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Description of a new species of the Trichadenotecnum roesleri species group from Brazil (Insecta: Psocodea: 'Psocoptera': Psocidae) and its phylogenetic implications

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Abstract

A new species of the genus Trichadenotecnum, T. shawi n. sp., belonging in the roesleri species group, is here described and illustrated. The species exhibits several morphological features that are valuable to revise the ancestral condition of the genus and the definition of the species group. Based on morphological observations, the phylogenetic position of the species within the roesleri group is also discussed.

Introduction

The genus Trichadenotecnum is one of the largest genera of the order Psocodea, containing more than 200 species to date. The genus was once composed of heterogeneous species based only on superficial similarities of wing venation and markings. However, the genus has been re-defined as a monophyletic group and has been subdivided into 21 monophyletic species groups based on morphological and molecular evidence (Yoshizawa 2001, 2004; Yoshizawa & Lienhard 2004; Yoshizawa et al. 2007, 2008). The New World fauna of Trichadenotecnum, including the Neotropical Region, was recently revised systematically in our previous paper (Yoshizawa et al. 2008). In that paper, we treated a total of 44 species and assigned them into 12 species groups. Of them, six species, including three endemics, were recorded from Brazil.

Among the New World species of Trichadenotecnum, species of the circularoides and roesleri groups are of the highest phylogenetic and biogeographical importance as follows: The roesleri and circularoides groups compose a monophyletic group and together represent the most basal lineages of the genus (Fig. 3: Yoshizawa et al., 2008). Trichadenotecnum excluding the roesleri + circularoides lineages is highly diversified, with about 200 species (Lienhard & Smithers, 2002; Yoshizawa, 2009). It is considered to have Old World origin (Yoshizawa et al., 2008), and a few groups have invaded the New World and have diversified in the Neotropical Region (about 30 species). In contrast, the circularoides + roesleri lineage only contains eight species and, except for a parthenogenetic species with artificial world wide distribution (T. circularoides Badonnel, 1955: Yoshizawa & Smithers, 2006), its distributional area is restricted to the Neotropical Region (Yoshizawa et al., 2008).

In the present paper, we describe an additional new species of the roesleri group from Brazil. The species has several features that are important to understand the ancestral condition of the genus and the species group.

Materials and methods

Only one male specimen was available for study that was stored in 80% ethanol for about 15 years until here described. After description of coloration, measurement of body length, and removal of the fore- and hindwings, the specimen was cleared with Proteinase K. The cleared specimen was then transferred to 80% ethanol and its morphological

features were described and illustrated. The wings and terminal parts were slide mounted with Euparal, and other body parts were stored in glycerol. Terminology and drawing methods follow Yoshizawa et al. (2008). The holotype will be deposited at the Museu de Zoologia da Universidade de São Paulo (MZUSP), Brazil.

Results

Key to species of the Trichadenotecnum roesleri group

The following key is modified from Yoshizawa et al. (2008). Because T. shawi is only known from the male, only the key to males is provided. See Yoshizawa et al. (2008) for the key to females.

1.   Hypandrial median tongue long, length > apical width 2
-      Hypandrial median tongue short, length ≈ apical width (Fig. 2CE) 5
2.   Phallosome without long processes 3
-      Phallosome with long processes arising from postero-lateral corners .... sinuatum New
3.   Phallosome narrowing posteriorly, with pair of short processes postero-medially 4
-      Phallosome broadened posteriorly, without pair of processes postero-medially .... ……………………………………………………… oaxacense Yoshizawa et al.
4.   Hypandrial median tongue almost parallel sided .... roesleri New
-      Hypandrial median tongue strongly constricted medially ………………………………... ……………………………………………………… tambopatense Yoshizawa et al.
5.   Hypandrium with short conical process on left postero-lateral corner (right corner missing from the type specimen: Fig. 2E) .... bos Yoshizawa et al.
-      Hypandrium with long processes, exceeding middle of hypandrium, on left postero-lateral corner (Fig. 2C) .... shawi n. sp.

Trichadenotecnum shawi n. sp. (Fig. 1, 2)

Type material

Holotype male. BRAZIL: Goias, Araguaia River Expedition, 8.1 km N. of Aruana, 28.VIII.1992, Malaise trap, Coll: Scott R. Shaw.

Description

Male. Head white in ground color; vertical and orbital marking brown; coronal suture black; frontal suture not bordered with brown band; frons without markings; gena white; eye black, large, IO/D = 0.6; ocelli white, ocellar field white; antennal socket broadly bordered with brown band; postclypeus mostly white, laterally with brown marking and ventrally with several rows of brown spots; anteclypeus brown. Antenna: pedicel and scape brown, flagellar segments missing from specimen. Mouthparts brown.

Thorax. Prothorax brown. Mesonotum white; anterior lobe of mesoscutum with pair of large dark brown markings separated by narrow white line, lateral lobe with brown spot anteriorly and posteriorly. Metanotum mostly brown, anterior lobe of scutum and scutellum white. Meso- and metapleurites dark brown except membranous region white.

Legs almost uniformly brown.

Forewing (Fig. 1) extensively but rather sparsely covered with tiny spots; spots in cell a indistinct; opposing spots in cell r indistinct; proximal band indistinct anteriorly, except for dark area around nodus, faint but continuous posteriorly, from below M+Cu fork to vein A; distal band indistinct; spot on roof of cell m3 indistinct; submarginal spots almost indistinct; marginal clouds distinct only along vein ends. Hindwing hyaline, cell cup with faint brown tinge; veins brown.

Abdomen white, with irregular brown markings.

Terminalia (Fig. 2). Eighth sternum (Fig. 2AC) short and wide, widely fused with hypandrium posteriorly. Clunium (Fig. 2A) with almost straight anterior margin, without clunial arm. Epiproct (Fig. 2AB) chair-shaped; epiproct lobe bilobed, medially with deep U-shaped notch, bottom of notch protruded posteriorly; posterior part protruded posteriorly. Paraproct (Fig. 2A) with short posterior lobe; distal process long, arched. Hypandrium (Fig. 2AC) asymmetrical, medially with broad transversal membranous

region; left postero-lateral corner with pair of processes directed posteriorly, outer process longer, reaching near distal end of median tongue, covered with denticles, inner process shorter, about 1/2 of outer process, conical in shape, with smooth surface, and with hemispherical swelling basal to processes covered with denticles; right postero-lateral corner with pair of processes directed postero-laterally, both processes about equal in length and smooth surfaced, and with sclerotized rod on membranous region between right processes; median tongue not separated from body of hypandrium by membrane, broadened distally with shallowly concave distal margin, ventral surface covered with wrinkles, postero-lateral regions with rows of denticles, postero-median region with fine long setae. Phallosome (Fig. 2D) open anteriorly; posteriorly with pair of median projections covered with denticles posteriorly and internally and with pair of lateral conical projections directed postero-laterally.

Length. Body 1.8 mm; forewing 2.4 mm; hindwing 1.9 mm.

Female unknown.

Etymology

The specific epithet honors S. R. Shaw, collector of the type specimen of this species.

Discussion

This species is assigned to the roesleri species group of Trichadenotecnum by the combination of the following character states: (1) forewing extensively covered with tiny spots (Fig. 1); (2) lack of clunial arm (Fig. 2A); (3) epiproct with posterior projection (Fig. 2A); (4) dorsal margin of epiproct lobe with setae (Fig. 2B); (5) eighth venter with transversal single sclerite fused to hypandrium (Fig. 2AC); (6) short paraproctal distal lobe (Fig. 2A). Character states (3)-(5) are autapomorphies supporting the monophyly of the roesleri group. The last character state (6) is a synapomorphy of the roesleri and circularoides groups (Yoshizawa et al., 2008). The condition of the dorsal setae of the epiproct lobe in T. shawi seems to be different from other species of the roesleri group, i.e., short and restricted to two regions of the epiproct lobe in T. shawi (Fig. 2B) whereas long and distributed on the entire margin in other species. However, presence of setae on the dorsal margin of the epiproct lobe itself is unique in Trichadenotecnum, and a different condition is probably due to highly modified, bilobed epiproct lobe of this

species (autapomorphic) so that these setae observed in species of the roesleri group are considered to be homologous. Combination of the above mentioned character states, including three autapomorphies of the group and a synapomorphy of the roesleri + circularoides groups, clearly support the placement of the new species within the roesleri group. The asymmetrical hypandrium of T. shawi (Fig. 2C) contradicts the original definition of the group proposed by Yoshizawa et al. (2008). However, the symmetric condition is a plesiomorphy and not valuable to define the group. In addition, independent origins of asymmetrical hypandrium is rather frequent in Trichadenotecnum (Yoshizawa et al. 2008; Yoshizawa & Johnson 2008) so that an asymmetrical hypandrium should be regarded as an autapomorphy of T. shawi independently evolved within the roesleri group. Therefore, the hypandrial condition of T. shawi does not contradict its placement within the roesleri group.

Some morphological characters are valuable to decide the phylogenetic position of T. shawi within the roesleri group. The phallosomal features of T. shawi are similar to T. bos from Peru in the following two apomorphies: presence of postero-lateral projections and anteriorly open condition (Fig. 2D). Both of these character states are also shared by T. sinuatum from Brazil. The hypandrial structure of T. sinuatum is also similar to T. shawi in the presence of long postero-lateral processes. In T. bos, the distal part of the hypandrium is missing in the only available specimen so that comparison of this important character with T. shawi is not possible. In contrast, setae on the hypandrial median tongue observed in T. shawi may provide a contradicting relationship. According to Yoshizawa et al. (2008), presence of long setae on the hypandrial median tongue have only been observed in T. tambopatense Yoshizawa et al., 2008 from Peru and T. oaxacense Yoshizawa et al. 2008 from Mexico. If this observation is correct, the setae on the median tongue suggest closer relationship between T. tambopatense, T. oaxacense and T. shawi, contradicting the evidence from the phallosomal structure. However, re-examination of the type specimens revealed that the fine setae on the median tongue were overlooked by Yoshizawa et al. (2008) and are also present in T. bos (Fig. 2E). Therefore, the presence of the setae on the median tongue should rather be regarded as an autapomorphy of the roesleri group and does not have phylogenetic information to decide systematic placement of T. shawi within the roesleri group. Considering the morphological evidence mentioned above, it is reasonable to assume that the present new species forms a monophyletic group with T. bos and T. sinuatum, on the basis of the

phallosomal apomorphies. As a result of the addition of the present new species and re-examination of other species of the roesleri group, the definition of the group proposed by Yoshizawa et al. (2008) is revised as follows (see Yoshizawa et al. 2008 for original definition including unmodified parts): epiproct lobe with setae of various lengths on dorsal margin; hypandrium symmetrical or asymmetrical; median tongue movable or unmovable, with long setae. The last character state is an additional autapomorphy supporting the monophyly of the roesleri group.

Among some characteristics of the genus Trichadenotecnum, presence of the hypandrial median tongue is the most prominent feature. In many species of the genus, the hypandrial median tongue is separated from the body of the hypandrium by a membranous region and is movable (as indicated by M in Fig. 3). However, in some basal groups of the genus, i.e., the circularoides and corniculum groups, the hypandrial median tongue is tightly connected to the body of hypandrium and is unmovable (as indicated by U in Fig. 3) (Yoshizawa 2003; Yoshizawa et al. 2008). Although the roesleri group is regarded as the sister group of the circularoides group, thus representing a basal group, the movable median tongue is evident for most species (the hypandrium of T. bos is damaged in the only available specimen and thus the condition of the median tongue is unknown for this species). The median tongue of the present new species is firmly connected to the body of the hypandrium and is apparently unmovable. Judging from the illustrations in the original description, the median tongue of T. sinuatum is also continuous with the body of the hypandrium and thus is undoubtedly unmovable. Therefore, by parsimonious estimation, the unmovable median tongue should be regarded as the most ancestral condition of the roesleri group and Trichadenotecnum, and the movable condition is considered to have evolved independently within the roesleri group and the common ancestor of the advanced Trichadenotecnum (i.e., the whole genus excluding the circularoides, roesleri and corniculum groups) (Fig. 3). Secondary fusion of the median tongue with the body of the hypandrium has also been detected in some advanced species (i.e., the majus group: Fig. 3).

As discussed above, the discovery of the present new species provides significant new insights for the systematic implications and the morphological evolution in the genus Trichadenotecnum. The circularoides + roesleri lineage is only represented by nine species, most of them collected by several limited surveys. The only exception is the extensive faunal survey at the Río Tambopata Reserved Zone conducted by Terry L.

Erwin, of the Smithsonian Institute, where four species of the lineage were collected at one locality (Yoshizawa et al., 2008). This situation and the discovery of the present new species indicates that there is probably still a considerable number of undiscovered species of this lineage in the Neotropical Region. Because the circularoides + roesleri groups represent the most basal clade of the genus Trichadenotecnum (Fig. 3), further faunal survey for these groups is encouraged not only for alpha-taxonomy but also for uncovering the phylogeny, biogeography and evolution of the genus.

References
Badonnel A. 1955. Psocoptères de l'Angola. Publ cult Cia Diamant Angola 26:1-267.

Lienhard C, Smithers CN. 2002. Psocoptera: World Catalogue & Bibliography. Instrumenta Biodiversitatis V. Genève (Switzerland): Muséum d'histoire naturelle.

New TR. 1972. A collection of Psocidae (Psocoptera) from central Brazil. Arq Zool 22:193-237.

Yoshizawa K. 2001. A systematic revision of Japanese Trichadenotecnum Enderlein (Psocodea: 'Psocoptera': Psocidae: Ptyctini), with redefinition and subdivision of the genus. Invertebr Taxon 15:159-204.

Yoshizawa K. 2003. Two new species that are likely to represent the most basal clade of the genus Trichadenotecnum (Psocoptera: Psocidae). Entomol Sci 6:301-308.

Yoshizawa K. 2004. Molecular phylogeny of major lineages of the genus Trichadenotecnum and a review of diagnostic morphological characters (Psocoptera: Psocidae). Syst Entomol 29:383-394.

Yoshizawa K. (ed) 2009. Psocid News: Hokkaido University [cited 2009 May 25]. Available from: http://hdl.handle.net/2115/35519.

Yoshizawa K, García Aldrete AN, Mockford EL. 2008. Systematics and biogeography of the New World species of Trichadenotecnum Enderlein (Insecta: Psocodea: 'Psocoptera': Psocidae). Zool J Linn Soc 153:651-723.

Yoshizawa K, Johnson KP. 2008. Molecular systematics of the barklouse family

Psocidae (Insecta: Psocodea: 'Psocoptera') and implications for morphological and behavioral evolution. Mol Phylog Evol 46:547-559.

Yoshizawa K, Lienhard C. 2004. Systematics of Trichadenotecnum (Psocoptera: Psocidae) in Hong Kong. Publ Esp Inst Biol, UNAM 20:121-149.

Yoshizawa K, Lienhard C, Thapa VK. 2007. Systematic study of the genus Trichadenotecnum in Nepal (Psocodea: 'Psocoptera': Psocidae). Ins matsum, ns 63:1-33.

Yoshizawa K, Smithers CN. 2006. Systematic position of Trichadenotecnum enderleini (Roesler) (Psocodea: 'Psocoptera': Psocidae). Rec Aust Mus 58:411-415.

Figure captions

Fig. 1. Forewing of the holotype of Trichadenotecnum shawi n. sp.

Fig. 2. Terminalia of the holotypes of Trichadenotecnum shawi n. sp. (A–D) and T. bos (E). A. Terminalia, lateral view; B. Epiproct, posterior view (setae on right half omitted); C. Hypandrium and 8th sternum, ventral view; D. Phallosome, ventral view; E. Hypandrium of T. bos, ventral view (redrawn from Yoshizawa et al. 2008, and setae on the median tongue were added).

Fig. 3. Phylogeny of the species groups of Trichadenotecnum as estimated by Yoshizawa et al. (2008). The condition of the hypandrial median tongue is indicated by M (movable) and U (unmovable) on the right margin. The most parsimonious estimation of the transformation of the hypandrial median tongue (a total of 3 steps) is also indicated on branches and at the root of the tree. An alternative interpretation (M as the most ancestral condition of Trichadenotecnum) requires a total of 4 steps (not shown in the figure). Thick branches indicate New World distribution whereas thin branches indicate Old World distribution. Thick broken branch indicates Holarctic distribution.

A

B

C

D

E

circularoides group — U

roesleri group — U/M

U→M (part)

corniculum group — U

spiniserrulum group — M

alexanderae group — M

U→M

majus group — U

M→U

vaughani group — M

medium group — M

sexpunctatum group — M

desolatum group — M

chiapense group — M

concinnum group — M

quaesitum group — M

aconcinnum group — M

slossonae group — M

decui group — M

U