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Atrichadenotecnum multispinosus* sp. n. (Psocoptera: Psocidae) from southwestern China, with new synonyms and new combinations from *Psocomesites* and *Clematostigma

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Abstract

Atrichadenotecnum multispinosus sp. n. is described from southwestern China. *Psocomesites* and *Clematostigma* from China are discussed, with five species transferred to *Atrichadenotecnum* and four species placed as new synonyms. Keys to adult males and females of *Atrichadenotecnum* species are presented.

Key words: Psocoptera, Psocidae, *Atrichadenotecnum*, *Psocomesites*, *Clematostigma*, new synonyms, new combinations, new species, keys

Introduction

The genus *Atrichadenotecnum* was erected by Yoshizawa (1998), with *A. quadripunctatum* from Japan as the type species. Species of this genus are very similar to those of *Trichadenotecnum* Enderlein in having marginal markings and triangular areola postica on the fore wing. However, male and female genitalic characters show that the two genera are assignable to different tribes (Yoshizawa, 1998). This relationship was also supported molecularly, and *Atrichadenotecnum* is now assigned to its own independent tribe, *Atrichadenotecnini*, and *Trichadenotecnum* to the tribe *Ptyctini* (Yoshizawa & Johnson, 2008). *Atrichadenotecnum* is characterized by maculate fore wings with continuous or distinct marginal markings, triangular areola postica, and small to medium sized body. In the male genitalia, the hypandrium is asymmetrical to form a pair of sinuate processes or is almost symmetrical with two tiers of projections, and the phallosome is closed and always asymmetrical. Female genitalia usually have a short stout egg-guide, with pigmented arms forming V-shaped regions, sometimes with a median band.

Morphological examination of the new species described below indicated that this is closely related to *Psocomesites laricolum* Li from northeastern China, due to similar fore wing and male genitalic characters. In addition, we found species of *Clematostigma* that match the generic definition of *Atrichadenotecnum* rather than *Clematostigma*, and we here transfer all species of *Clematostigma* and *Psocomesites* described from China to *Atrichadenotecnum*. With one new species described below, this genus now includes 13 species, all from Asia. These comprise two species from Japan, two from Indonesia, one each from Sri Lanka and Malaysia,

and seven from China, including Taiwan and Hong Kong (Table 1).

Material and methods

Specimen preparation and measurements were undertaken following Liu et al. (2011). All the specimens examined are deposited in the Entomological Museum of China Agricultural University (CAU), Beijing.

The following abbreviations are used: Bw = distance between top of post clypeus and apex of fore wing; B = body length; F = length of hind femur; f1, f2, f3 = length of first to third flagellomeres; FW = fore wing length; HW = hind wing length; IO/d = least distance between compound eyes divided by lateral diameter of a compound eye in either anterior or dorsal view; Mx4 = length of distal segment of maxillary palpus; T = length of hind tibia; t1, t2 = length of hind first and second tarsomeres.

TABLE 1. Checklist of *Atrichadenotecnum* species.

- Atrichadenotecnum forcipata* (Li) comb. n. China
 Clematostigma forcipata Li, 2002: 1429.
- Atrichadenotecnum guangzhouense* (Li) comb. n. China
 Psocomesites guangzhouense Li, 2002: 1458.
 Psocomesites guangzhouensis Li. Lienhard, 2003: 715.
- Atrichadenotecnum laricolum* (Li) comb. n. China
 Psocomesites laricolum Li, 2002: 1454.
- Atrichadenotecnum multidontatum* (Li) comb. n. China
 Psocomesites multidontatum Li, 1995b: 77; 2002: 1453.
- Atrichadenotecnum multispinosus* sp. n. China (Guizhou)
 Atrichadenotecnum nebulosum (Vaughan et al.) Indonesia
- Trichadenotecnum nebulosum* Vaughan et al., 1991: 154.
 Atrichadenotecnum nebulosum (Vaughan et al.) Endang et al., 2002: 141.
- Atrichadenotecnum nudum* (Thornton) Taiwan, Hong Kong.
 Trichadenotecnum nudum Thornton, 1961: 14.
 Atrichadenotecnum nudum (Thornton). Yoshizawa 1998: 201.
- Atrichadenotecnum quadripunctatum* Yoshizawa, 1998: 205 Japan.
- Atrichadenotecnum quinquepunctatum* (McLachlan) Sri Lanka,
 Psocus quinquepunctatum McLachlan, 1872: 75.
 Trichadenotecnum quinquepunctatum (McLachlan). Enderlein, 1909: 330.
- Atrichadenotecnum quinquepunctatum* (McLachlan). Yoshizawa 1998: 208.
- Atrichadenotecnum ryukyuense* Yoshizawa, 1998: 201 Japan.
- Atrichadenotecnum trifurcatum* (Li) comb. n. China, Taiwan. P
 socomesites trifurcatum Li, 1993: 403; 2002: 1455.
 Psocomesites bimaculatum Li, 1995a: 189, 2002: 1457 syn. n.
 Atrichadenotecnum tayal Yoshizawa, 1998: 203 syn. n.
 Clematostigma excavata Li, 2002: 1428 syn. n.
 Psocomesites edentalum Li, 2005: 102 syn. n.
- Atrichadenotecnum umbratum* (New & Thornton) Malaysia

Trichadenotecnum umbratum New & Thornton, 1975: 415.
 Atrichadenotecnum umbratum (New & Thornton). Endang et al., 2002: 143.
 Atrichadenotecnum yoshizawai Endang et al., 2002: 142 Indonesia

Key to adult males of Atrichadenotecnum

1. Submarginal markings in fore wing not extending to wing margin, appearing as distinct spots 2
 - Submarginal markings in fore wing extending to wing margin, sometimes continuous 4
2. Fore wing with submarginal markings in cell R3 A. quinquepunctatum
 - Fore wing without markings in cell R3 3
3. Submarginal markings in cell M1 and cell M2 continuous, vein M3 bordered with markings along entire length, hypandrium almost symmetrical with two tiers of processes A. multidontatum
 - Submarginal markings in cell M1 and cell M2 discontinuous, vein M3 bordered with markings only distally, hypandrium asymmetrical A. quadripunctatum
4. Fore wing with submarginal markings in cell R3, hypandrium bearing row of strong spikes on anterior and lateral margin A. yoshizawai
 - Fore wing without markings in cell R3, hypandrium not bearing strong spikes or only covered with denticles 5
5. Hypandrium almost symmetrical with two tiers of processes, pair of ventral projections always bearing denticles and leading postero-laterally, pair of distal processes curved and bearing a row of teeth 6
 - Hypandrium asymmetrical with denticulated field ventrally, pair of ventral projections asymmetrical and covering denticles, pair of distal processes asymmetrical with right process strongly protruded posteriorly A. trifurcatum
6. Fore wing with pterostigma entirely brown, hypandrium with five developed spines dorso-medially. A. multispinosus sp. n.
 - Fore wing with pterostigma hyaline basally, hypandrium without those spines 7
7. Dorsal shelf of clunium weakly developed, hypandrium pair of distal processes with row of sclerotized, blunt plate-like teeth A. ryukyuense
 - Dorsal shelf of clunium well developed, hypandrium pair of distal processes with row of sclerotized spines 8
8. Fore wing with nodal band continuous, phallosome gradually tapered apically with apex narrow A. nudum
 - Fore wing with nodal band discontinuous, phallosome parallel subapically with apex wide and flat A. laricolum

Key to adult females of Atrichadenotecnum

1. Submarginal markings in fore wing not extending to wing margin, appearing as distinct spots 2
 - Submarginal markings in fore wing extending to wing margin and continuous 3
2. Fore wing with submarginal markings in cell R3 A. quinquepunctatum

- Fore wing without markings in cell R3 *A. quadripunctatum* 3. Fore wing with submarginal markings in cell R3 4
- Fore wing without markings in cell R3 5
- 4. Fore wing cell M2 with large spot on basal half, subgenital plate with prominent row of long setae curved anteriorly in the middle *A. yoshizawai*
- Fore wing cell M2 without large spot on basal half, subgenital plate with prominent row of long setae not curved anteriorly in the middle *A. nebulosum*
- 5. Subgenital plate without median sclerotized band, or only with distinct markings anteromedially 6
- Subgenital plate with median sclerotized band 10
- 6. Forewing with pterostigma entirely brown 7
- Forewing with pterostigma hyaline basally 8
- 7. Fore wing with clouds of markings at basal half, subgenital plate with pigmented arm narrow posteriorly *A. umbratum*
- Fore wing without clouds of markings at basal half, subgenital plate with pigmented arm wide *A. forcipata*
- 8. Subgenital plate with pigmented arm narrow posteriorly, not extending to margin *A. nudum*
- Subgenital plate with pigmented arm wide posteriorly, almost extending to margin 9
- 9. Fore wing with nodal band continuous, Rs-M fusion almost as long as 1st section of Rs *A. guangzhouensis*
- Fore wing with nodal band discontinuous, Rs-M fusion shorter than half of 1st section of Rs *A. laricolum*
- 10. Fore wing with pterostigma entirely brown, subgenital plate with pigmented arm narrow posteriorly, not extending to margin. *A. ryukyuense*
- Fore wing with pterostigma hyaline basally, subgenital plate with pigmented arm wide posteriorly, almost extending to margin. *A. trifurcatum*

***Atrichadenotecnum multispinosus* sp. n.**

Male. Coloration (in alcohol). Body generally brown. Compound eyes grayish black; ocelli brown with dark brown ocellar field. Rest of head brown with dark brown markings. Antennae dark brown except scape, pedicel and first flagellar segment yellowish. Maxillary palpi dark brown. Thorax dark brown, with membranous regions paler. Legs brown, with margin of femora, distal part of tibiae, and tarsi dark brown. Fore wing (Fig. 1) hyaline with brown markings; basal region dark brown; nodal band continuous, without distinct spots; pterostigma entirely pigmented, without hyaline spots basally; submarginal markings continuous, ranging from cell R3 to middle of areola postica. Hind wing (Fig. 2) hyaline with pale brownish along anterior margin; veins brown except in basal regions white. Abdominal segments creamy brown, with brown irregular markings; apical regions dark brown. Morphology. Fore wing membranous, glabrous; Sc ending free in membrane, Rs and M fused for a distance, slightly shorter in length than 1st section of Rs; pterostigma triangular with apex

moderately rounded; distal closure of discoidal cell concave; areola postica triangular, with short roof almost of equal length as roof of cell M3; radial fork branches diverge at an angle less than 90°. Hind wing without marginal setae between R2+3 and R4+5. Phallosome (Figs. 3, 4) much longer than wide, gradually tapered apically, its left margin almost straight and right margin strongly curved to the left, apex with tiny projections. Hypandrium (Figs. 5, 6) almost symmetrical, with five developed spines dorso-medially (two in left and three in right); pair of serrated ventral projections strongly projected dorso-laterally; distal margin with pair of processes bearing with fine spines. Clunium (Fig. 7) with dorsal margin straight and slightly extended posteriorly. Epiproct (Fig. 7) with almost straight posterior margin, unsclerotized medially; paraprocts broad, with a strong apical spine, sensory fields with about 28 trichobothria.

Measurements. Bw: 3935, B: 2267, FW: 3233, HW: 2367; F: 573, T: 1253, t1: 393; t2: 146, fl: 492, f2: 372, f3: 338, Mx4: 121, IO/d: 705.

Female unknown.

Material examined. Holotype male, CHINA: Guizhou Province, Kuankuoshui Nature Reserve, 13.viii.2010, Luxi Liu (CAU).

Etymology. The species name refers to the prominent developed spines on the hypandrium.

Remarks. The new species appears to be closely related to *Atrichadenotecnum nudum* (Thornton, 1961) and *A. ryukyense* Yoshizawa, 1998, but can be distinguished from the two species by hypandrium characters with five strong spines dorso-medially.

***Atrichadenotecnum trifurcatum* (Li, 1993) comb. n.**

Psocomesites trifurcatum Li, 1993:403; 2002: 1455. *Psocomesites bimaculatum* Li, 1995a: 189; 2002: 1457 syn. n. *Atrichadenotecnum tayal* Yoshizawa, 1998: 203 syn. n. *Clematostigma excavata* Li, 2002: 1428 syn. n.

Psocomesites edentalum Li, 2005: 102 syn. n.

Material examined. *Clematostigma excavata*—Holotype ♂: CHINA, Shaanxi Prov., Huashan Reg., 21.viii.1962, Fasheng Li (CAU); *Psocomesites trifurcatum*—Holotype ♂: CHINA, Guangdong Prov., Chebaling Nature Reserve, 24.iv.1991, Fasheng Li (CAU); *Psocomesites bimaculatum*—Holotype ♂: CHINA, Zhejiang Prov., Baishanzu Nature Reserve, 24.ix.1993, Hong Wu; *Psocomesites edentalum*—Holotype ♂: CHINA, Guizhou Prov., Dashaha Nature Reserve, 5.v.2004. Maofa Yang.

Other material examined. CHINA: 1♀, Shaanxi Prov., Huashan Reg., 21.viii.1962, Fasheng Li (CAU); 1♂, Shanxi Prov., Guandishan Reg., 2.viii.1981, Chikun Yang (CAU); 1♀, Shanxi Prov., Guandishan Reg., 5.viii.1981, Fasheng Li (CAU); 1♂2♀, Guangdong Prov., Chebaling Nature Reserve, 24.iv.1991, Fasheng Li (CAU); 2♂, 23.iv.1991, same locality and collector; 1♂1♀, 25.iv.1991, same locality and collector; 1♂, Zhejiang Prov., Tianmushan Nature Reserve, 5.v.1998, Mingshui Zhao; 4♂3♀, Zhejiang Prov., Baishanzu Nature Reserve, 24.ix.1993, Hong Wu; 6♀, 20.xi.1993, same locality and collector; 1♀, Fujian Prov., Jianyang Co., Aotou To., 22.x.1974, Fasheng Li (CAU); 1♀, Guizhou Prov., Dashaha Nature Reserve, 5.v.2004. Maofa Yang; 1♀, Yunnan Prov., Yingjiang Co., Xima To., 5.v.

2011, Feiyang Liang (CAU); 1♀, Guizhou Prov., Leigongshan Nature Reserve, 14.iv.2005, Yi Tang; 1♂, Guizhou Prov., Leigongshan Nature Reserve, 4.vi.2005, Bingzhen Yan; 1♂, Fujian Prov., Wuyishan Nature Reserve, 8.vii.2009, Xiushuai Yang.

Remarks. *Psocomesites trifurcatum* was described by Li (1993) based on specimens from Guangdong, with *Psocomesites* newly recorded from China. The species was assigned to *Psocomesites* based mainly on the fore wing markings and venation, but Li pointed out that it differed from other species of this genus by distinct hypandrium characters. *Psocomesites bimaculatum* was described based on specimens from Zhejiang and Fujian, and *P. edentalum* was described from Guizhou on one male (accompanied by one female lacking genitalia). Both species were very similar to *P. trifurcatum*, but were differentiated by male hypandrium characters (Li, 1995a, 2005). *Clematostigma excavata* was described from Shaanxi and Shanxi, and the assignment was based mainly on the fore wing having a pterostigmal spurvein (Li, 2002). However, during our re-examination on these specimens, the pterostigmal spurvein was not a stable character, occasionally variational between the two wings of a single specimen. This is also true of *Psocomesites trifurcatum*. Moreover, after re-examining all specimens of the four species, we found the main characters of the wings and genitalia are nearly identical, e.g. the venation and markings in the fore wings, hypandrium and phallosome in male, and pigmented patterns of subgenital plate in female. Also they are mostly similar to another species, *Atrichadenotecnum tayal*, from Taiwan. Thus, we consider *P. bimaculatum*, *A. tayal*, *C. excavata* and *P. edentalum* to be junior synonyms of *A. trifurcatum*.

Discussion

The genus *Psocomesites* Roesler is a small group in tribe Ptyctini with the type species endemic to Brazil, and the distributional ranges of the two remaining species restricted to South America (Lienhard & Smithers, 2002). Li (1993, 1995a, 1995b, 2002) assigned six species from China to the genus, which makes the distributional area widely disjunct and thus assignments of the Chinese species to this genus highly questionable (Yoshizawa & Mockford, 2012). Judging from the published information, the genus *Psocomesites* is characterized by the *Trichadenotecnum*-type fore wing pattern, strong media processes in hypandrium, asymmetrical phallosome with prominent apical expansion, and female subgenital plate with pigmented arms forming a broad T-shape (Roesler, 1943; Badonnel, 1986; Thornton, 1961). During re-examination the Chinese species of *Psocomesites*, we found that genitalia of these six species from China do not match with the generic definition of *Psocomesites*, such as hypandrium lacking medial processes and phallosome lacking apical expansion in male, and subgenital plate with pigmented arms forming V-shaped regions with hyaline areas medially in female.

Two species from China placed in *Clematostigma* Enderlein meet the same situation. *Clematostigma* is now assigned to subfamily Kaindipsocinae and can be defined by the following characters: Rs and M fused for a length and spurvein present in fore wings; male hypandrium symmetrical, without teeth or apophyses; phallosome closed posteriorly and with long external parameres; female subgenital plate with long egg-guide lobe (Smithers, 1983; Yoshizawa et al., 2011). In contrast, the male genitalic structures of *C. excavata* Li do not correspond with this definition, the hypandrium being asymmetrical and dentate and the phallosome closed but simple. Moreover, these characters are more similar to those of *Psocomesites trifurcatum* Li and *Atrichadenotecnum quadripunctatum* Yoshizawa, the type

species of the genus *Atrichadenotecnum*. Therefore, all the species of *Clematostigma* and *Psocomesites* from China are here transferred to *Atrichadenotecnum* as new combinations.

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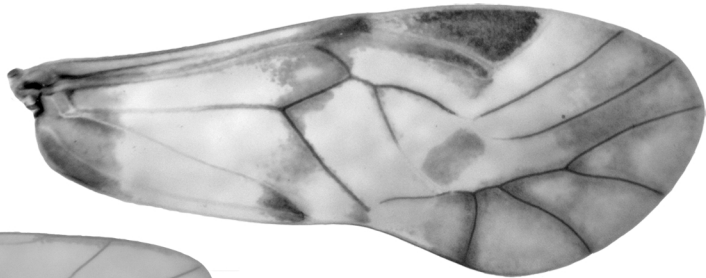
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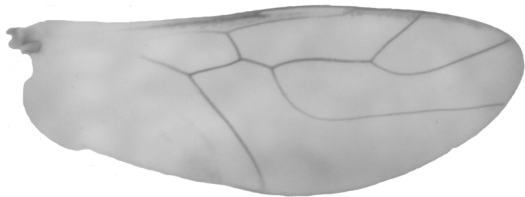
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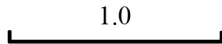
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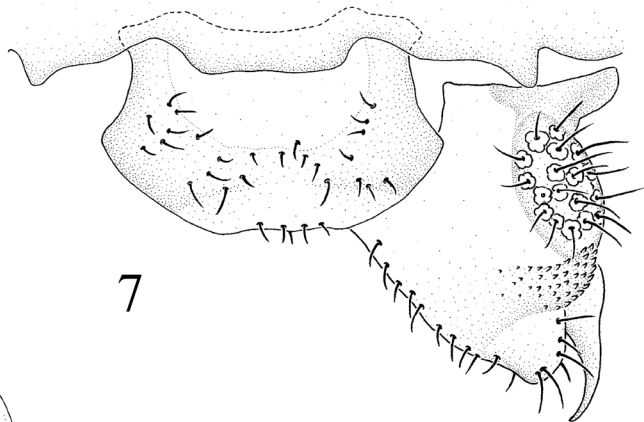
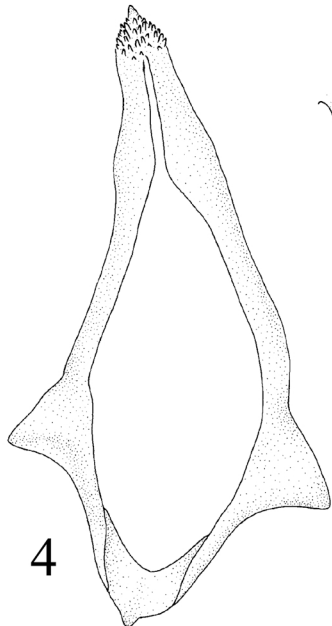
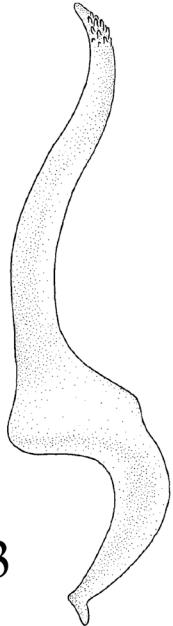
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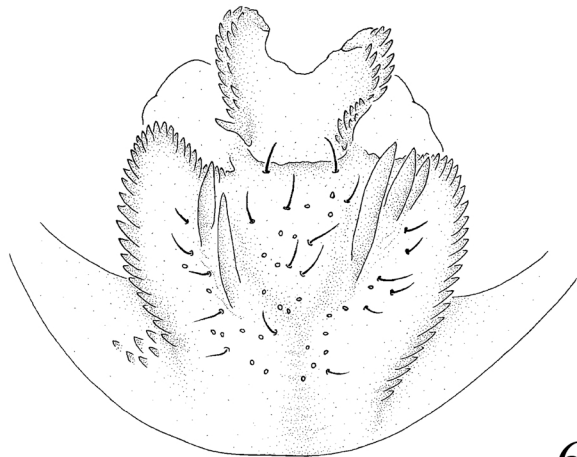
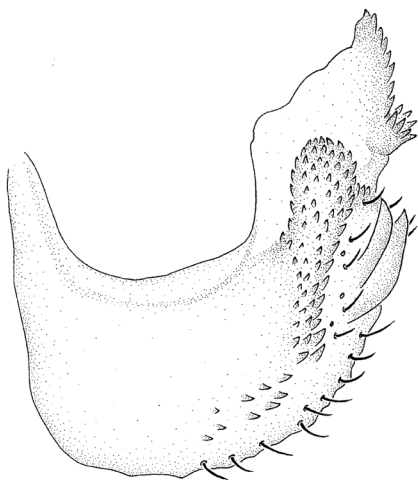
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