INSECTA MATSUMURANA

NEW SERIES 64: 23–34 MARCH 2008

SYSTEMATIC POSITIONS OF THE SPECIES CURRENTLY PLACED UNDER THE HOLDING GENUS PSOCIDUS S. L. DESCRIBED BY OKAMOTO (PSOCODEA: 'PSOCOPTERA': PSOCIDAE)

By KAZUNORI YOSHIZAWA

Abstract

YOSHIZAWA, K. 2008. Systematic positions of the species currently placed under the holding genus *Psocidus* s. l. described by Okamoto (Psocodea: 'Psocoptera': Psocidae). *Ins. matsum. n. s.* 64: 23–34.

Systematic positions of *Psocus formosanus* Okamoto, 1907, *Psocus pellucidus* Okamoto, 1907 and *Psocus tateokanus* Okamoto, 1907, all currently classified under the holding genus *Psocidus* (s. l.) Pearman, 1934, were revised as follow: *Symbiopsocus formosanus* n. comb., *Psocidus* (s.str.) *pellucidus*, and *Neoblaste tateokana* n. comb.. Males of *P. pellucidus* and *N. tateokana* were newly recorded, and genitalic characters of all species were described for the first time. A record of *Psocus obtusus* Hagen, 1858 (= *Blaste obtusa*) from Japan by Okamoto was also revised, and it was revealed that the species was actually not *P. obtusus* but corresponded to *Psocus cubitalis* Enderlein, 1919 (now *Neoblaste cubitalis*).

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Introduction

In early literatures, the genus *Psocus* Latreille was treated in a very wide sense, and the genus included almost all winged species of the order 'Psocoptera' (e.g., Hagen, 1858: at that time, psocopterans were treated as a member of the order Neuroptera). Even in the late 19th to early 20th century, when early taxonomic studies of Japanese psocopterans were carried out by H. J. Kolbe, G. Enderlein and H. Okamoto, the genus *Psocus* was still treated in a wide sense and was nearly equal to the subfamily Psocinae of the present sence (Mockford, 1993; Yoshizawa & Johnson, 2008). Later, Pearman (1932, 1934) redefined and restricted the generic concept of *Psocus*, and erected the genus *Psocidus* sensu lato for the species that had been assigned to the genus *Psocus* but could not be assigned to *Psocus* (*sensu* Pearman) or the other newly erected genera. Now, the genus *Psocidus* sensu stricto (type species: *Psocidus zanzibarensis* Pearman) is considered to be a well defined monophyletic group with separated trichobothrial fields as an autapomorphy, and it is recommended that new species should not be assigned to *Psocidus* s.l. and also that we should attempt to revise the generic position of the species now assigned to *Psocidus* s.l. (Lienhard & Smithers, 2002).

In Okamoto (1907), 14 Japanese and Taiwanese psocid species were treated under *Psocus*. Later, most of them were transferred to their appropriate genera in the present sense, but three of them are now placed under the genus *Psocidus* s.l. (Lienhard & Smithers, 2003). In the original descriptions, the most taxonomically relevant genitalic characters of these species are not described (Okamoto, 1907), and their morphological characters remain unexamined since their original description.

In the present study, I examine the type specimens of three species of *Psocidus* s.l. described by Okamoto (1907) and allocate them to appropriate genera in the modern sense of the psocid systematics. Unless specified, specimens examined in this study are stored in the Hokkaido University Insect Collection (SEHU). Methods and terminology followed Yoshizawa (2001). For further information on the Okamoto's type specimens, refer to Yoshizawa (2002).

Systematics

Family Psocidae
Subfamily Psocinae
Tribe Ptyctini

Symbiopsocus formosanus (Okamoto) n. comb.
(Fig. 2)

Psocus formosanus Okamoto, 1907: 130.
Psocidus formosanus: Smithers, 1967: 108.

Syntype male. Koshun [in Kanji], Formosa, Matsumura (originally dried, glued on a micro-pin, head, prothorax and wings missing: now all available parts soaked, genitalia slide mounted with Euparol, other parts stored in glycerol).

Description of syntype male terminalia. 8th sternum without sclerites. Clunium (Fig. 2AB): anterior margin deeply concave dorsally; posterior margin with pair of weak

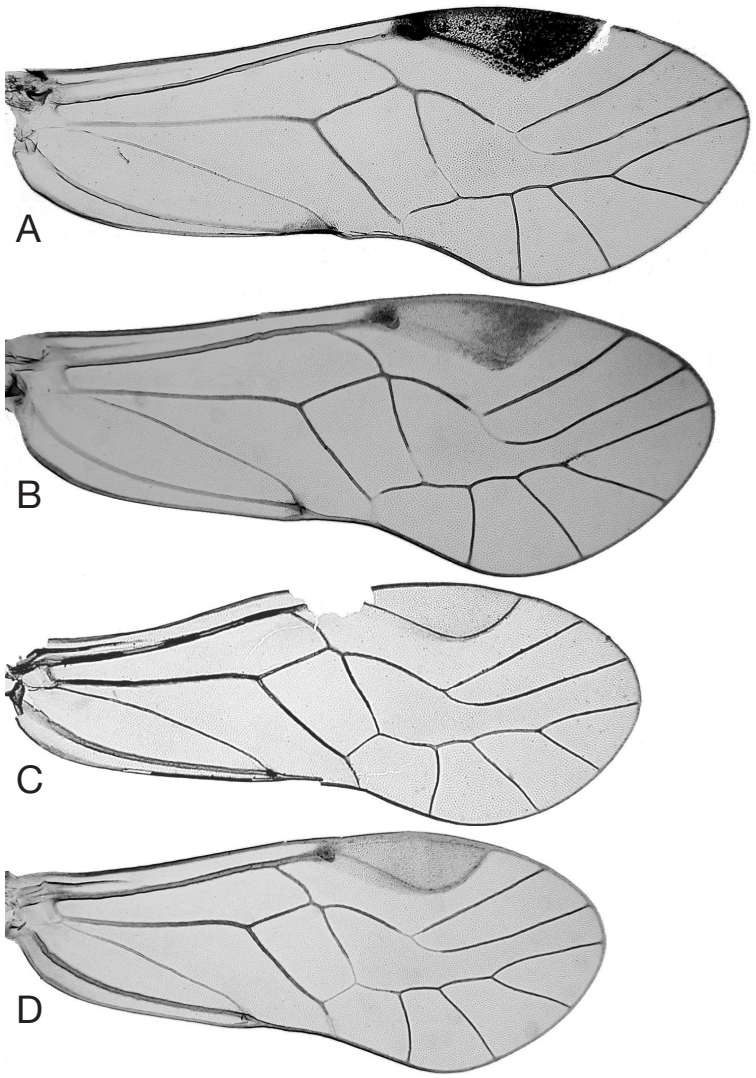

Fig. 1. Forewings of psocids examined in this study. A, *Psocidus pellucidus*, syntype female. B, *P. pellucidus*, male. C, *Neoblaste tateokana*, syntype female. D, *N. tateokana*, male.

projections at articulations with epiproct. Epiproct (Fig. 2AB) chair shaped, anterior and lateral margins strongly sclerotized; epiproct lobe short, not protruding over clunium. Paraproct (Fig. 2A) with small dorsal swelling near distal end of trichobothrial field; distal process short, not sharply pointed apically. Hypandrium (Fig. 2C) symmetrical, lateral margin with rows of denticules of various sizes and medially with several short fine spines; distal region with two pairs of lobes; lateral lobes triangular, pointed apically, covered with minute denticules; median lobes located dorsomedial to lateral lobes, separated from body of hypandrium by membranous region and forming median tongue-like structure, fused basally, U or V shaped, distally broadened, ventrally covered

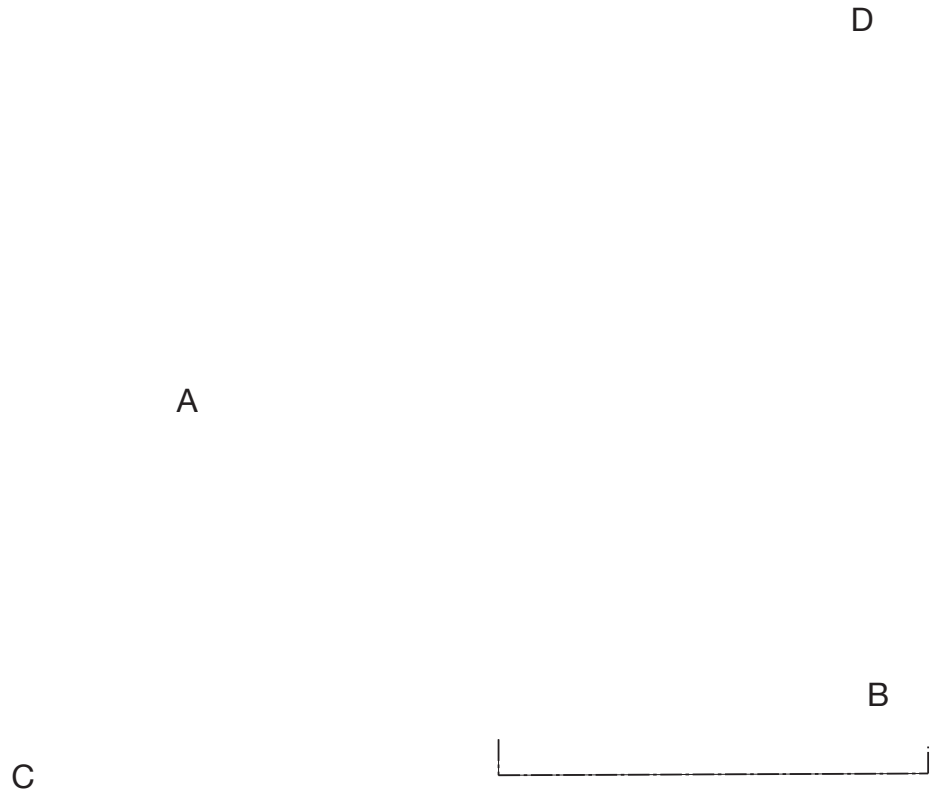

Fig. 2. Terminalia of *Symbiopsocus formosanus*, syntype male. A, terminalia, lateral view. B, posterior margin of clunium and epiproct, dorsal view. C, hypandrium, posterior view (sculptures, spines and hairs not drawn for right side). D, phallosome, ventral view.

with wrinkles (basally) and denticules (distally). Phallosome (Fig. 2D) long, rhomboid in shape; anteriorly narrowed with somewhat truncated apical tip; distally with crown-like distal process.

Female. Unknown.

Remarks. According to Li (1997) and Mockford (2003), the genus *Symbiopsocus* can be characterized by the following character states in male terminalia: male epiproct flat, strongly sclerotized around margin; hypandrium symmetrical with several tiers of lobe; phallosome slender, rhomboid-shaped. Of them, the hypandrial lobes and phallosomal characters are apomorphic and probably useful to define the genus as a natural taxon [polarities of character are estimated based on the observation by Yoshizawa (2002, 2005) and Yoshizawa & Johnson (2008)]. *Psocus formosanus* is assigned here to *Symbiopsocus* by having these apomorphies (Fig. 2CD). Especially, *Symbiopsocus*

formosanus is similar to *S. leptocladus* Li, 1997, the type species of the genus, in the shapes of the hypandrial lobes and phallosome. Condition of the epiproct in this species (chair-shaped: Fig. 2A) contradicts with the re-definition of the genus by Mockford (2003: epiproct flat). The shape of epiproct is known to be highly homoplasious (Yoshizawa, 2004; Yoshizawa & Johnson, 2008). As mentioned above, more reliable apomorphies are clearly recognized in this species by which its systematic placement under *Symbiopsocus* is justified. Therefore, the flat epiproct should be removed from the diagnostic characters of this genus.

Psocidus (s. str.) *pellucidus* (Okamoto)
(Figs 1AB, 3, 4)

Psocus pellucidus Okamoto, 1907: 123.
Psocidus pellucidus: Smithers, 1967: 110.

Syntype female. Late [in Kanji]/ vii 1905, Towada (originally dried, pinned with a micro-pin: now soaked, wings and genitalia slide mounted with Euparol, other parts stored in glycerol). *Other specimens examined*. 1 female, Utoro, Hokkaido, 29. viii. 1995, K. Yoshizawa; 3 females, Yawata-shitsugen, Geihoku, Hiroshima, 5. ix. 1992, K. Yoshizawa; 1 male, Chojabara, Geihoku, Hiroshima, 10. vii. 1994, K. Yoshizawa; 2 males 5 females, Nokonoshima, Fukuoka, 21. vi. 1994, K. Yoshizawa..

Description of syntype female genitalia. Epiproct with divided trichobothrial field.

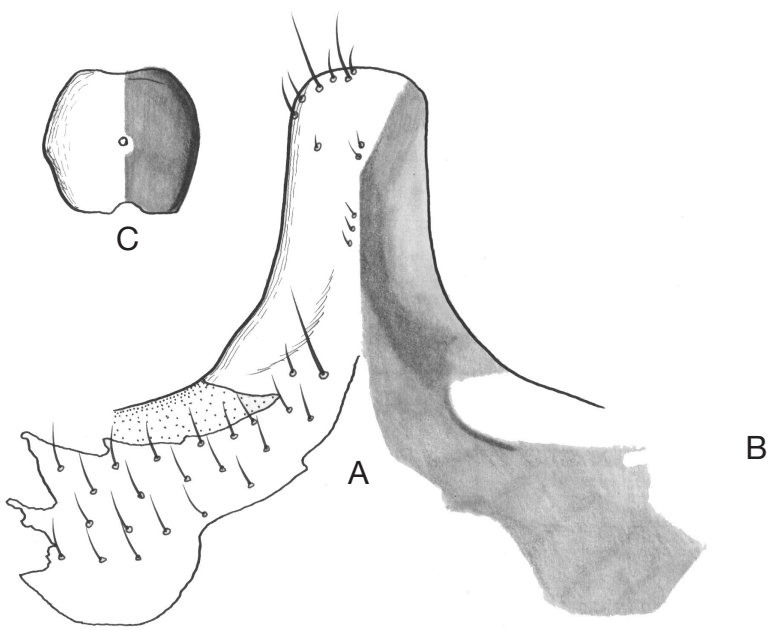

Fig. 3. Genitalia of *Psocidus pellucidus*, syntype female, ventral view. A, subgenital plate. B, gonapophyses. C, internal plate. A and C show structure (left) and color pattern (right).

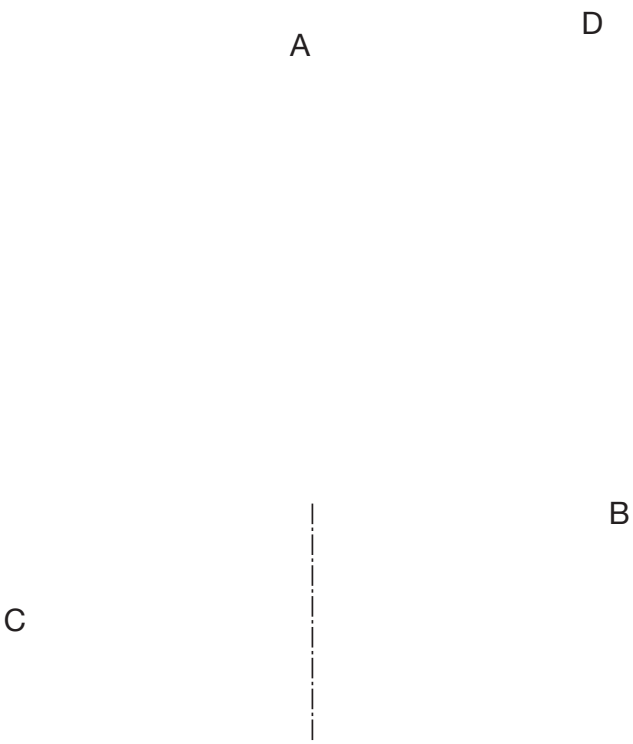

Fig. 4. Male terminalia of *Psocidus pellucidus*. A, terminalia, lateral view. B. terminalia, dorsal view (hairs on clunium and trichobothrial field not drawn). C, hypandrium, ventral view (hairs not drawn on right side). D, phallosome, ventral view.

Subgenital plate (Fig. 3A): egg guide long, distal 3/4 nearly parallel sided, then strongly broadened basally, posterior margin smoothly rounded; anterior arm not strongly expanded anteriorly, anterior margin with deep V-shaped notch medially. Gonapophyses (Fig. 3B): ventral valve broadened apically; dorsal valve with long distal process; posterior lobe of external valve broad. Internal plate (Fig. 3C) strongly swelling, well sclerotized, laterally rounded and anteriorly and posteriorly truncated.

Description of male terminalia based on non-type specimens. 8th sternum (Fig. 4A) with pair of circular or square shaped sclerites. Clunium (Fig. 4AB) with pair of needle-like projections arising from posterodorsal margin and directed posterodorsally, projections covered with wrinkles; posterolateral corner strongly expanding posteriorly, triangular in shape. Epiproct (Fig. 4AB) semicircular in shape, not chair-shaped. Paraproct (Fig. 4AB) with divided trichobothrial field; distal lobe with lateral expansion, with group of denticules posteriorly; distal process broad, with tiny spine apically. Hypandrium (Fig. 4AC) fused to clunium basally, symmetrical, anterior margin deeply concave, laterally with tongue-shaped ingrowth of sclerite, posteriorly with median lobe; median lobe with dorsolateral sinuated strips covered with scale-like sculptures. Phallosome (Fig. 4D) open basally, with well developed parameres; aedeagus with broad posterior margin.

Remarks. As also noted above, the genus *Psocidus* (s. str.) is now recognized as a monophyletic group characterized by an autapomorphy observed in terminalia of both sexes, i.e., trichobothrial field divided into two regions (Thornton, 1960; Badonnel, 1977: Fig. 4A). An additional apomorphic character possibly useful in diagnosing *Psocidus* s. str. is the triangular areola postica (Fig. 1AB), although this character state is also observed in some other genera of Ptyctini and thus should be used supplementary. These apomorphic character states are observed in all Oriental and African species (including the type species of the genus) which are currently assigned to *Psocidus* (s. str.). Mockford (1996) added four South American species to *Psocidus* (s. str.) because those species 'share taxonomically important characters with the type' (p. 73). However, he did not explicitly mention the characters on which his systematic assignment of these species were based. Judging from the published illustrations, those South American species did not possess the divided trichobothrial field nor triangular areola postica. As mentioned by Mockford (1996), those species resemble the type species of the genus (e.g., shape of the phallosome), but detailed morphology and systematic significance of these characters need further consideration.

Although the only available syntype specimen of *Psocus pellucidus* is female, I also observed male specimens of this species collected at western Honshu and Kyushu. Females collected at these locality are in good agreement with the syntype female in general and genitalic morphology and body coloration so that there is no doubt about their conspecificity. In both sexes, the divided trichobothrial field is obvious (Fig. 4A) which clearly shows that this species can be assigned to *Psocidus* (s. str.). The triangular areola postica is also evident for this species (Fig. 1AB). Male and female genitalic characters of this species are very similar to *Psocidus* (s. str.) *validus* Thornton, 1960, which might be a junior synonym of *P. pellucidus*.

Subfamily Amphigerontiinae
Tribe Blastini

Neoblaste tateokana (Okamoto) n. comb.
(Figs 1CD, 5, 6)

Psocus tateokanus Okamoto, 1907: 131.
Psocidus takeokanus [sic]: Smithers, 1967: 111.
Blaste sp. Yoshizawa, 2000: 33.

Syntype female. 5. 8. ‘06, Tateoka, Sapporo, Okamoto (originally dried, pinned with a micro-pin: right wings and abdomen were removed and the latter soaked with KOH, all removed parts now slide mounted with Euparol). *Other specimen examined*. 1 male, Imperial Palace, Tokyo, 6. vii. 1998, K. Yoshizawa (the specimen was once recorded as *Blaste* sp. by author in 2000: National Museum of Nature and Science, Tokyo).

Description of syntype female genitalia. Subgenital plate (Fig. 5A): egg guide short, posterior margin rounded, lateral margins parallel sided medially then strongly broadened basally; posterior margins of anterior arm nearly straight, anterior margin with broad triangular notch medially. Gonapophyses (Fig. 5B): ventral valve broadened subapically; dorsal valve not elongated; posterior lobe of external valve long and broad, internal lobe short, not exceeded ventral valve. Internal plate (Fig. 5C) not strongly sclerotized or pigmented; dorsally with layers of membrane on anterior margin and posterior tip.

Description of male terminalia based on non-type specimen. 8th sternum (Fig. 6A)widely and strongly sclerotized. Clunium (Fig. 6AB): anterior margin deeply

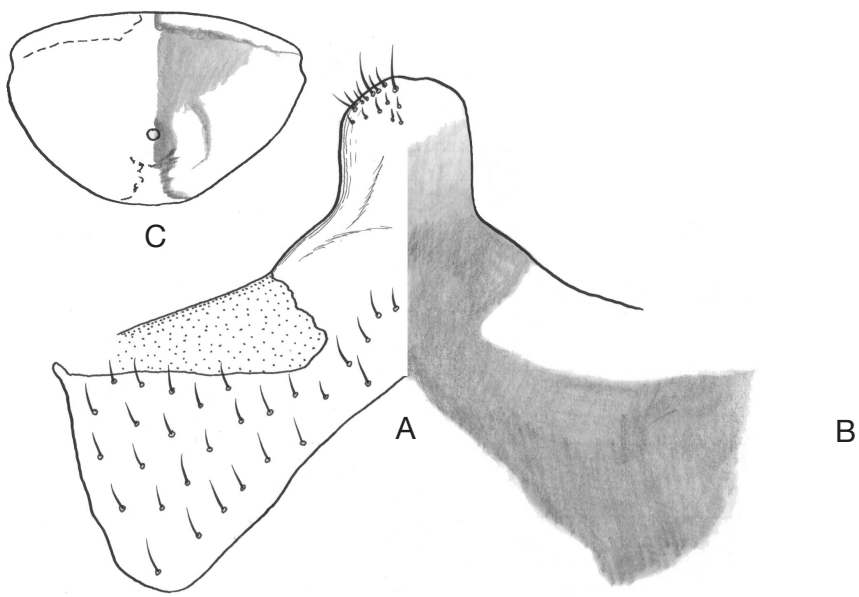

Fig. 5. Genitalia of *Neoblaste tateokana*, syntype female, ventral view. A, subgenital plate. B, gonapophyses. C, internal plate. A and C show structure (left) and color pattern (right).

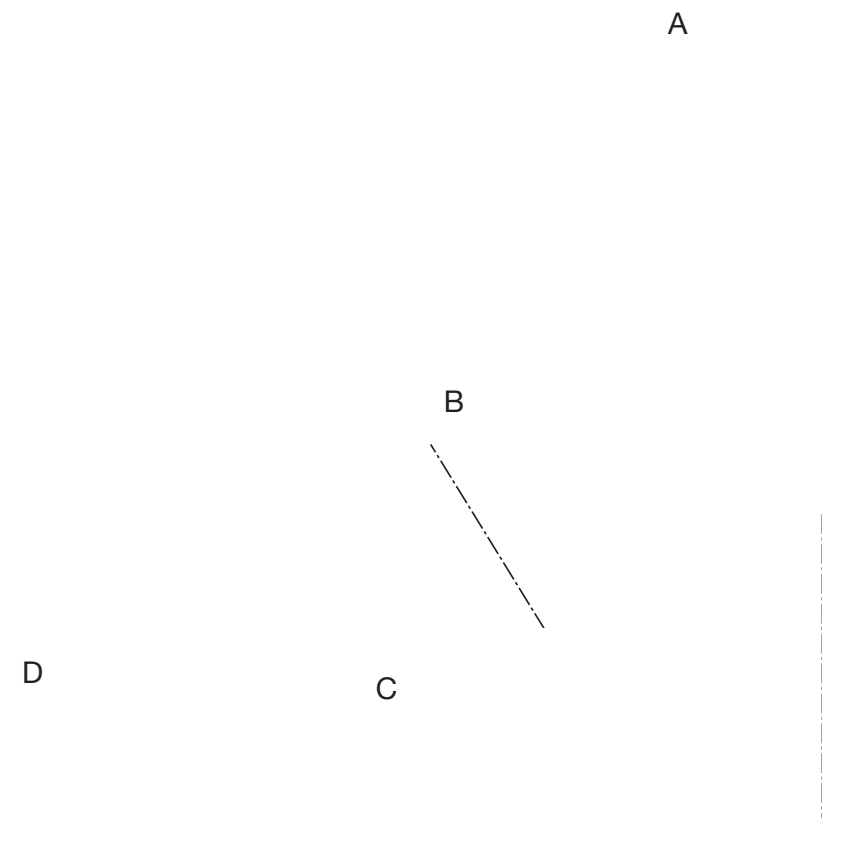

Fig. 6. Male terminalia of *Neoblaste tateokana*. A. terminalia, lateral view. B, terminalia, dorsal view (hairs on clunium and trichobothrial field not drawn). C, hypandrium, posterior view (sculptures, spines and hairs not drawn for right side). D, hypandrium and phallosome, dorsal view (membrane omitted).

concave; dorsal region with three weak swellings; posterior margin concave at middle. Epiproct (Fig. 6B)small, with posterior margin shallowly incised with membranous region, anteriorly with median projection. Paraproct (Fig. 6AB): trichobothrial field distant from articulation; distal lobe not well developed; distal process broad in dorsal view. Hypandrium (Fig. 6CD)symmetrical, dorsal surface with pair of weakly sclerotized strips connecting hypandrial posteromedian lobes and phallosomal anterior lobes (see below); posteromedially with pair of lobes narrowly and deeply separated, each lobe covered by wrinkles, with triangular distal end; lateral lobes well developed, covered with denticules, pointed apically;. Phallosome (Fig. 6D) fused anteriorly; posteriorly with two pairs of processes directed laterally, anterior pair rounded, lobe-like, posterior pair shorter, pointed.

Remarks. The systematics of *Neoblaste* and related genera (i.e., the *Blaste-Euclismia* complex *sensu* Thornton, 1960) is highly complicated (Thornton, 1960; Lienhard & Smithers, 2002). Females of *Neoblaste* and *Blaste* are almost indistinguishable (Smithers, 1990; Endang et al., 2002). In the Okamoto collection, only one female syntype of *Psocus tateokanus* is available and, although it was almost certain from female morphology that the species is a member of the *Blaste-Euclismia* complex, a male of this species was needed to decide its exact systematic placement. In the present study, I also examined one male specimen which is most probably conspecific with the syntype female of *Psocus tateokanus*. The two were collected from rather distant localities (syntype female from Hokkaido and male from central Honshu) so that their conspecificity might involve a little doubt. However, these specimens are in nearly complete agreement with each other in general morphology and coloration (e.g., Fig. 1CD), and I concluded that they represent male and female of the same species. On the basis of male terminal structures, the species is here assigned to the genus *Neoblaste*. Autapomorphy of the genus is the presence of the lateral accessory sclerites on the hypandrium (Thornton, 1960: Fig. 6AC).

In Japan, *Blaste obtusa* (Hagen, 1858) has been known as the only named species of the *Blaste-Euclismia* complex. Therefore, in the key to the Japanese species of Psocoptera (Tomita & Haga, 1991), characters applicable to any genus of the *Blaste-Euclismia* complex were used to distinguish the species from the other Japanese species. The H-shaped forewing marking is rather specific for *B. obtusa* but, in the key, the character is mentioned as unstable, absence of the marking being frequent (Tomita & Haga, 1991). As a result, by using the key, Japanese species of the *Blaste-Euclismia* complex, including *Neoblaste tateokana*, will be keyed out as *Blaste obtusa* so that the previous records of the latter species from Japan need to be reviewed.

The original record of *B. obtusa* from Japan involved some problems (Yoshizawa, 2000). This species was first recorded from Japan as *Psocus obtusus* Hagen by Okamoto (1906, 1907), and Ceylon (Okamoto, 1906) and Singapore (Okamoto, 1906, 1907) was mentioned as the other distributional record of the species. *P. obtusus* was originally described from Ceylon (Sri Lanka), and the specimen recorded from Singapore as *P. obtusus* by Enderlein (1903) was later considered to represent a different species and described as *Psocus cubitalis* Enderlein, 1919 (now treated as *Neoblaste cubitalis*). The original description of *P. obtusus* is very brief and not useful in diagnosing the species. In contrast, a more detailed description of '*P. obtusus*' (= *P. cubitalis*) was given in Enderlein (1903) which was also cited by Okamoto (1907). Judging from these points, identification of *P. obtusus* by Okamoto (1906, 1907) was probably based

on the description by Enderlein (1903) and thus Okamoto's *Psocus obtusus* should be interpreted as *Psocus cubitalis*. Unfortunately, the specimens which can be identified unambiguously as '*Psocus obtusus*' examined by Okamoto (1906, 1907) are not available in the Hokkaido University Insect Collection, but two female specimens were pinned under the name label of *Psocus obtusus*. These specimens may be the ones examined by Okamoto (1906, 1907). However, although detailed collecting information (locality and date) was provided in Okamoto's paper, no data label was attached to the specimens. The identification label was handwritten by Okamoto (Yoshizawa, 2002) so that, even though these specimens might not those examined by Okamoto (1906, 1907), they can be considered to represent *Psocus obtusus* in Okamoto's sense. Morphology and coloration of these specimens agree with the description of *Psocus obtusus* by Enderlein (1903) and *Psocus cubitalis* by Enderlein (1919). By examination of Okamoto's female specimens and additional conspecific specimens collected in Aomori Pref., where Okamoto's *P. obtusus* was collected, its generic assignment into *Neoblaste* was also confirmed.

In conclusion, the taxonomy and synonymy of Okamoto's *Psocus obtusus* should be as follow.

Neoblaste cubitalis (Enderlein)

Psocus obtusus: Enderlein, 1903: 227; Okamoto, 1906: 198; Okamoto, 1907: 129 (not *Psocus obtusus* Hagen, 1858).

Blaste obtusa: Tomita & Haga, 1991 [not *Blaste obtusa* (Hagen, 1858)].

Psocus cubitalis Enderlein, 1919: 36.

Neoblaste cubitalis: Thornton, 1984: 143.

Specimens examined. 2 females identified as *Psocus obtusus* by Okamoto; 1 male 1 female, Kitatsugaru, Aomori Pref., 15. ix. 1997; 1 female, Kuroishi, Aomori City, 8. vii. 1998; 1 male, same locality, 25. vii. 1999, all collected by T. Ichita.

Acknowledgments

I thank T. Ichita for valuable specimens and E. L. Mockford for critical review and valuable comments.

References

Badonnel, A. 1977. Psocoptères de l'île de La Réunion. Bulletin du Muséum National d' Histoire Naturelle (Zoologie) 335: 917–949.

Endang, S. K., Thornton, I. W. B. & New, T. R. 2002. The Psocidae (Insecta: Psocoptera) of Java and the eastern islands of Indonesia. Invertebrate Systematics 16: 107–176.

Enderlein, G. 1903. Die Copeognathen des indo-australischen Faunengebietes. Annales historico-natureles Musei nationalis Hungarici 1: 179–344, pls III-XIV.

Enderlein, G. 1919. Copeognatha. Collections Zoologiques du baron Edm. de Selys Longchamps 3 (2): 1–55 + 5 plates.

Hagen, H. 1858. Synopsis der Neuroptera Ceylons, Pars I. Verhandlungen der Zoologisch-Botanischen Gesellschaft Wien 8: 471–488.

Li, F. 1997. Psocoptera: Psyllipsocidae, Amphientomidae, Pachytroctidae, Caeciliidae, Stenopsocidae, Amphipsocidae, Dasydemellidae, Lachesillidae, Ectopsocidae,

Peripsocidae, Pseudocaeciliidae, Philotarsidae, Elipsocidae, Hemipsocidae and Psocidae. Pp. 385–530 in Yang X. (ed.). Insect of the Three Gorge Reservoir area of Yangtze river. Part 1.

Lienhard, C. & Smithers, C. N. 2002. Psocoptera: World Catalogue & Bibliography. Instrumenta Biodiversitatis V, Museum of Natural History, Geneva.

Mockford, E. L. 1993. North American Psocoptera. Flora & Fauna Handbook No. 10, Sandhill Crane Press, Florida.

Mockford, E. L. 1996. New species and records of Psocoptera from northern Venezuela. Tropical Zoology, Special Issue 2: 1–98.

Mockford, E. L. 2003. New species and records of Psocoptera from the Kuril Islands. Deutsche Entomologische Zeitchrift 50: 191–229.

Okamoto, H. 1906. On the Psocidae of Japan. Transactions of the Sapporo Natural History Society 1: 197–199.

Okamoto, H. 1907. Die Psociden Japans. Transactions of the Sapporo Natural History Society 2: 113–147, 11 figs.

Pearman, J. V. 1932. Notes on the genus *Psocus*, with special reference to the British species. Entomologist's Monthly Magazine 68: 193–204

Pearman, J. V. 1934. New and little known African Psocoptera. Stylops 3: 121–132.

Smithers, C. N. 1967. A catalogue of the Psocoptera of the world. The Australian Zoologist 14: 1–145.

Smithers, C. N. 1990. Keys to the families and genera of Psocoptera (Arthropoda: Insecta). Technical Reports of the Australian Museum 2: 1–82.

Thornton, I. W. B. 1960. New Psocidae and an aberrant new myopsocid (Psocoptera) from Hong Kong. Transactions of the Royal Entomological Society, London 112: 239–261.

Thornton, I. W. B. 1984. Psocoptera and Wallace's line: collections from the islands of Bali and Lombok. Treubia 29: 83–177.

Tomita, Y. & Haga, K. 1991. A check-list of Psocoptera (Insecta) from Japan with keys for identification. Bulletin of Sugadaira Montane Research Center of the University of Tsukuba 12: 35–54.

Yoshizawa, K. 2000. Psocopteran insects collected through biological investigations of the Imperial Palace, Tokyo. Memoirs of the National Science Museum, Tokyo 36: 29–34.

Yoshizawa, K. 2001. Systematic study of Amphipsocidae in Japan (Psocodea: 'Psocoptera': Caeciliusetae), with comments on higher classification within the family. Insecta Matsumurana, new series 58: 1–25.

Yoshizawa, K. 2002. Type specimens of Psocoptera described by H. Okamoto in Hokkaido University Insect Collection. Insecta Matsumurana, new series 59: 29–38.

Yoshizawa, K. 2004. Molecular phylogeny of major lineages of *Trichadenotecnum* and a review of diagnostic morphological characters (Psocoptera: Psocidae). Systematic Entomology 29: 383–394.

Yoshizawa, K. 2005. Morphology of Psocomorpha (Psocodea: 'Psocoptera'). Insecta Matsumurana, new series 62: 1–44.

Yoshizawa, K. & Johnson, K. P. 2008. Molecular systematics of the barklouse family Psocidae (Insecta: Psocodea: 'Psocoptera') and implications for morphological and behavioral evolution. Molecular Phylogenetics and Evolution 46: 547–559.