

**Macropterous form of *Dorypteryx domestica* (Psocoptera: Psyllipsocidae)**

ZUZANA KUČEROVÁ

Research Institute of Crop Production, Department of Stored Product Pest Control,  
Drnovská 507, 161 06 Prague 6, Czech Republic**Psocoptera, *Dorypteryx domestica*, macropterous form, wing morphology**

**Abstract.** The macropterous form of psocid *Dorypteryx domestica* (Smithers, 1958), previously only known as brachypterous, is described. The macropterous individuals were reared from brachypterous parents in a laboratory culture. Morphology of macropterous male and female and wing variation is given. Wing polymorphism in psocids is discussed.

## Introduction

*Dorypteryx domestica* (Smithers, 1958) was originally described from dwellings in Southern Rhodesia (now Zimbabwe). This psocid was intercepted for the first time in Europe in 1973 (Lienhard, 1977). Since then it has been recorded from 13 European countries. In addition to individuals found in dwellings, sporadic records are also known from a food factory (Kalinović et al., 1981), stored grain (Kučerová, 1992) and from open nature (Kalinović et al., 1981; Kalinović & Günther, 1985). The dynamics of the geographic distribution of this predominantly domestic species was analysed by Lienhard (1994). Lienhard (1977) provided a redescription of *D. domestica* and Smithers (1991a) and Lienhard & Schneider (1993) compiled an identification key to the three known species of *Dorypteryx* Aaron, 1884. These three brachypterous species occurring also in Europe differ especially in the length of the forewings and their venation, the colour of the abdomen, and the shape and structure of the spermatheca.

*Dorypteryx domestica* was described and subsequently has always been recorded as brachypterous and flightless. No observation of a fully winged form of this species has been mentioned in the literature, though macropterous individuals are known in a closely related genus *Psocathropos* Ribaga, 1899 (Mockford, 1993). This paper presents information on the macropterous form of *D. domestica*.

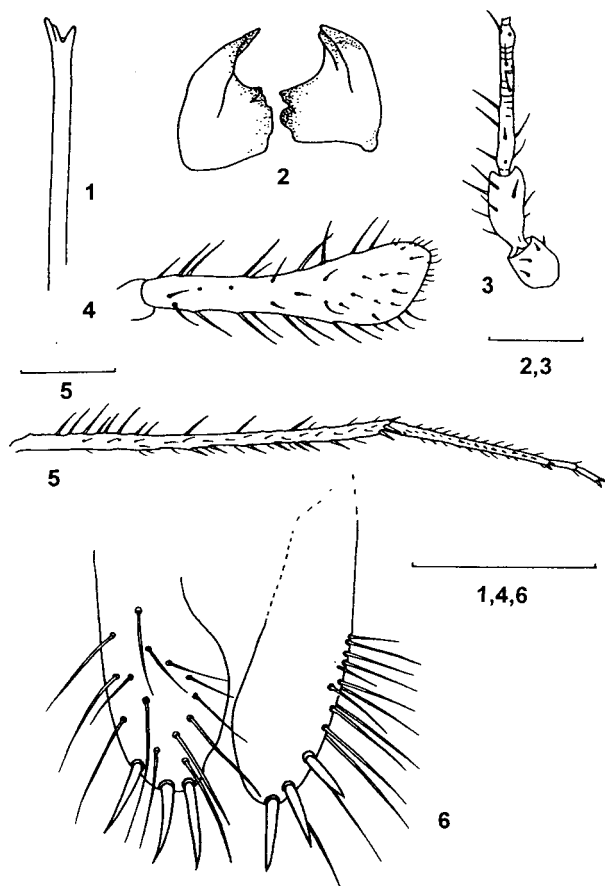
## Material and methods

The macropterous individuals (4♂, 2♀) were found among the progeny of brachypterous pairs of *D. domestica* reared in the laboratory at 28°C and 75% relative humidity in glass containers (25 ml, diam. 3 cm), with wheat germ as food, in continual darkness. The founder parents were caught indoors (under filter paper in the washing room of laboratory dishes, on the shelves of the rearing room for stored product pests) in the Research Institute of Food Industry building, Prague, in 1991. The identification of brachypterous forms of *D. domestica* was also verified by the examination of the spermatheca. The psocid specimens intended for morphological examination were mounted on slide mounts in Swan medium. Colour observations were made on live individuals and also on microscopic slides. All examined material is in the collection of the Department of Stored Product Pest Control, Research Institute of Crop Production, Prague.

Macropterous form of *Dorypteryx domestica*

## Description

**COLOURATION.** General colouration of both sexes as in brachypterous adults. Body pale, ground colouration whitish-yellow. Head ochre-brown with darker postclypeus. Compound eyes black, ocelli



Figs 1–6: *Dorypteryx domestica*, macropterous form. 1 – dorsal view of left lacinia; 2 – dorsal view of mandibles; 3 – left scape, pedicel and first flagellar segment; 4 – end segment of left maxillary palp; 5 – right hind tibia and tarsus; 6 – dorsal view of gonapophyses. Scale bars: 1–4, 6 = 0.1 mm; 5 = 0.2 mm.

and fourth segments large, fourth segment broadened and bevelled distally (Fig. 4). Antennae long and fine, reaching wing apex, having at least twenty segments (no intact specimen available). Scape shorter (0.053 mm) and broader (0.055 mm) than pedicel (0.095 and 0.045 mm respectively). Pedicel trapezoid, with three short, stout sensilla on the ventral side. Five basal segments of flagellum long, following segments shorter and varying in length. All segments of flagellum annulated. First segment of flagellum with indistinct annulation, bearing 15 to 17 setae (Fig. 3). Thorax covered with long scattered setae. Prothorax short and high. Mesothorax larger than metathorax. Metathorax with protruding praescutum. Legs long and slender. Hind tibia and tarsus as in Fig. 5. Two pairs of fully developed wings with rounded tips, held roofwise over the abdomen. Forewings about twice as long as abdomen and 1.3 times longer than hind wings. Wing venation (Fig. 7) more complete than in brachypterous adults. Forewings: Pterostigma usually present, bounded behind by R1. Vein Rs with 2 branches, M with 1–3 branches (usually 2), M fused with Rs for some length, M and CuA fused proximally. In most cases CuA forked distally, forming areola postica. CuP finer than other veins, reaching margin at same point as 1A, this sometimes forming hind

reddish. Mouth parts with reddish spots. Maxillary palps, antennal scape, pedicel and flagellum pale grey-brown. At least segments 2 to 5 of flagellum with two narrow transverse bands distally, proximal band being darker and distal paler than the ground colouration. Thorax and legs pale grey-brown. Both wing pairs hyaline with greyish veins. Abdomen whitish-yellow with two characteristic wide orange-brown irregular transverse bands across the dorsal surface, in the middle connected by a narrow longitudinal stripe. Termina lia dark ochre-brown.

**COLOUR VARIATION.** The colour of the two transverse bands on abdomen varies in both macropterous and brachypterous live adults of both sexes from orange through reddish to brown. The bands are darker in older individuals. They vary in width, and also have irregular margins, sometimes even disintegrating into spots. One macropterous female had five discrete narrow stripes replacing the two bands.

**MORPHOLOGY.** Male: Length of body (on slides) 1.5 mm. Head longer than wide, frons and vertex covered with long scattered setae. Postclypeus with shorter, finer setae. Compound eyes larger than in brachypterous male, composed of about 51 facets. Three ocelli developed. Mandibles as in Fig. 2, maxillary laciniae with 4 diverging terminal teeth of varying size (Fig. 1), maxillary palps with first and third segments short, second

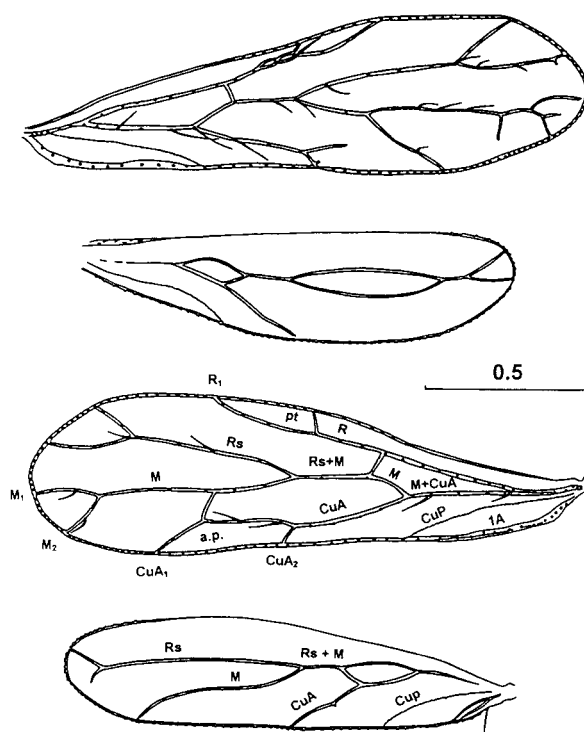


Fig. 7. *D. domestica*, fore and hind wings of a macropterous male. In addition to standard vein abbreviations, pt = pterostigma, a.p. = areola postica.

urements, and the second and third flagellar segment of macropterous male is longer than in the macropterous female and in both brachypterous forms. No other significant metric differences between both forms and sexes were found.

**VARIATION OF WING VENATION.** Forewing venation varies among individuals, and also between the right and left wing of the same individual. There are no specific differences in wing venation between the male and the female. Venational aberrations are frequent, especially additional branchings (cross-veins between C and R and between M and CuA). Much variation exists in the number of incomplete branches of CuA,

wing-margin. Vein C setose except for first 1/3 of forewing margin. Marginal setae shorter (0.10 mm) than in brachypterous wings (0.14 mm). Veins bearing sparse upstanding setae. Hind wings: Venation simple, R absent, Rs with 2 branches, M and CuA not branched. Vein C with setae except for first 2/3 of fore margin. Other veins completely without setae. Abdomen ovoid. Abdominal segments with rows of rather short and fine setae. Paraproct with strong spine 0.04 mm long. Male genitalia as in brachypterous adults.

**Female:** General morphology as in male. Body length 1.9 mm. Compound eyes composed of more than 60 facets. Scape 0.052 mm long, 0.058 mm wide; pedicel 0.096 mm long, 0.046 mm wide. Gonapophyses (Fig. 6) with three stout apical setae (length 0.043 mm). Spine of paraproct 0.042 mm long. Wing venation as in Fig. 8.

The main body measurements of macropterous male and female and comparison with measurements of the brachypterous form are summarised in Table 1. The macropterous and brachypterous forms do not differ in body length. In both forms the female is larger than the male. There are differences in wing and eye measurements,

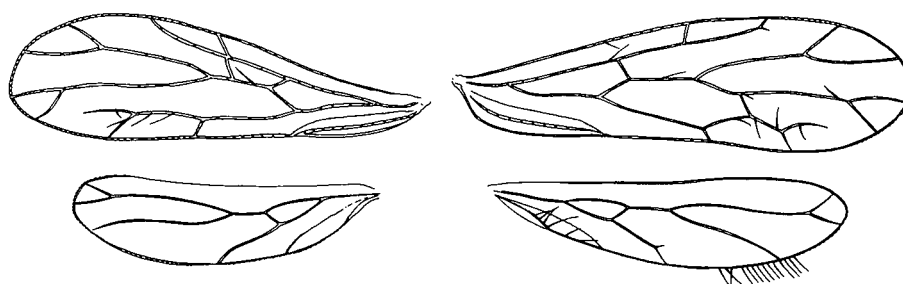


Fig 8. *D. domestica*, fore and hind wings of a macropterous female.

M, Rs and R (Figs 7–9). The setae inserted on veins also vary in number. The venation of hind wings does not vary so much, because of smaller number of veins.

TABLE 1. Body measurements (mm) of *D. domestica*.

Character	Macropterous				Brachypterous			
	n	male	n	female	n	male	n	female
BL	3	1.552 ± 0.079	2	1.865 ± 0.010	5	1.501 ± 0.010	6	1.830 ± 0.150
IO/D	1	1.948		—	2	3.260 ± 0.005	3	0.306 ± 0.006
PO	6	0.521 ± 0.004		—	6	0.545 ± 0.006	5	0.550 ± 0.005
f1	4	0.180 ± 0.014	4	0.167 ± 0.007	7	0.162 ± 0.012	10	0.166 ± 0.014
f2	3	0.174 ± 0.014	2	0.136 ± 0.000	6	0.137 ± 0.015	10	0.133 ± 0.012
f3	2	0.173 ± 0.016	2	0.146 ± 0.003	5	0.136 ± 0.008	9	0.136 ± 0.013
FWl	5	1.773 ± 0.066	2	1.822 ± 0.052	9	1.007 ± 0.072	8	0.976 ± 0.050
FWw	4	0.510 ± 0.011	3	0.550 ± 0.028	6	0.186 ± 0.012	8	0.179 ± 0.015
HWl	5	1.339 ± 0.046	3	1.415 ± 0.031		—		—
HWw	4	0.352 ± 0.007	2	0.367 ± 0.022		—		—
F	3	0.440 ± 0.017	2	0.471 ± 0.000	5	0.458 ± 0.017	4	0.475 ± 0.021
T	5	0.774 ± 0.031	3	0.797 ± 0.010	7	0.759 ± 0.039	5	0.768 ± 0.042
t1	5	0.370 ± 0.014	3	0.392 ± 0.006	6	0.365 ± 0.007	6	0.379 ± 0.025
t2	5	0.059 ± 0.006	3	0.059 ± 0.004	6	0.059 ± 0.004	6	0.056 ± 0.004
t3	5	0.069 ± 0.003	3	0.069 ± 0.002	5	0.069 ± 0.005	6	0.066 ± 0.003

n – no. of specimens measured; BL – body length; FWl, FWw – forewing length and width; HWl, HWw – hind wing length and width; IO/D – least distance between compound eyes divided by greatest antero-posterior eye diameter in dorsal view; PO – transverse diameter of eye divided by greatest antero-posterior eye diameter in dorsal view; f1, f2, f3 – length of first, second and third flagellar segments; F – length of hind femur; T – length of hind tibia; t1, t2, t3 – length of first, second and third hind tarsomeres.

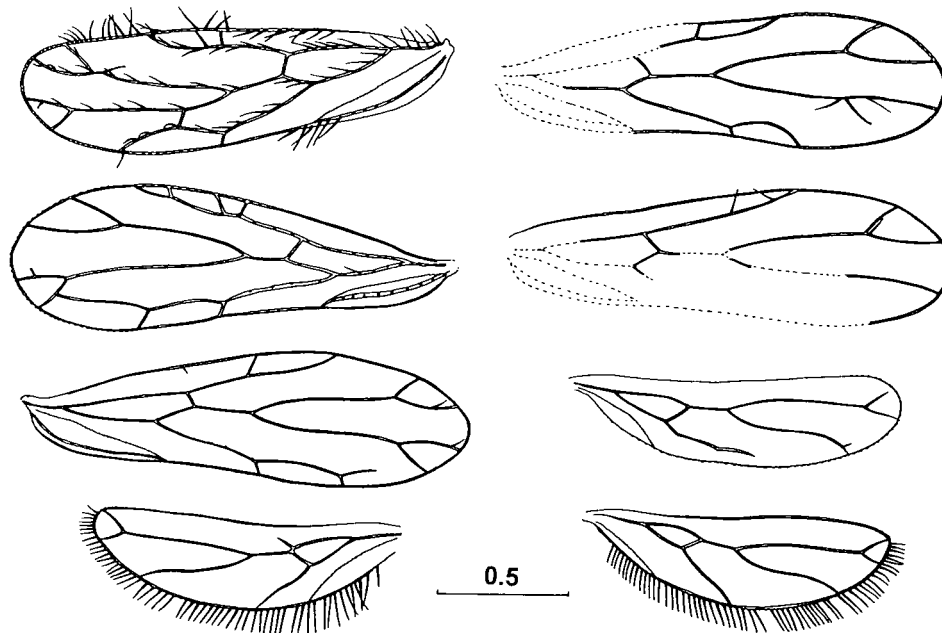


Fig 9. *D. domestica*, macropterous form, variation of wing venation.

TABLE 2. Comparison of environmental factors in laboratory cultures and two domestic sites possibly determining wing forms of *D. domestica*.

Factor	Laboratory conditions	Domestic conditions, site 1	Domestic conditions, site 2
light	continual darkness	ambient photoperiod	continual darkness
humidity	constant, 75%	fluctuating, 20–40%	fluctuating, 20–80%
temperature	constant, 28°C	fluctuating, 18–30°C	fluctuating, 25–27°C
food	wheat germ	organic debris, mould	organic debris, mould
space	closed container	open	open
crowding	sometimes	never	never
wing form produced	brachypterous and macropterous forms in ratio 3 : 1	brachypterous forms only	brachypterous forms only

#### Discussion

The macropterous adults of *D. domestica* differ from the brachypterous adults mainly in the following characters: both wing pairs are fully developed, with more complete venation (margin of forewings reached by 8 to 11 veins and that of hind wings by 3 to 5 veins), compound eyes are larger (more than 50 facets), all 3 ocelli are present, and the thoracic segments are strongly developed. These characters are also typical features of the macropterous forms of other wing-polymorphic psocid species. Interestingly the macropterous wings strongly differ in shape from brachypterous ones, which are narrow and pointed. In the closely related genera, e.g. *Psocathropos* Ribaga, 1889, *Pseudorypteryx* Garcia Aldrete, 1984 and *Psyllipsocus* Sélys-Longchamps, 1872, polymorphic wings usually differ only in the size and venation, not in the general shape.

The great variation in wing venation found in the macropterous form of *D. domestica* (Psyllipsocidae) also occurs in the brachypterous form of this species (Smithers, 1958). Considerable venation polymorphism is also known in three other genera of this family, e.g. in the free-living species *Pseudorypteryx mexicana* Garcia Aldrete, 1984 (Garcia Aldrete, 1984) and the domestic and cave species *Psyllipsocus ramburi* Sélys-Longchamps, 1872 (Lienhard, 1977). In the last-named species, the macropterous form, which is much scarcer than micropterous, shows frequent differences in venation between left and right wings in some individuals (Locatelli & Galli, 1984). In *Psocathropos microps* (Enderlein), another polymorphic species with very rare occurrence of macropterous individuals, the venation is variable in accord with wing reduction (Smithers, 1972). Vein aberrations are also frequent in some other families, e.g. in all species of the genus *Lachesilla* Westwood, 1840 (Lachesillidae) (Günther, 1974).

Until now, only brachypterous adults of *D. domestica* were found in domestic environments. The reason for the development of macropterous forms in laboratory cultures is not clear. The control of wing polymorphism appears to be at least in part environmental (Smithers, 1991b). According to various authors, the possible factors controlling the production of winged adults in polymorphic psocids are temperature, humidity, light (Schneider, 1978), population density (Broadhead, 1947), physical contacts between nymphs and starvation (Lee, 1987). Crowding and food contamination represent more unfavourable conditions (in *Psoquilla marginepunctata* Hagen, 1865) and the adaptive population response is the higher production of macropterous adults (Broadhead, 1961); in *Psyllipsocus ramburi* Selys-Longchamps, 1872 this is probably connected with the influence of a pheromone (Badonnel, 1948, 1959). Locatelli & Galli (1984) showed that food may be another possible factor, i.e. that fungal mycelium alone induced the development of the macropterous form of *Psyllipsocus ramburi*. In some beetles (Bruchidae) the adult wing polymorphism is induced during the postembryonic development and depends on the abiotic factors prevailing during this period – atmospheric humidity, seed water content and temperature; not only higher levels of those factors, but also the increased duration of thermophase induced a higher proportion of the flight form (Ouedraogo et al., 1991).

In *D. domestica* only brachypterous adults occurred in domestic localities, but both macropterous and brachypterous forms developed in ratio about 1 : 3 under controlled laboratory conditions. We can speculate that the development of either form is determined by a certain combination of environmental factors (Table 2).

Obviously, the most important environmental factors inducing the development of the macropterous form of *D. domestica* are constant high humidity and temperature, kind of food, and limited space. Influence of crowding is not unequivocal because brachypterous adults developed from isolated nymphs as well as from nymphs reared as a group within the same container. On the other hand, macropterous forms developed, together with brachypterous forms, only when at least 2 nymphs were kept together (groups of 2 to 5 nymphs were observed). A detailed study of individual factors and their correlations would be worthwhile when having sufficient experimental material.

It would be interesting to know whether these macropterous individuals also appear in natural conditions occasionally or if they occur only as an atavistic reaction to the stress of laboratory conditions. It is not known whether the other two brachypterous species of the genus *Dorypteryx* could produce macropterous individuals in laboratory conditions.

ACKNOWLEDGEMENTS. I thank C. Lienhard of the Museum of Natural History (Geneva, CH) for valuable recommendations and J. Zuska (RICP, Prague) for critical reading of the manuscript.

#### References

- BADONNEL A. 1948: L'effet de groupe chez *Psyllipsocus ramburi* Sélys-Longchamps. *Bull. Soc. Zool. Fr.* **73**: 80–83.
- BADONNEL A. 1959: Développement des ailes de *Psyllipsocus ramburi* Sélys-Longchamps: essai d'interprétation. *Bull. Soc. Zool. Fr.* **84**: 91–98.
- BROADHEAD E. 1947: The life-history of *Embiopsocus enderleini* (Ribaga) (Corrodentia, Liposcelidae). *Entomologist's Mon. Mag.* **83**: 200–203.
- BROADHEAD E. 1961: The biology of *Psoquilla marginepunctata* (Hagen) (Corrodentia, Trogidae). *Trans. Soc. Brit. Entomol.* **14**: 223–236.
- GARCIA-ALDRETE A.N. 1984: The Trogiomorpha (Psocoptera) of Chamela, Jalisco, Mexico. *Folia Entomol. Mex.* **59**: 25–69.
- GÜNTHER K.K. 1974: *Staubläuse, Psocoptera. Die Tierwelt Deutschlands. 61. Tiel.* G. Fischer, Jena, 314 pp.
- KALINOVIC I. & GÜNTHER K.K. 1985: Fauna Psocoptera raznih hibrida kukuruza (Insecta). [Psocoptera fauna in different corn hybrids (Insecta)]. *Znanost i Praksa u Poljoprivredi i Prehrambenoj Tehnologiji* **16**: 251–259 (in Croatian, English abstr.).
- KALINOVIC I., PIVAR G., GÜNTHER K.K. & KALINOVIC D. 1981: Fauna Psocoptera na prehrambenim proizvodima (Insecta). [Psocoptera fauna on the nutritional products (Insecta)]. *Zborn. Rad. Pol'opriv. Fak. Osieku* **7**: 61–66 (in Croatian, English abstr.).
- KUČEROVÁ Z. 1992: Faunistic records from Czechoslovakia. Psocoptera: Psyllipsocidae. *Acta Entomol. Bohemoslov.* **89**: 315.
- LEE S.S. 1987: Environmental factors inducing macroptery in the psocids *Psoquilla marginepunctata*. *Entomol. Exp. Appl.* **44**: 89–95.
- LIENHARD C. 1977: Die Psocopteren des Schweizerischen Nationalparks und seiner Umgebung (Insecta: Psocoptera). *Ergebn. Wiss. Unters. Schweiz. Natnparks* **14**: 417–551.
- LIENHARD C. 1994: Staubläuse (Psocoptera) – ungebetene Gäste in Haus und Vorrat. *Mitt. Entomol. Ges. Basel* **44**: 122–160.
- LIENHARD C. & SCHNEIDER N. 1993: *Dorypteryx longipennis* Smithers, un psoque domicole nouveau pour l'Europe (Psocoptera: Psyllipsocidae). *Bull. Annl. Soc. R. Belge Entomol.* **129**: 129–137.
- LOCATELLI D.P. & GALLI A. 1984: Influenza del regime dietetico sullo sviluppo delle ali in *Psyllipsocus ramburi* (Sélys-Longchamps) (Psocoptera, Trogiomorpha). *Boll. Zool. Agr. Bachic. (Ser. 2)* **18**: 23–33.
- MOCKFORD E.L. 1993: *North American Psocoptera (Insecta). Flora and Fauna Handbook No. 10.* Sandhill Crane Press, Gainesville, Florida, xviii + 455 pp.

- OUEDRAOGO P.A., MONGE J.P. & HUIGNARD J. 1991: Importance of temperature and seed water content on the induction of imaginal polymorphism in *Callosobruchus maculatus*. *Entomol. Exp. Appl.* **59**: 59–66.
- SCHNEIDER N.I. 1978: Staubläuse – unscheinbare Hausgenossen des Menschen. *Biol. Uns. Zeit* **8**(2): 54–56.
- SMITHERS C.N. 1958: A new genus and species of domestic psocid (Psocoptera) from Southern Rhodesia. *J. Entomol. Soc. S. Afr.* **21**: 113–116.
- SMITHERS C.N. 1972: *The Classification and Phylogeny of the Psocoptera*. Australian Museum, Sydney, 351 pp.
- SMITHERS C.N. 1991a: A new species of *Dorypteryx* Aaron (Psocoptera: Psyllipsocidae) described from Australia. *Gen. Appl. Entomol.* **23**: 45–48.
- SMITHERS C.N. 1991b: Psocoptera. In Naumann I.D. & Crane P.B. (eds): *The Insects of Australia, Vol. 1, 2nd ed.* Melbourne University Press, Carlton, pp. 412–420.

Received October 8, 1996; accepted December 13, 1996