

## A new *Liphistius* species (Mesothelae: Liphistiidae: Liphistiinae) from Thailand, with notes on its natural history

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**Abstract.** A new species of trapdoor spider of the genus *Liphistius* Schiödte, 1849 (Mesothelae: Liphistiidae) is described from specimens collected from Mae Wong National Park, Klonglan district, Kamphaeng Phet province, Thailand. This *Liphistius* species belongs to the *bristowei* species-group based on the elevated cumulus and the distinct embolic part, and resembles *L. yamasakii* Ono, 1988. Diagnostic characters of the male and female are discussed, and a map is provided for the type localities of the 32 previously described *Liphistius* species in Thailand. This is the first record of a *Liphistius* species in the *bristowei* species-group that builds a T- or Y-shaped burrow with two trapdoor openings.

**Keywords:** Systematics, checklist, conservation, spider

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The segmented trapdoor spiders of the Family Liphistiidae are the sister group to all other extant spiders. They bear many plesiomorphic characters, including the presence of abdominal tergal plates and the position of the spinnerets on the median area of the opisthosoma (Platnick & Gertsch 1976; Haupt 2003; Xu et al. 2015). Two allopatric subfamilies are included in the family: Liphistiinae Thorell, 1869 and Heptathelinae Kishida, 1923. The Liphistiinae includes a single genus, *Liphistius* Schiödte, 1849, found in Laos, Thailand, peninsular Malaysia, Myanmar and the Indonesian island of Sumatra (World Spider Catalogue 2017). The Heptathelinae includes the remaining seven genera of liphistiids, whose members are distributed in China, Japan and Vietnam. Heptathelinae can be distinguished from Liphistiinae by the absence of a male tibial apophysis and by the female internal genitalia (Platnick & Sedgwick 1984; Haupt 2003; Xu et al. 2015), and by differences in burrow construction (see below).

The genus *Liphistius* includes more than 50 described species, and in Thailand, 32 *Liphistius* species have been recorded from 22 provinces throughout the country (Fig. 1, Table 1), demonstrating a high level of diversity and endemism (Platnick & Sedgwick 1984; Schwendinger 1987, 1990, 1995, 1996, 1998, 2009, 2013; Ono 1988a, b; Ono & Schwendinger 1990; Sedgwick & Schwendinger 1990). The group is well known for its limited dispersal ability, and most *Liphistius* species described in Thailand have been recorded only from their type localities. Currently, only seven Thai *Liphistius* species are known to occur outside of their type localities: *L. bicoloripes* Ono, 1988, *L. bristowei* Platnick & Sedgwick, 1984, *L. isan* Schwendinger, 1998, *L. lahu* Schwendinger, 1988, *L. lannaianus* Schwendinger, 1990, *L. pusohm* Schwendinger, 1996, and *L. thaleban* Schwendinger, 1990. However, the apparently limited distributions of many *Liphistius* species could also be a result of insufficient sampling, habitat alteration, and deforestation.

Schwendinger (1990) classified *Liphistius* into three species-groups: the *bristowei* species-group, the *birmanicus* species-group, and the *trang* species-group, based on characters of the

male pedipalp—particularly the cumulus and the embolic parts—and the female genitalia. Based on a review of the literature, the number of species in each species-group in Thailand is as follows: *bristowei*-group (4 species), *birmanicus*-group (1 species), *trang*-group (26 species), and one *incertae sedis* species, *L. jarujini* Ono, 1988 (Fig. 1, Table 1). *Liphistius* habitats include sloped soil banks on man-made roads or paths cut into mountains or small hills (Haupt 2003). Other *Liphistius* species dwell in caves and among boulders. Three types of *Liphistius* burrows have been documented thus far; however, burrow types do not correspond with species-group classification. These are: (1) the more or less straight undivided terrestrial tube with one trapdoor opening equipped with silk “signal lines” for prey capture; (2) the T- or Y-shaped terrestrial burrow with two trapdoors, one equipped with signal lines, the other lacking signal lines; and (3) the sac-like retreat on the surface of a cave wall or boulder, without a burrowing tube structure but with a trapdoor equipped with signal lines (Platnick & Sedgwick 1984; Schwendinger 1990). Unlike *Liphistius*, members of the Heptathelinae do not construct signal lines.

Until now, only one *Liphistius* species, *L. kanthan* Platnick, 1997, from Perak, Malaysia, has been evaluated and designated as a critically endangered species under the IUCN (2017), showing the possibility of extinction in this group of spiders due to restricted ranges, habitat destruction and human exploitation. In August 2015, the authors (VS and NW) discovered an aggregation of *Liphistius* burrows along a man-made road cutting during a spider collecting expedition to Mae Wong National Park, Thailand. Here, we describe this species for the purpose of further ecological studies and for conservation assessment.

### METHODS

Spiders were collected in Mae Wong National Park, Klonglan district, Kamphaeng Phet province, Thailand (16°05.67'N, 99°07.436'E) on a man-made road cutting (Fig.

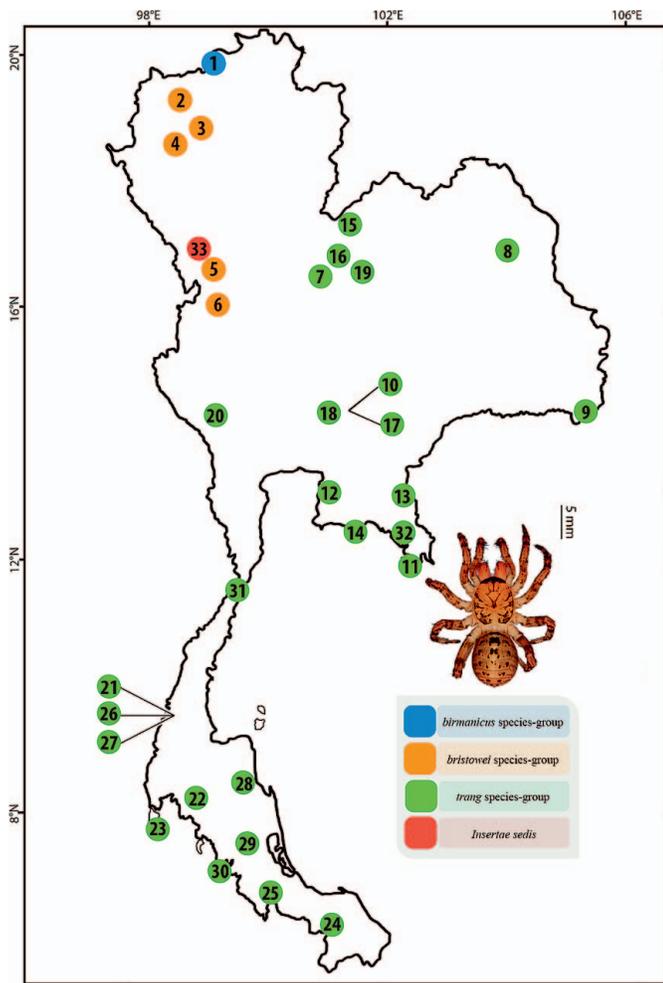


Figure 1.—Type localities of 33 described *Liphistius* species in Thailand based on descriptions from Platnick & Sedgwick (1984), Schwendinger (1987, 1990, 1995, 1996, 1998, 2009), Ono (1988a, b), Ono & Schwendinger (1990), and Sedgwick & Schwendinger (1990). See Table 1 for type locality information regarding each species. The species displayed is a female *L. erawan* Schwendinger, 1996 (dorsal view).

2). An estimated 300+ burrows were present on the banks at the time of discovery (August 2015). We excavated a subset of the burrows using forceps and collected 15 specimens (7 ♀, 8 subadults). Trapdoor width and length, and burrow depth were measured for each specimen using digital calipers (Mitutoyo). Numbers of signal lines were also recorded. One of the subadult specimens collected molted into an adult male on 30 October 2015 (this specimen is designated as the holotype). In late December 2015, we returned to the initial collecting site and discovered two additional collecting localities 1 km east and west of the original location (16°05.333'N, 99°07.88'E; 16°05.334'N, 99°07.88'E) and collected an additional 31 specimens (17 ♀, 14 subadults). Eleven egg sacs were also recovered from the female burrows. All live specimens were transported back to the Department of Biology, Chulalongkorn University, and reared until 1

November 2015 (for specimens collected in August 2015) and until 25 December 2015 (for specimens collected in December 2015) before being preserved in 95% ethanol.

Measurements are reported in millimeters and were obtained using a Zeiss Stemi DV4 stereomicroscope with ocular micrometer, or with digital calipers. Total length (with and without chelicerae length) does not include the anal tubercle. Appendage measurements were based on the left appendages. Pedipalp and leg lengths include the lengths of the femur, patella, tibia, metatarsus, and tarsus. The female genital area was removed from the specimens and cleared using 5% potassium hydroxide. Terminology of genital characters follows Schwendinger (1987, 1990, 1995, 1996, 1998, 2009) and Schwendinger & Ono (2011). The abbreviations used here are as follows: ALE, anterior lateral eye; AME, anterior median eye; CL, carapace length; CW, carapace width; EL, palpal coxal length; EW, palpal coxal width; LL, labium length; LW, labium width; OL, ocular tubercle length; OW, ocular tubercle width; PME, posterior median eye; PLE, posterior lateral eye; SL, sternum length; SW, sternum width; TL<sub>1</sub>, total length with chelicerae; TL<sub>2</sub>, total length without chelicerae.

## SYSTEMATICS

**Family Liphistiidae** Thorell, 1869

**Subfamily Liphistiinae** Thorell, 1869

**Genus *Liphistius*** Schiödte, 1849

***Liphistius maewongensis*** sp. nov.

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(Figs. 2–6)

**Type material.**—*Holotype male*. THAILAND: *Kamphaeng Phet*: Klonglan District, Mae Wong National Park, 16°05.67'N, 99°07.436'E, 1266 m, 23 December 2015, V. Sivayyapram (CUMZ-AR-ARA-Lip.2017.1).

*Paratypes*. THAILAND: *Kamphaeng Phet*: 1 ♀ allotype, same data as holotype except 6 August 2015 (CUMZ-AR-ARA-Lip.2017.2); 1 ♀, same data (CUMZ-AR-ARA-Lip.2017.3); 1 ♀, same data except 23 December 2015 (CUMZ-AR-ARA-Lip.2017.4); 1 ♀, same data (CUMZ-AR-ARA-Lip.2017.5); 1 ♀, same data (CUMZ-AR-ARA-Lip.2017.6).

**Other material examined.**—THAILAND: *Kamphaeng Phet*: 5 ♀, 7 subadult juveniles, Klonglan District, Mae Wong National Park, 16°05.67'N, 99°07.436'E, 1266 m, 6 August 2015, V. Sivayyapram (CUMZ-AR-ARA-Lip.2017.7–18); 14 ♀, 12 subadult juveniles, same data except 16°05.333'N, 99°07.88'E, 1193 m, 23 December 2015 (CUMZ-AR-ARA-Lip.2017.19–44); 2 subadult juveniles, same data except 1218 m (CUMZ-AR-ARA-Lip.2017.45–46).

**Etymology.**—The specific epithet refers to the type locality, Mae Wong National Park, an important tiger sanctuary in Southeast Asia.

**Diagnosis.**—*Liphistius maewongensis* sp. nov. is similar to *L. yamasakii* Ono, 1988, but can be distinguished from the latter by its smaller size, by the distinct shape of the embolus, which has a slender tip (Fig. 4b), by the less prominent sharp distal edge of the contrategulum (Fig. 4a), by the narrower paracymbium (Fig. 4a, b), by the less prominent cumulus

Table 1.—Synopsis of 33 described *Liphistius* species from Thailand. Type localities are provided verbatim from their original descriptions. Remarks are our interpretation and additions. *Liphistius* species-group classification is based on Schwendinger (1990). The species numbers correspond to Figure 1.

No.	Species	Type Locality	Type Locality Remarks	Original Description	Species-group
1	<i>L. lahu</i>	“Doi Angkhang (19°57'N, 99°05'E), 1500 m alt., Fang District, Chiang Mai Province, northern Thailand.”		Schwendinger (1998)	<i>birmanicus</i>
2	<i>L. lanmaianus</i>	“Thailand: Huay Nam Dang and Doi Chang”	Doi Chang is the highest peak in Huai Nam Dang National Park (1,962 m), Mae Taeng District, Chiang Mai province	Schwendinger (1990)	<i>bristowei</i>
3	<i>L. bristowei</i>	“Doi Suthep mountain, 1,100 m alt., Chiang Mai, Thailand”		Platnick & Sedgwick (1984)	<i>bristowei</i>
4	<i>L. yamasakii</i>	“Doi Inthanon, 1,700 m alt. between Maeo Khun Klang and Mae Chaem, Chiang Mai, Thailand”		Ono (1988a)	<i>bristowei</i>
5	<i>L. marginatus</i>	“Thailand: Lan Sang National Park”	Lan Sang National Park, Mueang District, Tak province	Schwendinger (1990)	<i>bristowei</i>
6	<i>L. maewongensis</i> n. sp.	Kamphaeng Phet province, Klonglan District, Mae Wong National Park (16° 05.670'N, 99° 07.436'E), elevation 1266 meter		Sivayyapram et al. (2017)	<i>bristowei</i>
7	<i>L. owadai</i>	“Thung Salaeng Luang, 550 m alt., Phitsanulok Province, Thailand”		Ono & Schwendinger (1990)	<i>trang</i>
8	<i>L. isan</i>	“Phu Phan National Park (16°43'N, 103°51'E), 520 m, Kut Bak District, Sakon Nakhon Province, northeastern Thailand.”		Schwendinger (1998)	<i>trang</i>
9	<i>L. dangrek</i>	“Phu Chong Nayoi National Park (14°18'N, 105°10'E), 300 m, Nam Yun District, Ubon Ratchathani Province, northeastern Thailand.”	Schwendinger (1996) indicated that <i>L. dangrek</i> is found only in the surrounding of Tham Bak Tew Waterfall in the NP. Currently, this waterfall has changed its name to “Huai Luang Waterfall”	Schwendinger (1996)	<i>trang</i>
10	<i>L. suwat</i>	“Heo Suwat Waterfall (14°21'N, 101°29'E), 580 m, Khao Yai National Park, Pak Chong District, Nakhon Ratchasima Province, northeastern Thailand.”		Schwendinger (1996)	<i>trang</i>
11	<i>L. nesioticus</i>	“Ko Chang National Park (12°01'N, 102°19'E), 50 m, Laem Ngop District, Trat Province, southeastern Thailand.”	Koh Chang district was separated from Laem Ngop district in 2007 and is the type locality of <i>L. nesioticus</i>	Schwendinger (1996)	<i>trang</i>
12	<i>L. sayam</i>	“Khao Khieo Wildlife Sanctuary (13°10'N, 100°58'E), 110 m, Si Racha District, Chon Buri Province, central Thailand”		Schwendinger (1998)	<i>trang</i>
13	<i>L. ornatus</i>	“Khao Soi Dao Wildlife Sanctuary, 300–400m alt., Chanthaburi Province, Thailand”		Ono & Schwendinger (1990)	<i>trang</i>
14	<i>L. phileion</i>	“Ao Phrao (=Coconut Bay), 10 m, Samet Island (12°33'N, 101°26'E), Khao Laem Ya & Mu KO Samet National Park, Rayong District and Province, southeastern Thailand.”		Schwendinger (1998)	<i>trang</i>
15	<i>L. ochraceus</i>	“Phu Rua National Park, 1,200m alt., Loei Province, Thailand”		Ono & Schwendinger (1990)	<i>trang</i>
16	<i>L. onoi</i>	“Phu Hin Rongkla National Park (16°52'N, 101°03'E), 1200 m, Nakhon Thai District, Phitsanulok Province, northeastern Thailand”		Schwendinger (1996)	<i>trang</i>

Table 1.—Continued.

No.	Species	Type Locality	Type Locality Remarks	Original Description	Species-group
17	<i>L. thoranie</i>	“Kong Kaeo Waterfall (14°21'N, 101°25'E), 680 m, Khao Yai National Park, Pak Chong District, Nakhon Ratchasima Province, northeastern Thailand.”		Schwendinger (1996)	<i>trang</i>
18	<i>L. tham</i>	“Thailand, Tham Suan Hin”	“Tham Suan Hin” described by Sedgwick and Schwendinger (1990) is currently known as Lumphinee Suan Hin cave, Wat Tham Phra Phothisat monastery, Kaeng Khoi District, Saraburi province (Ellis 2012)	Sedgwick & Schwendinger (1990)	<i>trang</i>
19	<i>L. pusohm</i>	“Nam Nao National Park (16°44'N, 101°32'E), 800 m Lom Sak District, Phetchabun Province, northeastern Thailand.”		Schwendinger (1996)	<i>trang</i>
20	<i>L. erawan</i>	“Erawan Waterfall and National Park (14°25'N, 99°03'E), 100 m, Bo Phloi District, Kanchanaburi Province, western Thailand”		Schwendinger (1996)	<i>trang</i>
21	<i>L. schwendingeri</i>	“Khlung Nakha, 50m alt., Ranong, South Thailand”	Khlung Na Kha Wildlife Sanctuary, Suk Samran district, Ranong province	Ono (1988b)	<i>trang</i>
22	<i>L. fuscus</i>	“Khao Phanom Bencha National Park (8°12'N, 98°56'E), 280 m, Krabi District, Krabi Province, Thailand.”		Schwendinger (1995)	<i>trang</i>
23	<i>L. phuketensis</i>	“Tone Sai Waterfall, Khao Phra Thaeo Non-hunting Area (8°02'N, 98°22'E), 100 m, Thalang District, Phuket Island and Province, southern Thailand.”		Schwendinger (1998)	<i>trang</i>
24	<i>L. rufipes</i>	“Than To Waterfall (6°2'N, 101°10'E), 150 m, Banglang National Park, Than To District, Yala Province, Thailand.”		Schwendinger (1995)	<i>trang</i>
25	<i>L. thaleban</i>	“Thailand: Thaleban National Park”	Thale Ban National Park, Wang Prachan, Khuan Don District, Satun province	Schwendinger (1990)	<i>trang</i>
26	<i>L. bicoloripes</i>	“Khlung Nakha, 50m alt, Ranong, South Thailand”	Khlung Na Kha Wildlife Sanctuary, Na Kha, Suk Samran District, Ranong province	Ono (1988b)	<i>trang</i>
27	<i>L. castaneus</i>	“Khlung Nakha Wildlife Sanctuary, 30 m, Kapoe District, Ranong Province, Thailand.”	Schwendinger (1995) might have erred in stating that Khlung Nakha WS is in Kapoe district, since this WS is located in Suk Samran district	Schwendinger (1995)	<i>trang</i>
28	<i>L. niphanae</i>	“Khao Luang National Park, 120 m alt., Nop Pitam, Tha Sala, Nakon Si Thammarat, South Thailand”		Ono (1988b)	<i>trang</i>
29	<i>L. trang</i>	“Krachong Forest, 100 m. near Trang, Thailand”	Krachong Forest, Na Yong District, Trang Province	Platnick & Sedgwick (1984)	<i>trang</i>
30	<i>L. thalери</i>	“Ko (= Island) Libong (also called Ko Talibong), near Ao Tokae (= Gekko Bay) (7°16'04"N, 99°22'38"E), 30 m”		Schwendinger (2009)	<i>trang</i>
31	<i>L. albipes</i>	“Khao Luang, Nam Tok Huay Yang National Park (11°38'N, 99°33'E), 550 m, Thap Sakae District, Prachuab Khiri Khan Province, Thailand.”		Schwendinger (1995)	<i>trang</i>
32	<i>L. tenuis</i>	“Nam Tok Phliu-Khao Sabap National Park (12°32'N, 102°12'E), 100 m, Chanthaburi District and Province, southeastern Thailand.”		Schwendinger (1996)	<i>trang</i>
33	<i>L. jarujini</i>	“Taksin Maharat National Park, 950 m alt, ca 30 km W of Tak, Muzng, Thailand”		Ono (1988a)	<i>Incertae sedis</i>

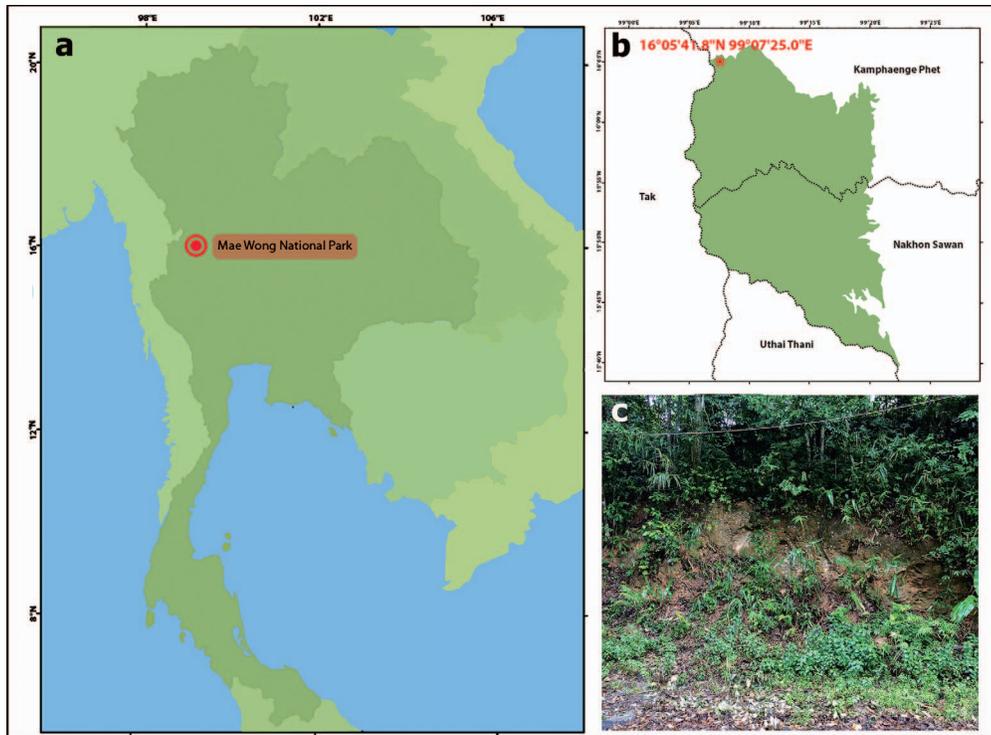


Figure 2.—Type locality of *Liphistius maewongensis* sp. nov. in Mae Wong National Park (a, b), Klonglan District, Kamphaeng Phet province, Thailand; (c), a man-made road cutting hill slope where *L. maewongensis* burrows were found.



Figure 3.—Dorsal habitus of *Liphistius maewongensis* sp. nov. Adult male (left) and female (right). Note the darker coloration of the male specimen.

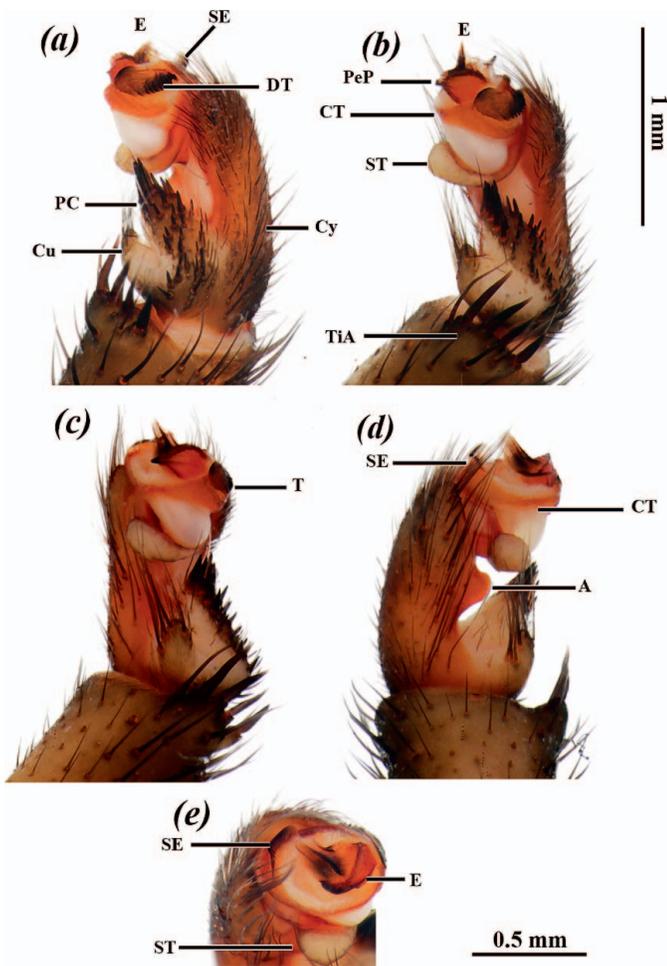


Figure 4.—Male pedipalp of *Liphistius maewongensis* sp. nov. (holotype: CUMZ-AR-ARA-Lip.2017.1): (a) retrolateral view; (b) retroventral view; (c) ventral view; (d) proventral view; (e) distal view. A = alveolar apophysis; CT = contrategulum; Cu = cumulus; Cy = cymbium; DT = dorsal extension of terminal apophysis of tegulum; E = embolus; PC = paracybium; PeP = paraembolic plate; SE = sharp distal edge of contrategulum; ST = subtegulum; TiA = tibial apophysis.

(Fig. 4a, b), and by the distinct subtegular apophysis (Fig. 4b, c) (see also Ono 1988a). The female *L. maewongensis* has larger medium-sized pores on the pore plate that lead to the ampulliform vesicles, and a distinct genital atrium and arrangement of the receptacular cluster (Fig. 5).

**Description.**—Male holotype (CUMZ-AR-ARA-Lip.2017.1). Color (live specimens): carapace black, paler in median area; opisthosoma black, abdominal tergites darker than other areas; chelicerae black, paler in proximal portion; leg and pedipalp pale yellow with black annulations; palpal coxa, leg coxae, labium and sternum black (Fig. 3). Total length: TL1 16.3, TL2 14.7. Carapace: CL 6.75, CW 6.25. Ocular tubercle: OL 0.99, OW 1.17. Eye sizes and interdistances: AME 0.9, ALE oval shape 0.18 and 0.75, PME oval shape 0.42 and 0.33, PLE oval shape 0.18 and 0.48; AME-AME 0.15, AME-ALE 0.18, PME-PME 0.03, PME-PLE 0.09,

AME-PME 0.09, AEL-PLE 0.06. Labium: LL 0.72, LW 1.36. Sternum: SL 3.08, SW 0.96. Palpal coxa: EL 1.96, EW 1.60. Chelicerae with 11 promarginal teeth. Paired tarsal claws with 4 teeth, unpaired tarsal claw with 1 small denticle. Pedipalp and leg measurements: pedipalp length: 11.36 (3.60+2.08+3.68+2.00), leg I: 17.12 (4.88+2.56+3.68+3.92+2.08), leg II: 15.00 (2.28+2.56+3.52+4.40+2.24), leg III: 19.92 (5.28+2.56+3.44+5.54+2.80), leg IV: 25.12 (6.32+2.88+4.96+7.12+3.84). Pedipalp with four tapering spines on short truncate tibial apophysis, paracybium protruding and narrow bearing numerous short strong spines, cumulus elevated bearing several long hairs, alveolar process well developed, subtegular apophysis slightly elevated, tegulum narrow with dentate dorsoproximal edge of tegulum, contrategulum broad with dentate ventral ridge, small paraembolic plate. Embolus short, adjoining sclerotized embolic parts with two longitudinal ridges that reach to tip (Fig. 4).

Female allotype (CUMZ-AR-ARA-Lip.2017.2). Color (live specimens): carapace orange-brown with thick black markings along the margins which radiate to thoracic groove; opisthosoma orange-brown with black spot on lateral surface, abdominal tergites orange-brown with black pattern in the middle and lateral margins (Fig. 3); chelicerae brown proximally, black distally; leg and pedipalp light-brown with black annulations; palpal coxa, leg coxae, labium, and sternum black. Total length: TL1 12.38, TL2 10.63. Carapace: CL 5.88, CW 5.38. Ocular tubercle: OL 0.88, OW 0.88, clypeus narrow. Eye sizes and interdistances: AME 0.09, ALE oval shape 0.51 and 0.15, PME 0.39, PLE oval shape 0.42 and 0.12, AME-AME 0.06, AME-ALE 0.12, PME-PME 0.03, PME-PLE 0.06, ALE-PLE 0.09. Labium: LL 0.76, LW 1.12. Sternum: SL 3.04, SW 1.32. Palpal coxa: EL 1.92, EW 1.16. Chelicerae with 12 promarginal teeth. Paired tarsal claws with 3 teeth, unpaired tarsal claw with 1 small denticle. Pedipalp and leg measurements: pedipalp length: 10.56 (3.68+1.92+2.40+2.56), leg I: 13.36 (4.48+2.08+2.72+2.56+1.52), leg II: 13.52 (4.40+2.08+2.80+2.64+1.60), leg III: 14.64 (4.40+2.08+2.88+3.36+1.92), leg IV: 20.80 (5.68+2.56+4.08+5.60+2.88). Vulva: anterodorsal poreplate rectangle, wider than long, anterior and lateral lips thick without distinct lobe, large ventral vesicle (Fig. 5). Receptacular cluster racemose, well develop. Genital atrium wide, sclerotized portion well developed, with W-shaped posterior margin, connected to lateral margin of atrium.

**Variation.**—Pedipalp and leg measurements for nine adult female specimens (individuals with egg sacs collected on 23 December 2015) are provided in Table 2.

**Remarks.**—*Liphistius maewongensis* belongs to the *bristowei* species-group *sensu* Schwendinger (1990), based on the elevated cumulus (Figs. 4a–d) and the two longitudinal ridges on the sclerotized part of the embolic parts that reach the tip (Fig. 4e). Thus, the *bristowei* species-group of *Liphistius* is currently comprised of *L. bristowei*, *L. lanaianus*, *L. marginatus* Schwendinger, 1990, *L. yamasakii*, and *L. maewongensis*. Despite the similarity between *L. yamasakii* and *L. maewongensis*, the male pedipalp shapes are grossly different (see Diagnosis, above).

**Distribution, burrows and natural history.**—*Liphistius maewongensis* is found only in the area surrounding the type locality in Mae Wong National Park, which spans an area of approximately 2–3 km<sup>2</sup> within an altitudinal range of 1193–

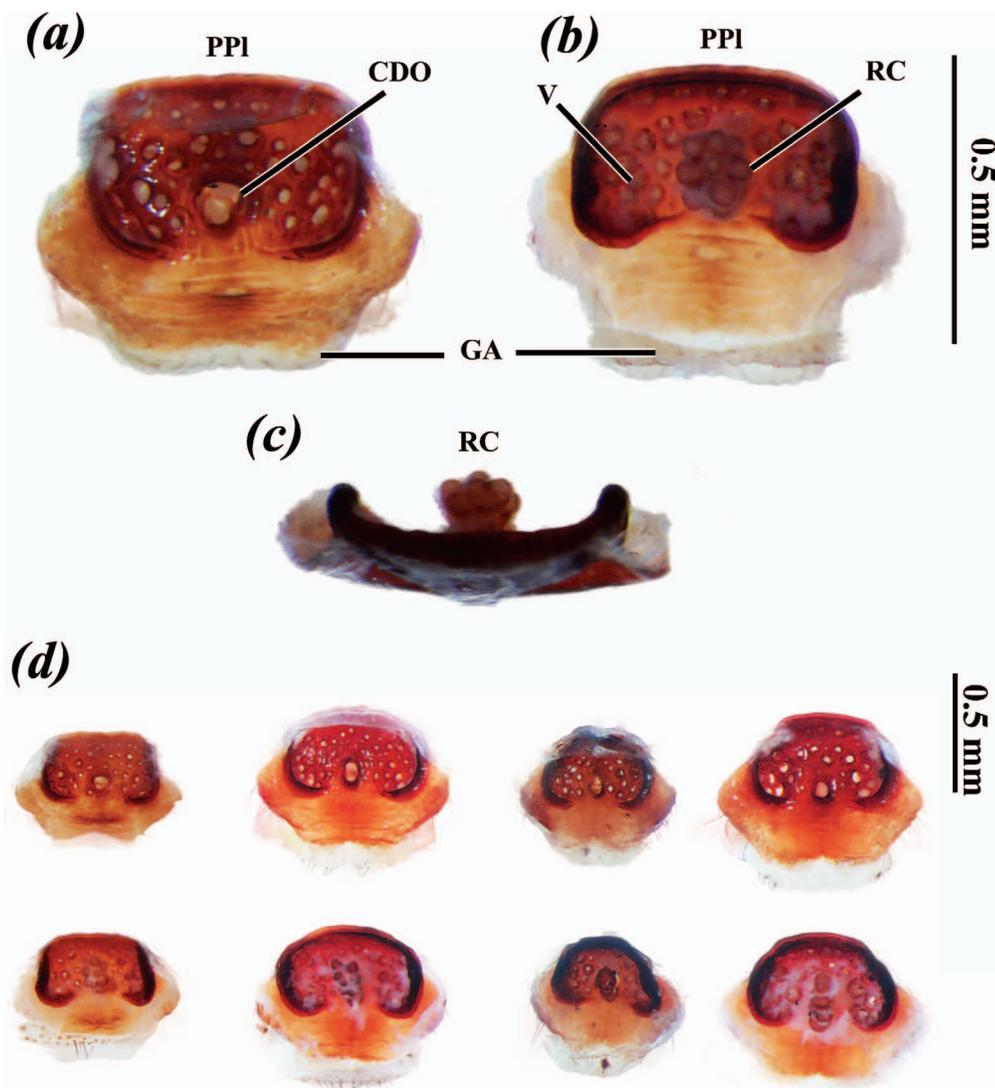


Figure 5.—Female vulvae of *Liphistius maewongensis* sp. nov. (a–c) Allotype (CUMZ-AR-ARA-Lip.2017.2): (a) dorsal view; (b) ventral view; (c) distal view; (d) Variations in four female paratype vulvae (upper row, dorsal view; lower row, ventral view), from left to right (CUMZ-AR-ARA-Lip.2017.3–6, respectively). CDO = central dorsal opening; GA = genital atrium; PPI = poreplate; RC = receptacular cluster; V = ampulliform vesicle.

1266 m. No additional individuals were found beyond 10 km from the type locality. *Liphistius maewongensis* was found in soil burrows on man-made road cuttings with a gentle surface inclination of 68.2–87.1 degrees measured from ground level. All burrows, regardless of size, had a trapdoor. Two types of burrows were observed, the simple straight burrow with a single opening (with signal lines) ( $n = 21$ ) and the T- or Y-shaped burrow ( $n = 25$ ) with two openings (one trapdoor is equipped with signal lines, whereas the other is not) (Fig. 6). The number of signal lines on trapdoors ranged from 4–8 ( $n = 46$ ). Straight burrows had an average number of signal lines of  $5.86 \pm 1.01$  (4–7;  $n = 21$ ), whereas T- or Y-shaped burrows had an average number of signal lines of  $6.24 \pm 0.88$  (5–8;  $n = 25$ ). The shape of trapdoors with signal lines was more or less oval with an average width of  $11.17 \pm 4.03$  mm (4.6–24 mm;  $n = 46$ ), an average length of  $16.42 \pm 5.21$  mm (7–28 mm;  $n =$

46), and an average depth of  $69.02 \pm 23.84$  mm (24.66–144.5 mm;  $n = 46$ ). The shape of trapdoors of straight burrows with signal lines was more or less oval with an average width of  $10.02 \pm 4.97$  mm (4.6–24 mm;  $n = 21$ ), an average length of  $14.84 \pm 6.37$  mm (7–28 mm;  $n = 21$ ), and an average depth of  $70.26 \pm 21.02$  mm (40–105.1 mm;  $n = 21$ ). The shape of trapdoors of T- or Y-shaped burrows with signal lines was more or less oval with an average width of  $12.14 \pm 2.77$  mm (8.1–17.9 mm;  $n = 25$ ), an average length of  $17.74 \pm 3.63$  mm (12.3–27.3 mm;  $n = 25$ ), and an average depth of  $67.97 \pm 27.74$  mm (27.6–144.5 mm;  $n = 25$ ). The shape of trapdoors of T- or Y-shaped burrows without signal lines was more or less oval with an average width of  $9.6 \pm 2.42$  mm (5.1–15.5 mm;  $n = 25$ ) and an average length of  $12.92 \pm 2.67$  mm (9.5–18.8 mm;  $n = 25$ ). In the field, we observed that while excavating for individual spiders in a T- or Y-shaped burrow through its trapdoor with

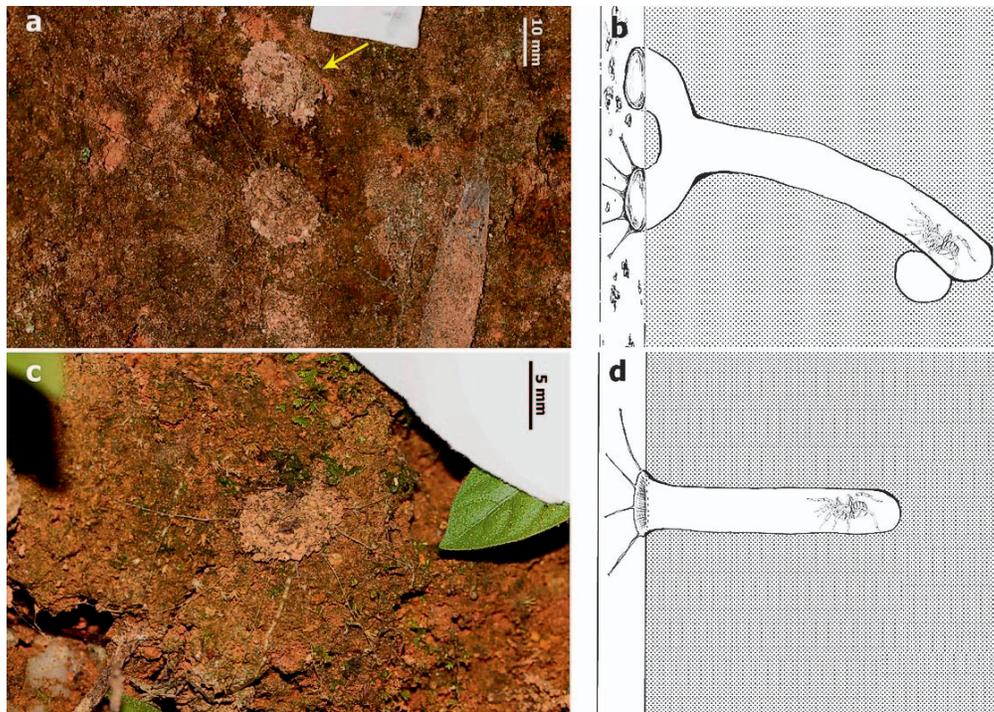


Figure 6.—Burrow types of *Liphistius maewongensis* sp. nov.: (a) two trapdoor openings of a T- or Y-shaped burrow (note the opening without signal lines used as escape door; yellow arrow); (b) a cross-sectional sketch of a T- or Y-shaped burrow; (c) an opening of a trapdoor of a simple horizontal burrow with signal lines; (d) a cross-sectional sketch of a simple horizontal burrow.

signal lines, the spider frequently escaped through the second trapdoor without signal lines. We speculated that one of the functions for the second trapdoor is that it is used as an “escape door” (Fig. 5a). This is the first report of a T- or Y-shaped burrow found in a species belonging to the *bristowei* species-group, since Schwendinger (1990) earlier reported that such a burrow characteristic is usually only found in the *birmanicus*- and *trang* species-groups.

The number of eggs per egg sac was between 31–52 eggs ( $n = 11$ ). Since one male of *L. maewongensis* molted to an adult in October, and high numbers of female egg sacs were found in December and not in August, we inferred that the mating period is likely to be around October–December. This annual cycle concurs with the findings of Schwendinger (1990) for species of the *bristowei* and *birmanicus* species-groups, which also have mating seasons during this time in Thailand.

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Table 2.—Pedipalp and legs measurements of nine adult females of *Liphistius maewongensis* sp. nov. collected on 23 December 2015. All measurements (mean  $\pm$  s.d.) are given in millimeters.

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total length
<b>Pedipalp</b>	3.34 $\pm$ 0.52	1.73 $\pm$ 0.41	2.34 $\pm$ 0.44	-	2.35 $\pm$ 0.40	9.76 $\pm$ 1.69
<b>Leg I</b>	4.06 $\pm$ 0.57	2.07 $\pm$ 0.30	2.51 $\pm$ 0.43	2.38 $\pm$ 0.40	1.38 $\pm$ 0.18	12.39 $\pm$ 1.81
<b>Leg II</b>	4.10 $\pm$ 0.62	2.04 $\pm$ 0.32	2.53 $\pm$ 0.43	2.54 $\pm$ 0.36	1.42 $\pm$ 0.30	12.64 $\pm$ 1.92
<b>Leg III</b>	4.06 $\pm$ 0.59	2.06 $\pm$ 0.33	2.64 $\pm$ 0.41	2.96 $\pm$ 0.67	1.74 $\pm$ 0.25	13.45 $\pm$ 2.17
<b>Leg IV</b>	5.17 $\pm$ 0.77	2.39 $\pm$ 0.32	3.60 $\pm$ 0.47	5.09 $\pm$ 0.82	2.54 $\pm$ 0.36	18.79 $\pm$ 2.68

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## LITERATURE CITED

- Ellis, M. 2012. The Caves of Saraburi, Thailand. Takobi Limited, Somerset, UK.
- Haupt, J. 2003. The Mesothelae – monograph of an exceptional group of spiders (Araneae: Mesothelae) (Morphology, behaviour, ecology, taxonomy, distribution and phylogeny). *Zoologica* 154:1–102.
- IUCN 2017. The IUCN Red List of Threatened Species. Version 2017–1. Online at <http://www.iucnredlist.org>
- Ono, H. 1988a. Liphistiid spiders (Araneae, Mesothelae) of northwest Thailand. *Bulletin of the National Museum of Nature and Science Tokyo (A)* 14:35–41.
- Ono, H. 1988b. Liphistiid spiders (Araneae, Mesothelae) of south Thailand. *Bulletin of the National Museum of Nature and Science Tokyo (A)* 14:145–150.
- Ono, H. & P.J. Schwendinger. 1990. Liphistiid spiders (Araneae, Mesothelae) from central and eastern Thailand. *Bulletin of the National Museum of Nature and Science Tokyo (A)* 16:165–174.
- Platnick, N.I. & W.J. Gertsch. 1976. The suborders of spiders: a cladistic analysis (Arachnida, Araneae). *American Museum Novitates* 2607:1–15.
- Platnick, N.I. & W.C. Sedgwick. 1984. A revision of the spider genus *Liphistius* (Araneae, Mesothelae). *American Museum Novitates* 2781:1–31.
- Schwendinger, P.J. 1987. On the male of *Liphistius trang* (Araneae: Mesothelae) with notes on the natural history of the species. *Natural History Bulletin of the Siam Society* 35:9–25.
- Schwendinger, P.J. 1990. On the spider genus *Liphistius* (Araneae: Mesothelae) in Thailand and Burma. *Zoologica Scripta* 19:331–351.
- Schwendinger, P.J. 1995. New *Liphistius* species (Araneae, Mesothelae) from southern Thailand and northern Malaysia. *Zoologica Scripta* 24:143–156.
- Schwendinger, P.J. 1996. New *Liphistius* species (Araneae, Mesothelae) from western and eastern Thailand. *Zoologica Scripta* 25:123–141.
- Schwendinger, P.J. 1998. Five new *Liphistius* species (Araneae, Mesothelae) from Thailand. *Zoologica Scripta* 27:17–30.
- Schwendinger, P.J. 2009. *Liphistius thaleri*, a new mesothelid spider species from southern Thailand (Araneae, Liphistiidae). *Contributions to Natural History* 12:1253–1268.
- Schwendinger, P.J. 2013. On two *Liphistius* species (Araneae: Liphistiidae) from Laos. *Zootaxa* 3702:51–60.
- Schwendinger, P.J. & H. Ono. 2011. On two *Heptathela* species from southern Vietnam, with a discussion of copulatory organs and systematics of the Liphistiidae (Araneae: Mesothelae). *Revue suisse de Zoologie* 118:599–637.
- Sedgwick, W.C. & P.J. Schwendinger. 1990. On a new cave-dwelling *Liphistius* from Thailand (Araneae: Liphistiidae). *Bulletin of the British Arachnological Society* 8:109–112.
- World Spider Catalog. 2017. World Spider Catalog. Version 18.0. Natural History Museum, Bern. Online at <http://www.wsc.nmbe.ch>
- Xu, X., F. Liu, J. Chen, H. Ono, D. Li & M. Kuntner. 2015. A genus-level taxonomic review of primitively segmented spiders (Mesothelae, Liphistiidae). *ZooKeys* 488:121–151.

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