International Journal of Entomology Vol. 26, no. 4: 378–385 31 December 1984

AN UNUSUAL PSOCOPTERAN FROM NEW GUINEA AND ITS RELATIONSHIPS WITHIN THE PHILOTARSIDAE

I. W. B. Thornton[1]

Abstract. The genus *Novopsocus* is erected within the Zelandopsocinae (Philotarsidae) for the New Guinea species *Austropsocus stenopterus* and the male is described. Highly apomorphic characters include straplike wings, a flattened head capsule with a sharp-edged vertex, and a massive, flattened basal flagellar segment in the male. A supplementary key to philotarsid genera is provided, along with a cladogram of 16 taxa comprising 64 of the 65 species of Zelandopsocinae, based on 20 characters. The relationships of the 3 New Guinea representatives are examined and found to lie with the Australian and New Caledonian sections of *Austropsocus* rather than with the New Zealand section.

The psocopteran family Philotarsidae has been the subject of extensive systematic studies over the past decade (Mockford & Evans 1976; New 1971; Thornton 1981; Thornton & New 1977a, 1977b; Thornton & Smithers 1974, 1977, 1978; Thornton et al. 1977), and its biogeography relative to the possible roles of fragmentation and dispersal in producing the present pattern of distribution of the family has been discussed (Thornton 1980, 1981).

Two subfamilies have been recognized (Thornton 1981). One of these, the Zelandopsocinae (65 species), comprises the genera *Bryopsocus* Thornton, Wong & Smithers, *Zelandopsocus* Tillyard, and *Austropsocus* Smithers. The 2 species of *Bryopsocus* are confined to New Zealand; *Zelandopsocus* (31 species) is richly represented in New Caledonia with 27 species and has representatives in NE Australia (1) and New Zealand (3); the 32 species referred to *Austropsocus* occur in New Guinea (3), New Caledonia (7), Western Australia (1), eastern Australia (12), New Zealand (8, 1 in common with eastern Australia), Macquarie, Campbell, Auckland, Antipodes and Snares islands (1), and the Chatham Islands (1). The subfamily appears to be absent from islands of the Outer Melanesian Arc and strictly confined to Australian Plate fragments (Thornton 1980).

The 3 New Guinea species referred to *Austropsocus, novoguinensis* (Thornton & Smithers, 1977), *perforatus* Thornton & Smithers, 1977, and *stenopterus* (Thornton & Smithers, 1977), are in some respects intermediate between the genera *Zelandopsocus* and *Austropsocus* (Thornton & Smithers 1977, Thornton 1981). *Austropsocus stenopterus,* which was known only from the female, and *novoguinensis,* known from both sexes, were originally provisionally placed in *Zelandopsocus* (Thornton & Smithers 1977) on the basis of characters of the female epiproct (both species) and phallosome sclerites (*novoguinensis*), although *Austropsocus*-like character states were noted (cil-

1. Department of Zoology, La Trobe University, Bundoora, Victoria 3083, Australia.

iation of fore wing veins, subgenital plate and dorsal valve structure). As a result of a multivariate analysis of the family (Thornton 1981), they were placed with *perforatus* in *Austropsocus*. At the time of the Thornton & New (1977b) and Thornton (1981) studies, the 3 New Guinea species were recognized as being most similar to 1 of 3 recognizable groups of Australian *Austropsocus* species—the *cuneatus* group. The median lobe of the hypandrium of *novoguinensis* is not itself bilobed and is thus in reasonable conformity with this interpretation. That of *perforatus* is highly peculiar and is less so.

The species *stenopterus* is evidently less widely distributed and/or less common in New Guinea than the other 2 species. Whereas *perforatus* is common and widespread at heights of from 1000 to 3000 m (3300 to 9800 ft) and *novoguinensis*, although less common, is also widely distributed, occurring from 500 to 1900 m (1600 to 6200 ft), *stenopterus* was described from a single female collected above 2300 m (7500 ft) at Woitape in SE New Guinea. I have now examined 5 additional specimens from the B.P. Bishop Museum collection, all clearly conspecific with the above female. These comprise a female each from the Bulolo River and the Sepik River, NE New Guinea, a specimen of each sex from Koroba in SE New Guinea, and a male from Ulap, NE New Guinea. The head shape of *stenopterus*, shape of fore and hind wings, and male antennal structure are highly unusual, and their combination is unique. In view of the material now available of both sexes, I propose generic status for *stenopterus* and give a further description of the species.

Novopsocus Thornton, **new genus**

Type-species: *Zelandopsocus stenopterus* Thornton & Smithers, 1977.

Diagnosis. Belonging to the Zelandopsocinae. Subgenital plate bilobed, lobes not overlapping, each with group of apical setae; epiproct with dorsal setose flap; basal flagellar segment massive, flattened; hypandrium 3-lobed; phallosome with massive sclerites, no ribbon-sclerite, pair of membranous (not spinous) sacs; wings long, narrow, straplike; head capsule flattened, vertex sharp-edged.

The genus keys to couplet 4 (*Austropsocus* and *Zelandopsocus*) of the key to philotarsid genera provided by Thornton (1981: 441). A supplementary key follows:

4A. Phallosome containing spinous sacs and ribbon-sclerite; middle lobe of hypandrium mushroom-shaped; ♀ epiproct with dorsal setose flap ..... **Zelandopsocus**

Phallosome not containing ribbon-sclerite, usually no spinous sacs [exceptions: *insularis* group and *apicipunctatus* (Tillyard)]; middle lobe of hypandrium usually not mushroom-shaped (exception: *novoguinensis*); ♀ epiproct with or without dorsal flap 4B

4B. Head capsule flattened, vertex sharp-edged; wings long, narrow, straplike, leading and trailing edges almost parallel; basal flagellar segment of ♂ massive, flattened; ♀ epiproct with dorsal setose flap ..... **Novopsocus, n. gen.**

Head capsule normal; fore wing distinctly wider subapically; basal flagellar segment of ♂ not extraordinarily developed and flattened; ♀ epiproct usually without dorsal setose flap (exception: *novoguinensis*) ..... **Austropsocus**

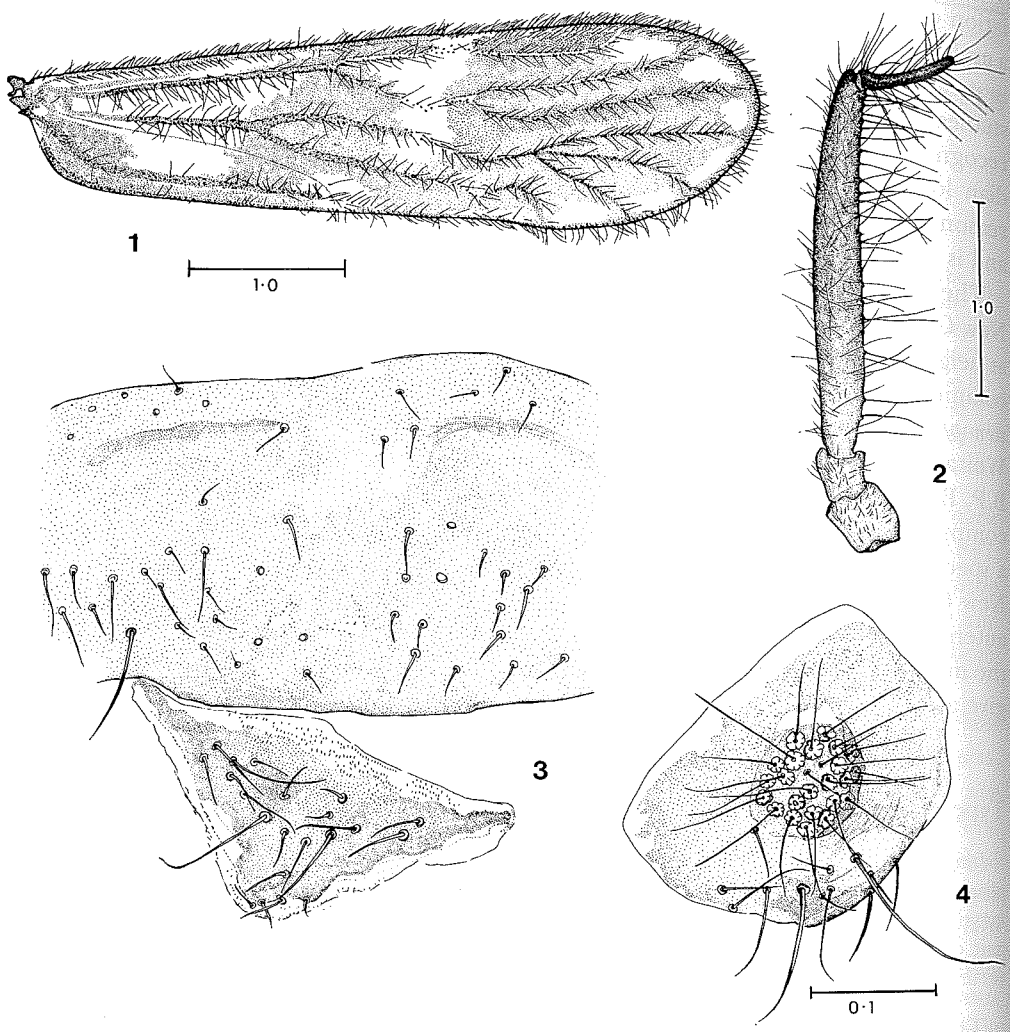

FIG. 1–4. *Novopsocus stenopterus*, ♂ from Koroba: **1,** fore wing; **2,** basal 4 antennal segments; **3,** 9th tergite and epiproct; **4,** paraproct. Fig. 3 and 4 to common scale. Scales in mm.

Novopsocus stenopterus (Thornton & Smithers), **new combination** Fig. 1–7

Zelandopsocus stenopterus Thornton & Smithers, 1977: 443.

Austropsocus stenopterus: Thornton, 1981: 440. Holotype ♀, SE New Guinea, Woitape (Australian Museum, Sydney) (examined).

Further description:

♂. *Coloration* (after 20 yr dry storage, then softening). As ♀ but antennae brown; fore wing (Fig. 1) differing from holotype in details of pattern only; coxa brown, trochanter colorless, femur colorless in basal ½, dark brown over apical ½, tibia basal ⅕ very pale buff, apical ⅘ brown, basal tarsal segment colorless, apical segments dark brown. *Morphology.* Head flattened,

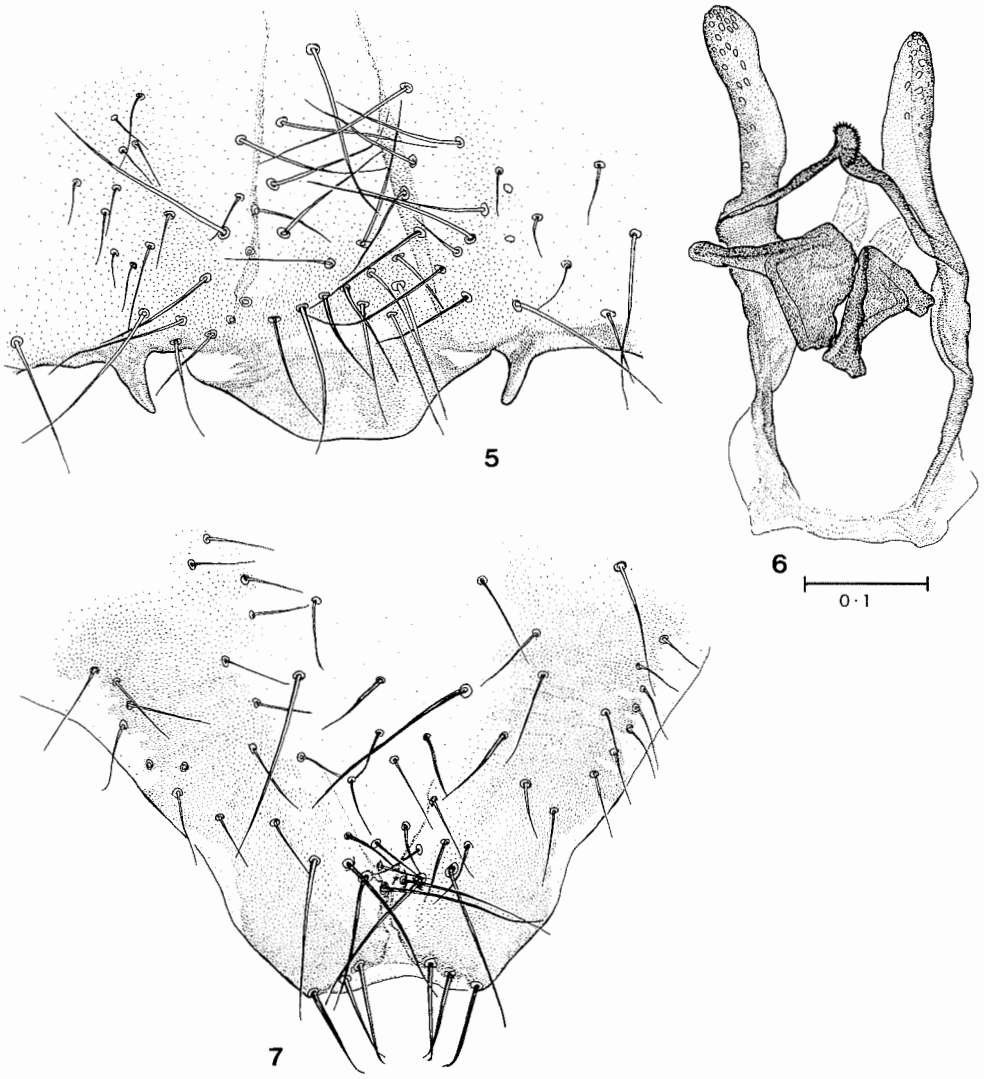

FIG. 5–7. *Novopsocus stenopterus*: **5,** hypandrium of Koroba ♂; **6,** phallosome of Koroba ♂; **7,** subgenital plate of Koroba ♀. Scale in mm.

sharply produced vertically, as ♀. I.O.:D. = 3:1, eyes larger than in ♀. Basal flagellar segment (Fig. 2) massive, flattened. Apical segment of maxillary palp as in ♀. 9 weak ctenidia on basal hind tarsal segment, claw as ♀. Crossvein between veins *Rs* and *M* in fore wing evidently absent in both wings (present in ♀). Epiproct (Fig. 3) triangular, basal angles sclerotized. 9th abdominal tergite (Fig. 3) without spines or posterior marginal sclerotization. Paraproct (Fig. 4) with oval field of 23 trichobothria and 2 setae not in rosette sockets. Hypandrium (Fig. 5) median lobe not itself bilobed, each side a smooth pointed prong. Phallosome (Fig. 6) with pair of complexly shaped sclerites.

♀. *Coloration.* Differs from holotype in femur pale buff basal ¼, brown apical ¾; tibia brown

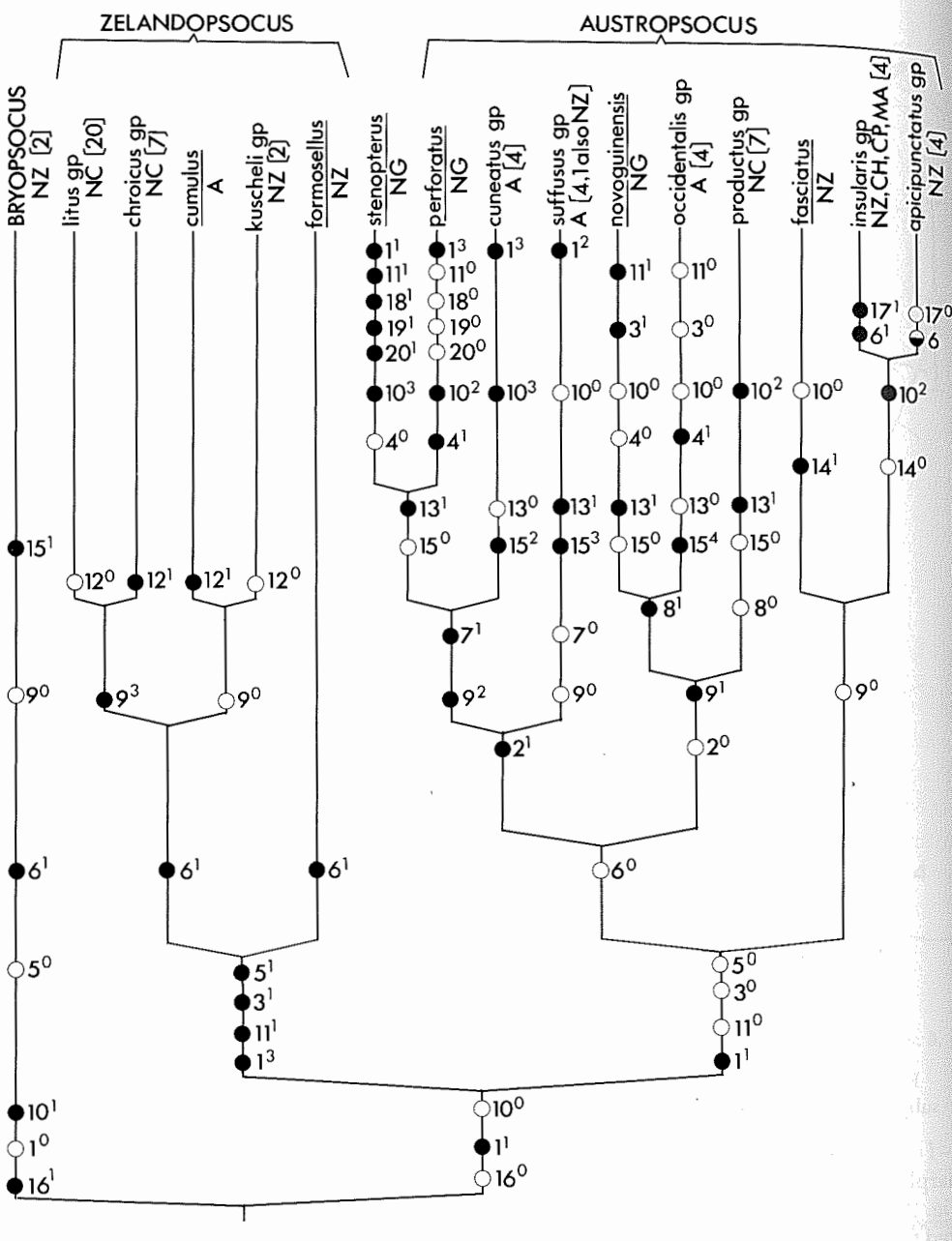

FIG. 8. Cladogram of 16 zelandopsocine taxa (species and species groups, comprising 61 species) based on 20 characters. Characters and states (plesiomorphous to apomorphous): hypandrium unlobed (1^0), 3-lobed (1^1), incipiently 2-lobed (1^2), 3–7-lobed (1^3); hypandrium without (2^0), with (2^1) lateral prongs; hypandrium median lobe simple (3^0), mushroom-shaped (3^1); hypandrium median lobe single (4^0), bifid (4^1); phallosome without (5^0), with (5^1) ribbon-sclerite; phallosome without (6^0), with (6^1) pair of spinous sacs; phallosome without (7^0), with (7^1) ham-shaped sclerites; ♂ 9th tergite

apical ⅙; scape, pedicel and basal ⅔ basal flagellar segment light brown, 2nd and 3rd flagellar segments (rest lost) brown. *Morphology.* Subgenital plate apical process (Fig. 7) with 3 marginal setae each side.

Specimens on which above further descriptions based. PAPUA NEW GUINEA: 1♂,1♀, SE, Koroba, 40 km W of Tari, 1650 m, 17,19.IX.1963 (R. Straatman). *Other specimens examined.* 1♀, NE, Bulolo Riv, 1130 m, 17.IX.1969 (A.B. Mirza); 1♀, NE, Sepik Riv, Ambunti, 200 m, 4.V.1963, light trap (R. Straatman); 1♂, Morobe Distr, Ulap, 800–1100 m, IX.1968 (N.L.H. Krauss).

At the time of examination, the abdomen of the Bulolo River female was mauve dorsally.

Character-states of 20 characters within 16 taxa (comprising 64 of the 65 species) of the subfamily are shown in a cladogram (Fig. 8) and listed in the legend. The species groups named are referred to in earlier publications (Thornton & Smithers 1974, 1977; Thornton & New 1977b; Thornton et al. 1977). *Austropsocus frogatti* (Enderlein) is incompletely known (Thornton & New 1977b) and is not included in the cladogram. Some comment is needed on the *Zelandopsocus* section of the cladogram. First, it was earlier reported (Thornton 1981) that *cumulus* Thornton & New and *formosellus* Tillyard lack spinous sacs and a ribbon-sclerite in association with the phallosome. Re-examination shows that, in fact, they possess these structures. Second, the New Caledonian species of the genus are a monophyletic group based on subgenital plate structure, with the Australian *cumulus* being intermediate between the New Caledonian and New Zealand sections of the genus. Third, the New Zealand species do not form a monophyletic group.

The straplike shape of the fore and hind wings of *Novopsocus stenopterus* (character 19 in the cladogram) and the remarkable development of the male basal flagellar segment (18) are found nowhere else in the subfamily; the only other example of the latter condition, but to a much lesser degree, is in *Austropsocus antennalis* Thornton

---

←

simple (8^0), thickened or ornamental posteriorly (8^1); ♀ subgenital plate lobe single (9^0), shallowly bifid (9^1), bilobed, lobes triangular (9^2), lobes overlapping (9^3); ♀ subgenital plate apical setae 4 (10^0), lacking (10^1), 2 (10^2), more than 5 (10^3); ♀ epiproct simple (11^0), with dorsal setose flap (11^1); ♀ epiproct without (12^0), with (12^1) apical setose extension; ♀ dorsal valve tine shorter (13^0), longer (13^1) than lobe; ♀ dorsal valve lobe rounded (14^0), rectangular (14^1); ♀ outer valve normal (15^0), massive (15^1), very small (15^2), curved, fusiform (15^3), with distinct setose prominence (15^4); subapical tooth on claw absent (16^0), present (16^1); vein Cu_2 in fore wing bare (17^0), setose (17^1); basal flagellar segment of ♂ normal (18^0), massive, flattened (18^1); wings normal in shape, fore wing distinctly widest subapically (19^0), long, narrow, straplike (19^1); head capsule normal (20^0), flattened, vertex sharp-edged (20^1). ○, most plesiomorphous state; ●, apomorphous states; ⊖ (character 6, *apicipunctatus* group of *Austropsocus*), line is not monophyletic for character, both plesiomorphic and apomorphic states represented in the group. Character 6 is not available in *A. fasciatus*, known only from the ♀. The most plesiomorphous state is indicated only where it is on the alternative clade to a more apomorphous state; where a character is unrepresented in a lineage it may be assumed that, if known, it is in the most plesiomorphous state. **A,** Australia; **CH,** Chatham Islands; **CP,** Campbell Islands; **MA,** Macquarie Island; **NC,** New Caledonia; **NG,** New Guinea; **NZ,** New Zealand. Numbers in brackets refer to number of species in species groups.

& New of the Australian *cuneatus* group. The peculiar, calopsocid-like, sharply produced vertex and flattened head of *N. stenopterus* (20) (Thornton & Smithers 1977: Fig. 74) is only approached in the subfamily by the brachypterous *Austropsocus chathamensis* Thornton, Wong & Smithers from the Chatham Islands. The shape of the phallosome sclerites (7) recalls *perforatus* and several Australian species of *Austropsocus*, but particularly *antennalis* and *Austropsocus omega* Thornton & New, both of the *cuneatus* group of *Austropsocus*. In the female the outer valve of the gonapophyses (15) is unusually fusiform and elongate posteriorly, a condition approached in *Austropsocus cuneatus* Thornton & New, and in the lobe of the subgenital plate (9), bearing 6 marginal setae (10), *N. stenopterus* is similar to *cuneatus, omega,* and the 4th member of the *cuneatus* group, *Austropsocus sinuosus* (Banks).

In hypandrial characteristics (1, 2), *N. stenopterus* most closely resembles a 2nd group of Australian *Austropsocus* species, the *suffusus* group [*suffusus* Thornton & New, *venosus* Thornton & New, *hyalinus* Thornton, Wong & Smithers (also in New Zealand) and *costalis* Thornton & New]. All 3 New Guinea species of the subfamily possess a dorsal valve of the female gonapophyses with a long prominent subapical tine extending beyond the apex of the valve (13). This feature occurs in the *suffusus* group and also in the *productus* group of 7 *Austropsocus* species from New Caledonia. A 3rd group of Australian *Austropsocus* species, the *occidentalis* group [*occidentalis* Thornton & New, *viridis* (Enderlein), *tibialis* Thornton & New, and *punctatus* Thornton & New] is characterized by an apomorphic condition of the outer valve (15) differing from that of the *suffusus* group, and a bilobed median process in the hypandrium (4), the latter feature being found in only 1 other species within the subfamily, the New Guinea *perforatus*. The *occidentalis* group also shares with *novoguinensis* the apomorphic ornamentation and thickening of the posterior margin of the 9th tergite in the male (8) as well as the form of the subgenital plate (9).

There are thus links in specialized characters between the New Guinea species of the subfamily and those of Australia and New Caledonia: *A. perforatus* and *N. stenopterus* with the Australian *cuneatus* and *suffusus* groups, and *novoguinensis* with the *occidentalis* (Australia) and *productus* (New Caledonia) groups. One monophyletic group of *Austropsocus* in New Zealand, the *insularis* group of 4 species, can be distinguished by the synapomorphy vein Cu_2 in the fore wing being setose (17), but the remaining New Zealand species of *Austropsocus* have no obvious unique synapomorphy. Four New Zealand species (the *apicipunctatus* group) combine with the *insularis* group as a monophyletic section on ciliation of the subgenital plate (10), and a 9th species, *fasciatus* Thornton, Wong & Smithers, is related to these by the presence of phallosome spinous sacs (6). There is no evidence, on apomorphic characters, of any link between the New Guinea species and those of the New Zealand area, apart from the ciliation of the subgenital plate (10) of *perforatus*.

Both *N. stenopterus* and *A. novoguinensis* possess a dorsal setose flap on the female epiproct (11), a condition usual in *Zelandopsocus,* unusual in *Austropsocus*. Although generic status for *stenopterus* is not justified by the cladistics (Fig. 8) (an earlier branch-

ing from either the *Zelandopsocus* or *Austropsocus* stem would involve many parallelisms), I believe that on an evolutionary systematics approach the combination of the highly apomorphic characters 18, 19, and 20 does justify generic status.

Thus, as so often with psocopteran systematics (and I suspect that of other groups), one is confronted with an overlapping, incongruent mosaic when apomorphies are analyzed; the neat, nested, congruent cladograms of the textbooks do not emerge, and parallelisms, such as in characters 1, 6, and 10, would have to be recognized however a cladogram was devised. I believe that this situation is so common that it must reflect some general natural phenomenon. Throckmorton (1962, 1965) convincingly demonstrates that where evolution has proceeded from heterozygous populations and the heterozygosity has been maintained through many speciation events, genotypic homology, although requiring genetic continuity, does not require genotypic continuity, and a given genotype may be produced independently in several phyletic lines. Throckmorton (1962) believes that recognition of this fact "removes socalled parallel evolution from the ranks of the inexplicable to those of the expected."

The discovery of further material of *stenopterus* thus provides additional evidence of the large number of apomorphies in the New Guinea representatives of the subfamily and that their relationships lie with the Australian and New Caledonian sections of the subfamily rather than with the New Zealand section.

Acknowledgments. I am grateful to Dr T.R. New for comments on this paper, and to Mrs J. Browning for the illustrations.

LITERATURE CITED

Mockford, E.L. & H.A. Evans. 1976. Descriptions and records of some Philotarsidae from Trinidad, West Indies (Psocoptera). *Florida Entomol.* **2:** 171–81.

New, T.R. 1971. Two dimorphic Philotarsidae (Psocoptera) from Australia. *J. Aust. Entomol. Soc.* **10:** 25–30.

Thornton, I.W.B. 1980. Plate tectonics and the distribution of a family of psocopteran insects in the SW Pacific. *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **31:** 251–66.

1981. The systematics, phylogeny and biogeography of the psocopteran family Philotarsidae. *Syst. Entomol.* **6:** 413–52.

Thornton, I.W.B. & T.R. New. 1977a. Philotarsidae (Psocoptera) of the Bismark Archipelago. *Pac. Insects* **17:** 451–57.

1977b. The Philotarsidae (Insecta: Psocoptera) of Australia. *Aust. J. Zool., Suppl. Ser.* **54:** 1–62.

Thornton, I.W.B. & C.N. Smithers. 1974. The Philotarsidae (Psocoptera) of New Caledonia. *Pac. Insects* **16:** 177–243.

1977. Philotarsidae (Psocoptera) of New Guinea. *Pac. Insects* **17:** 419–50.

1978. Philotarsidae (Psocoptera) of the Solomon Archipelago. *Pac. Insects* **18:** 227–33.

Thornton, I.W.B., S.K. Wong & C.N. Smithers. 1977. The Philotarsidae (Psocoptera) of New Zealand and islands of the New Zealand Plateau. *Pac. Insects* **17:** 197–228.

Throckmorton, L. 1962. The problem of phylogeny in the genus *Drosophila*. *Univ. Texas Publ.* **6205:** 207–343.

1965. Similarity *versus* relationship in *Drosophila*. *Syst. Zool.* **14**(3): 221–36.