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Citation	Records of the Australian Museum, 58(3), 411-415 https://doi.org/10.3853/j.0067-1975.58.2006.1467
Issue Date	2006-11-29
Doc URL	https://hdl.handle.net/2115/47521
Type	journal article
File Information	RofAM58_2006_411.pdf



Systematic Position of *Trichadenotecnum enderleini* (Roesler) (Psocodea: “Psocoptera”: Psocidae)

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ABSTRACT. *Trichadenotecnum enderleini* (Roesler, 1943) is the only native species of the genus known from Australia to date. However, its exact systematic position is not firmly fixed mainly due to the lack of information on taxonomically and phylogenetically important morphological characters. In this study, *T. enderleini* is examined morphologically to clarify further its systematic position. The forewing markings and male terminal structures clearly show that the species lacks all apomorphies of *Trichadenotecnum* Enderlein, 1909 and is thus only distantly related to the genus. Therefore, *T. enderleini* is excluded from *Trichadenotecnum*. *Ptycta floresensis* Endang, Thornton & New, 2002 from Indonesia is considered to be the closest relative of *T. enderleini*, and *T. enderleini* is consequently transferred to the genus *Ptycta* Enderlein, 1925. As a result, Australia is excluded from the distributional range of *Trichadenotecnum*, except for *T. circularoides* Badonnel, 1955 considered to be introduced.

YOSHIKAWA, KAZUNORI, & COURTENAY N. SMITHERS, 2006. Systematic position of *Trichadenotecnum enderleini* (Roesler) (Psocodea: “Psocoptera”: Psocidae). *Records of the Australian Museum* 58(3): 411–415.

The genus *Trichadenotecnum* Enderlein, 1909 (“Psocoptera”: Psocidae) has long been characterized by the superficial similarities of forewing markings and venation and has included a heterogeneous assemblage of species. Although recent morphological and molecular analyses provided a clear limit of the genus as a monophyletic group (Yoshizawa, 2001, 2003, 2004), further examination of some species placed currently in the genus is required to clarify their exact systematic position. In particular, the correct systematic placement of the only endemic Australian species of the genus, *T. enderleini* (Roesler, 1943) (Smithers, 1996), is needed to understand more clearly the distributional range

and biogeography of the genus. Morphological characters of *T. enderleini* have not been examined since its original description, in which only fore- and hindwing venation and coloration were illustrated; no information on genital structures has been provided.

The species was originally described as *Psocus conspurcatus* Enderlein, 1903. Subsequently, the species was transferred to the genus *Trichadenotecnum* by Enderlein (1925) based on the superficial resemblance of forewing venation and markings. The specific epithet, *conspurcatus*, was preoccupied by *Psocus conspurcatus* Rambur, 1842 and thus Roesler (1943) gave the new specific epithet,

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enderleini, to the species and placed it in the genus *Psocidus* s.l. Thornton (1961) noted a possibility of close affinity between the species and the genus *Trichadenotecnum* based on the triangular areola postica and the spotted forewing. However, he did not make a formal nomenclatural statement concerning its generic placement. The species was transferred formally to the genus *Trichadenotecnum* by Smithers (1967), and this taxonomic treatment has been followed subsequently (see synonymy below).

The above taxonomic acts were done without detailed morphological information on the species. Especially, placement of the species in the genus *Trichadenotecnum* is based on superficial similarities of the forewing venation and markings. However, such venation and markings are known in some distantly related groups (Yoshizawa, 1998). Therefore, to decide the exact taxonomic position of the species, detailed information on important taxonomic and phylogenetic characters (e.g., male terminalia) is required. In the present paper, *Trichadenotecnum enderleini* is examined morphologically and its systematic position is discussed.

Methods of morphological examination follow Yoshizawa (2002). All specimens examined are in the Australian Museum, Sydney.

Systematics

Ptycta enderleini (Roesler) n.comb.

Figs 1–3

Psocus conspurcatus Enderlein, 1903: 224 (type locality: Royal Botanical Gardens Sydney, NSW, Australia).—Junior homonym of *Psocus conspurcatus* Rambur, 1842.

Trichadenotecnum conspurcatum (Enderlein).—Enderlein, 1925: 105.

Psocus enderleini Roesler, 1943: 13 (new name for *P. conspurcatus* Enderlein).

Psocidus enderleini (Roesler).—Roesler, 1943: 13; Thornton, 1961: 2.

Trichadenotecnum enderleini (Roesler).—Smithers, 1967: 115; Smithers, 1977: 290; Smithers, 1996: 75; Lienhard & Smithers, 2002: 464.

Material examined. AUSTRALIA, NEW SOUTH WALES: 1 ♀, Lake Cathie, nr Port Macquarie, 12.v.1977, A.S. & C.N. Smithers; 2 ♂♂ 1 ♀, Trial Bay Gaol, 12.v.1977, C.N. & A.S. Smithers; 3 ♂♂ 3 ♀♀, Golden Hole, 10 km S. Stuarts Pt, 13.v.1977, C.N. & A.S. Smithers; 2 ♂♂, Broadwater Nat. Park, 6.v.1978, C.N. Smithers; 1 ♂, Wyrabalong Nat. Park, 27.xi.1997, L. Wilkie; 1 ♀, Bola Creek, Nat. Park, 6.x.1965, A.S. Smithers.

Redescription. *Male.* Head white in ground colour; vertical and orbital markings brown; coronal suture pale; epicranial suture bordered with narrow brown band dorsally; frons pale brown, with irregular brown spots; eye black, large, IO/D= 0.85; ocelli white, ocellar field blackish brown; gena white; antennal socket bordered with narrow brown band; postclypeus with c. 10 longitudinal rows of brown spots; anteclypeus pale brown. Antenna pale brown, scape and pedicel slightly darker. Mouth parts white, tip of fourth segment of maxillary palpus blackish brown. Thorax. Prothorax brown. Mesonotum brown except median part, anterior lobe and lateral margins of lateral lobes of scutum

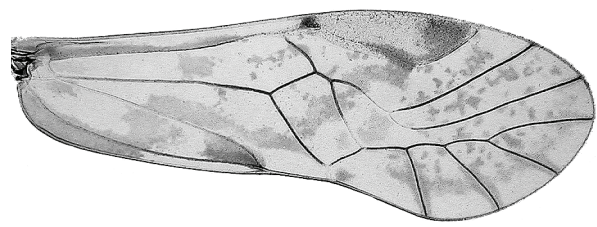


Fig. 1. Forewing of *Ptycta enderleini*, male.

white; scutellum brown; postnotum blackish brown. Metanotum brown except anterior lobe of scutum white. Meso- and metapleura blackish brown except membranous regions white. Legs white; mid and hind coxae brown; all femora with blackish brown marking near distal end; 2nd tarsomere and claws brown. Forewing (Fig. 1) hyaline with brown markings; distal region sparsely covered with small spots; medially with narrow brown band running from posterior corner of pterostigma through centre of discoidal cell to distal end of cell cup; basal quarter with broad band widely interrupted around vein M. Pterostigma white except distal $\frac{2}{5}$; posterior margin brown. Anal cell brown in basal half. Veins blackish brown except along Rs fork, distal half of M closing discoidal cell, and CuA₂ white; Rs fork acute; areola postica almost triangular. Hindwing hyaline; veins brown except R1, basal section of Rs and Rs+M paler. Abdomen white except first segment and terminalia brown. Terminalia (Fig. 2): Posteroventral region of clunium (Fig. 2A) widely membranous. Eighth sternum (Fig. 2A) without sclerite. Epiproct (Fig. 2B) with two pairs of long setae laterally; epiproct lobe weakly expanded dorsally. Paraproct (Fig. 2A) with large basal lobe dorsally and with cone-like projection posteromedial to trichobothrial field; distal process very long, strongly curved. Hypandrium (Fig. 2C) symmetrical, deeply incised at middle; posterodorsal arms bulbous, each with row of tiny denticles; posterodorsal region with two pairs of processes, external pair small, triangular, arising just below bulbous arms, internal pair large, each with broad and rounded base and pointed distal end; lateral region covered with denticles; median region with longitudinal row of long and transparent articulated spines just below incision; ventral region with two pairs of processes, external pair small, internal pair long. Phallosome (Fig. 2D,E) very long; phallobase with well-developed lateral process, anteroventrally rounded. Length (mm): body (B) 2.5–3.0; forewing (FW) 3.4–3.7; hindwing (HW) 2.6–2.9.

Female. Coloration and general morphology, except terminalia, almost as in male; pigmentation much paler, probably due to long alcohol preservation; eye small, IO/D= 2.0. Genitalia (Fig. 3): Egg guide of subgenital plate (Fig. 3A) almost as long as wide, parallel sided, apical margin almost straight, with six thick setae and many fine setae, lateral margin also with few strong setae; body of subgenital plate V-shaped but very slightly pigmented, probably due to long alcohol preservation. Ventral valve of gonapophyses (Fig. 3B) short; dorsal valve narrow; external valve without posterior lobe, anteroexternally with thumb-shaped lobe. Internal plate well sclerotized. Length: B 2.8–3.2; FW 3.8–4.0; HW 2.7–3.0.

Distribution. Australia (NSW).

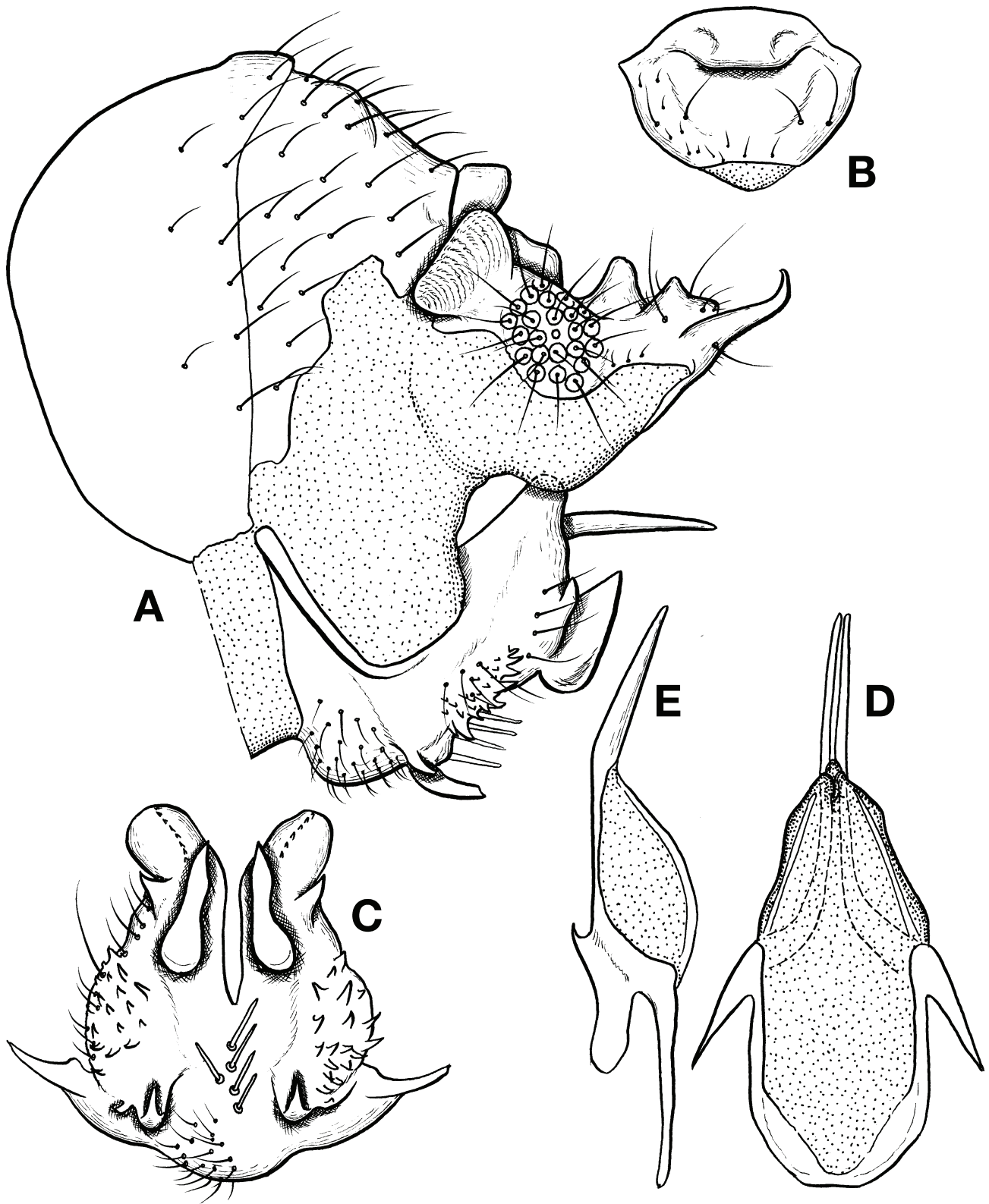


Fig. 2. Male terminal structures of *Ptycta enderleini*. (A) Terminalia, lateral view. (B) Epiproct, dorsal view. (C) Hypandrium, posterior view. (D) Phallosome, ventral view. (E) Ditto, lateral view.

Remarks. *Ptycta enderleini* is most similar to *P. floresensis* Endang, Thornton & New, 2002 in forewing markings (especially in the female), medially incised hypandrium, and apically elongated phallosome. In particular, the apically elongated phallosome is apomorphic and uniquely shared by *P. floresensis* and *P. enderleini*; this character state indicates their close affinity. Female structures of gonapophyses in *P. enderleini*, such as the narrow dorsal valve and lack of the posterior lobe of the external valve, are similar to *P. verticalis* Vaughan, Thornton & New, 1991 and *P. merapiensis* Endang, Thornton & New, 2002. However, *P. enderleini* can be easily distinguished from these species by the unique forewing markings and the hypandrial structures.

Discussion

We conclude that *P. enderleini* cannot be assigned to the genus *Trichadenotecnum* because of lack of all apomorphies supporting the monophyly of the genus (Yoshizawa, 2001, 2003). For example, the forewing of *P. enderleini* lacks the six submarginal spots and opposing spots in cell r which characterize the genus *Trichadenotecnum*. Rather, presence

of the paraproctal basal lobe in the male suggests that the species is related to the genus *Copostigma* Enderlein, 1903 (Smithers, 1985; Endang *et al.*, 2002).

However, *P. enderleini* lacks an important apomorphic character of *Copostigma*, namely a cross vein connecting Rs and M in the forewing. In addition, the male genital structures in Psocidae are known to be highly variable and sometimes homoplasious (e.g., Yoshizawa, 2004; Yoshizawa & Lienhard, 2004), and the paraproctal basal lobe observed in *Copostigma* and *P. enderleini* might also possibly have evolved independently; this should be tested on the basis of molecular phylogeny. Here, we place this species in the genus *Ptycta* Enderlein, 1925, following the treatment by Endang *et al.* (2002). Judging from the morphological features, the closest relative of *P. enderleini* is considered to be *P. floresensis* Endang, Thornton & New, 2002 (see remarks above). In addition, some species of *Ptycta* are known to possess the paraproctal basal lobe in males (e.g., Endang *et al.*, 2002). Therefore, placement of *P. enderleini* under the genus *Ptycta* is considered to be the best solution at present. However, as mentioned by Lienhard & Smithers (2002) and Endang *et al.* (2002), the genus *Ptycta* now includes many heterogeneous species and is thus possibly

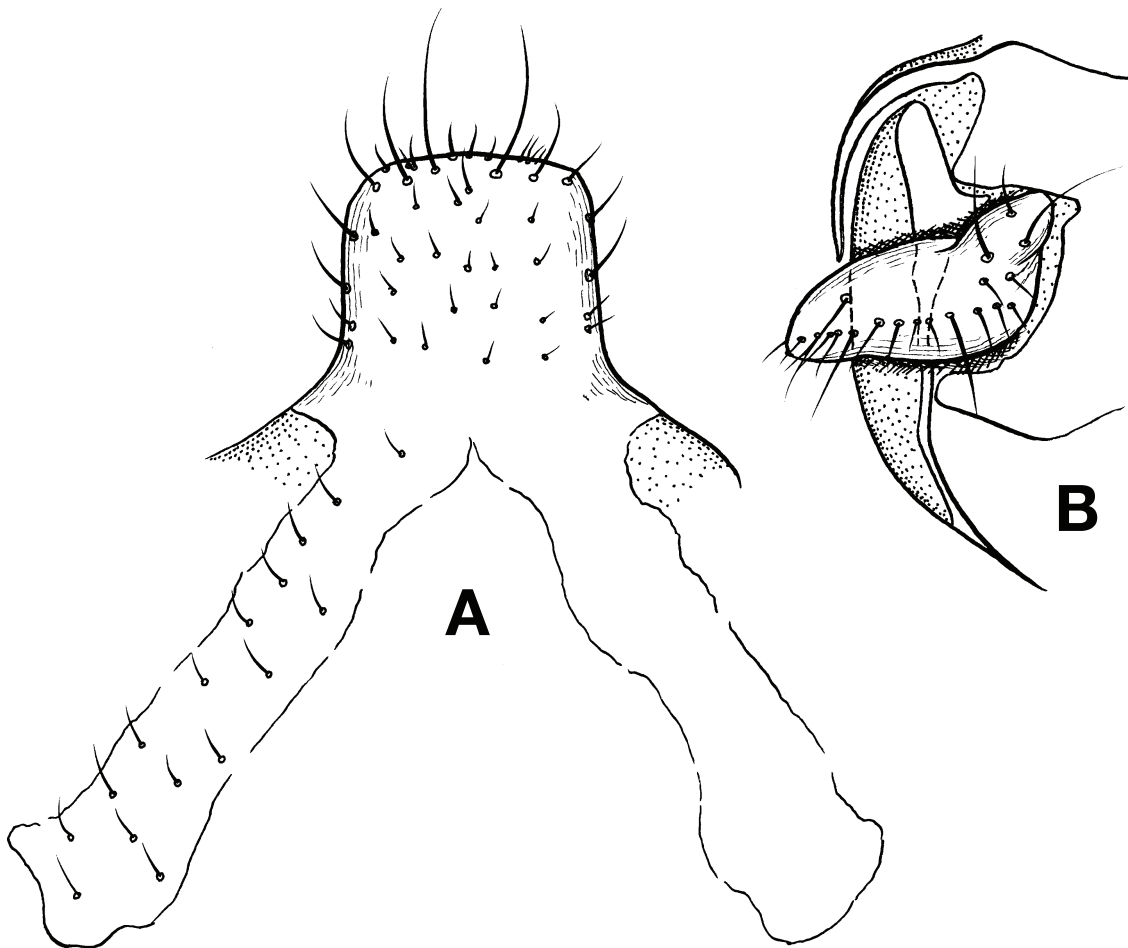


Fig. 3. Female genitalia of *Ptycta enderleini*. (A) Subgenital plate, ventral view, setae on right half omitted. (B) Gonapophyses, ventral view.

polyphyletic. Therefore, its generic status and the higher systematics of the genus complex *Clematostigma-Copostigma-Mecampsis-Ptycta* must be revised by detailed morphological and molecular analyses based on a wide range of taxon sampling (Smithers, 1983; Lienhard & Smithers, 2002; Endang *et al.*, 2002).

Australia is thus excluded from the distributional range of the genus *Trichadenotecnum* except for *T. circularoides* Badonnel, 1955 which was recorded from Queensland, Australia by Yoshizawa (2004). For the following reasons, it is considered that the species is probably introduced to Australia and is not native: (a) the species shows extremely broad distributional range (Mockford, 1993; Yoshizawa, 2001; Lienhard & Smithers, 2002); (b) Australian and Japanese populations of *T. circularoides* show completely identical gene sequences (cytochrome oxidase I, NADH dehydrogenase subunit 5, 12S, 16S and 18S rDNA: Yoshizawa, unpublished data; those sequences of the Australian sample are available online at GenBank); (c) close relatives of the species are known only from Central and South America (Mockford, 1993; Yoshizawa, unpublished data).

ACKNOWLEDGMENTS. We thank L. Wilkie for valuable material and two anonymous referees for valuable comments.

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Manuscript received 15 August 2005, revised 2 December 2005 and accepted 13 January 2006.

Associate Editor: Dan J. Bickel.

