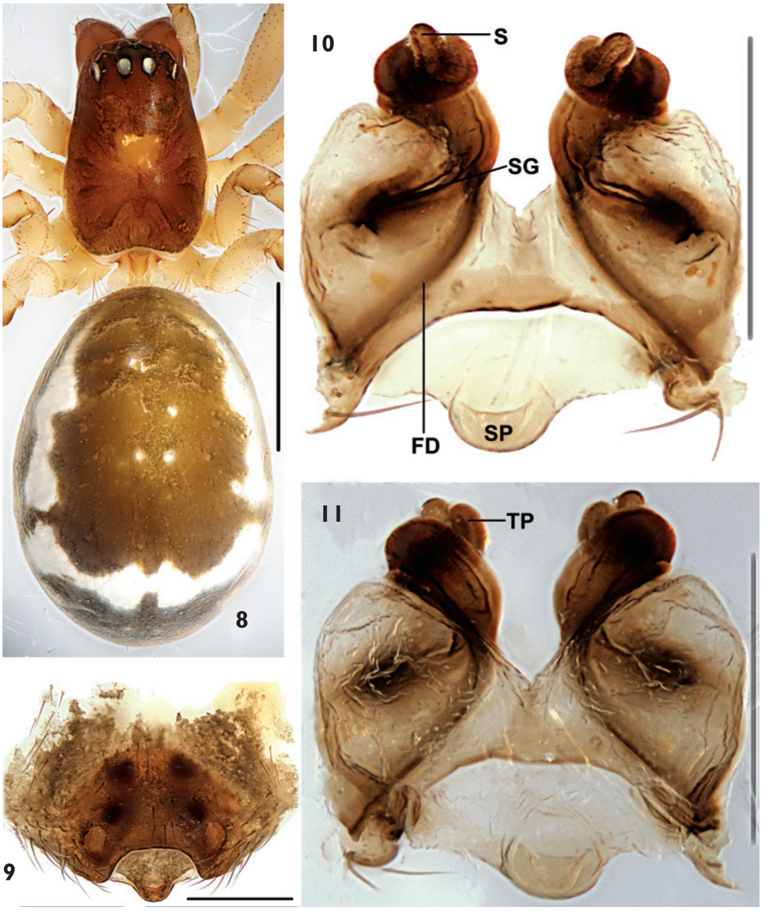
Description. Male: Total length: 2.78. Carapace: 1.22 long, 0.94 wide. Abdomen: 1.54 long, 0.98 wide. Carapace brown, unmodified. Eyes subequal. AER recurved, AME-AME shorter than AMEd, AME-ALE slightly longer than AMEd; PER straight, PME-PME about PMEd, PME-PLE slightly longer than PMEd; ALE and PLE juxtaposed. Chelicerae brown, stridulatory ridges absent, promargin of fang groove with three teeth, median tooth largest;, retromargin with three small teeth, first bigger than others. Lengths of legs: I 5.36 (1.47+1.58+1.52+0.79), II 4.90 (1.33+1.43+1.38+0.76),



Figures 3–7. *Neriene birmanica* (Thorell, 1887), male from Nansan Town (Yunnan Province, China). **3** left palp, prolatral view **4** left palp, retrolateral view **5** terminal apophysis, retrolateral view **6** embolus, retrolateral view **7** median apophysis, retrolateral view. Scale bars = 0.2 mm.

III 4.08 (1.19+1.16+1.08+0.65), IV 4.41 (1.25+1.21+1.29+0.66). Each tibia, patella and femur with two dorsal spines. Tm I: 0.20. Tm IV absent. Abdomen cylindriform, without tubercle; colour and pattern as in Fig. 1.

Patella short, with long spine dorsally. Tibia shorter than cymbium, with several long spines on lateral and ventral surfaces, and one prodorsal, two retrodorsal trichobothria. Paracymbium tiny, long and slender, U-shaped, slightly membranous (Fig. 4). Median apophysis long, slender in lateral view, with dorsal tip hook-shaped (Figs 4, 7). Lamella well-developed, with four projections: lateral one and posterior one long, lateral one with sharp, membranous end, posterior one with blunt end; anterior one



Figures 8–11. *Neriene birmanica* (Thorell, 1887), female from Nansan Town (Yunnan Province, China). **8** female habitus, dorsal view **9** epigynum, ventral view **10** epigynum without skin, ventral view **11** spermathecae, dorsal view. Scale = 1 mm (**8**), scales = 0.2 mm (**9**, **10**, **11**).

broad, blunt; dorsal one short (Fig. 3). Terminal apophysis simple, broad and short, strongly membranous from prolateral view, with about one coil (Figs 2, 5). Embolus simple, perpendicularly curved at half length, with a sword-shaped end (Figs 4, 6).

Female: Total length: 2.86. Carapace: 1.14 long, 0.69 wide. Abdomen: 1.71 long, 1.30 wide. Carapace brown, unmodified. Eyes subequal. AER recurved, AME-AME shorter than AMEd, AME-ALE slightly shorter than AMEd; PER straight, PME-PME shorter than PMEd, PME-PLE about equal with PME-PME; ALE and PLE juxtaposed. Chelicerae brown, stridulatory ridges absent, promargin of fang groove with three teeth, median tooth largest; retromargin with three equal teeth. Lengths of legs: I 5.27 (1.44+1.61+1.44+0.78), II 4.60 (1.26+1.42+1.23+0.69), III 3.17 (0.93+0.94+0.79+0.51), IV 4.47 (1.37+1.27+1.21+0.62). Each tibia, patella and femur with two dorsal spines. Tm I: 0.22. Tm IV absent. Abdomen oval, without tubercle, the colour and patch see Fig. 8.

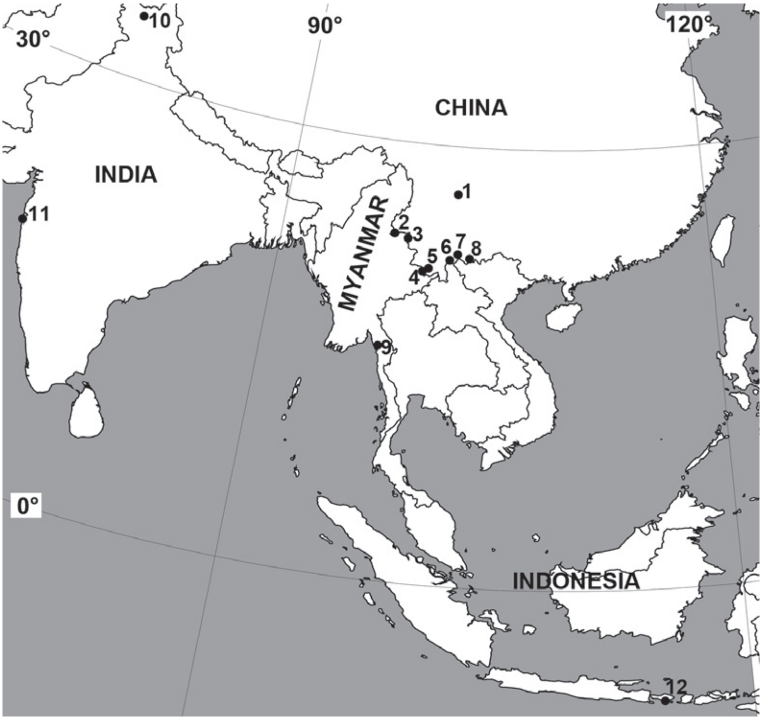


Figure 12. Distribution of *Neriene birmanica* (Thorell, 1887). Numbers correspond to the localities on the map: **1** China, Sichuan Province, Miyi County **2** China, Yunnan Province, Ruili City **3** China, Yunnan Province, Zhenkang County **4** China, Yunnan Province, Menghai County **5** China, Yunnan Province, Menghai County **6** China, Yunnan Province, Jiangcheng Hani and Yi Autonomous County **7** China, Yunnan Province, Luchun County **8** China, Yunnan Province, Jinping Miao, Yao, and Dai Autonomous County **9** Myanmar, Mawlamyine, Burma **10** Kashmir, Garhi near Jhelum **11** India, Bombay **12** Indonesia, Bali.

In ventral view, atrium opening small, trapeziform. Lateral depression present (Fig. 9). Scape arising from dorsal wall, short, with slightly rounded tip, and with small semi-covered depression on ventral surface (Fig. 10). Spermathecae as long as wide; spiral grooves started from entrances situated in the middle of the ventral wall of either atrium to the apical turning-points, with about two coils; fertilized ducts started from spermathecae, with (about) two coils; turning points situated laterally; spermathecae long and slender, situated laterally (Fig. 11).

Remarks. Although we didn't examine the type speciemens of *A. complexipalpis*, the tiny paracymbium, the sword-shape embolic tip, broad and the short terminal apophysis, the uniquely trapeziform atrium opening shown in the original illustrations (Millidge and Russell-Smith 1992, figs 52–54) leave no doubts that our identification is correct. The original illustration of the spermathecae by Millidge and Russell-Smith (1992, fig. 55) is rather simplified and shows some differences with the specimen of *N. birmanica* we have examined (cf. Fig. 11). However, such the difference does not affect our identification.

Distribution: Southeast Asia (India, Kashmir, Myanmar, China, Indonesia) (Fig. 12).

Acknowledgments

The manuscript benefited from the comments of Dr. Daiqin Li (National University of Singapore) and of two anonymous reviewers. The authors also thank Hao Yu (Hubei University, China) for taking the measurements of the specimens. This study was supported by the National Natural Sciences Foundation of China (NSFC-39870105/30370206), and by the Ministry of Science and Technology of the People's Republic of China (MOST grant # 2006FY120100/2006FY110500), and by Kadoorie Farm and Botanic Garden of Hong Kong. The English of the final draft was kindly edited by Dr Robin Leech (Canada).

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ZooKeys 52: 9–45 (2010)
doi: 10.3897/zookeys.52.471
www.pensoftonline.net/zookeys

RESEARCH ARTICLE

A peer-reviewed open-access journal
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New species and records of ortholasmatine harvestmen from México, Honduras, and the western United States (Opiliones, Nemastomatidae, Ortholasmatinae)

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Academic editor: *Dmitry Logunov* | Received 4 May 2010 | Accepted 23 June 2010 | Published 30 July 2010

urn:lsid:zoobank.org:pub:8F1B0D99-51DB-4B6E-964E-CC087A92DB85

Citation: Shear WA (2010) New species and records of ortholasmatine harvestmen from México, Honduras, and the western United States (Opiliones, Nemastomatidae, Ortholasmatinae). ZooKeys 52: 9–45. doi: 10.3897/zookeys.52.471

Abstract

The genus *Trilasma* Goodnight & Goodnight, 1942 is reinstated for Mexican ortholasmatines, and *Cladolasma* Suzuki, 1963 is reinstated for two species from Japan and Thailand, *C. parvula* Suzuki, **comb. n.** and *C. angka* (Schwendinger & Gruber), **comb. n.** Eight new species in the subfamily Ortholasmatinae Shear & Gruber, 1983 are described, as follows: *Ortholasma colossus* **sp. n.** is from California, *Trilasma tempestado* **sp. n.**, *T. hidalgo* **sp. n.**, *T. trispinosum* **sp. n.**, *T. ranchonuevo* **sp. n.**, *T. petersprousei* **sp. n.** and *T. chipinquensis* **sp. n.** are from México, and *T. tropicum* **sp. n.** from Honduras, the farthest south for a dyspnoan harvestman in the New World. A new distribution record for *Martensolasma jocheni* Shear, 2006 is given. The recently described Upper Cretaceous amber fossil *Halitherses grimaldii* Giribet & Dunlop, 2005 is not a member of the Ortholasmatinae, but is likely a troguloidean of an undiagnosed family.

Keywords

Ortholasma, Dendrolasma, Trilasma, Cladolasma, Halitherses, amber, fossil, California, Sierra Nevada, Nuevo León, Tamaulipas, Hidalgo, Veracruz, Honduras, Japan, Thailand, new species, new combination

Introduction

The harvestman subfamily Ortholasmatinae was monographed by Shear and Gruber (1983). That work focused perforce on the western United States, whence came the majority of material available for study, and the seeming center of diversity for the two recognized genera of the subfamily, *Ortholasma* Banks, 1894 and *Dendrolasma* Banks, 1894. Outside the US, a single species of *Dendrolasma* was known at that time from Japan, and two *Ortholasma* species had been recorded from México.

Since 1983, there has been little activity in the study of these most unusual harvestmen, but a few years after the 1983 monograph's publication, Shear and Gruber (1987) found that *O. setulipes* Shear & Gruber, 1987, from southern California, was a synonym of *O. coronadense* Cockerell, 1916. Schwendinger and Gruber (1992) later described a fourth species of *Dendrolasma* from Thailand. More recently, Giribet and Dunlop (2005) postulated a fossil record for ortholasmatines going back to the Upper Cretaceous (Albian; ca. 100 million years ago), but their fossil species from Burmese amber, *Halitherses grimaldii* Giribet & Dunlop, 2005, lacks both the characteristic tergal ornamentation and eye-tubercle projection, and has no clear synapomorphies of Ortholasmatinae. It is clearly a troguloid of some kind, but not likely a member of any extant family. Finally, Shear (2006) reported on a new genus and species of ortholasmatine (*Martensolasma jocheni* Shear, 2006) from Aguascalientes, México.

Ortholasmatines have received some attention in studies of harvestman phylogeny. Giribet et al. (2002) presented molecular evidence for a relationship between Nemastomatinae Simon, 1872 and Ortholasmatinae, but a more recent study (Giribet et al. 2010), including more loci and denser taxonomic sampling, analyzed under direct parsimony optimization, showed Nemastomatidae as paraphyletic, and ortholasmatines sister to a clade including Trogulidae Sundevall, 1833, Dicranolasmatidae Simon, 1879 and Nipponopsalididae Martens, 1976. On the other hand, the same data analyzed by maximum likelihood showed a monophyletic Nemastomatidae, including the ortholasmatines. Giribet et al. (2009) call for further sampling and analysis in the Dyspnoi, and it would be premature to make any taxonomic changes based on these studies.

Shear and Gruber (1983) took a conservative approach in grouping the species of ortholasmatines into only two genera, *Dendrolasma* and *Ortholasma*. Suzuki (1963) had originally described the species *Dendrolasma parvulum* in a different genus, *Cladolasma* Suzuki, 1963*,* only later synonymizing this genus with *Dendrolasma* (Suzuki 1974). Schwendinger and Gruber (1992) argued that because of distinctive characters their new species from Thailand (*Dendrolasma angka* Schwendinger & Gruber, 1992) shared with *D. parvulum,* the genus *Cladolasma* might well be revalidated. However, they did not take that formal step because males had not been collected (and are still unknown). After restudying the matter based on new specimens and some of the same material available in 1983, I agree with Schwendinger and Gruber (1992), and in this paper revalidate the generic name *Cladolasma* Suzuki, 1963, for *C. parvulum* and *C. angka*. Like Schwendinger and Gruber (1992), I fully anticipate a wealth of new species in this genus to arise from ongoing exploration of the montane forests of southern China, Laos, Vietnam and Thailand.

The first Mexican species of ortholasmatine, previously *Ortholasma (Trilasma) bolivari* (Goodnight & Goodnight, 1942), was placed by Goodnight and Goodnight (1942) in a new genus, *Trilasma* Goodnight & Goodnight, 1942, which Shear and Gruber (1983) retained as a subgenus under *Ortholasma.* The appearance of several new species from México, all sharing the diagnostic characters of subgenus *Trilasma*, leads me to restore that taxon to full generic level for all the Mexican species, and a new one from Honduras.

I also describe in this paper a new Californian species from the Sierra Nevada, including Sequoia National Park. *Ortholasma colossus,* new species, occurs at the southern end of the Sierra Nevada distribution of *Ortholasma levipes* Shear & Gruber, 1983, and a single specimen of the new species was mentioned and briefly characterized in Shear and Gruber's monograph. The collection of much additional material makes possible the description of this, the largest of all ortholasmatines, nearly half again as long as the previously known largest species.

Though Shear and Gruber (1983) had available numerous samples of most of the species they studied (except, for example, the troglobiont *Trilasma sbordonii* (Šilhavý, 1974), still known only from a few specimens), most of the new species below are described from single specimens or a small number of specimens. However, the earlier monographic study gave a very clear picture of the ranges of variation to be expected in species of the subfamily, and in each of the cases below, I am confident that the new taxa lie outside those ranges as they are understood in better known congeners. In particular, the new Mexican species are mostly geographically distant from the distribution of *T. bolivari* and *T. sbordonii*, the previously known Mexican species, and are easily distinguished from them and from each other. The new Honduran species, *Trilasma tropicum,* is distinctive and represents an extension of the subfamily into the New World humid tropics, just as *Cladolasma angka* pushed the range southward in Asia. With the discovery of this species, ortholasmatines are now known from very near the border between Alaska and British Columbia south to Honduras.

Shear and Gruber (1983) presented an admittedly confusing scenario for the historical biogeography of the ortholasmatines. However, they were clear about proposing an origin for the subfamily in the central Mexican highlands, or Transverse Volcanic Belt, with subsequent dispersal northward into northwestern North America and ultimately far eastern Asia. That hypothesis is strengthened by the documentation in this study (and in Shear 2006) of considerable additional diversity in México, close to the supposed region of origin, which includes *Martensolasma jocheni* Shear, 2006, a species lacking the unusual modifications of the eye tubercle found in all other species, as well as exhibiting a simple pattern of cuticular sculpture and a penis from which it would be possible to derive the more apomorphic forms found in all other ortholasmatines. The new species far to the south in Honduras suggests that during appropriate climatic regimes, perhaps glacial maxima, ortholasmatines also spread southward; this is reinforced by the fact that *T. tropicum* sp. n. is characterized by a narrow median hood process inserted dorsally on the eye tubercle, rather than a broad hood process arising from the rostral side of the eye tubercle.

Ortholasmatines are the most southerly occurring members of the harvestman suborder Dyspnoi, which appears to be limited to the northern hemisphere. In many cases these harvestmen are clearly associated with boreal regions or relatively high elevations, and indeed such is the case with ortholasmatines, though they seem tolerant of drier habitats so long as temperatures are moderate to low. With the exception of *O. pictipes* Banks, 1911, and the species of *Dendrolasma,* which are found in moist coniferous forests from northern California to Alaska, North American *Ortholasma* species are often characteristic of sclerophyll vegetation (though collecting notes suggest they are found even there in moister microhabitats, such as caves and canyons). There may be additional species awaiting discovery in such habitats in southern California, and the diversity of the subfamily in México may be significantly greater than presently documented. Found near sea level in northwestern North America, this proclivity for cool temperature regimes carries ortholasmatines to high elevations in México, where *Trilasma* species are found in coniferous forests mostly above 2100 m (7000') elevation, or in cloud forests. Even at these elevations, collection data suggest that some tropical and subtropical species are troglophiles, seeking out the damper, cooler conditions in caves. In the Sierra Nevada of California, individuals are often taken in caves, but show no troglomorphic adaptations, and while two of the new species described below from México are from caves and are conspicuously long-legged, they do not appear to be troglobionts. The caves have been much more fully explored than their surface environs, so the number of records of ortholasmatines from caves in California and México is probably more an artifact of collecting than an indicator of habits.

Is the fossil *Halitherses grimaldii* an ortholasmatine?

Giribet and Dunlop (2005) published a detailed description of a remarkably well-preserved fossil harvestman species from 100 myr-old Burmese (Myanmar) amber. Their new genus and species, *Halitherses grimaldii*, was based on two specimens found in the same small block of amber. It was not possible to determine the sex of the specimens. They tentatively assigned the taxon to Ortholasmatinae. The presence of clavate glandular setae ("Kugelhaare" of Wachmann 1970; see below for a note on these setae) on the clawless palpi places the species in the superfamily Troguloidea, and its general appearance suggests Nemastomatidae, except for the extraordinarily large eye tubercle. However, the specimens show no synapomorphies of the subfamily Ortholasmatinae, and the arguments for placing the species there are based on misunderstandings. Giribet and Dunlop (2005) refer to "the forward-projecting eye tubercle, the heavy cuticular ornamentation, and the fused meso- and metapeltidia….". However, the eye tubercle of ortholasmatines does not project forward at all but is simple and moundlike. The anterior projection (median hood process) is an extension from the dorsal or rostral surface; no such projection is seen in *H. grimaldii,* which has a very large caddid-like eye tubercle with a median depression, that resembles no known nemastomatid. Unlike the small eyes of nemastomatids, the eyes of *H. grimaldii* are inordinately large. The fossil, in short, exhibits no sign of the "troguloid facies" in which processes from the eye tubercle and forward margin of the carapace form a hood concealing the chelicerae and palpi, and in which the body is distinctly flattened. This facies is diagnostic of ortholasmatines.

The cuticular ornamentation of *H. grimaldii* consists of low, rather rounded, densely scattered tubercles quite unlike the anvil-shaped, T-shaped, or multi-armed tubercles found in ortholasmatines, and indeed are more like the ornament of the ischyropsalidoid genus *Hesperonemastoma*. There is no organization of the ornamentation into keel cells, as seen in all ortholasmatines, even the single species lacking the median hood process. Likewise, lateral hood processes, universal in all ortholasmatines, are not seen in the fossil species. It is not clear what the authors mean by "fused meso- and metapeltidia" since it is obvious from their illustrations that at least the metapeltidium is free. The condition of the specimen and the angles of observation available make it difficult to see. No troguloideans have a free mesopeltidium, this "first thoracic segment" always being fused to the carapace, or propeltidium, and the free metapeltidium with *scutum parvum* is found in several troguloideans (Shultz & Pinto-da-Rocha 2007). It seems to me likely that Giribet and Dunlop are mistaken and that, as usual, the mesopeltidium is fused to the carapace (propeltidium) and the metapeltidium is free.

Giribet and Dunlop included *H. grimaldii* in the morphological dataset of Giribet et al. *(*2002), and the result in a strict consensus cladogram was simply to group the species with all other included troguloids in a "comb" (fig. 6 of Giribet & Dunlop 2005). This was undoubtedly due to much missing data for the fossil species, but also showed no close relationship to Nemastomatidae.

All the evidence suggests to me that *Halitherses grimaldii* is not an ortholasmatine. The large eyes and eye tubercle are unique, and among troguloids, only the cavernicolous nemastomatids have such extraordinarily long legs. I think it highly likely that this species represents at the least a new, probably extinct, family within Troguloidea.

Palpal setae

Two distinct types of palpal setae in the Dyspnoi, not necessarily homologous, have been confused in some recent literature, where both are referred to as "clavate" hairs or setae. In the superfamily Troguloidea, the palpal setae are of the type described in great detail by Rimsky-Korsakov (1924) and Wachmann (1970) as *Kugelhaare,* and to which I have previously referred as "Rimsky-Korsakov setae". These setae are quite complex, broad at the base and set in special sockets; near the distal tip a radial array of small tubules emerges, not unlike the ribs of an umbrella, and from the openings at their tips, a sticky secretion is produced which is often seen as coagulated droplets on preserved specimens (Figs 6, 8, 43). Because these setae actually are club- or mace-shaped, they can correctly be called clavate (though *Kugel* [German] means "ball" [English]).

However, the palpal setae in some species of the superfamily Ischyropsalidoidea, illustrated by me in 1986 using scanning electron micrographs, are quite different. In these setae, fine tubules occupy at least the distal half of the seta, are not arranged radially, and may or may not be the source of a secretion. Similar setae are often found on the palpi of both juvenile and some adult Eupnoi (Shear 1986, 2004; Hunt and Cokendolpher 1991). This second type of seta might conveniently be termed "plumose," as I did in 1986. Whatever name is finally adopted, it is clear from the electron micrography that the two types of seta are quite different, and may not be homologous as glandular setae.

Details need to be examined before these setae are used further as characters in phylogenetic reconstructions. For example, both types of hairs appear to be absent at least in adults of the ischyropsalidoid genera *Ischyropsalis, Ceratolasma* and *Acuclavella. Crosbycus dasycnemus* plumose setae appear different from those of *Taracus* or *Sabacon;* the former are truncate, not pointed, and the tubules appear not to extend all the way to the tip.

Chemical defenses

Several specimens of *Ortholasma pictipes* and *O. rugosum* were dropped alive into small amounts of methanol, and the extract analyzed for volatile components. This method has proven itself as a way of determining the presence and nature of the chemical defenses of harvestmen (Jones et al. 2009; Shear, Jones et al. 2010; Shear, Snyder et al. 2010). In both species, no volatile compounds could be detected in the extract, suggesting strongly that at least two species of ortholasmatine lack the usual chemical defenses found in Opiliones. More results will be reported in detail in a later publication, but of five species, all in different genera, and three different families, of North American Dyspnoi studied, none had chemical defenses extractable by methanol, and at least one species may lack ozopores.

Recently, Raspotnig et al. (2010) have reported the first determination of the chemical defense of a dyspnoan, *Paranemastoma quadripunctatum* (Perty, 1833) (Nemastomatidae); they found an array of naphthoquinones and anthraquinones. At least the anthraquinones are usually solids at environmental temperatures, and Raspotnig et al. (2010) suggest they become available for defense only after being dissolved in enteric fluid regurgitated through the mouth. They found that in some dyspnoans, ozopores are present but cryptic, facing downward toward the mouth under the carapace, and this indeed may be the case in the species I examined—a second look is required. However, Raspotnig et al. (2010) were able to recover the same set of compounds using two methods, absorption on filter paper, and whole-body extraction. So our failure to find any secretions *via* whole-body extraction remains puzzling if in fact chemical defenses are present in the species we examined.

Methods

Measurements of the appendages of single specimens were taken from material temporarily mounted in glycerine on microscope slides, using a calibrated ocular micrometer in an Olympus BX-50 compound microscope. Lengths and widths of appendage segments were taken from their greatest lengths and greatest widths; length of first cheliceromere includes the apodeme, that of the second cheliceromere the fixed finger. Total leg lengths do not include coxae or trochanters, and are the summed lengths of the femora, patellae, tibiae, metatarsi and tarsi. Body dimensions were measured under an Olympus SZH stereomicroscope, using an external scale and *camera lucida* attachment, and photomicrographs were taken using this microscope and a mounted Luminera Infinity 1 digital camera; photographs were manipulated for clarity in the programs PhotoShop and IPhoto. The animals in these photographs appear red or orange rather than their field color of brown or black because the use of transmitted light in taking the photographs enhanced the clarity of the keel cells, but incidentally produced the colors; removing the color results in less clarity.

Total length was measured from the distal tip of the median hood process to the posterior margin of the abdominal scute, excluding the extended keel tubercles; total width at the widest point of the body (usually near the posterior margin of the scute). Length of the median hood process was measured in dorsal view from the keel just posterior to the eye tubercle to the distal tip, and width was measured at the widest point. All measurements are in millimeters. Tarsal article counts vary, sometimes on the left and right sides of the same individual, but usually only by one or two articles. The counts given in the descriptions below should be taken as possibly varying by one or two in either direction.

Map coordinates and approximate elevations were obtained from Google Earth when the data did not appear on collection labels.

Depositories:

TMM Texas Memorial Museum
AMNH American Museum of Natural History
CAS California Academy of Sciences.

Taxonomy

Family Nemastomatidae Simon, 1872
Subfamily Ortholasmatinae Shear & Gruber, 1983

Ortholasmatinae Shear and Gruber 1983, p. 13 (see for pre-1983 references); Schwendinger and Gruber 1992, p. 60; Shear 2006, p. 192 (emended diagnosis).

Diagnosis. Nemastomatid Opiliones with the anvil-shaped tubercles on the dorsum exaggerated, with long horizontal arms overlapping in patterns to form distinctive keel cells (Figs 2, 3); lateral anterior margins of the carapace with at least one (up to three) forward-projecting lateral hood process on either side of the eye tubercle; eye tubercle in all but one genus with long, forward-projecting median hood process bearing large T-shaped tubercles laterally and sometimes dorsally. All these characters are absent from nemastomatines.

Key to Genera

1. With a forward-projecting process on the eye tubercle, bearing elongate T-shaped tubercles laterally **2**
– Without such a process, eye tubercle with small, blunt dorsal spine; Aguascalientes, Puebla, México .... ***Martensolasma jocheni*** **Shear**
2. Frontal border of the carapace with a single long process on either side of the eye tubercle **3**
– Frontal border of the carapace with two or more such processes **4**
3. Metapeltidium separated from both carapace and abdominal scutum; keel cells small, not in transverse rows; southern Japan and SE Asia .... ***Cladolasma*** **Suzuki**
– Metapeltidium fused to abdominal scutum, partially fused to carapace; keel cells larger, arranged in approximate transverse rows; northern Pacific coast of North America .... ***Dendrolasma*** **Banks**
4. Dorsal hood process with median armed tubercles; scute with rows of small cells between rows of large ones; males without a gland on first cheliceromere; central and northwestern México to Honduras .... ***Trilasma*** **Goodnight & Goodnight**
– Dorsal hood process without median armed tubercles; only large cells on scute; males with dorsal gland on first cheliceromere; western North America from southern California to northern British Columbia .... ***Ortholasma*** **Banks**

Martensolasma **Shear, 2006**

Martensolasma Shear 2006, p. 192.

Type species. *Martensolasma jocheni* Shear, 2006, by monotypy.

Diagnosis. Ortholasmatines lacking a median hood process on the eye tubercle and having a simple pattern of keel cells; *scutum magnum* present.

Maratensolasma jocheni **Shear, 2006**

Martensolasma jocheni Shear 2006, p. 193.

New record: 24 km north of Xicotepec de Juarez, 1070 m asl, oak forest litter, Puebla, México, collected 17 June 1983 by R. Anderson, male (AMNH).

Notes. This specimen is virtually identical to the holotype and paratype males from Aguascalientes, Aguascalientes, México, despite having been collected about 480 km (300 miles) east-southeast of there. The Aguascalientes type specimens came from a garden, and I speculated that they might have been introduced, but then only considered introductions from *outside* México. While it is possible (though unlikely) that the species has a natural range of this size, the Aguascalientes specimens could have been brought to that major urban center with garden plants from Puebla. Future collecting may solve the dilemma, and may also produce the presently unknown females.

Cladolasma Suzuki, 1963

Cladolasma Suzuki 1963, p. 40.
Dendrolasma, Shear and Gruber 1983, p. 51 (in part, only *D. parvulum* Suzuki 1963; complete pre-1983 references).

Type species. *Cladolasma parvula* Suzuki 1963, by monotypy. Shear and Gruber (1983) changed the name of the type species to *parvulum* to agree in gender with the generic name.

Diagnosis. Ortholasmatines with single lateral hood processes on each side of eye tubercle (two or more such processes in *Ortholasma* and *Trilasma*), two-thirds or more length of median hood process; metapeltidium free from abdominal scutum (fused to scutum in *Dendrolasma*); scute ornamentation of small keel cells only (large or small cells in *Dendrolasma*); leg femoral microsculpture of broad denticles. Penis with short stylus, two lateral rows of macrosetae.

Included species: In addition to the type, *Cladolasma angka* (Schwendinger & Gruber, 1992).

Distribution. Southern Japan; northern Thailand.

Notes. While the male of *C. angka* is unknown, Schwendinger and Gruber (1992) noted that the penis of *C. parvulum* is quite different from that of the North American *Dendrolasma,* with a shorter shaft, compressed glans and short, slender, pointed stylus—opposed to the long, thin shaft, flattened glans and spiral stylus of *Dendrolasma* (see illustrations of *C. parvulum* in Shear and Gruber 1983; penis unknown in *C. angka*). Schwendinger and Gruber (1992) pointed out several additional consistent differences between the North American and Asian species placed in *Dendrolasma,* and suggested the revalidation of *Cladolasma* for the two known Asian species. However, they described *angka* under *Dendrolasma,* and did not formalize the revalidation. The wide geographical separation of the two known species of *Cladolasma* and the dearth of collecting of soil and litter animals in southeast Asia and southern China almost guarantees the addition of numerous species to this genus in the future.

With regard to *Dendrolasma,* the two species now included there are quite different from one another. *Dendrolasma mirabile* Banks 1894 has a scute ornamentation of large cells ranged in rows, while in *D. dentipalpe* Shear & Gruber, 1983, there are only small cells even smaller than in *Cladolasma* species. In addition, *D. dentipalpe* has unique secondary sexual modifications in males, including exaggerated cheliceral apophyses and a distomedial tooth on the palpal patella. Discovery of further species could lead to additional splitting of *Dendrolasma.*

Ortholasma Banks, 1894

Ortholasma Banks 1894, p. 11; Shear and Gruber 1983, p. 14 (in part; with all pre-1983 references); Shear and Gruber 1987, p. 134.

Type species. *Ortholasma rugosum* Banks, 1894, by monotypy.

Emended diagnosis. Ortholasmatines in which the median hood process arises rostrally and is distinctly spoon-shaped, widest past its midlength, and lacks a median, dorsal row of T-shaped tubercles (*Trilasma* species have parallel-sided median hood processes with a median row of tubercles); two lateral hood processes; males with glands dorsally on the first cheliceromere (glands lacking in *Trilasma*); male first cheliceromere with or without distal inner tooth; males of some species with palpal femoral and patellar glands (needs verification for all species using scanning electron microscopy); keel cells large, not subdivided into smaller cells (some cells subdivided in *Trilasma*; sometimes in *Dendrolasma*).

Notes. *Ortholasma* species are best distinguished from one another by characters of the dorsal ornamentation, in particular the numbers of lateral T-shaped tubercles on the median hood process and the elevation of the median paired spines of the scute. The proportions of the appendages and their microsculpture are also valuable, but the form of the penis is so similar in all species that it is of little systematic value. The absence of an inner tooth on the basal articles of the chelicerae of males may be synapomorphic for at least some *Ortholasma;* however, *O. rugosa* has a small tooth, and the tooth is not present in all species of *Trilasma*.

As delimited here, *Ortholasma* is found almost exclusively in the United States and Canada, though *O. coronadense* extends into Baja California, México, on Islas Coronados, offshore and just south of the border with the United States. This species has not been reported from mainland Baja California, but likely occurs there.

Key to species of *Ortholasma* (adapted from Shear and Gruber 1983)

1.	Large animals, males 4.5 mm or longer, females 6 mm or longer; southern Sierra Nevada in Tulare and Kern Cos., California	***colossus* sp. n.**
–	Smaller animals, males less than 4 mm, females 4.5 mm or less	**2**
2.	Leg femora banded, body with median light stripe; northern California north to Vancouver Island	***pictipes* Banks**
–	Leg femora not banded, body uniform in color	**3**
3.	Leg femora without false articulations; San Francisco Bay area	***rugosum* Banks**

– At least second femora with false articulations...**4**

4. All femora with false articulations; San Francisco Bay area south to Los Angeles, Sierra Nevada foothills, caves in higher Sierras ....***levipes* Shear & Gruber**

– False articulations only in femora 2 and 4; southern California and Coronado Islands ....***coronadense* Cockerell**

***Ortholasma colossus* sp. n.**
urn:lsid:zoobank.org:act:78E03B21-192C-47C3-B964-C179BC06EF60
Figs 1–8, 10, 20, 30, 31

Types. Male holotype and two female paratypes collected in Bear Den Cave, Sequoia National Park, Tulare Co., California, 1 May 2004, by J. Krejca et al., deposited in California Academy of Sciences (CAS); male and female paratypes from same locality, collected 17–18 July 2003 by J. Krejca et al., deposited in Field Museum of Natural History (FMNH).

Diagnosis. The notably larger size of the females distinguishes this species of *Ortholasma* from all others.

Etymology. The species name, a Latin noun in apposition, refers to a gigantic statue, or by implication, anything outlandishly large for its type.

Description. Male holotype: total length, 4.5, width, 2.25. Color uniform blackish brown, legs somewhat lighter brown. Carapace arcuate, about twice as wide as long, with complete lateral and posterior submarginal keels; median keels connect eye tubercle and

Figure 1. *Ortholasma colossus* sp. n., live female specimen in habitat. Photo courtesy of Marshal Hedin.

Table 1. Appendage article measurements (mm) of *O. colossus* male.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	1.10	0.76	0.70	-	0.52
Leg 1	1.90	0.60	1.10	1.10	1.10
Leg 2	4.00	0.75	3.50	2.50	1.20
Leg 3	1.90	0.40	2.00	0.90	1.10
Leg 4	3.20	1.00	3.00	1.30	1.20

innermost lateral hood process, lateral keels also arising on innermost lateral hood process. Two acute lateral hood processes each about half as long as median hood process. Circumocular keels absent, only subocular portion present. Median hood process arising dorsally on eye tubercle, length 1.6, width 1.0; bearing 24 lateral T-shaped tubercles, all connected. Metapeltidium free, complete keel along anterior margin. Scute 2.6 long, 2.25 wide. Pattern of scute keels typical, paired median scute spines low, scarcely standing above level of keels; posterior marginal keel with complete fenestrations (Fig. 2).

Chelicerae (Figs 4, 5, 10) with basal article 0.9 long, 0.25 wide, prominent epigamic gland with dense vestiture of small, fine setae (Fig. 5), otherwise sparsely setose; second article 0.75 long, 0.21 wide, with small, curved mediobasal tooth. Palpus (Figs 6, 20) with dense vestiture of clavate setae; trochanter with several ventral seta-tipped tubercles; tibia swollen; dimensions given in Table 1. Legs in order of length, 2 (11.95), 4 (9.7), 3 (6.3), 1 (5.8); metatarsus 2 with 8 false articulations, otherwise false articulations lacking; tarsi 1–4 with 10, 11, 10, 11 articles respectively. Lengths of leg segments given in Table 1. Leg femora with typical ornamentation (Fig. 7).

Genital operculum broadly rounded, marginate, suture faintly indicated. Penis (Fig. 30) 1.0 long, typically thin; glans (Fig. 31) sinuate with hooked tip, subtended by small setae.

Female paratype: total length, 6.6, width, 4.2. Nonsexual characters as in male (Fig. 3); median hood process 1.7 long, 0.9 wide. Scute 4.5 long, 4.2 wide. Chelicera without gland on basal article, distal article lacking tooth, basal article 1.05 long, 0.26 wide; distal article 0.90 long, 0.24 wide. Palpal tibia not swollen, dimensions given in Table 2. Legs in order of length, 2 (10.6), 4 (7.34), 3 (5.7), 1 (4.87); metatarsus 2 with 6 false articulations; tarsi 1–4 with 7, 8, 9, 11 articles respectively. Lengths of leg segments given in Table 2. Genital operculum broadly rounded, marginate, without suture. Ovipositor typical.

Distribution. All specimens deposited in CAS unless otherwise noted. CALIFORNIA: *Fresno Co.,* 3 mi. south of Trimmer, 4 June 1967, under rhyolite in oak forest, T. Briggs, female (AMNH). *Tulare Co.,* Johnsondale, Kern River, 4 July 1956, V. Roth, W. Gertsch, female (AMNH); Lost Soldier's Cave, December 1977, A. Grubbs, female (AMNH); 21 July 2003, J. Krejca et al., female, 23 July 2003, molt fragment, 9 November 2003, female; Lightening Cave, 30 June 1952, A. Lange, female (used for SEM; AMNH); Sequoia National Park, Ash Mtn., 26 April 1951, E. Schlinger, male (AMNH); Paradise Cave, 30 April 2004, J. Krejca et al., male, juveniles; Lange Cave, 6 May 2004, J. Krejca et al., male, 2 females, 6 May 2004, male, female, 7 May 2004,

Table 2. Appendage article measurements (mm) of *O. colossus* female.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	1.10	0.90	0.70	-	0.46
Leg 1	1.50	0.52	1.20	1.00	1.10
Leg 2	3.50	0.80	2.60	2.10	1.60
Leg 3	1.80	0.52	1.52	0.90	0.96
Leg 4	2.20	0.80	2.20	1.10	1.04

late instar juvenile; Carmoe Crevice, 5 July 2003, J. Krejca et al., male; May's Cave, 16 May 2004, J. Krejca et al., female, early juvenile; Hidden Cave, 15 November 2003, J. Krejca, V. Loftin, male; Highway 245, 14 mi. north of Woodlake, near Cottonwood Creek and Rattlesnake Creek confluence, 26 March 2009, M. Hedin et al., female (pictured alive and in the field in Fig. 1).

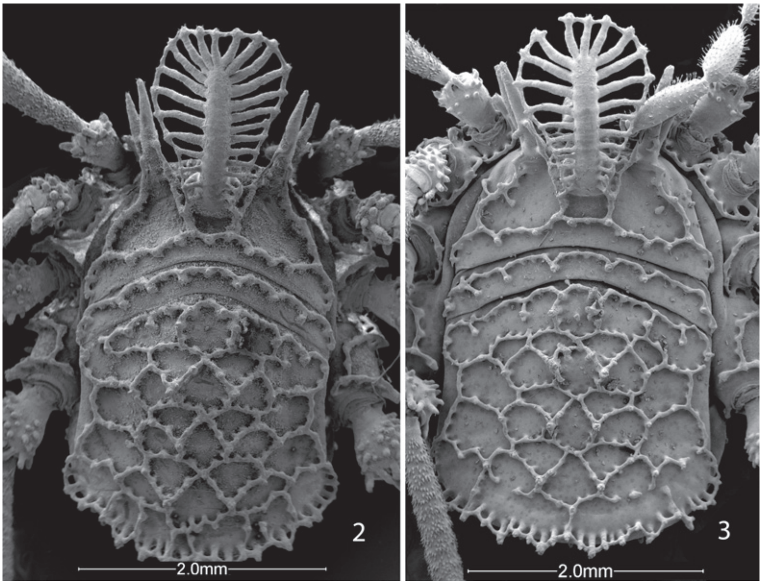
Notes. The preponderance of cave records is probably misleading; the species shows no signs of troglomorphosis and specimens from caves are nearly identical to the few surface-collected specimens. The cool, moist environment of caves probably attracts individuals (troglophily). Caves have been much more thoroughly collected than surface habitats, and in this case most of the records come from a biological survey of the caves of Sequoia and Kings Canyon National Parks. The caves mentioned in the Distribution section are located on a map in Shear and Shelley (2008: Fig. 9). The Fresno Co. record may be questionable. The label places Trimmer in Kern Co., but according to all sources, it is an unincorporated community in Fresno Co., on the north shore of the Pine Flat Reservoir (shown on some maps as Isabella Reservoir). The elevation in the vicinity is less than 610 m (2000') asl, while no other records of the species but one (near Woodlake) come from below 2100 m (about 7000') asl. If accurate, this record suggests a wider distribution for *O. colossus* sp. n.

The size of the species, at least 50% longer than the next largest, is striking when seen side-by-side with congeners; only *O. rugosum* approaches it with some 4.5-mm-long males. However, most males of *colossus* sp. n. are longer than 4.5 mm, and the largest females of *rugosum* are only 4.8 mm long, compared to the usual 6–7 mm in *colossus* sp. n.

Trilasma Goodnight & Goodnight, 1942

Trilasma Goodnight & Goodnight 1942, p. 7.
Ortholasma Shear & Gruber 1983, p. 14 (in part; only the species *bolivari* and *sbordonii;* see for complete references before 1983).
Ruaxphilos Goodnight & Goodnight 1945a, p. 299. First synonymized with *Ortholasma* by Shear & Gruber (1983).

Type species. *Trilasma bolivari* Goodnight & Goodnight, 1942, by monotypy. Of *Ruaxphilos, R. petrunkevitchou* Goodnight & Goodnight, 1945, by monotypy.

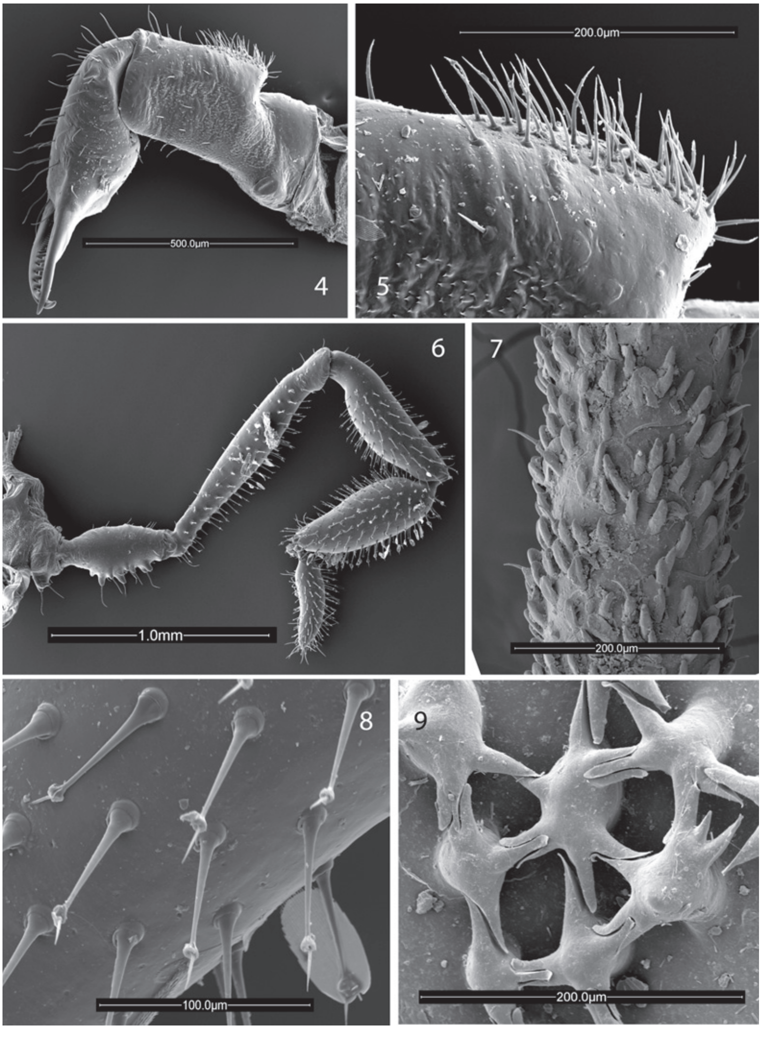


Figures 2, 3. Scanning electron micrographs of *Ortholasma colossus* sp. n., dorsal views. **2** male **3** female.

Emended diagnosis. Ortholasmatines in which the median hood process arises dorsally, projects anteriorly in a shallow curve, and is parallel-sided or nearly so, with a dorsal row or rows of tubercles (spoon-shaped and lacking dorsal tubercles in *Ortholasma*); two or three lateral hood processes; males without cheliceral glands (cheliceral glands present in *Ortholasma*); male first cheliceromere with distal inner tooth, dorsal tooth or sharp tubercle present or absent, curved mediobasal tooth on second cheliceromere (not verified for species known only from females); palpal patella with only two seta-bearing tubercles (*Ortholasma* with several); large keel cells separated by transverse rows of much smaller keel cells (*Ortholasma* lacks rows of smaller cells; *Dendrolasma* has either large or small cells but not both).

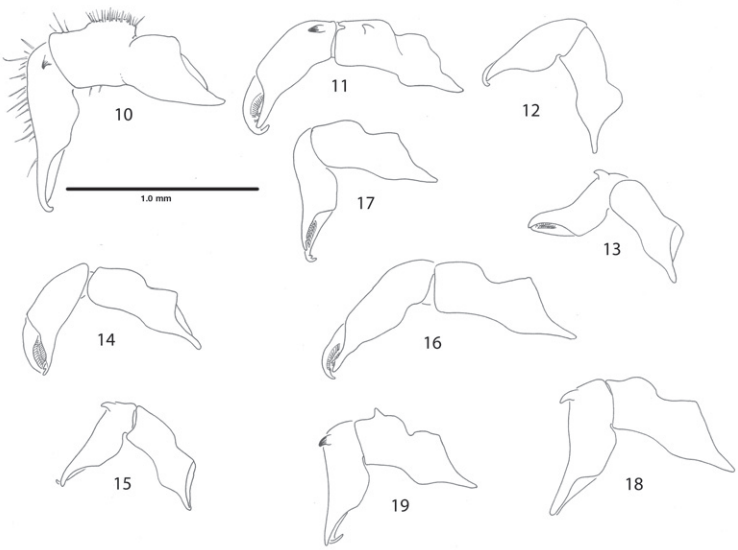
Notes. *Trilasma* consists of seven species extending from Nuevo León, México, in the north to Honduras in the south. Not much ecological information is available. One species, *sbordonii,* is troglomorphic, but while other cave collections exist, none of the other species seems especially adapted for life underground (although both *petersprousei* sp. n. and *tempestado* sp. n. have unusually long, thin legs and palpi) and probably are at most troglophilic. Surface collections are from cloud forest litter, and from under the bark of pines. Except for *chipinquensis,* collected at an altitude of about 1525 m (5000'), all species come from altitudes ranging from 2100–3050 m (7000–10000') asl.

Trilasma species are immediately separable from *Ortholasma* species due to the presence of areas of small keel cells on the abdominal scutum (compare Figs 42, 45, and 54 with 1, 2). It appears that the small cell groups are at the anterior borders of the scute areas because in some species the first group is to be found at the very anterior margin of the scute (of area 1) and succeeding groups appear anterior to the paired me-



Figures 4–9. Scanning electron micrographs. **4–8** *Ortholasma colossus* sp. n. **4** right chelicerae of male, mesal view **5** glandular area of basal cheliceral article of male, mesal view **6** right palpus of male, mesal view **7** sculpture of second femur of female **8** *kugelhaare* of female palpus **9** *Trilasma trispinosum* sp. n., branched tubercles forming small keel cells of scute.

dian spines of the succeeding areas. The maximum number of groups is thus five, but the anteriormost is absent in some species, and the posteriormost is generally broken up into two groups on either side of the midline and consists of just two or three small cells on each side, or may be absent as well. The small cell groups of areas 2, 3 and 4 are the most marked and are successively wider, with the group of area 4 occupying about two-thirds the width of the scute and consisting of up to 20 small cells. In addition, *Trilasma* species have dorsal tubercles on the median hood process of the eye tubercle; these may be few (*trispinosum* sp. n., Fig. 43) or very numerous (*tempestado* sp. n., Fig. 44) and bearing branches that connect complexly with each other and with the

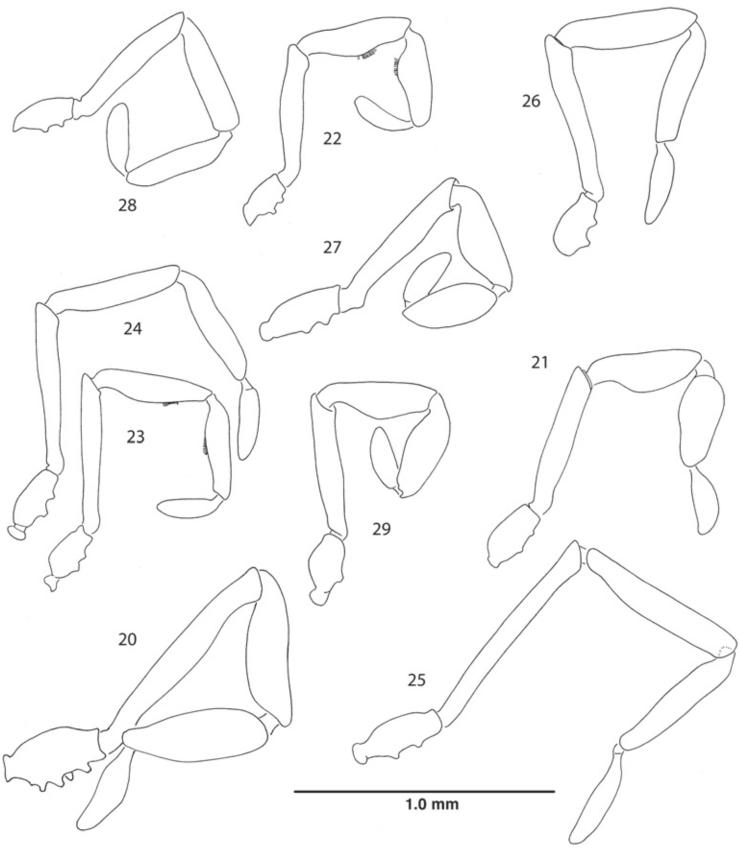


Figures 10–19. Right chelicerae, mesal views. **10** *Ortholasma colossus* sp. n., male **11** *Trilasma ranchonuevo* sp. n., male **12** *Trilasma trispinosum* sp. n., female **13** *T. trispinosum* sp. n., male **14** *Trilasma tempestado* sp. n., female **15** *T. tempestado* sp. n., male **16** *Trilasma petersprousei* sp. n., female **17** *Trilasma chipinquensis* sp. n., female **18** *Trilasma hidalgo* sp. n., male **19** *Trilasma tropicum* sp. n., male. All drawings to the same scale.

usual lateral tubercles. Instead of the typically spatulate dorsal hood processes of *Ortholasma* species, *Trilasma* species have dorsal hood processes with nearly parallel sides that are obviously longer and narrower than in the former genus, reaching an extreme in the very narrow hood of *T. trispinosum* sp. n. (Fig. 43). In several species the process tapers apically to a point.

Trilasma species are on average significantly smaller than *Ortholasma* species, ranging from a minimum of 2.1 mm in length to just 3.4 mm, including the hood. As in other members of the subfamily, the order of legs in length is 2, 4, 3, 1. In some species false articulations are present in at least some femora and metatarsi, but sometimes only in males. The detailed ornamentation of the leg femora, of taxonomic value in *Ortholasma,* because it differs between species, is quite uniform in *Trilasma,* consisting of numerous, short, club-shaped setae, among which are dispersed a few blunt, rod-shaped setae on elevated sockets. This character was studied for all species using scanning electron microscopy. The short, club-shaped setae are clearly seen to be hollow in some of the photomicrographs, but there appear not to be any pores communicating with the outside. In species of both *Ortholasma* and *Dendrolasma*, the longer setae on elevated sockets are acute and tapered, not blunt and rod-shaped.

Sexual dimorphism in *Trilasma* species is more pronounced than in *Ortholasma* species. Males are significantly smaller than females, with relatively longer



Figures 20–29. Right palpi, lateral views. **20** *Ortholasma colossus,* sp. n., male **21** *Trilasma ranchonuevo* sp. n., male **22** *Trilasma trispinosum* sp. n., male **23** *Trilasma tempestado* sp. n., male **24** *Trilasma tempestado* sp. n., female **25** *Trilasma petersprousei* sp. n., female **26** *Trilasma chipinquensis* sp. n., female **27** *Trilasma hidalgo* sp. n., male **28** *Trilasma tropicum* sp. n., female **29** *T. tropicum* sp. n., male. All drawings to the same scale.

legs, especially legs 2 and 4, which may also have increased numbers of tarsal segments, and in some species the males have false articulations in the fourth leg femora that are not present in the females. In addition to the basal, median tooth on the second cheliceral segment and the glands in the patellae and tibiae of the palpi, males of *Trilasma* species may have somewhat reduced dorsal ornamentation when compared to females, expressed in fewer small cells and lower paired tubercles of the dorsal areas. This dimorphism is especially notable at the posterior margin of the scute, where in females there is an obvious "post and rail fence" with long "posts" (Shear and Gruber, 1983); in males of the same species, this feature may be hardly noticeable.

The following characters seem to be useful in defining and separating the species of *Trilasma*: the relative length and robustness of the legs, the presence or absence and the number (if present) of false articulations in the femora and metatarsi of the legs (this may be sexually dimorphic in some species), the range of numbers of tarsal articles (difficult to evaluate because of small sample size; the counts given should be taken as variable by one or two articles in either direction), the relative prominence of the ocular keels, the patterns of small keel cells on the scute, the height of the paired area tubercles, and the shape and size of the dorsal hood process. In addition, there are autapomorphies of single species, such as the very narrow dorsal hood process and three lateral hood processes in *T. trispinosum* sp. n.

While I am still certain that *Ruaxphilos* is a synonym of *Trilasma,* it is no longer clear that *R. petrunkevitchou* Goodnight & Goodnight, 1945 is a synonym of *T. bolivari*, as placed by Shear and Gruber (1983). The type specimen of the former species came from Veracruz, whereas the latter is known from several localities in the transverse volcanic belt of central México.

Key to species of *Trilasma*

1.	Troglomorphic facies, depigmented animals with reduced eyes and elongate legs and palpi; caves in Tamaulipas	***sbordonii* (Šilhavý)**
–	Medium tan or dark brown to black animals with normal eyes	**2**
2.	Two lateral hood processes	**4**
–	Three lateral hood processes	**3**
3.	Femora 2 and 4 of males each with a false articulations (females unknown); median hood process normally broad, with 5 or 6 dorsal tubercles; Tamaulipas	***ranchonuevo* sp. n.**
–	All femora of males with false articulations; median hood process extremely narrow, with only 1 or 2 dorsal tubercles; Veracruz	***trispinosum* sp. n.**
4.	Femur of second leg longer than or equal to scute length	**5**
–	Femur of second leg shorter than scute	**6**
5.	Fourth femur with two false articulations; second femur about as long as scute; Nuevo Léon	***tempestado* sp. n.**
–	All femora without false articulations; second femur longer than scute; San Luis Potosí	***petersprousei* sp. n.**
6.	Fourth femur with a basal false articulation; Nuevo Léon	***chipinquensis* sp. n.**
–	All femora lacking false articulations	**7**
7.	Second metatarsus with two or three false articulations; Distrito Federal, Puebla and adjacent states	***bolivari* Goodnight & Goodnight**
–	Second metatarsus without false articulations	**8**
8.	Males about 3.0 mm long; about 15 dorsal tubercles on median hood process; Hidalgo, México	***hidalgo* sp. n.**
–	Males about 2.5 mm long; about 8 dorsal tubercles on median hood process; Honduras	***tropicum* sp. n.**

Trilasma ranchonuevo **sp. n.**
urn:lsid:zoobank.org:act:7BCAB326-0BF9-414A-8E16-BC5773077567
Figs 11, 21, 32, 33, 47

Type. Male holotype (TMM) from Rancho Nuevo, Tamaulipas, México, collected 10 April 1982 by Terri Treacy.

Diagnosis. Like *T. trispinosum* sp. n., *ranchonuevo* sp. n. has three lateral hood processes, but the median hood process of *ranchonuevo* sp. n. is much broader and has more dorsal tubercles. There are more small keel cells on the scute of *trispinosum* sp. n. than in *ranchonuevo* sp. n. The male of *ranchonuevo* sp. n. has a single false articulation in each of the second and fourth leg femora; such are present in all legs of *trispinosum* sp. n. males. Tarsal counts of the single available specimen are 3, 4, 4, 4, the lowest for any *Trilasma.*

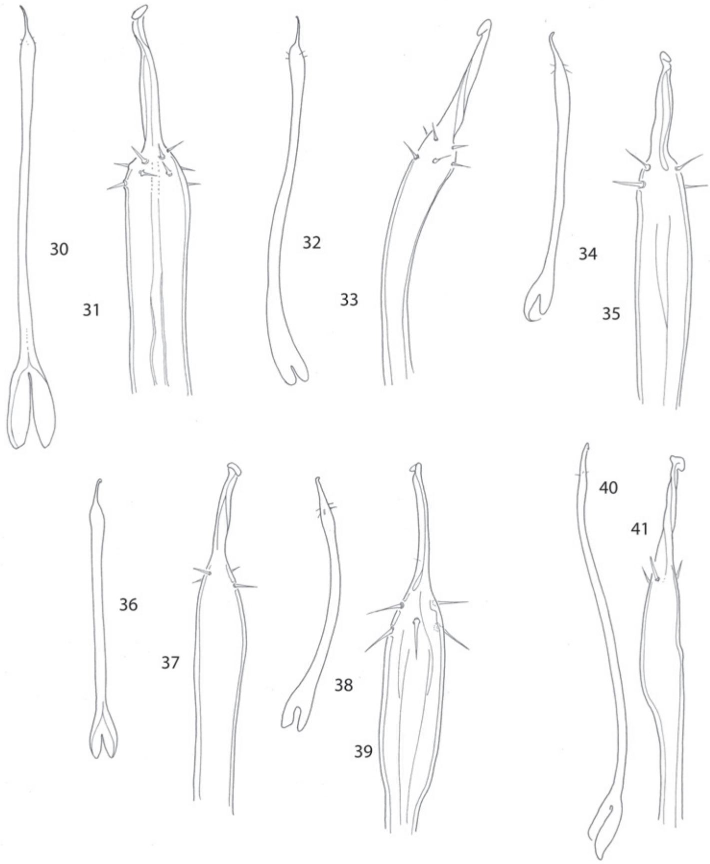
Etymology. The species epithet, a noun in apposition, refers to the type locality.

Description. Male holotype: total length, 2.7, width, 1.6. Color pale tan to yellowish brown. Carapace arcuate, about 1.5× as wide as long, with complete lateral and posterior submarginal keels; pair of median keels connecting eye tubercle and innermost lateral hood process, lateral keels arising both on innermost and middle lateral hood processes. Three blunt lateral hood processes each about one-half as long as median hood process. Circumocular keels suppressed, subocular portion vaguely indicated, eyes relatively large, bulging. Median hood process arising dorsally on eye tubercle, with nearly parallel sides, then converging distally, length 0.9, width 0.3; median keels of carapace continuing as rows of lateral tubercles on median hood process, about 18–20 lateral tubercles, linearly connected; 5 or 6 dorsal tubercles present, connected linearly to one another but not obviously to lateral tubercles. Metapeltidium free, complete keel along anterior margin, 6 tubercles posterior to keel, connected to it by single branch each. Scute 1.6 long, 1.6 wide. All keels relatively low. Small keel cells present only on areas 2–4, as single transverse rows of 6–8 cells. Paired median scute spines prominent, on areas 4, 5 larger than adjacent keel tubercles (Fig. 47).

Chelicerae (Fig. 11) with basal article 0.62 long, 0.22 wide, sparsely setose, with small, median distal tooth; second article 0.62 long, 0.20 wide, with dark, median basal tooth. Palpus (Fig. 21) with dense vestiture of clavate setae; patella and tibia swollen, but glands not marked by patches of small setae, trochanter with ventral seta-tipped tubercles very low, almost obselete; dimensions given in Table 3. Legs in order

Table 3. Appendage article measurements of *T. ranchonuevo* sp. n. male.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.70	0.50	0.50	-	0.31
Leg 1	0.80	0.40	0.60	0.80	0.40
Leg 2	1.50	0.60	1.20	1.94	1.60
Leg 3	0.90	0.44	0.66	0.72	0.40
Leg 4	1.40	0.52	1.00	1.00	0.82



Figures 30–41. Penes. **30, 31** *Ortholasma colossus* **30** dorsal view **31** glans **32, 33** *Trilasma ranchonuevo* sp. n. **32** dorsal view **33** glans **34, 35** *Trilasma trispinosum* sp. n. **34** dorsal view **35** glans **36, 37** *Trilasma tempestado* sp. n. **36** dorsal view **37** glans **38, 39** *Trilasma tropicum* sp. n. **38** dorsal view **39** glans **40, 41** *Trilasma hidalgo* sp. n. **40** lateral view **41** glans. All drawings to the same scale; penis of *Ortholasma colossus* is 1 mm long.

of length, 2 (6.66), 4 (4.74), 3 (3.12), 1 (3.0); metatarsus 2 with 2 false articulations, femora 2, 4 with single basal false articulation; tarsi 1–4 with 3, 4, 4, 4 articles respectively. Lengths of leg segments given in Table 3. Length/width ratios of femora, in order: 3.64, 8.33, 3.46, 7.0. Leg femora with typical ornamentation.

Genital operculum broadly rounded, marginate, notched. Penis (Figs 32, 33) typical of genus.

Notes. The male holotype of *Trilasma ranchonuevo* sp. n. is significantly larger than the male paratype of *T. trispinosum* sp. n. and has longer legs. The pattern of small cells on the scute is quite different, and the median hood process is much broader in relation to its width, with many more dorsal tubercles. On the left side of the body of the holotype, the innermost lateral hood process is irregularly developed, suggesting that the innermost process is the "extra" one and that its presence or absence might be subject to variation.

Rancho Nuevo is in the Sierra Nevada Oriental in western Tamaulipas, near the Nuevo Léon border and about 22 miles northwest of Ciudad Victoria. Coordinates: 23°51'50.40'N, 99°27'07.43'W, elevation 8600' (2650 m).While the region around Rancho Nuevo is famous for its caves, this specimen was collected on the surface and shows no signs of troglobiosis.

Trilasma trispinosum sp. n.

urn:lsid:zoobank.org:act:F39EF9AA-DD3B-48F2-8C8E-B0EC3E17BF6D
Figs 9, 12, 13, 22, 34, 35, 42, 43

Types. Female holotype, male and female paratypes (TMM) from Puerto del Aire, Veracruz, México, collected 6 January 1966 by J. Richter, in cloud forest oak litter.

Diagnosis. Differing from all other *Trilasma* except *ranchonuevo* sp. n. in the three, rather than two, lateral hood processes of the carapace, but distinct from *ranchonuevo* sp. n. in the extremely narrow median hood process, with only a few dorsal tubercles.

Etymology. The species epithet refers to the three lateral hood processes.

Description. Female holotype: total length, 2.6, width, 1.7. Color uniform chestnut brown, legs somewhat lighter brown, proximal parts of femora whitish yellow. Carapace arcuate, about 1.5× as wide as long, with complete lateral and posterior submarginal keels; pair of median keels connect eye tubercle and innermost lateral hood process, lateral keels also arising on innermost lateral hood process. Three blunt lateral hood processes each about one-fourth as long as median hood process. Circumocular keels absent, subocular portion vaguely indicated, eyes relatively large, bulging. Median hood process arising dorsally on eye tubercle, narrow, length 0.9, width 0.11; median keels of carapace continue as rows of reduced lateral tubercles on median hood process, about 18–20 lateral tubercles, linearly connected; only 2 or 3 dorsal tubercles present. Metapeltidium free, complete keel along anterior margin, 6 tubercles posterior to keel, connected to it by single branch each. Scute 1.5 long, 1.7 wide. All keels relatively low. Small keel cells of scute area 1 absent, small keel cell rows progressively wider posteriorly, widest on area 4; small cells of area 5 in two groups either side of midline. Paired median scute spines small, on areas 4, 5 no larger than adjacent keel tubercles (Figs 42, 43).

Table 4. Appendage article measurements of *T. trispinosum* sp. n. female.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.60	0.57	0.50	-	0.25
Leg 1	0.70	0.40	0.50	0.80	0.65
Leg 2	1.05	0.55	0.70	1.60	1.55
Leg 3	0.75	0.40	0.50	0.80	0.65
Leg 4	1.05	0.40	0.74	1.00	1.80

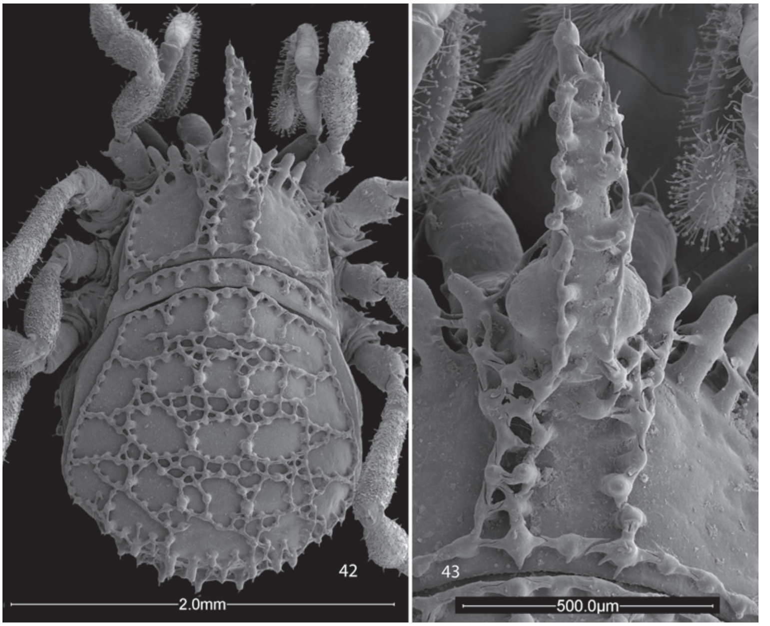
Table 5. Appendage article measurements of *T. trispinosum* sp. n. male.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.65	0.51	0.49	-	0.30
Leg 1	0.78	0.40	0.50	0.80	0.74
Leg 2	1.18	0.44	0.74	1.70	1.70
Leg 3	0.80	0.38	0.60	0.74	0.80
Leg 4	1.10	0.46	0.80	1.30	1.30

Chelicerae (Fig. 12) with basal article 0.65 long, 0.18 wide, sparsely setose; second article 0.52 long, 0.18 wide. Palpus with dense vestiture of clavate setae; trochanter with ventral seta-tipped tubercles; dimensions given in Table 4. Legs in order of length, 2 (5.45), 4 (4.99), 3 (3.10), 1 (3.05); metatarsi without false articulations, femur 4 with single basal false articulation; tarsi 1–4 with 4, 5, 4, 5 articles respectively. Lengths of leg segments given in Table 4. Length/width ratios of femora, in order: 3.5, 7.0, 3.75, 5.25. Leg femora with typical ornamentation.

Genital operculum broadly rounded, marginate, with suture. Ovipositor typical of subfamily.

Male paratype: total length, 2.3, width, 1.2. Nonsexual characters as in female, but dorsal ornament reduced, obscured in paratype by secretion; median hood process 0.79 long, 0.2 wide. Scute 1.2 long, 1.2 wide. Chelicera (Fig. 13) without gland on basal article, second article with forward-projecting tooth, basal article 0.60 long,

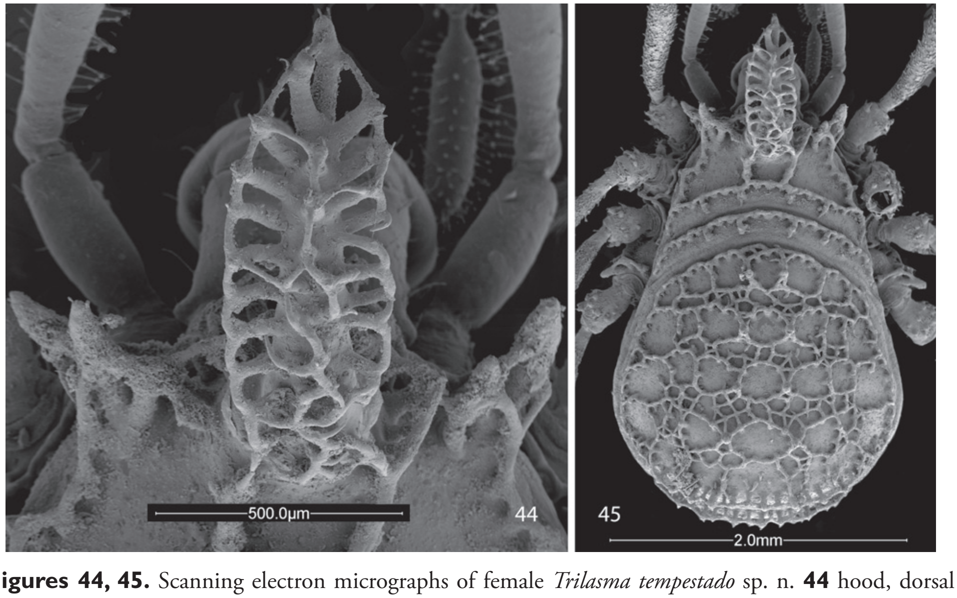


Figures 42, 43. Scanning electron micrographs of female *Trilasma trispinosum* sp. n. **42** body, dorsal view **43** hood, dorsal view.

0.20 wide; distal article 0.51 long, 0.15 wide. Palpal patella and tibia swollen, small ventral glandular areas indicated by patches of fine setae (Fig. 22), dimensions of palpus given in Table 5. Legs in order of length, 2 (5.76), 4 (4.96), 3 (3.32), 1 (3.22); all femora with single, basal false articulation, metatarsi without false articulations; tarsi 1–4 with 4, 5, 4, 5 articles respectively. Lengths of leg segments given in Table 5. Length/width ratios of femora, in order: 3.9, 9.8, 4.0, 6.1. Genital operculum broadly rounded, marginate, with two small, lateral notches. Penis typical (Figs 34, 35).

Notes. This species is the most distinctive of all *Trilasma* species due to the very short and narrow median hood process, which has only one or two dorsal armed tubercles. The female holotype (Figs 42, 43) is anomalous in that the keel extending from the eye tubercle to the posterior margin of the carapace is doubled on the left side. The pattern of keel cells is very distinct in the female holotype and paratype, but the male paratype has a much-reduced ornament. However, this is uncertain because of the thick secretion covering the dorsum and median hood process in the single available specimen; this material could not be cleaned off using ultrasonics, or methanol as a solvent. Notable also is the presence in the male of basal false articulations in all the femora. In the female, only the fourth femur has a basal false articulation. The presence of palpal glands in the male palpal patellae and tibiae is indicated by the patch of fine setae on the ventral side, and in still-adhering secretion on the tibia.

Puerto del Aire is a small village west of the larger city of Acultzingo, Veracruz, and southeast of Morelos Canadá, Puebla, virtually at the Puebla-Veracruz border (18°42'13.5'N, 97°21'29.6'W). The elevation is about 2556 m (7500 ft.) asl.



Figures 44, 45. Scanning electron micrographs of female *Trilasma tempestado* sp. n. **44** hood, dorsal view **45** body, dorsal view.

Trilasma tempestado **sp. n.**
urn:lsid:zoobank.org:act:2755568D-A57D-4B19-80BF-62EE1547B1DC
Figs 14, 15, 23, 24, 36, 37, 44, 45, 48

Types. Holotype female and male paratype (TMM) from Cueva de Polvo Tempestado, 1–2 km south of San Josecito, Nuevo Léon, México, collected 1 March 1989 by George Veni and Allan Cobb; female paratype (TMM) from Sótano de las Tres Ventanas, Purifacición area, Cuauhtémoc, Nuevo Léon, México, collected 29 November 1981 by Paul Fambro; male paratype (TMM) from Pozo de las Pantaletas, Santa Marta de Arriba, 20 km southeast of Zaragoza (UTM 433010/2656459), collected 26 November 1999 by Peter Sprouse. See Notes, below, for a detailed discussion of these localities.

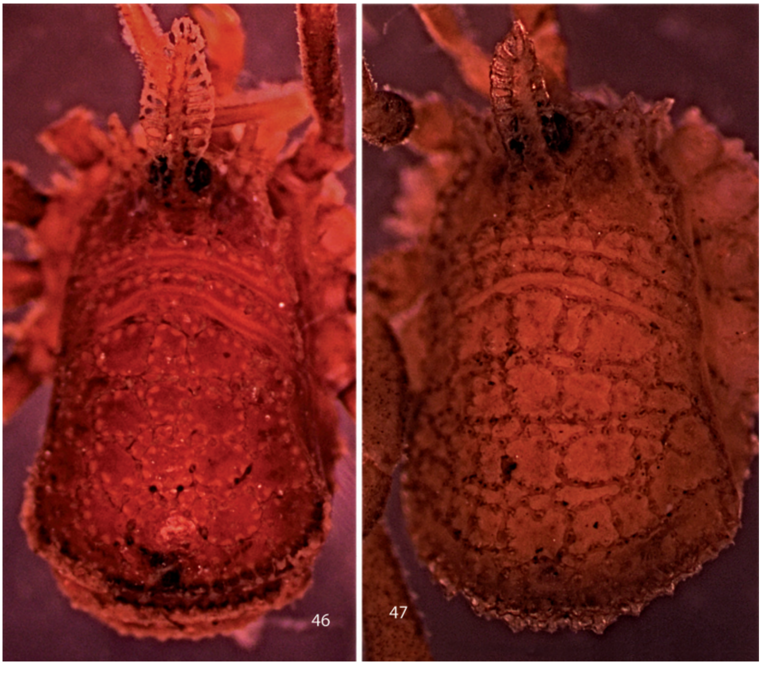
Diagnosis. A long-legged, pale species most similar to *T. petersprousei* sp. n., which is about half again as large. *Trilasma tempestado* sp. n. has the second femur about the same length as the scute, and has two false articulations in the fourth femora of both males and females, while *petersprousei* sp. n. lacks femoral false articulations. With the male paratype only 2.1 mm in length, this species is the smallest known *Trilasma,* about the same size as *Martensolasma jocheni,* the smallest known ortholasmatine.

Etymology. The species epithet is a noun in apposition, referring to the type locality.

Description. Female holotype: total length, 2.6, width, 1.5. Color pale tan to yellowish brown. Carapace arcuate, about 1.5× as wide as long, with complete lateral and posterior submarginal keels; pair of median keels connecting eye tubercle and innermost lateral hood process, lateral keels arising both on innermost and middle lateral hood processes. Two blunt lateral hood processes each about one-third or less as long as median hood process. Circumocular keels suppressed, but subocular portion visible, eyes relatively small. Median hood process arising dorsally on eye tubercle, with nearly parallel sides, then converging distally, widest at about midlength, length 0.90, width 0.40; median keels of carapace continuing as rows of lateral tubercles on median hood process, about 20 lateral tubercles, linearly connected; 11–12 dorsal tubercles present, connected complexly to one another and to lateral tubercles. Metapeltidium free, complete keel along anterior margin, 4 tubercles posterior to keel, connected to it by single branch each. Scute 1.6 long, 1.5 wide. All keels relatively high. Small keel cells present on areas 1–5; area 1 with 3–4 small cells in midline, area 2 with about 10 small cells in transverse row less than ½ width of scute, area 3 with about 16 small cells in midline, area 4 with 20–23 small cells in transverse row about

Table 6. Appendage article measurements of *T. tempestado* sp. n. female.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.80	0.65	0.56	-	0.34
Leg 1	1.10	0.40	0.70	1.12	1.00
Leg 2	2.00	0.60	1.50	2.90	1.80
Leg 3	1.12	0.40	0.80	1.16	1.00
Leg 4	1.70	0.40	1.28	1.50	1.24



Figures 46, 47. Photographs of bodies, dorsal views. **46** male *Trilasma petersprousei* sp. n. **47** female *Trilasma ranchoneuvo* sp. n.

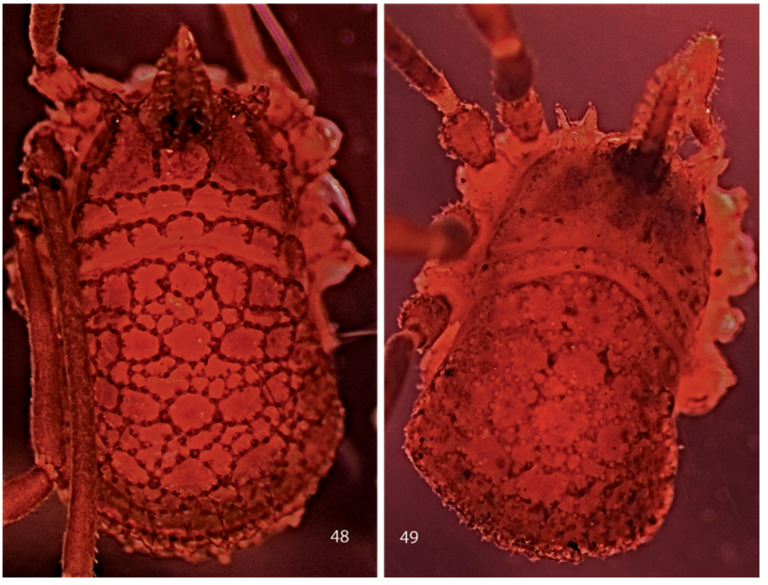
2/3 width of scute, area 5 with two paramedian groups of 3–4 small cells. Paired median scute spines relatively prominent, on all areas distinctly larger than adjacent keel tubercles (Figs 44, 45).

Chelicerae (Fig. 14) with basal article 0.60 long, 0.20 wide, sparsely setose; second article 0.56 long, 0.18 wide. Palpus (Fig. 24) slender, with dense vestiture of clavate setae; trochanter with two prominent seta-bearing ventral tubercles; dimensions given in Table 6. Legs in order of length, 2 (8.80), 4 (6.12), 3 (4.48), 1 (4.32); metatarsus 2 with 3 false articulations, femora 4 with 3 false articulations; tarsi 1–4 with 5, 6, 7, 8 articles respectively. Lengths of leg segments given in Table 6. Length/width ratios of femora, in order: 7.33, 16.67, 8.0, 12.14. Leg femora with typical ornamentation.

Genital operculum broadly rounded, separated from sternite by suture. Ovipositor typical of genus.

Table 7. Appendage article measurements of *T. tempestado* sp. n. male.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.72	0.60	0.46	-	0.30
Leg 1	0.90	0.46	0.64	0.90	0.90
Leg 2	1.50	0.56	1.08	2.00	1.30
Leg 3	0.84	0.50	0.66	0.80	0.96
Leg 4	1.40	0.56	1.28	1.00	1.10



Figures 48, 49. Photographs of bodies, dorsal views. **48** male *Trilasma tempestado* sp. n. **49** male *Trilasma tropicum* sp. n.

Male paratype: total length, 2.1, width, 1.3. Color uniform light chestnut brown. Nonsexual characters as in female (see Figs 44, 45, 48 and description, above), but dorsal ornament somewhat reduced; median hood process 0.70 long, 0.25 wide. Scute 1.3 long, 1.3 wide. Chelicera (Fig. 15) without gland on basal article, second article with strong, anteriodorsal, slightly hooked, conical protuberance, basal article 0.50 long, 0.17 wide; distal article 0.52 long, 0.16 wide. Palpal patellae and tibiae swollen, epigamic glands present and marked by patches of fine setae (Fig. 23), dimensions of palpus given in Table 7. Legs in order of length, 2 (8.68), 4 (6.00), 3 (4.48), 1 (4.26); metatarsus 2 with 2 false articulations, femur 4 with 3 false articulations; tarsi 1–4 with 5, 5, 6, 6 articles respectively. Lengths of leg segments given in Table 7. Length/width ratios of femora, in order: 7.43, 20.0, 6.89, 10.5. Genital operculum broadly rounded, marginate, with two small, lateral notches. Penis typical (Figs 36, 37).

Notes. Like *T. petersprousei* sp. n., this species is pale and long-legged, yet does not appear to be a troglobiont. It occurs in at least two distinct karst areas. Cueva de Polvo Tempestado is located 1–2 km south of the village of San Josecito (23°58'12.68'N, 99°54'21.18'W, elev. ca. 2300m (7570')). This is a small, vertical cave, one of several in the area. Sótano de las Tres Ventanas is a pit in the well-known Río Purificación karst region located in Nuevo Léon and Tamaulipas between Zaragoza, NL, and Ciudad Victoria, Tamps. The coordinates are 23° 53' 30.583'N, 99° 28' 20.445'W, at an elevation of 2210 m asl. The entrance pit drops 35 m to a rubble pile, which slopes down to a plug at -45 meters. Temperature measured at this point was 8.6° C during exploration on 29 November 1981 (P. Sprouse, pers. comm.) Sistema Purificación, located in this area, is one of the deepest and longest cave systems in México. Pozo de las Pantaletas is located near the village of Santa Marta at coordinates of 23° 51' 40.16'N, 99° 41' 23.982'W and an elevation of 2800 m asl. This is a vertical cave with multiple rope drops leading to a depth of 140 m. All of these records are rather tightly clustered in a mountainous region of Nuevo Léon that makes an easterly salient into Tamaulipas 35–45 km northwest of Ciudad Victoria. It would be no surprise to see specimens from the adjoining part of Tamaulipas.

Trilasma petersprousei sp. n.

urn:lsid:zoobank.org:act:A8DA8437-E2B4-4F4E-8434-05EEAFAC56BC
Figs 16, 25, 46

Types. Female holotype (TMM) from Hoya de las Guaguas, 10 km south of Aquismón, San Luis Potosí, México, collected 29 August 1986 by Peter Sprouse.

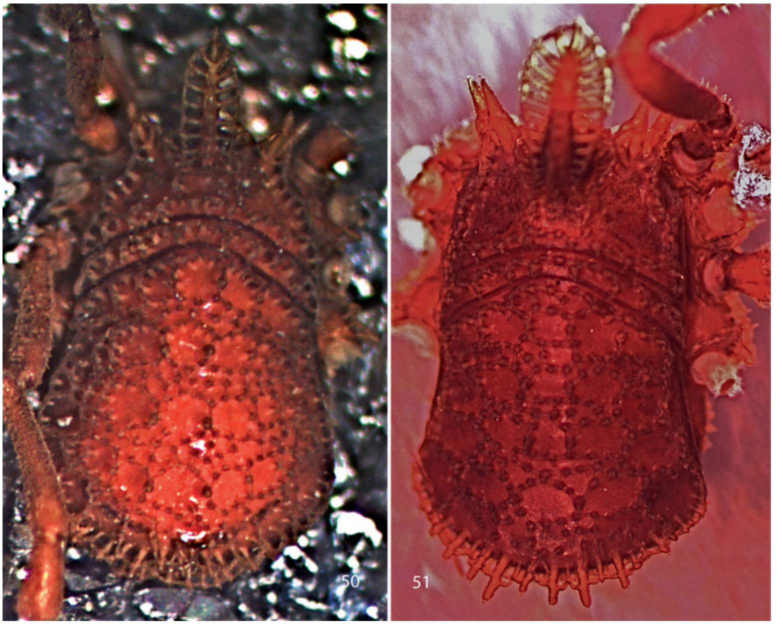
Diagnosis. *Trilasma petersprousei* sp. n. is a long-legged species, with long, thin pedipalps. The high tarsal count of the holotype (6, 12, 6, 8) and the presence of 12 false articulations in the second metatarsi also distinguish it from other species.

Etymology. The species is named for the collector, Peter Sprouse of Zara Environmental, LLC, a noted explorer of Mexican caves who has collected many new species of troglobionts and troglophiles.

Description. Female holotype: total length, 3.4, width, 1.9. Color pale tan to yellowish brown. Carapace arcuate, about 1.5× as wide as long, with complete lateral and posterior submarginal keels; pair of median keels connecting eye tubercle and innermost lateral hood process, lateral keels arising both on innermost and middle lateral hood processes. Two blunt lateral hood processes each about one-half as long as median hood process. Circumocular keels suppressed, but subocular portion obvious, eyes relatively large, bulging. Median hood process arising dorsally on eye tubercle, with nearly parallel sides, then converging distally, widest slightly beyond midlength, length 1.10, width 0.45; median keels of carapace continuing as rows of lateral tubercles on median hood process, about 20 lateral tubercles, linearly connected; about 15 dorsal tubercles present, connected complexly to one another and to lateral tubercles. Metapeltidium free, complete keel along anterior margin, 6 tubercles posterior to keel, connected to it by single branch each. Scute 1.8 long, 1.9 wide. All keels relatively low. Small keel cells present on areas 1–4; area 1 with 2–3 small cells in midline, area

Table 8. Appendage article measurements of *T. petersprousei* sp. n. female.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	1.00	0.86	0.70	---	0.44
Leg 1	1.65	0.60	1.08	1.15	1.25
Leg 2	4.05	0.90	3.10	3.50	2.50
Leg 3	1.80	0.50	1.30	1.05	1.25
Leg 4	3.10	1.10	2.40	1.25	1.58



Figures 50, 51. Photographs of bodies, dorsal views. **50** female *Trilasma chipinquensis* sp. n. **51** male *Trilasma hidalgo* sp. n.

2 with 4–6 small cells in transverse row less than ½ width of scute, area 3 with 5–6 small cells in midline, area 4 with 10–12 small cells in transverse row about ½ width of scute. Paired median scute spines not prominent, on areas 4, 5 only slightly larger than adjacent keel tubercles (Fig. 46).

Chelicerae (Fig. 16) with basal article 0.70 long, 0.23 wide, sparsely setose; second article 0.72 long, 0.20 wide. Palpus (Fig. 25) slender, with dense vestiture of clavate setae; trochanter with two prominent seta-bearing ventral tubercles; dimensions given in Table 8. Legs in order of length, 2 (14.05), 4 (9.43), 3 (5.90), 1 (5.73); metatarsus 2 with about 12 false articulations, femora without false articulations; tarsi 1–4 with 6, 12, 6(7), 9 articles respectively. Lengths of leg segments given in Table 8. Length/width ratios of femora, in order: 8.25, 36.8, 9.0, 28.2. Leg femora with typical ornamentation.

Genital operculum broadly rounded, separated from sternite by suture. Ovipositor typical of genus.

Notes. While *T. petersprousei* sp. n. has long, thin legs and palpi, it does not appear in any other way to be a troglobiont; the eyes are large and well-pigmented and it lacks the exaggerated median hood process of *T. sbordonii,* a true troglobiont.

Hoya de las Guaguas (sometimes spelled Huahuas in Spanish) is an immense pit, 478 m (1565’) deep, developed in limestone of the Sierra Huasteca, and located at 21°31'56'N, 99°02'01.15W, about 460 m (1500’) asl. The entrance is large enough that sufficient light reaches the floor to sustain a plant community (P. Sprouse, pers. comm.).

Trilasma chipinquensis **sp. n.**
urn:lsid:zoobank.org:act:6C2FDB74-23B9-4266-92F9-FE96DD129CB6
Figs 17, 26, 50

Types. Female holotype (AMNH) from Chipinque Mesa, Monterrey, Nuevo Léon, México, collected 24 June 1969 by Stewart B. Peck.

Diagnosis. The paired median area tubercles are strongly developed in this species and project well above the level of the keels. Like *trispinosum* sp. n., there is a single false articulation in female femur 4, but *trispinosum* sp. n. has 3 lateral hood processes, while *chipinquensis* sp. n. has 2.

Etymology. The species epithet, an adjective, refers to the type locality.

Description. Female holotype: total length, 2.7, width, 1.5. Color dark brown, nearly black (possibly artifact of preservation). Carapace arcuate, about 1.5× as wide as long, with complete lateral and posterior submarginal keels; pair of median keels connecting eye tubercle and innermost lateral hood process, lateral keels arising both on innermost and middle lateral hood processes. Two blunt lateral hood processes each about one-half as long as median hood process. Circumocular keels strongly developed, but subocular portion easily seen in dorsal view, eyes relatively small. Median hood process arising dorsally on eye tubercle, with nearly parallel sides, only slightly converging distally, length 0.95, width 0.40; median keels of carapace continuing as rows of lateral tubercles on median hood process, about 16 lateral tubercles, linearly connected; about 6 dorsal tubercles present, connected in a single row to one another but not to lateral tubercles. Metapeltidium free, complete keel along anterior margin, 6 tubercles posterior to keel, connected to it by single branch each. Scute 1.7 long, 1.5 wide. All keels well elevated above dorsum. Small keel cells present on areas 2–4; areas 2, 3 with 5–8 small cells in midline, area 4 with 10–12 small cells in transverse row about 2/3 width of scute. Paired median scute spines prominent, on all areas significantly larger than adjacent keel tubercles, standing well above keels; pair of spines also present on metapeltidium (Fig. 50).

Chelicerae (Fig. 17) with basal article 0.64 long, 0.21 wide, sparsely setose; distal article 0.60 long, 0.19 wide. Palpus (Fig. 26) relatively slender, with dense vestiture of clavate setae; trochanter with two prominent seta-bearing ventral tubercles; dimensions given in Table 9. Legs in order of length, 2? (-), 4 (5.62), 3 (4.66), 1 (4.20); metatarsi without false articulations, femora 4 without single false articulation; tarsi 1–4

Table 9. Appendage article measurements of *T. chipinquensis* sp. n. female.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.80	0.32	0.30	---	0.40
Leg 1	1.00	0.40	0.64	1.20	0.96
Leg 2	1.80	0.60	1.10	---	---
Leg 3	1.00	0.46	1.00	1.20	1.00
Leg 4	1.52	0.50	1.00	1.40	1.20

with 5, -, 7, 6 articles respectively (tarsi 2 missing). Lengths of leg segments given in Table 9. Length/width ratios of femora, in order: 5.56, 12.86, 5.56, 7.60. Leg femora with typical ornamentation.

Genital operculum broadly rounded, separated from sternite by suture. Ovipositor typical of genus.

Notes. The holotype female was mentioned and briefly described by Shear and Gruber (1983). The present examination resulted in some different observations, primarily in that I could not see the false articulation of the second femur observed in 1983. The second leg is absent from the left side, and broken off at the tibia-metatarsus joint on the right.

Chipinque Mesa is a ridge of the Sierra Madre Oriental overlooking the city of Monterrey, to the north. Approximate coordinates are 25°36'29.43'N, 100°21'18'W; elevation at the top of the ridge is 1524 m (5000’). Chipinque Mesa is now a part of the Parc Nacional Cumbre and is a popular sight-seeing destination for visitors to Monterrey. It is densely forested in pines.

Trilasma bolivari Goodnight & Goodnight, 1942

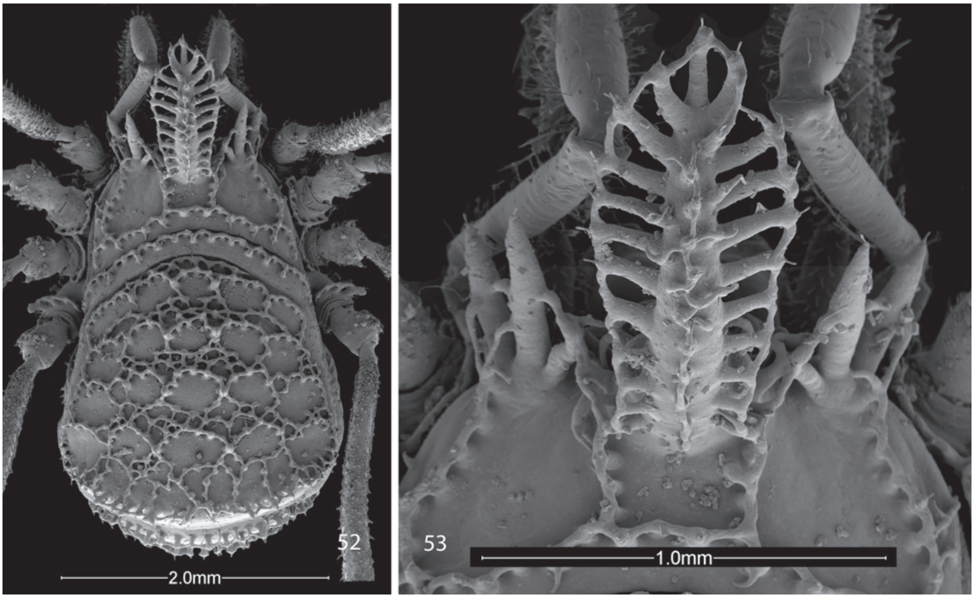
Figs 52, 53

Trilasma bolivari Goodnight & Goodnight 1942, p. 7; Roewer 1940, p. 56; Shear and Gruber 1983, p. 42.

Notes. Shear and Gruber (1983) provided a detailed description based on specimens from Llano Grande, Puebla, México, a location about 28 km due northwest of the type locality, Río Frío. Now, judging from Google Earth aerial photographs, both of these places have become heavily urbanized and it seems unlikely conditions exist any longer that could support this species. Shear and Gruber (1983) mapped some of the localities given by Goodnight and Goodnight (1942, 1945b), but were not able to find all of them. Shear and Gruber expressed doubt about the identity of specimens from the Nevada de Colima, Jalisco, locality in particular; it is far separated from the others, as is the Guanajuato locality (Goodnight and Goodnight 1942). The presence of another species (see below) in Hidalgo, not far from the localities in Puebla and El Distrito Federal, suggests that at least the Guanajuato and Jalisco material may also represent undiagnosed species.

I no longer include *Ruaxphilos petrunkevitchou* Goodnight & Goodnight in the synonymy of *T. bolivari,* as Shear and Gruber (1983) did, because of the distance between the type localities (that of *petrunkevitchou* is in Veracruz). It is very likely that *petrukevitchou* is another species, but the type is an early instar that has not developed any of the species-diagnostic characters. Its identity can only be established by the collection of adults at the type locality.

I provide some new illustrations (Figs 52, 53) for comparison with the other species described here as new. The illustrations are of a female specimen collected by Fred



Figures 52, 53. Scanning electron micrographs of female *Trilasma bolivari* Goodnight & Goodnight 1942 **52** body, dorsal view **53** hood, dorsal view.

Coyle at the pass between Toluca and México City, Distrito Federal, on Rt. 15, elev. 3000 m (9800') asl, on 4 June 1982.

Trilasma hidalgo sp. n.

urn:lsid:zoobank.org:act:1CA2B4A7-FC11-471B-A1DF-BF4236BDB5B2
Figs 18, 27, 40, 41, 51

Trilasma bolivari Goodnight & Goodnight, 1945b (not 1942), p. 8, in part only.

Type. Male holotype (TMM) from El Chico, Pachuco, Hidalgo, México, collected 1 January 1976, no collector named.

Diagnosis. This species is closest to *T. bolivari* sp. n., but differs from it in having fewer small cells on the scute, shorter, stouter legs, and less prominent scute area tubercles. In addition the dorsal tubercles on the median hood process of *T. bolivari* sp. n. are much more numerous and are scattered over the stem of the process, with connections to the lateral tubercles; *T. hidalgo* sp. n. has fewer dorsal tubercles which are arrayed in a line and only rarely connected to the lateral tubercles.

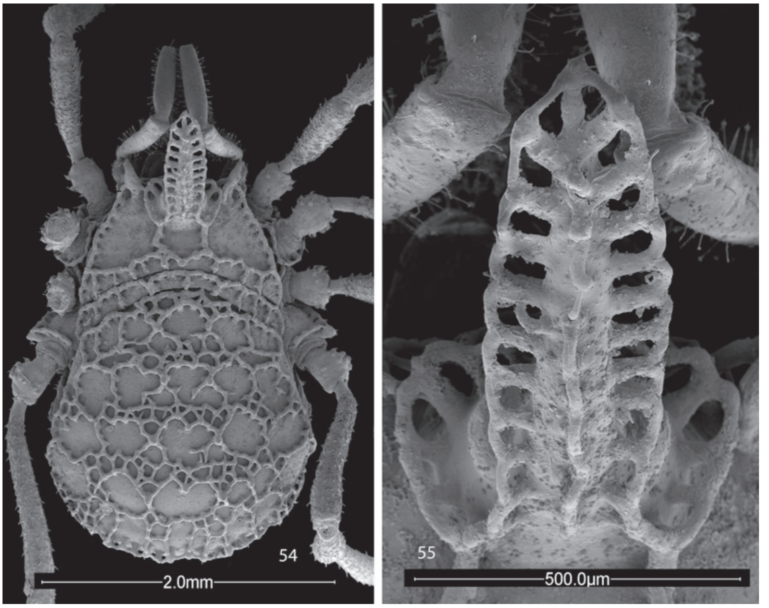
Etymology. The species epithet is a noun in apposition, referring to the Mexican state of Hidalgo.

Description. Male holotype: total length, 3.2, width, 1.3. Color dark brown, nearly black. Carapace arcuate, about 1.5× as wide as long, with complete lateral and posterior submarginal keels; pair of median keels connecting eye tubercle and inner-

Table 10. Appendage article measurements of *T. hidalgo* sp. n. male.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.80	0.56	0.44	---	0.37
Leg 1	1.10	0.60	0.80	0.70	0.78
Leg 2	2.00	0.70	1.70	1.60	1.44
Leg 3	1.10	0.56	0.90	0.65	0.80
Leg 4	1.60	0.60	1.60	0.90	1.00

most lateral hood process, lateral keels arising both on innermost and middle lateral hood processes. Two blunt lateral hood processes each about one-third as long as median hood process. Circumocular keels strongly developed, subocular portion especially prominent. Median hood process arising dorsally on eye tubercle, widest point past midline of length, length 1.0, width 0.4; median keels of carapace continuing as rows of lateral tubercles on median hood process, about 30 lateral tubercles, linearly connected; about 15 dorsal tubercles present, connected in a single row to one another but not to lateral tubercles. Metapeltidium free, complete keel along anterior margin, 8 tubercles posterior to keel, connected to it by single branch each. Scute 1.3 long, 1.3 wide. All keels well elevated above dorsum. Small keel cells present on areas 2–5; area 2 with 5 or 6 small cells in single transverse row; area 3 with 10 to 12 small cells in single transverse row, but row is slightly wider than row on area 2; area 4 with two paramedian groups of 2 or 3 small cells each; area 5 similar, but only 1 or 2 small cells.



Figures 54, 55. Scanning electron micrographs of female *Trilasma tropicum* sp. n. **54** body, dorsal view **55** eye tubercle, dorsal view.

Paired median scute spines prominent, significantly larger than adjacent keel tubercles on areas 2–5 (Fig. 51).

Chelicerae (Fig. 18) with basal article 0.82 long, 0.28 wide, sparsely setose; second article 0.65 long, 0.22 wide. Palpus (Fig. 27) stout, tibia, patella crassate, with dense vestiture of clavate setae; trochanter with two prominent seta-bearing ventral tubercles; dimensions given in Table 10. Legs in order of length, 2 (7.44), 4 (5.70), 3 (4.01), 1 (3.98); no false articulations; tarsi 1–4 with 4, 5, 5, 6 articles respectively. Lengths of leg segments given in Table 10. Length/width ratios of femora, in order: 4.58, 12.50. 4.58, 8.0. Leg femora with typical ornamentation.

Genital operculum broadly rounded, not separated from sternite by suture. Penis typical of genus (Figs 40, 41).

Notes. "El Chico" doubtless refers to what is now Parque Nacional El Chico, located north of the city of Pachuca. The Parque is extensive but approximate coordinates are 20°12'26'N, 98°43'52'W; elevations within the park range from 2300–3090 m (7540–10131') asl. The mountains are covered with a dense pine forest, with fir at the higher elevations. Goodnight and Goodnight (1945b) reported *T. bolivari* from three separate collections at this place; those specimens (AMNH, not re-examined for this study) are undoubtedly *hidalgo.*

Trilasma tropicum **sp. n.**

urn:lsid:zoobank.org:act:58A227AB-0922-4C73-A739-510A54F7732F
Figs 19, 28, 29, 38, 39, 49, 54, 55

Types. Male holotype and female paratype from "Las Ventas, Honduras," collected 11 February 1939 by R. V. Chamberlin (AMNH).

Diagnosis. The short, relatively crassate legs and the extremely prominent subocular keels (Fig. 55) separate this species from others. *Trilasma ranchonuevo* sp. n. (Tamaulipas, México) has false articulations in femora 2 and 4 that are absent in *T. tropicum* sp. n.. The male has an acute dorsal knob on the basal article of the chelicerae, as well as the tooth on the second article.

Etymology. The species epithet refers to the occurrence of the species in the Neotropics.

Description. Male holotype: total length, 2.5, width, 1.4. Color uniform light chestnut brown, metatarsi and tarsi of legs 3, 4 whitish yellow. Nonsexual characters as in female (see Figs 54, 55, and description, below), but dorsal ornament reduced, partially obscured in holotype by secretion; median hood process 0.80 long, 0.3 wide. Scute 1.4 long, 1.4 wide.

Chelicera (Fig. 19) without gland on basal article but with dorsal, conical protuberance, second article with forward-projecting tooth, basal article 0.50 long, 0.21 wide; distal article 0.55 long, 0.19 wide. Palpal patellae and tibiae swollen, epigamic glands probably present but not marked by patches of fine setae (Fig. 29), dimensions of palpus given in Table 11. Legs in order of length, 2 (6.44), 4 (5.34), 3 (3.76) , 1

Table 11. Appendage article measurements of *T. tropicum* sp. n. male.

	Femur	Patella	Tibia	Metatarsus	Tarsus
Palpus	0.72	0.60	0.46	---	0.30
Leg 1	0.90	0.46	0.64	0.90	0.90
Leg 2	1.50	0.56	1.08	2.00	1.30
Leg 3	0.84	0.50	0.66	0.80	0.96
Leg 4	1.40	0.56	1.28	1.00	1.10

(3.80); legs lacking false articulations; tarsi 1–4 with 5, 5, 6, 7 articles respectively. Lengths of leg segments given in Table 11. Length/width ratios of femora, in order: 4.5, 10.7, 4.2, 7.8.

Genital operculum broadly rounded, marginate, with two small, lateral notches. Penis typical (Figs 38, 39).

Female paratype: The female paratype (Figs 54, 55) is mounted on a SEM stub, therefore it was not possible to get accurate measurements of the appendages. Total length, 2.9, width, 1.8. Carapace arcuate, about twice as wide as long, with complete lateral and posterior submarginal keels; pair of median keels connect eye tubercle and innermost lateral hood process, lateral keels also arising on innermost lateral hood process. Two blunt lateral hood processes each about one-fourth as long as median hood process. Circumocular keels prominent, subocular portion strongly developed, eyes of usual size. Median hood process arising rostrally on eye tubercle, relatively narrow, length 0.8, width 0.3, ten fenestrations on each side, sides nearly parallel; median keels of carapace continue as rows of reduced lateral tubercles on median hood process, about 20–22 lateral tubercles, linearly connected; about 8 dorsal tubercles present, connected to each other but not to lateral tubercles. Metapeltidium free, complete keel along anterior margin, 10 tubercles posterior to keel, connected to it by single branch each. Scute 1.7 long, 1.7 wide. All keels relatively low. Small keel cells of scute area 1 present, small keel cell rows progressively wider posteriorly, widest on area 4; small cells of area 5 few, in two small groups near midline. Paired median scute spines moderately developed, on areas 4 distinctly larger than adjacent keel tubercles.

Chelicerae as described for male, but lacking dorsal protuberance on basal article, tooth on second article. Palpus (Fig. 28) as in male but patellae and tibiae not swollen. Legs in order of length, 2, 4, 3, 1; leg articles without false articulations. Leg femora with typical ornamentation.

Genital operculum broadly rounded, marginate, with suture.

Notes. I mounted the only female on an SEM stub under the impression there was a second female in the collection, but the second specimen turned out to be a male. Thus measurements of the appendages of the female became impossible, but there is no reason not to suspect that the typical sexual dimorphism in appendage lengths is characteristic of this species.

Las Ventas is not listed for Honduras by the U. S. Board on Geographical Names (http://geonames.nga.mil/ggmagaz), nor could it be found by Google Earth. There are four places named Las Ventanas and one called Las Ventanillas, scattered in four different departments of Honduras. There is a village of Las Ventas in El Salvador (13°35'58.55'N, 88°21'00'W; 365 m (1050’) asl) but it is in the central part of the country, not close to the border with Honduras. Otherwise the name evidently is not used for a populated place in Central America. The type locality is therefore in doubt, but because the collection was made 70 years ago, it is possible “Las Ventas” was in existence then in Honduras, having since disappeared from geographic databases, or the label is a *lapsus* for one of the Las Ventanas. In any case, if this species is really from Honduras, it occurs farther south than any New World dyspnoan, at approximately the same latitude as *Cladolasma angka* in Thailand.

Acknowledgements

I am grateful to Jean Krejca, Stewart Peck, James Reddell, Lorenzo Prendini and Darrell Ubick for loans of material, and to Fred Coyle for specimens of *Trilasma bolivari* sp. n. from México. Marshal Hedin provided the photograph in Fig. 1, and additional specimens of *Ortholasma colossus* sp. n. I especially thank Peter Sprouse for detailed information on cave localities in México. Detailed comments from Peter Schwendinger, Jürgen Gruber, Adriano Kury and an anonymous referee materially improved the manuscript. Asa Kreevich assisted with laboratory preparations. Work on this project was financially supported by grants from the Professional Development Committee of Hampden-Sydney College.

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ZooKeys 52: 47–56 (2010)
doi: 10.3897/zookeys.52.362
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The genus *Keilbachia* Mohrig from Mainland China, with descriptions of two new species (Diptera, Sciaridae)

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Academic editor: *Chris Thompson* | Received 3 December 2009 | Accepted 2 July 2010 | Published 30 July 2010

urn:lsid:zoobank.org:pub:E1C5E2DD-2EDF-4DA7-83DA-519B37D2E1F1

Citation: Zhang S-J, Huang J, Wu H, Wang Y-P (2010) The genus *Keilbachia* Mohrig from Mainland China, with descriptions of two new species (Diptera, Sciaridae). ZooKeys 52: 47–56. doi: 10.3897/zookeys.52.362

Abstract

Seven species of *Keilbachia* Mohrig are recognized, and among them, two new species, *K. subacumina* Wu & Zhang, **sp. n.** and *K. fengyangensis* Wu & Zhang, **sp. n.** are described and illustrated. Five species, *K. orthonema*, *K. flagrispina*, *K. demssia*, *K. oligonema* and *K. acumina* are reported for the first time from China. A key to the 15 Chinese species of this genus is also provided.

Keywords

Diptera, Sciaridae, *Keilbachia*, new species, Mainland China, Oriental Region

Introduction

The genus *Keilbachia* was firstly proposed for *K. nepalensis* Mohrig from Nepal (Mohrig and Martens 1987: 483). Subsequently, additional species are described from the Oriental, Palaearctic, Neotropical, and Australian Regions. Menzel and Martens (1995) described two species from Nepal-Himalaya. Mohrig et al. (1999) described four species from Nepal. Menzel and Mohrig (2000) transferred two Palaearctic species to *Keilbachia*. Mohrig (2004) described one new species from Papua New Guinea. Mohrig et al. (2004) described one new species from Dominica. Vilkamaa et al. (2006) described eight new species from Myanmar. Hippa and Vilkamaa (2007a, b) described 15 species from Oriental regions and reassigned one Nearctic species to the genus. Rudzinski (2008) described five new species from Taiwan. Vilkamaa et al. (2009) reviewed the genus, adding 11 new species from Oriental Region and one more species by combination. Therefore, 52 species of the genus have been recorded until now, mostly from the Oriental Region, including eight species that occur in Taiwan.

In this study, seven species of *Keilbachia* are recognized from Mainland China. Among them, two new species, *fengyangensis* and *subacumina* are described and illustrated. Five species, *flagrispina*, *demssia*, *orthonema*, *oligonema* and *acumina* are reported for the first time from China. An additional 8 species of *Keilbachia* are known from Taiwan China: *adjuncta* Vilkamaa, Menzel & Hippa (2009: 5); *ferrata* (Hippa & Vilkamaa 1994: 50, *Camptochaeta*); *grandiosa* Rudzinski (2008: 347); *praedicata* Rudzinski (2008: 348); *profana* Rudzinski (2008: 349); *sasakwawai* (Mohrig & Menzel 1992: 21, *Corynoptera*); *subferrata* Rudzinski (2008: 346) and *ulcerate* Rudzinski (2008: 349).

Materials and methods

All specimens were collected by sweeping in the field and preserved in 75% ethanol. They were mounted on glass slides in xylol-based Canada balsam after clearing in creosote. The heads of specimens from Yunnan province were bleached in 10% NaOH for about 24 hours at room temperature. The specimens were observed and measured under a Nikon SMZ1500 stereoscopic microscope. The illustrations were prepared under a Nikon Eclipse 50i optical microscope, with an attached drawing tube. The terminology follows Hippa and Vilkamaa (2007b). The length of 4th flagellomere is taken from the apex of the neck to the base of the body. The wing length is the straight distance from the humeral angle to the apical angle. The body length is the straight distance between apex of head and apex of hypopygium. The type specimens designated in the present study are deposited in the collection of the Laboratory of Forest Protection, Zhejiang A & F University, Hangzhou, Zhejiang province, China [ZAFU].

Results and discussion

Key to Chinese Species of Keilbachia (Based on Males)

1.	Gonostylus with subapical megasetae	**3**
–	Gonostylus with no subapical megasetae	**2**
2.	Gonostylus with one mesial megaseta	***praedicata***

–	Gonostylus with two mesial megasetae	***oligonema***
3.	Gonostylus with one or two subapical megasetae	**5**
–	Gonostylus with three or more subapical megasetae	**4**
4.	Gonostylus with one mesial megaseta on middle and another one at the base of gonostylus	***profana***
–	Gonostylus with only one mesial megaseta at the base of gonostylus	***ulcerate***
5.	Gonostylus with two subapical megasetae	***adjuncta***
–	Gonostylus with two subapical megasetae	**6**
6.	Mesial megaseta of gonostylus short, shorter than maximal width of gonostylus	***orthonema***
–	Mesial megaseta of gonostylus long, at least as long as maximal width of gonostylus	**7**
7.	Subapical megasetae of gonostylus close to each other, both at apical fourth of gonostylus	**11**
–	Subapical megasetae of gonostylus widely apart, basal most one at apical third or apical half of gonostylus	**8**
8.	Tegmen modified, slightly broader subbasally than subapically	***sasakawai***
–	Tegmen simple, much broader subbasally than subapically	**9**
9.	Basal body of mesial megaseta of gonostylus long and slender	***subferrata***
–	Basal body of mesial megaseta of gonostylus short and stout	**10**
10.	Basalmost subapical megasetae at apical half of gonostylus (Fig. 5)	***subacumina***
–	Basalmost subapical megasetae at apical third of gonostylus (Fig. 6)	***acumina***
11.	Subapical megasetae of gonostylus subequal in size	**13**
–	Subapical megasetae of gonostylus not equal in size	**12**
12.	Apicalmost subapical megaseta of gonostylus slender	***ferrata***
–	Apicalmost subapical megaseta of gonostylus stout	***grandiosa***
13.	Apex of gonostylus rounded and broad	***flagrispina***
–	Apex of gonostylus pointed and	**14**
14.	Mesial megaseta of gonostylus long and strongly curved (Fig. 10)	***fengyangensis***
–	Mesial megaseta short and slightly curved	***demissa***

Keilbachia flagrispina

Keilbachia flagrispina Mohrig, in Mohrig, Röschmann & Rulik 1999: 198.

Diagnostic characters (Male). Body length 1.64–1.71mm; wing length 1.36–1.41mm.
Eye bridge 3–4 facets wide. Length/width of 4th flagellomere 2.19–2.32.
Anterior pronotum with 5–6 setae. Episternum 1 with 3–4 setae.
c/w 0.69–0.72, R_1/R 0.71–0.76, r-m with one seta.

The mesial megaseta on gonostylus very long and curved, nearly three times as long as the width of gonostylus. The basal body of mesial megaseta is not distinct. Tegmen simple, much broader subbasally than subapically.

Specimens examined. China, Yunnan, Baoshan, Mts. Gaoligongshan, 24°49.729'N, 98°46.074'E, sweep-net 11.V.2009. 4 males, Man-Man Wang [SM00878–00880, SM00882] (ZAFU); 3 males, Su-Jiong, Zhang [SM00886, SM00902–00903] (ZAFU).

Distribution. China (Yunnan), Myammar, Nepal.

Biology. Unknown.

Remarks. This species is new to China, which was firstly described from Nepal, based on two males. It is similar to *K. ferrata* (Hippa & Vilkamaa, 1994) in having two subapical megaseta and a long mesial megaseta, but *K. flagrispina* can be separated by the mesial megaseta very long and strongly curved, and two subapical megaseta subequal in length on gonostylus. The materials examined from China do not show distinct variation, but we found the Chinese specimens are much smaller in body length, which is 1.64–1.71 mm, while 2.5 mm in Nepal materials.

Keilbachia demissa Vilkamaa, Komarova & Hippa

Keilbachia demissa Vilkamaa, Komarova & Hippa, 2006: 45.

Diagnostic characters (Male). Body length 1.73–1.78 mm; wing length 1.47–1.49 mm.

Eye bridge 3–4 facets wide. Prefrons with 10–12 setae. Length/width of 4th flagellomere 2.17–2.41.

Anterior pronotum with 5–6 setae. Episternum 1 with 7–8 setae.

Length of spur/width of fore tibia 1.20–1.27. Length of metatibia /length of thorax 1.05–1.12.

c/w 0.62–0.64, R_1/R 0.52–0.56, r-m with no setae.

The mesial megaseta on gonostylus long and slightly curved, basal body long. Tegmen simple, much broader subbasally than subapically.

Specimens examined. China, Yunnan, Baoshan, Mts. Gaoligongshan, 24°49.729'N, 98°46.074'E, sweep-net, 11.V.2009. 6 males, Su-Jiong Zhang [SM00856, SM00859, SM00862, SM00869, SM00875, SM00881] (ZAFU); 1 male, Man-Man Wang [SM00888] (ZAFU).

Distribution. China (Yunnan), Burma.

Biology. Unknown.

Remarks. This species is new to China, which was firstly described from Burma based on seven males. It is similar to *K. scutica* Vilkamaa, Komarova & Hippa, 2006 and *K. flagrispina* by the tegmen broadest subbasally (Mohrig et al. 1999; Vilkamaa, Komarova and Hippa 2006). But it differs in having the mesial megaseta of the gonostylus much shorter and less strongly curved. The materials examined in China do not show distinct intraspecies variation, but the apical of gonostylus in the specimens SM00881 and SM00856 is more attenuated and curved than the other specimens.

Keilbachia orthonema Hippa & Vilkamaa

Keilbachia orthonema Hippa & Vilkamaa, 2007b: 66.

Diagnostic characters (Male). Body length 1.76–1.82 mm; wing length 1.35–1.37 mm.

Eye bridge 3–4 facets wide. Prefrons with 9–11 setae. Length/width of 4th flagellomere 2.47–2.53.

Anterior pronotum with 4–5 setae. Episternum 1 with 5–6 setae.

Length of spur/width of protibia 1.76–1.81.

c/w 0.79–0.82, R_1/R 0.71–0.73, r-m with 0–1 seta.

The mesial megaseta on gonostylus short and straight, slightly longer than its basal body. Two slender megasetae at apical forth of gonostylus. Tegmen slightly broader subbasally than subapically.

Specimens examined. China, Yunnan, Yingjiang, Tongbiguan, 24°36.004'N, 97°39.139'E, sweep-net, 20.V.2009. 6 males, Su-Jiong Zhang [SM00657–00658, SM00663–00664, SM00670, SM00680] (ZAFU); 3 males, Man-Man Wang [SM00653, SM00666–00667] (ZAFU).

Distribution. China (Yunnan), Malaysia.

Biology. Unknown.

Remarks. This species is new to China, which was firstly described from Sabah, Malaysia, based on two male specimens. It is similar to *K. apprima* Vilkamaa, Komarova & Hippa, 2006 from Vietnam by sharing a short mesial megaseta (Hippa & Vilkamaa 2007b), but *K. orthonema* can be distinguished by mesial megaseta longer and much less curved, and apical forth of gonostulus with two slender megasetae. The Chinese material examined does not show distinct intraspecies variation, but the two megasetae at the apical forth of the gonostylus are stronger than in Malaysia materials, judging from the figures prepared by Hippa and Vilkamaa (2007b). What's more, length/width of 4th flagellomere is 2.47–2.53, smaller than in Malaysia materials, which is about 3 times as long as wide.

Keilbachia acumina Vilkamaa, Menzel & Hippa

Keilbachia acumina Vilkamaa, Menzel & Hippa, 2009: 4.

Diagnostic characters (Male). Body length 1.51–1.57 mm; wing length 1.25–1.28 mm.

Eye bridge three facets wide. Prefrons with 3–5 setae. Length/width of 4th flagellomere 2.35–2.71.

Anterior pronotum with 3–4 setae. Episternum 1 with 4–5 setae.

Length of spur/width of protibia 1.55–1.57.

c/w 0.64–0.65, R_1/R 0.72–0.75, r-m with no setae.

Gonostylus with two megasetae widely apart, one at subapical and stout, the other at apical third and slender (Fig. 6). Basal third of gonostylus excavated, with a long and strongly curved subbasal mesial megaseta on broad basal body. Tegmen simple, much broader subbasally than subapically, with sparsely placed teeth.

Specimens examined. 1 male, China, Zhejiang, Linan, Mt. Xijingshan, 30°23'N, 119°72'E, sweep-net, 21.VI.2008, Su-Jiong Zhang [SM00018] (ZAFU); 1 male, China, Zhejiang, Lishui, Mt. Jiulongshan, 28°59'N, 119°25'E, sweep-net, 10.X.2008, Su-Jiong Zhang [SM00114] (ZAFU); 1 male, Yunnan, Tengchong, Shaba, Mt. Tiantaishan, 25°24.524'N, 98°42.735'E, sweep-net, 13.V.2009, Su-Jiong Zhang [SM00933] (ZAFU).

Distribution. China (Zhejiang, Yunnan), Japan.

Biology. Unknown.

Remarks. The species is similar to *K. subferrata* Rudzinski and *K. ferrata* (Hippa & Vilkamaa) by having a rather long subbasal mesial megaseta on a large basal body, But it can be distinguished from *K. subferrata* by the smaller mesial megaseta in a more apical position (Vilkamaa et al. 2009), and differs from *K. ferrata* by having the basal body slightly smaller, and the socket of the apical megaseta more distinct (Vilkamaa et al. 2009). Vilkamma et al. (2009) mentioned *K. acumina* shows intraspecies variation in the structure of the gonostylus and the length of the flagellomeres. The variations are also examined in the Chinese materials, that the position of basalmost subapical megasetae varies in the apical third of gonostylus and the length of the 4th flagellomere among 67.63–87.58 um.

Keilbachia subacumina **Wu & Zhang, sp. n.**

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Figs 1–5

Description (Male). Body length 1.81–2.32 mm; wing length 1.49–1.52 mm.

Color. Head, thorax and abdomen brown; antenna, palpus, coxae, and hypopygium yellowish-brown; leg yellow; wing fumose.

Head (Figs 1, 2). Eye bridge 3–4 facets wide. Prefrons with 5–6 setae, clypeus with 0–1 seta. Palpus three-segmented. Basal segment with one seta, with a narrow sensory pit, 2nd segment with 4–6 setae, 3rd segment with 6–7 setae. Length/width of 4th flagellomere 2.74–2.79.

Thorax. Anterior pronotum with 5–6 setae. Episternum 1 with 6–7 setae.

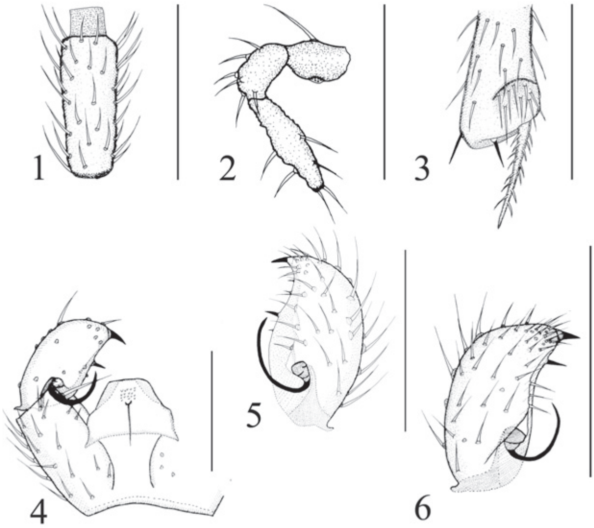
Legs. Apex of protibia (Fig. 3). Length of spur/width of protibia 1.79–1.83. Length of profemur/length of protibia 0.76–0.79. Length of metatibia /length of thorax 1.23–1.31.

Wings. Width/length 0.44–0.49.

c/w 0.71–0.77, R_1/R 0.96–0.98. r-m with 1–2 setae.

Abdomen. Sternite 8 with 10–11 setae. Gonostylus and gonocoxa subequal in length. Gonostylus with two megasetae widely apart, one at apex and stout, the other at apical half of gonostylus and slender. Basal third of gonostylus excavated, with a long and strongly curved mesial megaseta on broad basal body. Tegmen simple, much broader subbasally than subapically, with sparsely placed teeth. (Figs 4, 5).

Specimens examined. Holotype, male. China, Zhejiang, Linan, Mt. Xijingshan, 30°23'N, 119°72'E, sweep-net, 21.VI.2008, Su-Jiong Zhang [SM00025] (ZAFU).



Figures 1–6. 1–5, *Keilbachia subacumina*, male. **1** 4th flagellomere, lateral view **2** palpus, lateral view **3** apex of protibia, prolateral view **4** part of hypopygium, ventral view **5** gonostylus, ventral view. **6** *Keilbachia acumina*, male, gonostylus, ventral view. Scale bar = 0.1 mm.

Paratypes. 2 males, same data as holotype [SM00018, SM00024] (ZAFU); 5 males, same data as holotype but 19.VII.2008 [SM00057–00061] (ZAFU). China, Zhejiang, Lishui, Mt. Fengyangshan, 28°04'N, 119°08'E. sweep-net, 3 males, 11.VIII.2008, Sheng-Long Liu [SM00282] (ZAFU); 1 male, 24.VIII.2008, Sheng-Long Liu [SM00231–00233] (ZAFU); 1 male, 01.VIII.2008, Xiao-Ling Niu [SM00306] (ZAFU). 1 male, China, Zhejiang, Lishui, Mt. Jiulongshan, 28°59'N, 119°25'E, sweep-net, 10.X.2008, Su-Jiong Zhang, [SM00114] (ZAFU).

Biology. Unknown.

Remarks. This species is very similar to *K. acumina* in the structure of the hypopygium (Fig. 5, 6), but *K. subacumina* can be distinguished by having the apex of gonostylus broader, and the stouter and shorter basalmost megaseta at the apical half of the gonostylus. What's more, the anterior pronotum bears 5–6 setae in *K. subacumina* while 3–4 setae in *K. acumina*, and the r-m nervation of the wing with 1–2 setae in *K. subacumina* while bare in *K. acumina*. The structure of the hypopygium in the new species does not show distinct intraspecies variation. The species is named after its similarity to *K. acumina*. This epithet is an adjective.

Keilbachia fengyangensis Wu & Zhang, sp. n.

urn:lsid:zoobank.org:act:3BA818B3-5B93-495A-9117-BC26DDE09CF8
Figs 7–11

Description (Male). Body length 2.31–2.48 mm; wing length 1.92–1.94 mm.

Color. Head, thorax and abdomen brown; antenna, palpus, coxae, legs and hypopygium yellowish-brown; wing fumose.

Head (Fig. 7, 8). Eye bridge 3–4 facets wide. Prefrons with 7–8 setae, clypeus with no setae. Palpus three-segmented. Basal segment with one seta, with wide sensory pit, 2nd segment with 4–6 setae, 3rd segment with 7–8 setae. Length/width of 4th flagellomere 2.91–2.94.

Thorax. Anterior pronotum with 4 setae, episternum 1 with 5–6 setae.

Legs. Apex of protibia (Fig. 9). Length of spur/width of protibia 1.45–1.49. Length of profemur/length of protibia 0.65–0.68. Length of metatibia/length of thorax 1.03–1.11.

Wings. Width/length 0.45–0.47.

c/w 0.62–0.69; R_1/R 0.83–0.91. r-m with one seta.

Abdomen. Sternite 8 with nine setae. Gonostylus longer than gonocoxa, slightly curved, with two slender apical and subapical megaseta. The basal third of gonostylus with a long and curved mesial megaseta on a narrow and short basal body. Tegmen higher than broad, with sparse placed teeth (Fig. 10, 11).

Specimens examined. Holotype, male. China, Zhejiang, Lishui, Mt. Fengyangshan, 28°04'N, 119°08'E, sweep-net, 26.IV.2008, Sheng-Long Liu [SM00342] (ZAFU). Paratypes. 2 males, same data as holotype [SM00335, SM00338] (ZAFU); 1 male, same data as holotype but 19.IV.2008 [SM00346] (ZAFU).

Biology. Unknown.

Remarks. This species is found only from Mt. Fengyangshan, Zhejiang. It is similar to *K. demissa* and *K. flagrispina* by having a long mesial megaseta, but it can be distinguished from *K. demissa* by having the megaseta of the gonostylus longer and more curved, and the tegmen with no distinct basolateral. The new species can be distinguished from *K. flagrispina* by the apex of gonostylus distinct attenuated, and the mesial megaseta shorter and not strongly curved. The species is named after its type locality (Mt. Fengyangshan).

Keilbachia oligonema Hippa & Vilkamaa

Keilbachia oligonema Hippa & Vilkamaa, 2007a: 45.

Diagnostic characters (Male). Body length 1.71 mm; wing length 1.66 mm.

Eye bridge four facets wide. Prefrons with nine setae. Length/width of 4th flagellomere 3.30.

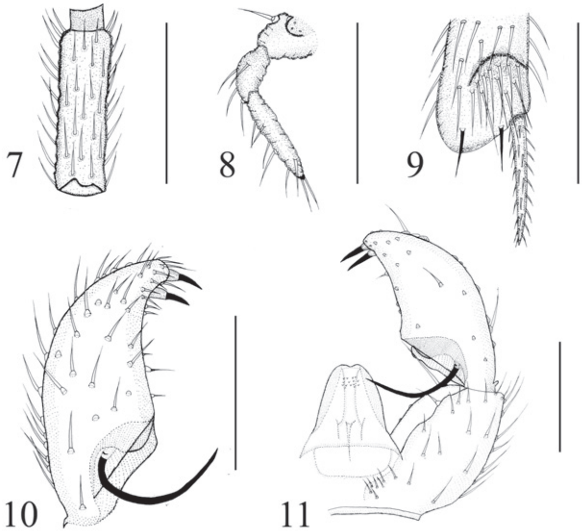
Anterior pronotum with five setae, episternum 1 with three setae.

Apex of protibia. Length of spur/width of protibia 1.48.

Width/length 0.40,

c/w 0.73, R_1/R 0.87. r-m with no setae.

Gonocoxa ventrally with a slight indication of an intercoxal lobe. Gonostylus nearly as long as gonocoxa, with no apical and subapical megaseta. The basal third of gonostylus excavated, with two long and curved mesial megaseta on a broad basal body. Tegmen simple, much broader subbasally than subapically.



Figsures 7–11. *Keilbachia fengyangensis*, male. **7** 4th flagellomere, lateral view **8** palpus, lateral view **9** apex of protibia, prolateral view **10** gonostylus, ventral view **11** part of hypopygium, ventral view. Scale bar = 0.1 mm.

Specimens examined. 1 male. China, Yunnan, Tengchong, Dahaoping, 98°45'N, 24°55'E, sweep-net, 22.V.2009, Man-Man Wang, [SM00757] (ZAFU).

Distribution. China (Yunnan), Burma.

Biology. Unknown.

Remarks. The gonostylus of *K. oligonema* Hippa & Vilkamaa, 2007 with two long and curved mesial megaseta, and without apical and subapical megaseta. It is different from all the other species in the group of *flagria*, which has more than one mesial megaseta on the gonostylus. *K. oligonema* is unique in having different characters in width of the eye bridge, setosity of sternite 8, and the ventral intercoxal area of the hypopygium between the holotype and two additional specimens, from which the authors suspected they may represent two different species (Hippa & Vilkamaa 2007a). The same as the holotype of *K. oligonema*, the Chinese material has gonocoxa ventrally with a slight indication of an intercoxal lobe, but its four facets wide eye bridge, and six setose sternite 8 are similar to the additional materials.

Acknowledgements

We wish to express our sincere thanks to Dr. Heikki Hippa (Swedish Museum of Natural History, Stockholm), Dr. Pekka Vilkamaa (Finnish Museum of Natural History, Helsinki), Dr. Frank Menzel (Senckenberg Deutsches Entomologisches Institut, Müncheberg) and Dr. Werner Mohrig (Poseritz, Germany) for their kind cooperation and generous help. Special thanks are given to Dr. Hippa for his advice to improve the text. We also thank the collectors of the materials examined, Manman Wang from Zhejiang University and Shenglong Liu from Fengyangshan National Nature Reserve. This study was supported by NSFC grant 30870334.

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ZooKeys 52: 57–64 (2010)
doi: 10.3897/zookeys.52.476
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Academic editor: *Donald Lafontaine* | Received 17 May 2010 | Accepted 29 June 2010 | Published 30 July 2010

urn:lsid:zoobank.org:pub:D4EFD581-5944-43B1-AA3E-FA50BA6ADF6E

Citation: Pogue MG (2010) A new species of *Schinia* Hübner from the southeastern United States (Lepidoptera, Noctuidae, Heliothinae). ZooKeys 52: 57–64. doi: 10.3897/zookeys.52.476

Abstract

Schinia psamathea **sp. n.** is described from the southern coastal plain in Georgia and the East Gulf coastal plain in Florida and Alabama in habitats associated with sandy soil or dunes. Adult males and females and their genitalia are described and illustrated. *Schinia psamathea* is compared to *Schinia saturata* (Grote).

Keywords

Southern coastal plain, East Gulf coastal plain, sand dunes, taxonomy

Introduction

Since Hardwick (1996) revised the North American Heliothinae there have been several new species described in the genus *Schinia* Hübner (Knudson, Bordelon, and Pogue 2003; Pogue and Harp 2003; Pogue and Harp 2004; Pogue 2004; Pogue and Harp 2005). This paper describes a new species that seems to be associated with sandy areas and dunes of the southern coastal plain in Georgia and the East Gulf coastal plain in Alabama and Florida.

A revision of the Heliothinae is currently in preparation and the genus *Schinia* will be divided into numerous species groups based on morphology. This new species is in the *gracilenta* species group and will be included in a key to this group within the revision of *Schinia* in the Moths of North America fascicle on the Heliothinae.

The distribution of *Schinia psamathea* sp. n. includes coastal dune areas within the Bon Secour National Wildlife Refuge in southeastern Alabama and St. Joseph Peninsula State Park in Gulf Co., Florida. These areas are in potential danger of the British Petroleum oil spill in the Gulf of Mexico. *Schinia psamathea* sp. n. is being described in order to track any changes in its population dynamics along the Gulf Coast that may be due to this oil spill.

The solid brown color of the forewing, the absence of or faint antemedial and postmedial lines and the solid, slightly darker brown hind wing will separate *S. psamathea* sp. n. from *S. saturata* (Grote) in the southeastern United States.

Methods

Genitalia dissections follow the method described in Pogue (2002) except specimens were mounted in Euparal and stained in Mercurochrome. Terms used in the descriptions of male genitalia follow Forbes (1954) and those for the female follow Klots (1970). Images of adult moths and genitalia were taken with a Visionary Digital Imaging System using a Nikon D1X camera with a modified K2 long-distance lens and a pulsed xenon flash. Forewing length was measured using a calibrated ocular micrometer from the juncture of the thorax to the apex, including fringe.

Specimens examined were from the private collection of Charles E. Harp, Littleton, CO (CEH), Mississippi Entomological Museum, Mississippi State University, Mississippi State University, MS (MEM), and the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM).

Systematics

***Schinia psamathea* Pogue, sp. n.**
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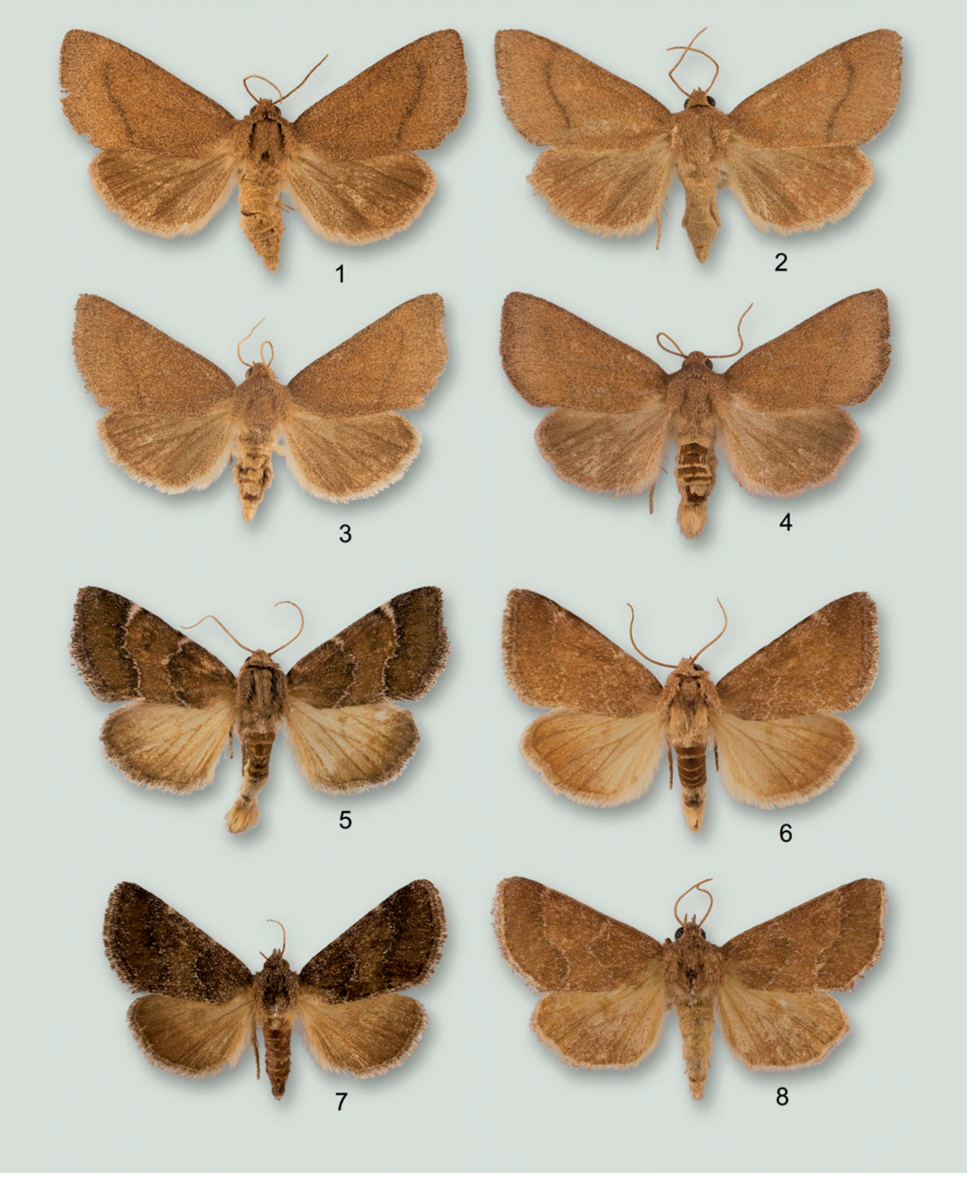
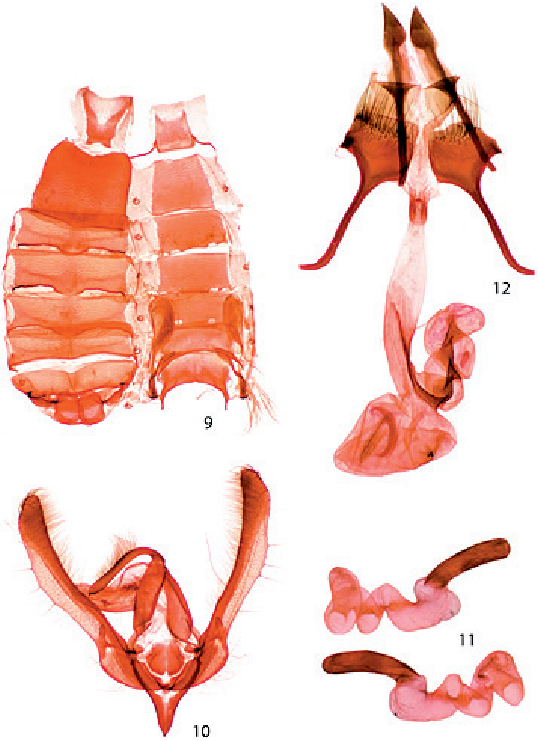
Figs 1–4, 9–12

Type material. Holotype ♂. USA, Alabama, Baldwin Co., 1 mi E Oyster Bay, T9S, R4E, Sec. 7 NW, 13 Oct. 1990, R.L. Brown, MEM 34951. Deposited in USNM. *Paratypes*: 153 ♂, 49 ♀: **USA, Alabama.** Baldwin Co., 56 ♂, same data as for holotype, ♂ genitalia slide USNM 51792; Bon Secour National Wildlife Refuge, T9S, R2E, Sec. 25 S, 5 Oct. 1996 (3 ♂), genitalia slide USNM 51384, J. Slotten, 12–16 Oct. 1991 (39 ♂, 32 ♀), R. Brown, D. Pollock, ♂ genitalia USNM 51794; Bon Se-



Figures 1–8. Adults of *Schinia* species. **1** *S. psamathea,* male holotype **2** *S. psamathea,* male paratype **3** *S. psamathea,* male paratype **4** *S. psamathea,* male paratype **5** *S. saturata*, male **6** *S. saturata*, male **7** *S. saturata*, female **8** *S. saturata*, male.

cour National Wildlife Refuge, T9S, R3E, Sec. 11NW, 13–14 Oct. 1991 (1 ♂), R. Brown, D. Pollock; Bon Secour National Wildlife Refuge, 15 Oct. 1996 (36 ♂, 9 ♀) ♂ genitalia slide USNM 51793, T.L. Schiefer, 17 Oct. 1997 (3 ♂, 1 ♀), R.L. Brown; east of Mobile St., approximately 250 yds from beach, 21 Oct. 2000 (1 ♀), H. Grisham & R. Brown. **Florida.** Gulf Co., St. Joseph Peninsula State Park, 24 Oct. 2000



Figures 9–12. Abdomen and genitalia of *Schinia psamathea*. **9** Abdomen **10** Male genital capsule **11** Two lateral views of aedeagus **12** Female genitalia.

(1 ♂), J. Slotten. Okaloosa Co., Shalimar, 29 Sep. 1964 (1), 1 Oct. 1964 (1 ♂), 1 Oct. 1965 (1 ♂), 22 Oct. 1965 (1 ♂), H.O. Hilton. Walton Co., 0.5 mile S of I-10 on Rd. 285, 3 Oct. 2004 (5 ♂, 2 ♀), ♀ genitalia slide USNM 51385, J. Slotten. **Georgia.** Emanuel Co., Ohoopee Dunes Natural Area, Tract 1, wooded area, 0.3 mi N of Co. Rd. 160 (Hall's Bridge Rd.) near Little Ohoopee River, 7 Sep. 2002 (1 ♂), J. Adams; Ohoopee Dunes N.A., 5 Oct. 2007 (2 ♂, 1 ♀), S.M. Lee, R.L. Brown. Tatinall Co., Ohoopee Dunes Area, 10 mi NE Lyons, Handy Kennedy Rd., 0.8 mi N of GA Hwy. 152, 23–25 Sep. 2009 (2 ♂, 2 ♀), J.K. Adams & I.L. Finkelstein. **Mississippi.** Jackson Co., Belle Fontaine Point, 14 Oct. 1998 (1 ♀). Paratypes deposited in CEH, CNC, MEM, and USNM.

Etymology. The specific epithet comes from the Greek noun, *psamathos,* for sand of the seashore. It is plural referring to the type of habitat that this species inhabits.

Diagnosis. Eye large and globular; foretibia with a single, large, straight spine-like seta on inner apex; forewing ground color a dull medium brown; antemedial line absent; postmedial line black, slightly sinuate; hind wing pale rufous to gray; male abdominal sternites with well-developed hair pencils and pockets.

Description. Male. *Head:* Frons and vertex with light-brown scales tipped with white; labial palp curved, mostly white with light-brown and rufous scales; antenna filiform, scaled dorsally with white and brown; eye large and globular. *Thorax:* scales narrow, light brown tipped with white; foretibia a mixture of light-brown and white scales, inner margin with one large apical spinelike seta and from 1–3 progressively smaller spinelike setae, outer margin with 2–3 spinelike setae progressively smaller proximally, tarsi with light-brown and white scales, apical rings white; middle leg with light-brown and white scales; hind leg mostly white mixed with pale-rufous scales; underside white. *Forewing* (Figs. 1–4): Length 12.6–14.2 mm. From wing base to postmedial line scales a mixture of pale rufous and pale rufous tipped with rufous, giving a medium brown appearance; distal to the postmedial line scales are mostly pale rufous tipped with rufous giving a slightly lighter appearance than basal two-thirds; antemedial and medial lines absent; postmedial line slightly sinuate, dark brown; fringe a mixture of rufous and dark-brown scales tipped with white; underside pale rufous, central area darker, costal area and posterior margin lighter. *Hind wing:* pale rufous to gray; fringe white. *Abdomen* (Fig. 9): mostly cream colored with some scales tipped with pale rufous; hair pencils and scent pockets on sternites 2 and 4 well developed. *Genitalia* (Figs. 10–11): uncus moderately elongate, approximately 0.33–0.35 × length of valve; valve narrow, width approximately 8.3 × length, costal margin slightly curved, ventral margin curved, slightly produced at about 2/3 length of valve, and with a few stout setae along margin; apex of valve rounded; cucullus consists of a single row of less than 25 setae; ampulla wide, 0.05 × length of valve; juxta ovate, dorsal margin straight, lateral margins slightly flared; saccus narrow, V shaped; aedeagus slightly curved, apex produced to a dull point dorsally, minute dorsal scobinations from apex to approximately 0.3 × length; vesica with 2 coils.

Female. As in male except forewing length 12.6–13.8 mm. *Genitalia* (Fig. 12): Papilla analis sclerotized, triangular, dorsal margin slightly concave, ventral margin greatly convex basally, apex pointed; ostium bursae consists of 2 slightly sclerotized lateral bars with a medial membranous area; ductus bursae elongate, membranous; appendix bursae with 2 coils, coiled sclerotized internal ribbon of appendix bursae extends approximately midlength into ductus bursae; corpus bursae ovate with produced apex; signa consists of 4 scobinate ribbons.

Distribution. *Schinia psamathea* is known from east-central Georgia southwestward to the Panhandle of Florida, southeastern Alabama, and southwestern Mississippi.

Discussion. *Schinia psamathea* is unique within the genus in having a simple forewing pattern that consists of only a slightly sinuate, dark-brown postmedial line and a solid-colored hind wing. *Schinia saturata* is a widespread species that occurs in Florida and somewhat resembles *S. psamathea* but is a dark-rufous moth compared to grayish-brown color of *S. psamathea.* The forewing markings will easily separate *S. psamathea* from *S. saturata* as the white antemedial line is usually present in *S. saturata* and the postmedial line is white in *S. saturata* and dark brown in *S. psamathea.* The inner margin of the foretibia has a single, large apical spinelike seta and 1–3 smaller proximal spinelike setae in *S. psamathea* and in *S. saturata* the large apical spinelike seta is more robust than in *S. psamathea* and there are 1–2 smaller proximal spinelike setae.

The outer margin of the foretibia has 2–3 spinelike setae that get progressively smaller proximally in *S. psamathea* and in *S. saturata* there are 3–4 spinelike setae.

Both male and female genitalia are useful in separating *S. psamathea* from *S. saturata.* In the male genitalia, uncus is relatively longer in *S. psamathea* (0.33–0.35 × length of valve) than in *S. saturata* (0.28 × length of valve); valve is narrow (8.3 × length of valve) in *S. psamathea* and wide (6.7 × length of valve) in *S. saturata*; valve is only slightly angled just below apex in *S. psamathea*, but is abruptly angled at 3/4 length of valve in *S. saturata*; and corona consists of a single row of less than 25 setae in *S. psamathea* and contains five rows and more than 25 setae in *S. saturata*. In the female genitalia, papillae anales is triangular shaped in both species, but apex is sharply pointed and slightly curved in *S. psamathea* and in *S. saturata* apex is more rounded and not curved; on ninth segment the minute spicules are short in *S. psamathea* and long in *S. saturata*; and on eighth segment the distal setae are elongate (extend to or beyond the distal margin of the posterior apophyses) and dense in *S. psamathea*, whereas in *S. saturata* the distal setae are short and sparse. Shared characters between *S. psamathea* and *S. saturata* include the abdominal hair pencils and associated pockets, two coils in the male vesica, two coils in the female accessory bursae, and triangular shaped papillae anales.

There is some variation in the forewing pattern of *S. psamathea.* The postmedial line varies from being quite visible to almost absent. The hind wing is usually gray, but in some individuals it can be pale rufous.

Schinia psamathea seems to prefer sandy soils either in dune type habitats or near sandy beaches. Moths are active in the mid- to late afternoon and are attracted to light. They nectar on several different flowers and the flight is similar to other day-flying *Schinia,* being very fast and darting. Adults fly between 7 September and the end of October, being most abundant in mid-October (J.K. Adams, pers. comm.).

A possible host plant for *S. psamathea* is woody goldenrod (*Chrysoma paucifloscu-losa* (Michx.) Greene, Asteraceae), which is a small sprawling, evergreen shrub with thick, almost succulent, grayish-green leaves and bright yellow flowers that bloom in late summer. Woody goldenrod occurs in sandy scrub and sandhills habitats along the Fall Line in the Carolinas and Georgia, and on the Coastal Plain in Alabama, Mississippi, and the Florida Panhandle. Along the Gulf Coast, woody goldenrod occurs in coastal scrub behind the primary dune system. Other plant associations in the sandhills include turkey oak (*Quercus laevis* Walter, Fagaceae) and longleaf pine (*Pinus palustris* Mill., Pinaceae). In scrub habitats the woody goldenrod is associated with sand live oak (*Q. geminata* Small, Fagaceae) and sand pine (*P. clausa* (Chapm. Ex Engelm.) Vasey ex Sarg., Pinaceae) (Chritsman 2008).

The known distribution of *S. psamathea* in Mississippi, Alabama, Florida, and Georgia completely overlaps the distribution of woody goldenrod. The state and county distribution of woody goldenrod from west to east is given here as a guide to further explore the distribution of *S. psamathea*: Mississippi (Harrison and Jackson Counties), Alabama (Mobile and Baldwin Counties), Florida (Escambia, Santa Rosa, Okaloosa, Walton, Washington, Bay, Calhoun, Gulf, Liberty, Franklin, and Wakulla Counties), Georgia (Wheeler, Emanuel, and Tatinall Counties), South Carolina (Lexington County), and North Carolina (Robeson County) (Wunderlin and Hansen 2008).

Acknowledgements

I thank Richard L. Brown, Mississippi Entomological Museum, Mississippi State, MS and Irving L. Finkelstein, Atlanta, GA for donating specimens used in this study. Charles E. Harp, Littleton, CO loaned specimens for this study. James K. Adams, Dalton State College, Dalton, GA gave additional distributional and observational data from Georgia. Taina Litwak, USDA, Systematic Entomology Lab, Washington, DC imaged the adults and genitalia and made the plates. For reviewing earlier versions of the manuscript I thank Charles E. Harp, Littleton, CO, J. Donald Lafontaine, Canadian National Collection of Insects, Arachnids, and Nematodes, Biodiversity Program, Ottawa, Canada, B. Christian Schmidt, Canadian Food Inspection Agency, Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Canada, and Thomas J. Henry and Stuart McKamey, U.S.D.A. Systematic Entomology Lab, Washington, DC.

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ZooKeys 52: 65–67 (2010)
doi: 10.3897/zookeys.52.541
www.pensoftonline.net/zookeys

BOOK REVIEW

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B.V. Brown, A. Borkent, J. M. Cumming, D. M. Wood, N. E. Woodley, and M. Zumbado (Eds) (2009) National Research Council of Canada, Ottawa, 714 pp.

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Received 28 June 2010 | Accepted 2 July 2010 | Published 30 July 2010

Citation: Atilano Contreras-Ramos (2010) Book review: Manual of Central American Diptera, Volume 1. B. V. Brown, A. Borkent, J. M. Cumming, D. M. Wood, N. E. Woodley, and M. Zumbado (Eds) (2009) National Research Council of Canada, Ottawa, 714 pp. ZooKeys 52: 65–67. doi: 10.3897/zookeys.52.541

As an undergraduate biology major in northern Mexico I do remember my first attempts at keying out some aquatic insects I had collected for a class project. That was in the early 80's, still some of the manuals for North America (United States and Canada) worked out fairly well. Nonetheless, soon I realized that even for Mexico, close to the United States yet with a strong Neotropical component, insect identification was a difficult and somewhat uncertain task. As a Mexican entomologist I have a general perception about well-studied faunas (e.g., western Europe, North America, Australia), but if I had to select a well-known taxon I would probably pick Diptera. And if I had to name a diverse and complex fauna, where species would be hard to identify, most likely I would say South America and the rest of the Neotropics.

However, things are changing for us in Latin America, and for good. A solid tradition of dipterology in South America is now getting organized to produce a fast-publication journal, Neotropical Diptera (Amorim and Papavero 2008). This goes side by side with the goal of having a Manual of Neotropical Diptera, a challenging job. The Neotropics hold about 25,000 described fly species (Amorim and Papavero 2008), which would be about 21% of the world Diptera fauna of 120,000 species (Grimaldi and Engel 2005), a pretty respectable figure. Meanwhile, a subsection of Neotropical fly diversity has become manageable in the form of a Manual of Central American Diptera (MCAD), an intended two-volume set, of which the second one will become available any time.

The MCAD will treat 106 families in the region, of which 42 have been included in volume 1. The area of coverage for the manual is circumscribed from Panama to Guatemala and Belize, plus tropical Mexico (the Yucatan, southeastern Mexico, through both coastal lines, the Balsas Depression south of the Volcanic Axis, and the tip of the Baja California Peninsula). Volume 1 includes seven condensed introductory chapters, corresponding to an introduction, adult morphology and terminology, natural history, economic importance, phylogeny, key to families for adults, and key to families for larvae. A total of 45 specialists authored the different chapters, of which only 6 are based in Latin America; the rest are based in Australia (1), Europe (12), United States and Canada (25). This speaks of the need to stimulate entomology in Latin America, a role this book for sure will have to a decent share.

As its ancestor, the 3 volume series Manual of Nearctic Diptera (MND; McAlpine et al. 1981, 1987, 1989), the MCAD has excellent illustrations, many taken from the MND. Chapter 2 on adult morphology is a delicacy for current and potential dipterists. It is organized in the form of seriated glossaries, following a body region arrangement. This seems to be a more straightforward fashion of presenting complex information that might be arid in regular prose. There is no chapter on larval morphology, however chapter 7 on a key to families for larvae might cover some of that need. The preceding chapter on a key to families for adults is complemented at the end with nice color photographs of habitus of each fly family.

The chapter on phylogeny is a succinct, yet quite complete synthesis of the relationships of Diptera major groups and families. It sacrifices, of course, much of the detail in volume 3 of the MND, such as the extensive character discussion. Both treatments are fairly concordant, however some differences are more or less evident in the MCAD (e.g., Nematocera is explicitly paraphyletic as Brachycera is sister to Anisopodidae; phylogeny of Brachycera is better resolved and it contains Schizophora, so it is explicitly paraphyletic).

The title of each family chapter includes the taxon Latin name followed by common names in English and Spanish. Each chapter is to be praised. They include sections on diagnosis, biology, classification, identification, a key to genus, and synopsis of the fauna. A strong effort to synthesize available information on a previously mostly untreated fauna is worth recognizing, especially for highly diverse groups. The emphasis is on adults, however most chapters include at least some illustrations of immatures, some include keys to larvae (e.g., Simuliidae), others include expansion of coverage area (e.g., Nearctic Mexico, in Simuliidae and Stratiomyidae).

Taxonomic chapters correspond to nematocerous families (23) and lower brachycerous families (19). Of the former, one is an unplaced group within Sciaroidea (the Ohakunea group), and in the latter, the Mythicomyiidae is recognized as a distinct family out of Bombyliidae. Many families are shared with the Nearctic fauna, yet several are not included in the MND (i.e., the nematocerous Ditomyiidae, Diadociidae, Keroplatidae, Lygistorrhinidae, and the brachycerous Pantophthalmidae), some are surprisingly present (e.g., Ptychopteridae). This manual will for sure increase noticeably the amount of works on Diptera species in the region, not only taxonomic, but also ecological and biological. Volume 1 is a more than welcome addition to the library of any dipterist, broad minded entomologist, or naturalist, and should be present in university libraries throughout the region. Meanwhile, volume 2 is anxiously awaited for the completion of the set. This book may be acquired through the online bookstore of the National Research Council of Canada (http://pubs.nrc-cnrc.gc.ca/eng/books/browse/list-0-0.html).

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