

A review of the Spider Genus *Atmetochilus* of Sumatra, Indonesia, with First Analysis of Male Characters and Description of Three New Species (Araneae, Nemesiidae)

Sergei L. Zonstein^{1,*} and Yuri M. Marusik^{2,3,4}

¹Department of Zoology, The George S. Wise Faculty of Life Sciences, Tel-Aviv University, 69978 Tel-Aviv, Israel ²Institute for Biological Problems of the North RAS, Portovaya Str. 18, Magadan, Russia ³Department of Zoology & Entomology, University of the Free State, Bloemfontein 9300, South Africa ⁴Far Eastern Federal University, Sukhanova 8, Vladivostok 690950, Russia

(Received June 28, 2014; Accepted October 16, 2015)

Sergei L. Zonstein and Yuri M. Marusik (2016) The first Sumatran representatives of *Atmetochilus* Simon, 1887, the genus formerly known only from two species from Myanmar and one species from India, are currently revealed and reviewed. Three new species (listed below) are described and the current concept of *Atmetochilus* is redefined following study of the male characters previously almost completely unknown. Most of these characters are studied, illustrated and discussed for the first time. The studied genus is found to be represented in Sumatra by three new species described here: *A. koponeni* sp. n. ($\mathcal{S} \neq$), *A. lehtineni* sp. n. ($\mathcal{S} \neq$) and *A. sumatranus* sp. n. (\mathcal{S}).

Key words: Mygalomorph spiders, New species, Taxonomy, South-Eastern Asia.

BACKGROUND

Atmetochilus Simon, 1887 belongs to the widespread spider family Nemesiidae, currently comprising 45 genera and 382 species (World Spider Catalogue 2015) occurring mostly in subtropical and warm-temperate regions. Initially, the genus was described as monotypic on the basis of a single female from Myanmar and placed in the Ctenizidae (Simon 1887). Pocock (1900) described an additional species, also represented by only a female from the same country. For more than a century the entire genus was known only from these two specimens. When revising the infraorder Mygalomorphae, Raven (1985) rediagnosed the genus and transferred it together with its closest relatives into the Nemesiidae; in addition, he provided a series of figures for the species described by Pocock. Recently, Zonstein and Marusik (2014) transferred to *Atmetochilus* one species, *A. bifidus* (Gravely, 1935), originally placed in the related genus *Damarchus* Thorell, 1891. Thus, prior to this study the genus encompassed three species; two of which at that were known only from females. All the three species of the genus were poorly illustrated: the vulva and male palp had never been depicted for any species; while the key characters of the genus, such as the ridged dorsum of the bulb, was mentioned by Raven (1985) but never illustrated.

This study was triggered by the finding of several specimens of this genus in the collections of ZISP, SMF and ZMUT (full list of acronyms is provided at the end of the article). Some comparative material included specimens (mostly types) of *Atmetochilus* and representatives of all other genera of the Bemmerinae: *Spiroctenus* Simon, 1889, *Damarchus* Thorell, 1891 and

^{*}Correspondence: E-mail: znn@post.tau.ac.il

Pionothele Purcell, 1902. The material deposited in the collections listed below, was also examined: MNHL - $\stackrel{\circ}{\rightarrow}$ *A. fossor* Pocock, 1900, and $\stackrel{\circ}{\rightarrow} \stackrel{\circ}{\rightarrow} S.$ *collinus* (Pocock, 1900); MNHN - $\stackrel{\circ}{\rightarrow} S. personatus$ (Simon, 1889); MRAC - representatives of severalSouth African species belonging to*Spiroctenus* $(<math>\stackrel{\circ}{\rightarrow} \stackrel{\circ}{\rightarrow} \stackrel{\circ}{\rightarrow}$, not types) and *Pionothele* ($\stackrel{\circ}{\rightarrow} \stackrel{\circ}{\rightarrow} \stackrel{\circ}{\rightarrow}$, not types); NRS - $\stackrel{\circ}{\rightarrow} D.$ *workmanni* Thorell, 1891 and $\stackrel{\circ}{\rightarrow} P.$ *oathesi* Thorell, 1895, SMF - $\stackrel{\circ}{\rightarrow} \stackrel{\circ}{\rightarrow} D.$ *cavernicola* Abraham, 1924 (deposited there under *Latouchia batuensis* Roewer, 1962).

The goals of this study were as follows: 1) to describe three new species, 2) to redefine the genus based on the new characters found, and 3) to show the distribution of all known species.

MATERIALS AND METHODS

Photographs were taken using a Canon 500D digital camera with a 100 mm Canon macro lens, a Canon PowerShot G9 digital camera attached to a Zeiss Discovery V20 stereomicroscope, and an Olympus E-520 digital camera attached to an Olympus SZX16 stereomicroscope. Digital images were prepared using "CombineZP" image stacking software (http://www.hadleyweb.pwp.blueyonder. co.uk/). Illustrations of vulvae were made after maceration in 20% potassium hydroxide aqueous solution and exposure for a few minutes in an alcohol/water solution of Chlorazol Black.

Measurements were taken through both stereomicroscopes with an accuracy of 0.01 mm. All measurements are given in millimetres. Total body length, as accepted for mygalomorph spiders (see Raven and Schwendinger 1995), includes chelicerae but not spinnerets. Diameter of AME is given usually as a diameter of a sharply edged AME pupil. When the eye dome is mounded well and also could be measured, the corresponding data follow then being placed in the brackets. Any measurements counting this parameter also are given in the brackets. The length of sternum was measured along the straight line between the posterior tip of the sternum and the hindmost part of the labium. Lengths of leg and palp segments were measured on the dorsal side, and lengths of spinneret segments on the ventral side, from midpoint of anterior margin to midpoint of posterior margin.

page 2 of 17

RESULTS

Family Nemesiidae Simon, 1889

Nemeseae Simon 1889: 179; 1892: 110; 1903: 906. Nemesiidae: Raven 1985: 79.

Subfamily Bemmerinae Simon, 1903

Bemmereae Simon 1903: 894. Bemmerinae: Raven 1985: 90.

The subfamily is considered currently to include five genera: South Asian *Atmetochilus* Simon, 1887, *Damarchus* Thorell, 1891 and *Damarchulus* Siliwal, Molur & Raven, 2015, and South African *Spiroctenus* Simon, 1889 and *Pionothele* Purcell, 1902 (Raven 1985, with counting Siliwal et al. 2015). The history and composition of this group are briefly discussed below.

Atmetochilus Simon, 1887

Simon 1887: 109, type species *Atmetochilus fossor* Simon, 1887, by monotypy; 1892: 109; Raven, 1985: 91.

Diagnosis: Closely related to *Damarchus* and *Spiroctenus* by possessing subcentral posterior sternal sigilla, proventral to prolateral mating spur and one S-shaped teeth row on paired tarsal claws in males, all considered apomorphic (Raven 1985). It differs from these taxa by posterior sternal sigilla more or less confluent (vs. broader spaced) and by distinctly flattened male metatarsus I covered with numerous ventral spinules (vs. unmodified state), and by having ventral ridges on the bulb looking like saw in lateral view.

Description: Medium-sized to large nemesiids with carapace 7-12 mm long. Carapace slightly hirsute. Fovea short U-shaped. Eight eyes, AME or ALE largest, eye tubercle well developed. Chelicerae with rastellum. Maxillae broad rectangular with few to numerous cuspules. Serrula not evident. Labium wider than long with few or without cuspules. Sternal sigillae confluent in central part of sternum. Leg formula 4123. Metatarsal preening combs present on metatarsi III and IV. Tarsi III and IV with or without spines.

Males: maxillary cuspules considerably smaller than in females; intercheliceral tumescence not evident; palpal tibia short, swollen, and aspinose; cymbium short and massive, without spines, tegulum with 1-5 ventral ridges; tibia I long cylindrical with usually two (sometimes one) megaspines on the raised prodistal process; metatarsus I straight to slightly curved, flattened laterally, ventrally covered with dense short spinules.

Females: spermathecae entire, not branched, without distinct heads, upper halves diverging. Four spinnerets: PMS large well-developed, apical segment of PLS triangle to digitiform.

Composition: Six species: A. atriceps Pocock, 1900 ($\stackrel{\circ}{\uparrow}$, Myanmar), A. bifidus (Gravely, 1935) ($\stackrel{\circ}{\circ}$, India), A. fossor Simon, 1887 ($\stackrel{\circ}{\uparrow}$, Myanmar), A. koponeni sp. n. ($\stackrel{\circ}{\circ} \stackrel{\circ}{\uparrow}$, Indonesia), A. lehtineni sp. n. ($\stackrel{\circ}{\circ} \stackrel{\circ}{\uparrow}$, Indonesia) and A. sumatranus sp. n ($\stackrel{\circ}{\circ}$, Indonesia).

Distribution: Southeastern Asia from Assam (India) to Sumatra (Indonesia) as shown in figure 1. The undescribed congeners were also reported by Schwendinger (1996) from Thailand.



Fig. 1. Localities of Atmetochilus species, in view of new data.

Atmetochilus koponeni sp. n.

(Figures 2a,b, 3a,b, 4a,b, 5a,b, 6a,b, 7a, 8a, 9a, 10a, 11a, and 12a,b) urn:lsid:zoobank.org:act:B7A634A7-BD83-4D3A-8FFA-2B0DF4C6D89D

Types: & holotype (ZMUT) - INDONESIA: Sumatra, Mt. Mamas, 3°33'N, 97°39'E, 1600-1700 m, 28.07-7.08.1983, H. Räisänen. Paratype: 1 \updownarrow (ZISP) - "Sumatra, 1889" (no other data).

Etymology: Named after our colleague and friend, a famous Finnish arachnologist Seppo Koponen (Turku, Finland).

Diagnosis: The species can be distinguished from *A. fossor* and *A. atriceps* by presence of cuspules on the labium (vs. unarmed state) and from *A. lehtineni* sp. n. and *A. sumatranus* sp. n. - by the shallow tegular ridges (*cf.* Figures 8-11). Males of *A. koponeni* sp. n. differ from those of *A. bifidus* by less raised tibial process on leg I with confluent megaspines and by shorter, stouter and slightly curved metatarsus I (more raised with diverging megaspines and longer, slender and straight, respectively, in the latter species - *cf.* Figures 6a,b and Gravely 1935: figure 1a).

Description: Male (holotype). Habitus as in figure 2a. Body length 15.85. Colour in alcohol: carapace and chelicerae dark cherry-brown, labium, sternum, maxillae, palps and legs intensive reddish-brown; abdomen dorsally dark-brown uniformly and densely covered with light brownish spots, ventral abdominal surface and spinnerets pale yellowish grey.

Carapace (Figure 3a) 6.94 long, 6.11 wide. Eye tubercle and clypeus as shown in figure 4a. Eye sizes and interdistances: AME 0.25 (0.33), ALE 0.37, PLE 0.35, PME: 0.32; AME-AME 0.17 (0.09), ALE-AME 0.19 (0.13), ALE-PLE 0.14, PLE-PME 0.02, PME-PME 0.63. Rastellum consists of 8-9 robust spines. Cheliceral furrow with 9-10 promarginal teeth and 15-17 mesobasal denticles. Labium, sternum and maxillae as shown in Figure 5a. Labium 0.82 long, 1.36 wide, with 2 tiny cuspules. Sternum 3.66 long, 3.24 wide. Maxillae with 15-20 tiny cuspules each. Palp and leg measurements as shown in Table 1.

Spination: Femora I-III with 1-2 (femur IV with 4-5) basodorsal spines and few stiff bristles (undeveloped spines) located medially and distally; femora III-IV also with few dorsodistal spinules, patellae III-IV with numerous pro- and retrolateral spinules; palp entirely, patellae I-II and tarsi I-IV aspinose. Leg I: tibia pv1-1-0, rv0-

page 4 of 17



Fig. 2. Atmetochilus, holotype males (a, c, d, f) and paratype females (b, e), dorsal (a-c, e, f) and lateral (d) view. (a, b) *A. koponeni* sp. n.; (c-e) *A. lehtineni* sp. n.; (f) *A. sumatranus* sp. n. (scale bar: a-c, e, f = 5 mm; d = 2 mm).

Table 1.	Atmetochilus	<i>koponeni</i> sp. n.	, holotype male,	length of p	alpal and le	eg segments
----------	--------------	------------------------	------------------	-------------	--------------	-------------

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	3.37	1.79	3.04	-	1.51	9.71
I	6.43	3.03	5.11	4.68	2.60	21.90
II	5.52	2.49	3.51	4.26	2.23	18.01
111	4.32	2.15	2.89	4.13	2.39	15.88
IV	6.64	2.57	5.29	5.87	2.43	22.80

0-2M; metatarsus v1-1-3. Tibia and metatarsus I and tibial process carrying megaspines as shown in Figures 6a,b. Leg II: tibia v0-1-2; metatarsus v1-1-3. Leg III: tibia d1-2-2, v0-0-2; metatarsus p0-1-0, r0-1-1, v1-0-2-3(2). Leg IV: tibia v0-0-2; metatarsus d1-1-0, v1-0-1-2-2.

Scopula: relatively short and sparse, distal on metatarsus I, entire on tarsi I and II, absent elsewhere. Paired claws on tarsi I-III with 5-6 teeth in one S-shaped row. Trichobothria: 2 rows of 6-8 per row on tibiae, 10-12 on metatarsi, 10-11 on tarsi, 7 on cymbium.

Palp: cymbium aspinose (Figure 7a); bulb with low carina; tegulum with one low slanting ridge; embolus curved (Figures 8a, 9a, 10a, 11a).

PMS: 0.72; diameter 0.34. PLS: maximum diameter 0.57; length of basal, medial and apical segments 1.22, 0.61, 0.87; total length 2.70; apical segment digitiform.

Female (paratype): Habitus as in Figure 2b. Body length 28.50. Colour in alcohol as in male, but carapace coloured only slighter darker than legs, medium chestnut-brown.

Carapace (Figure 3b) 11.15 long, 8.88 wide. Eye tubercle and clypeus as shown in figure 4b. Eye sizes and interdistances: AME 0.38 (0.50), ALE 0.48, PLE 0.49, PME 0.46; AME-AME 0.23 (0.11), ALE-AME 0.32 (0.26), ALE-PLE 0.23, PLE-PME 0.03, PME-PME 0.92. Rastellum consists of 12-15 robust cone spines. Cheliceral furrow with 8-9 promarginal teeth and 20-25 mesobasal denticles. Labium, sternum and maxillae as shown in Figure 5b. Labium 1.53 long, 2.56 wide, with 3 cuspules. Sternum 6.47 long, 5.64 wide. Maxillae with 22-25 cuspules each. Palp and leg measurements as shown in Table 2.

Spination: Femora I-IV with few dorsal bristles (femora III-IV also with few dorsoapical spinules),

<image>

patellae III with few and IV with numerous proand retrolateral spinules; patellae I-II and tarsi I-II aspinose. Palp: tibia p1-1, v1-2-3; tarsus v2(1). Leg I: tibia v1-1-0; metatarsus v1-1-1-1-2. Leg II: tibia v1-1-0; metatarsus v1-1-2-1-3. Leg III: tibia p1-1, r0-1, v2-2(1)-3; metatarsus d7, p8, r2, v8; tarsus p2, v1. Leg IV: tibia r1-1, v1-2(1)-1-3(2); metatarsus d0-1-1, p0-1-2, v6(5); tarsus p2 v1.

Scopula: dense, distal and entire on metatarsus I-II; entire on palpal tarsus and tarsi I and II; absent on tarsi III-IV. Palpal claw with 4 promarginal tiny teeth. Paired claws on tarsi I-II with 0-1 tooth on inner and 4-5 teeth on outer margin; on tarsi III-IV - with basal outer cluster of 2-3 teeth, unpaired claw steeply curved. Trichobothria: 2 rows of 7-8 per row on tibiae, 10-12 on metatarsi, 11-12 on tarsi, 13 on palpal tarsus.

Spermathecae as in Figures 12a,b, gradually tapering without distinct heads, height about 1.5 longer than width near the base, heads separated by the height of spermatheca; apical half of spermatheca gently bent laterally.

Spinnerets: PMS 1.26 long; diameter 0.51. PLS: maximum diameter 0.98; length of basal, medial and apical segments 1.56, 1.07, 1.15; total length 3.78; apical segment short-digitiform.

Note: Although the holotype male and the



Fig. 4. Atmetochilus, holotype males (a, c, f) and paratype females (b, d, e): eye tubercle and clypeus, dorsal view (a-d, f), and spinnerets, lateral view (e). (a, b) *A. koponeni* sp. n.; (c-e) *A. lehtineni* sp. n.; (f) *A. sumatranus* sp. n. (scale bar = 1 mm).

Table 2. Atmetochilus k	<i>oponeni</i> sp. n.	, paratype female,	length of pa	Ipal and leg	g segments
-------------------------	-----------------------	--------------------	--------------	--------------	------------

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	5.76	2.33	3.82	-	3.83	15.74
I	8.55	4.54	5.97	5.59	2.97	27.62
11	7.34	3.84	4.46	4.76	2.57	22.97
111	5.18	3.60	2.85	3.98	2.43	18.04
IV	8.28	4.84	6.10	6.90	2.68	28.80

paratype female were found preserved in different spider collections, a very similar shape of the eye group, sternal sigillae and spinnerets in both specimens indicates that they belong to the same species.

Distribution: The new species is known only from Sumatra.

Atmetochilus lehtineni sp. n.

(Figures 2c-e, 3c,d, 4c,d, 5c,d, 6c,d,e, 7b,c, 8b,c, 9b,c, 10b,c, 11b,c, and 12c,d) urn:lsid:zoobank.org:act:25C136AF-09D7-4439-A771-2765277E43E5

Types: ♂ holotype (ZMUT) - INDONESIA: Sumatra, Sumalumgun, Pisarani (ca. 2°58'N 99°16'E, 100-200 m), roadside wall, 22.09.1978, P. Lehtinen. Paratypes: $2 \stackrel{\circ}{_{+}}$, $1 \stackrel{\circ}{_{+}}$ subad., 2 juv. (ZMUT) - collected together with the holotype; 1 β

(SMF 7674) - "Sumatra" (no other data).

Etymology: Named after our friend and senior colleague, a prominent Finnish arachnologist Pekka Lehtinen (Turku, Finland).

Diagnosis: The species differs from all other species of Atmetochilus by the following characters: AME is noticeably larger than other eves (smaller in other species); posterior sternal sigilla smaller and broader spaced from each other vs. larger and confluent). Additionally, A. lehtineni sp. n. may be distinguished from A. fossor and A. atriceps by the presence of cuspules on the labium (vs. unarmed state) and from A. koponeni sp. n. and A. sumatranus sp. n. - by having 5 well developed tegular ridges (cf. Figures 8-11). Males of A. lehtineni sp. n. differ from those of A. bifidus by shorter, stouter and somewhat swollen metatarsus I (longer and uniformly slender in the

Fig. 5. Atmetochilus, holotype males (a, c, e) and paratype females (b, d): labium, sternum and maxillae, ventral view. (a, b) A. koponeni sp. n.; (c, d) A. lehtineni sp. n.; (e) A. sumatranus sp. n. (scale bar = 1 mm).



latter species - *cf.* Figures 6c,d and Gravely 1935: fig. 1a).

Description: Male (holotype). Habitus as in figures 2c,d. Body length 25.50. Colour in alcohol: carapace and chelicerae uniformly very dark chestnut-brown; labium, sternum, maxillae, palps and legs intensive orange-brown; dorsal abdomen dark brown and densely spotted with numerous small light brown marks, ventral abdominal surface and spinnerets light greyish-brown.

Carapace (Figure 3c) 9.69 long, 8.38 wide. Eye tubercle and clypeus as shown in figure 4c. Eye sizes and interdistances: AME 0.39 (0.53), ALE 0.33, PLE 0.26, PME 0.21; AME-AME 0.21



Fig. 6. *Atmetochilus*, holotype males: tibia and metatarsus I shown entirely (a, c, f) and in part (d), and tibial spur close-up (b, e, f), retrolateral view: (a, b) *A. koponeni* sp. n.; (c-e) *A. lehtineni* sp. n.; (f, g) *A. sumatranus* sp. n. (scale bar = 1 mm).

(0.11), ALE-AME 0.27 (0.20), ALE-PLE 0.18, PLE-PME 0.10, PME-PME 0.88. Rastellum consists of 10-11 robust and long cone spines. Cheliceral furrow with 8-9 promarginal teeth and *ca*. 20 mesobasal denticles each. Labium, sternum and maxillae as shown in Figure 5c. Labium 0.93 long, 1.74 wide, with 2 tiny cuspules. Sternum 5.43 long, 4.41 wide. Maxillae with about 15-20 tiny and almost indistinct cuspules each. Palp and leg measurements as shown in Table 3.

Spination: Femora I-III with few dorsal bristles (femur IV also with 4-5 thin basodorsal spines and few dorsoapical spinules), patellae III with few and IV with numerous pro- and retrolateral spinules; palp entirely, patellae I-II and tarsi I-II aspinose. Leg I: tibia p1a, pv0-0-2M, rv1-0-0; metatarsus v0-1-1-1-2. Tibia and metatarsus I and tibial process carrying megaspines as shown in Figures 6c-e. Leg II: tibia v1-1-1-0; metatarsus v0-1-2-1-2. Leg III: tibia p1-1, r1-1-1, v1-1-3; metatarsus d2-2-2, p1-1-2-1, r1-1-1, v2-1-2-1-3; tarsus p2, v2. Leg IV: tibia r1-1, v1-1-3; metatarsus d0-0-1-2, p0-1-1, r1-0-0, v2-1-2-1-3; tarsus p2 v2.

Scopula: dense, distal on metatarsus I; entire on tarsi I and II; vestigial to absent on tarsi III and IV. Paired claws on tarsi I-III with 5-6 teeth in one S-shaped row, on tarsus IV - with basal cluster of 3 teeth and one distant small subapical tooth; unpaired claw moderately small and steeply curved. Trichobothria: 2 rows of 8-10 per row on tibiae, 10-12 on metatarsi, 10-13 on tarsi, 8 on cymbium.

Palp: cymbium aspinose (Figures 7b,c); bulb

with low long carina; tegulum with 5 well developed ventral ridges; embolus curved (Figures 8b,c, 9b,c, 10b,c, 11b,c).

Spinnerets: PMS: 1.16 long; diameter 0.43. PLS: maximum diameter 0.96; length of basal, medial and apical segments 1.79, 1.07, 1.06; total length 3.92; apical segment short-digitiform.

Female (paratype): Habitus as in Figure 2e. Body length 29.30. Colour in alcohol as in male, but carapace coloured only slighter darker than legs, medium chestnut-brown.

Carapace (Figure 3d) 9.07 long, 7.32 wide. Eye tubercle and clypeus as shown in figure 4d,e. Eye diameters and interdistances: AME 0.36 (0.50), ALE 0.53, PLE 0.40, PME 0.29; AME-AME 0.16 (0.04), ALE-AME 0.30 (0.22), ALE-PLE 0.16, PLE-PME 0.06, PME-PME 0.85. Rastellum consists of 7-8 very robust and 4-5 more slender long cone spines. Cheliceral furrow with 8-9 promarginal teeth and 20-25 mesobasal denticles. Labium, sternum and maxillae as shown in Figure 5d. Labium 1.20 long, 1.51 wide, with 4 cuspules. Sternum 5.38 long, 4.58 wide. Maxillae with 22-25 cuspules each. Palp and leg measurements as shown in Table 4.

Spination: Femora I-III with few dorsal bristles (femur IV also with 4-5 thin basodorsal spines and few dorsoapical spinules), patellae III with few and IV with numerous pro- and retrolateral spinules; patellae I-II and tarsi I-II aspinose. Palp: tibia p1-2, v1-1-2; tarsus p1, v2. Leg I: tibia v1-1-0-0; metatarsus v1-1-1-1-3. Leg II: tibia v1-1-0-0; metatarsus v1-2-1-3. Leg III: tibia p4(3), r1-1, v1-

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	4.42	2.19	4.38	-	2.10	13.09
1	8.40	3.75	7.06	6.67	3.28	29.16
11	7.05	3.72	5.60	6.09	3.04	25.50
111	5.56	3.30	4.22	6.18	2.98	22.24
IV	8.71	3.78	7.29	8.41	3.22	31.41

 Table 3. Atmetochilus lehtineni sp. n., male holotype, length of palpal and leg segments

Fable 4. Atmetochilus lehtineni sp. n.,	female paratype, ler	ength of palpal and	leg segments
---	----------------------	---------------------	--------------

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	4.70	2.33	3.60	-	3.59	14.22
I	7.26	3.59	5.08	4.81	3.05	23.79
II	6.18	3.34	3.92	4.15	2.78	20.37
111	4.76	2.71	2.85	3.77	2.87	16.96
IV	7.51	4.12	5.54	5.95	2.83	25.95



Fig. 7. Atmetochilus, holotype males: palp, retrolateral (a, b, d) and prolateral (c) view: (a) *A. koponeni* sp. n.; (b, c) *A. lehtineni* sp. n.; (d) *A. sumatranus* sp. n. (scale bar = 1 mm).

1-3; metatarsus d12(10), p8(5), r5, v *ca*. 15; tarsus p4, v1. Leg IV: tibia r1-1, v1-1-3; metatarsus d1-1-2, p0-1-1, v10(9); tarsus p2 v2.

Scopula: dense, absent on metatarsus I-II and tarsi III-IV; entire on palpal tarsus and tarsi I and II. Palpal claw with 2 probasal tiny teeth. Paired claws on tarsi I-II with one tooth on inner and 4-5 teeth on outer margin; on tarsi III - with basal outer cluster of 3 teeth, on tarsus IV - with same cluster of 2 teeth, unpaired claw moderately small and steeply curved. Trichobothria: 2 rows of 8-9 per row on tibiae, 12-15 on metatarsi, 12-13 on tarsi, 15 on palpal tarsus. Spermathecae as in figures 12c,d; apical half strongly bent (almost to right angle); height and width in the base almost subequal, stems separated by basal width of spermatheca, heads separated by about 1.5 basal width.

Spinnerets (Figure 4e). PMS: length 1.08; diameter 0.51. PLS: maximum diameter 1.09; length of basal, medial and apical segments 1.60, 0.96, 0.95; total length 3.51; apical segment short-digitiform.

Distribution: The new species is known only from Sumatra.



Fig. 8. Atmetochilus, holotype (a, b, d) and paratype (c) males: bulb, retrolateral view. (a) *A. koponeni* sp. n.; (b, c) *A. lehtineni* sp. n.; (d) *A. sumatranus* sp. n. (scale bar: a, d = 1 mm; b, c = 0.5 mm).

(Figures 2f, 3e, 4f, 5e, 6f,g, 7d, 8d, 9e, 10d, and 11d,e) urn:lsid:zoobank.org:act:088B7C5E-1640-4145-B8D9-ADBD1847F9E8

Types: δ holotype - INDONESIA: Sumatra, Pantai Permai, near sea coast, 3°39'N, 98°58'E, 19.02.1913, O. Zohn - 1 δ (ZISP).

Etymology: Named after the distribution area: Sumatra Island.

Diagnosis: Atmetochilus sumatranus sp. n. can be distinguished from *A. fossor* and *A. atriceps* by presence of cuspules on the labium (vs. unarmed state) and from *A. koponeni* sp. n. and *A. lehtineni* sp. n. - by having two well developed tegular ridges (*cf.* Figures 8-11). Males of *A. sumatranus* sp. n. differ from those of two latter species as well as from males of *A. bifidus* by a narrower prodistal process on tibia I carrying one megaspine (vs. two megaspines in all other male congeners - *cf.* Figures 6b,e,g and Gravely, 1935: figure 1a).

Description: Male (holotype). Habitus as shown in figure 2f. Body length 19.87. Colour in alcohol: carapace including eye tubercle and chelicerae intensive reddish-orange; eyes circled with blackish markings; labium, sternum, maxillae, palps and legs light to medium yellowish-orange; abdomen and spinnerets light greyish brown, dorsal abdominal pattern uniformly medium brown. Carapace (Figure 3e) 7.70 long, 7.13 wide. Eye tubercle and clypeus as shown in figure 4f. Eye sizes and interdistances: AME 0.26 (0.50), ALE 0.47, PLE 0.36, PME: 0.24; AME-AME 0.33 (0.05), ALE-AME 0.24 (0.16), ALE-PLE 0.16, PLE-PME 0.04, PME-PME 0.81. Rastellum weak, composed of 4-5 thick setae in front of fang base. Cheliceral furrow with 7-8 promarginal teeth and 9-12 mesobasal denticles. Labium, sternum and maxillae as shown in Figure 5e. Labium 0.84 long, 1.36 wide, without cuspules. Sternum 4.43 long, 3.65 wide. Maxillae with 11-12 tiny cuspules confined to probasal edge. Palp and leg measurements as shown in Table 5.

Spination: Femora I-III with 1-2 (femur IV with 4-6) basodorsal spines and few stiff bristles (undeveloped spines) located medially and distally; femora III-IV also with few dirsodistal spinules, patellae III-IV with numerous pro- and retrolateral spinules; tibia III dorsally with about 15 stiff bristles; palp entirely, patellae I-II and tarsi I-II aspinose. Leg I: tibia pv0-0-M, rv1-0-0; metatarsus v1-1-3. Tibia and metatarsus I and tibial process carrying megaspines as shown in Figures 6f,g. Leg II: tibia v1-1-2; metatarsus v1-2-1-2-3. Leg III: tibia p1-1, r1-1, v1-1-3; metatarsus p1-1-1-1, r1-1-1, v2-2-2-1-4(3); tarsus p5, v3. Leg IV: tibia r0-0-1-0, v1-1-3; metatarsus d1(0)-0-1-1, p0-1-1-1-2, r0-1-1, v0-1-1-1-4; tarsus p2 v3(2).

Scopula: relatively dense, distal on metatarsus I; entire on tarsi I and II; vestigial to



Fig. 9. Atmetochilus, holotype (a, d, e) and paratype (b, c) males: bulb, prolateral (a, b), retrolateral (c) and retrodorsal (d, e) view. (a) *A. koponeni* sp. n.; (b, c) *A. lehtineni* sp. n.; (d, e) *A. sumatranus* sp. n. (scale bar: a, c, e = 0.2 mm; b, d = 0.5 mm).

page 13 of 17

absent on tarsi III and IV. Paired tarsal claws with 4-5 teeth in S-shaped row, unpaired claw very small and gently curved. Trichobothria: 2 rows of 7-8 per row on tibiae, 9-12 on metatarsi, 9-11 on tarsi, 8 on cymbium.

Palp: cymbium aspinose (Figure 7d); bulb with protruding carina; tegulum with 2 well developed ridges, ridges form coil in ventral view; embolus curved (Figures 8d, 9d,e, 10d, 11d,e).

Spinnerets: PMS: 1.01 long; diameter 0.33. PLS: maximum diameter 0.85; length of basal,

medial and apical segments 1.72, 0.84, 0.77; total length 3.33; apical segment short-digitiform.

Female unknown.

Distribution: The new species is known only from the type locality.

DISCUSSION

Shortly after being described as a member of the "Aviculariidae" (which now corresponds



Fig. 10. Atmetochilus, holotype (a, d) and paratype (b, c) males: bulb, retrodorsal (a), retrolateral (b) and prodorsal (c, d) view. (a) *A. koponeni* sp. n.; (b, c) *A. lehtineni* sp. n.; (d) *A. sumatranus* sp. n. (scale bar: a, c = 0.2 mm; b, d = 0.5 mm).

Table 5.	Atmetochilus	sumatranus sp.	n., male	holotype,	length	of palpal	and leg segments
----------	--------------	----------------	----------	-----------	--------	-----------	------------------

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	3.58	1.89	3.43	-	1.51	9.71
I	7.45	3.69	5.11	4.68	2.60	21.90
11	6.33	3.12	3.51	4.26	2.23	18.01
111	4.75	2.84	2.89	4.13	2.39	15.88
IV	7.49	3.36	5.29	5.87	2.43	22.80

almost to the entire infraorder Mygalomorphae), Atmetochilus was placed by its author, Simon (1892), into the tribe Cyrtauchenieae of the subfamily Ctenizinae. That tribe mostly united the genera assigned currently to the families Cyrtaucheniidae Simon, 1892 and Euctenizidae Raven, 1985, whereas that subfamily did not exactly correspond to the currently recognized Ctenizidae but incorporated all the trionychous mygalomorph trapdoor spiders known to date. Within the mentioned subfamily, Atmetochilus was considered to resemble Entychides Simon, 1888 (located currently in the Euctenizidae). Though Simon also included Damarchus in his Cyrtauchenieae, he considered this genus to be most closely related to the nemesiid Stenoterommata Holmberg, 1881. In contrast, Spiroctenus Simon, 1889, where males also possess one S-shaped teeth row on PTC, was placed in the tribe Nemesieae (Simon 1889, 1892).

When Simon (1903) presented the next mygalomorph classification, he retained *Atmetochilus* and *Spiroctenus* within the same spider group, but transferred *Damarchus* to the tribe Amblyocareneae; he also established the tribe Bemmereae to include five genera - all later considered invalid and synonymised with either *Spiroctenus* or the cyrtaucheniid *Homostola* Simon, 1892 (Purcell 1904, Hewitt 1916, Raven 1985). This remained unchanged in the spider classifications of Petrunkevitch (1928) and Caporiacco (1938), with the only exception being that they followed Pocock (1897, 1903) in elevating Simon's subfamilies to families.

Raven (1985) regrouped Atmetochilus together with Damarchus and Spiroctenus



Fig. 11. *Atmetochilus*, holotype (a, b, d) and paratype (c) males: bulb, ventral (a-d) and dorsal (e) view: (a) *A. koponeni* sp. n.; (b, c) *A. lehtineni* sp. n.; (d, e) *A. sumatranus* sp. n. (scale bar: a-d = 0.5 mm; e = 0.2 mm).

(= *Bemmerus* Simon, 1903). He proposed the monophyly of this group on the basis of possession of one S-shaped teeth row on PTC in males and the subcentral position of the posterior sternal sigilla. Having placed this triad within Simon's Bemmereae (refined from the invalid other genera), he elevated the former taxon to the subfamily Bemmerinae and transferred it from the Ctenizidae to the Nemesiidae. An additional genus, the monotypic *Pionothele*, with biserially toothed PTC in the only known male of *P. straminea* Purcell, 1902, was also tentatively added to this group.

Damarchilus, the very large nemesiid and the latest genus assigned to this subfamily, was described from India and stated to share characters with both *Damarchus* and *Atmetochilus* (Siliwal et al. 2015). Since the genus, currently containing two species, has been described only from females, there is no information concerning so important male character as a dentition of the tarsal claws. However, when visited SMF in 2014, the senior author (SZ) had a possibility to examine a pair of large male nemesiids from Thailand, most probably representing an undescribed species of *Damarchilus* and clearly possessing one S-shaped teeth row on PTC.

Since prior to this study Atmetochilus has been known predominantly from females, the corresponding characters regarding male features were unknown or feebly described. Gravely (1935) first illustrated a male actually belonging to the Atmetochilus but assigned originally to Damarchus; at that he did not count any significance neither to the structure of first male leg he had illustrated nor to peculiarities of the bulb (even not described). Raven (1985) first mentioned for Atmetochilus the presence of keels on the bulb (an observation based upon the undescribed male congeners in MNHL). However, apart from S-shaped claw dentition in males, he did not use the former character for Atmetochilus in the key to the nemesiid genera published in the same monograph.



Fig. 12. *Atmetochilus*, paratype females: receptacles Fig. d with using reflecting (a, c) and transmitted (b, d) microscopy, respecively, ventral view: (a, b) *A. koponeni* sp. n.; (c, d) *A. lehtineni* sp. n. (scale bar: a = 0.5 mm; c = 0.2 mm).

While examining the available material and published data used in our previous work (Zonstein and Marusik 2014) and in the course of the current study, we observed that the structure of the tibia and the metatarsus I in males belonging to Damarchus and Spiroctenus differs essentially from those of Atmetochilus. The tibial process in two former genera carries a single megaspine, less modified in Damarchus, but combined with a prolateral sessile thorn in Spiroctenus (cf. Zonstein and Marusik 2014, figs. 1, 17, 21-23 and Raven 1985, fig. 61, respectively). The shape of the tibial process in the above-noted presumed males of Damarchilus does not differ significantly from that in the members of *Damarchus*. On the contrary, in Atmetochilus the same structure has been found to bear mostly two and sometimes only one megaspine (in A. sumatranus sp. n.) - see Figures 6a-g. Within other nemesiid genera, the similar twin megaspines set on the raised proventral process were found only outside the Bemmerinae: in Brachythele Ausserer, 1871 and Calisoga Chamberlin, 1937 (Chamberlin 1937, fig. 5; Raven 1985, fig. 91; Goloboff 1995, fig. 81D; Zonstein 2007, figs. 5, 6).

The male metatarsus I was found to be flattened and densely covered with tiny ventral spinulae, in both *Atmetochilus bifidus* (Zonstein and Marusik 2014, fig. 25) and in all three Sumatran congeners described above (Figure 6a,c,d,f). No similar modification has been observed in males belonging to other nemesiid genera.

The presence of a dorsal tegular mound provided with raised dentate keels appears to be one more possible generic authapomorphy. Strictly speaking, the elevated subparallel keels and ridges on the bulb are known for many members of the family; these structures are especially well developed in the South American genera Rachias Simon, 1892, Stenoterrommata Holmberg, 1881, some Acanthogonatus Karsch, 1880, Pycnothele Chamberlin, 1917 (Goloboff 1995, figs. 65F, J, 66A-C, 67C-E, 72J, 73D, 74E, 114D, 116B) and Psalistopoides Mello-Leitão, 1934 (Lucas and Indicatti 2006, figs. 1-6). However, except for Atmetochilus those keels and ridges have never been observed clustered together to form a raised dentate comb (cf. Figures 8a-d, 9a-e, 10a-d, 11ae). Raven (1985) notes that undescribed males of Atmetochilus from Myanmar also possess a keeled tegular process characteristic for the abovedescribed Sumatran species.

Thus, the presence of a single S-shaped

page 16 of 17

tooth row on PTC in males, combined with a distal proventral spur bearing 1-2 megaspines on male tibia I, additionally confirm the true allocation of *Atmetochilus* to the genera of the subfamily Bemmerinae. A specific configuration of the male bulb provided with the unique dentate comb, together with a shape of the tibial spur carrying mostly two megaspines (rather than a single one), and a strongly flattened metatarsus I, distinguish *Atmetochilus* from its affinities, in addition to the already known character - the unique form of the confluent sternal sigilla.

CONCLUSIONS

The genus *Atmetochilus*, known previously only from Eastern India and Myanmar, is found to be represented in Sumatra by three new species described above: *A. koponeni* sp. n., *A. lehtineni* sp. n. and *A. sumatranus* sp. n. The male characters, which were for the first time figured and considered in details, confirm the current allocation of *Atmetochilus* within the subfamily Bemmerinae Simon, 1903 and provide the additional arguments to distinguish it from the related genera.

List of abbreviations

a: apical; ALE: anterior lateral eyes; AME: anterior median eyes; d: dorsal; M: megaspine (stout curved spine on tibial process); p: prolateral; PLE: posterior lateral eyes; PLS: posterior lateral spinnerets; PME: posterior median eyes; PLS: posterior median spinnerets; PTC: paired tarsal claws; pv: proventral; r: retrolateral; rv: retroventral; UTC: unpaired tarsal claw; v: ventral.

Acronyms

IEE: Institute of Ecology and Evolution, Russian Academy of Sciences, Moscow, Russia

MNHL: Museum of Natural History, London, UK

MNHN: Muséum national d'Histoire naturelle, Paris, France

MRAC: Musée royal de l'Afrique centrale, Tervuren, Belgium

NRS: Naturhistoriska riksmuseet, Stockholm, Sweden

SMF: Senckenberg Museum, Frankfurt-am-Main, Germany

ZISP: Zoological Institute, Russian Academy of Sciences, St.-Petersburg, Russia

ZMUT: Zoological Museum, University of

Turku, Turku, Finland

Acknowledgments: This work and the new subspecies name have been registered with ZooBank under urn:lsid:zoobank. org:pub:FBFD6FC4-16EB-4CF7-81D9-66175DE70D58. SLZ was responsible for species description, examination of the materials, making habitus photographs and in drafting the manuscript. YMM drafted the manuscript and revised it critically for important intellectual content, made figures of copulatory organs and assembled all figures into the plates. All authors read and approved the final manuscript. We are thankful to all colleagues who helped us in the course of this study. Seppo Koponen (ZMUT) kindly provided us with most part of the studied material and with working facilities when we temporarily worked in Turku. Peter Jäger & Julia Altmann (SMF) generously helped to examine the SMF spider collection, where some additional material also has been obtained. Janet Beccaloni (MNHL). Christine Rollard (MNHN) and Rudy Jocqué (MRAC) kindly provided us with a possibility to obtain and examine the comparative material. Andrei Tanasevich (IEE) friendly helped us with the imagery processing. Naomi Paz (TAU) kindly checked and corrected the English of the final draft. We are also grateful to the reviewers for their helpful comments. The project was supported in part by Ministry of Absorption, Israel.

REFERENCES

- Caporiacco L di. 1938. Il sistema degli Araneidi. Archivio Zoologico Italiano 25 (Suppl. 4):35-155.
- Chamberlin RV. 1937. On two genera of trap-door spiders from California. Bulletin of the University of Utah **28(3):**1-11.
- Goloboff PA. 1995. A revision of the South American spiders of the family Nemesiidae (Araneae, Mygalomorphae). Part I: species from Peru, Chile, Argentina, and Uruguay. Bulletin of the American Museum of Natural History **224:**1-189.
- Gravely FH. 1935. Notes on Indian mygalomorph spiders. II. Records of the Indian Museum, Calcutta **37**:69-84.
- Hewitt J. 1916. Descriptions of several species of Arachnida in the collection of the Durban Museum. Annals of the Durban Museum **1**:217-227.

- Lucas SM, Indicatti RP. 2006. On the genus *Psalistopoides* Mello-Leitão, 1934 (Araneidae, Mygalomorphae, Nemesiidae). Revista Brasileira de Zoologia **23(2):**547-549.
- Petrunkevitch A. 1928. Systema Aranearum. Transactions of the Connecticut Academy of Arts and Sciences 29:1-270.
- Pocock RI. 1897. On the spiders of the suborder Mygalomorphae from the Ethiopian region, contained in the collection of the British Museum. Proceedings of the Zoological Society of London **1897**:724-774.
- Pocock RI. 1900. The fauna of British India, including Ceylon and Burma. Arachnida. London, pp. 1-279.
- Pocock RI. 1903. The geographical distribution of spiders of the order Mygalomorphae. Proceedings of the Zoological Society of London **1**:340-368.
- Purcell WF. 1904. Descriptions of new genera and species of South African spiders. Transactions of the South African Philosophical Society 5:15-173.
- Raven RJ. 1985. The spider infraorder Mygalomorphae (Araneae): Cladistics and systematics. Bulletin of the American Museum of Natural History **182:**1-180.
- Raven RJ, Schwendinger PJ. 1995. Three new mygalomorph spider genera from Thailand and China (Araneae). Memoirs of the Queensland Museum **38:**623-641.
- Siliwal M, Molur S, Raven RJ. 2015. New genus with two new species of the family Nemesiidae (Araneae: Mygalomorphae) from Arunachal Pradesh, India. Journal of Asia-Pacific Biodiversity 8:43-48.
- Simon E. 1887. Etude sur les arachnides de l'Asie méridionale faisant partie des collections de l'Indian Museum (Calcutta). I. Arachnides recueillis à Tavoy (Tenasserim) par Moti Ram. Journal of the Asiatic Society of Bengal 56:101-117.
- Simon E. 1889. Arachnides. In: Voyage de M. E. Simon au Venezuela (décembre 1887-avril 1888). 4e Mémoire. Annales de la Société Entomologique de France 6(9):169-220.
- Simon E. 1892. Histoire naturelle des araignées. Paris 1:1-256.
- Simon E. 1903. Histoire naturelle des araignées. Paris 2:669-1080.
- Schwendinger PJ. 1996. The fauna of orthognathous spiders (Araneae: Mesothelae, Mygalomorphae) in Thailand. Revue Suisse de Zoologie, special edition **2**:577-584.
- World Spider Catalog. 2015. World Spider Catalog. Natural History Museum Bern, online at http://wsc.nmbe.ch, version 16.0. Accessed on 15 June 2015.
- Zonstein SL. 2007. A new species of the mygalomorph spider genus *Brachythele* Ausserer, 1871 (Aranei: Nemesiidae) from Greece. Arthropoda Selecta **16:**15-17.
- Zonstein SL, Marusik YM. 2014. A redescription of *Damarchus cavernicola* Abraham, 1924, with notes on *Damarchus* Thorell, 1891 and *Atmetochilus* Simon, 1887 (Aranei: Nemesiidae). Arthropoda Selecta **23(3):**273-278.