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The **cover image**, by Hannah Finlay, is of a new empidid fly genus discovered by Australian Museum entomologist Dan Bickel*. These flies are primarily collected at light traps in tropical monsoonal woodlands of Cape York Peninsula—males are distinctive in having swollen antennae and a strong dorsoapical seta on their foreleg (see cover image). Hundreds of new species of animals are being described annually in *Records of the Australian Museum*, the results of important discoveries in anthropology, archaeology and geology are also featured. Since 1999 the primary scientific literature published in print by the Australian Museum has also been freely available online at our website (in addition, certain earlier papers, are being scanned and uploaded). These and many other works may be purchased as bound issues from the Australian Museum Shop.

* www.amonline.net.au/pdf/publications/1455_complete.pdf

The background image is the echinoderm *Asterodiscides elegans*, a species reported in waters off northeastern Australia (Rowe, 1977, *Records of the Australian Museum* 31[5]).

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Larval Development in the Lutjanid Subfamily Lutjaninae (Pisces): the Genus *Macolor*

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ABSTRACT. Larval development of the Indo-west Pacific lutjanine lutjanid *Macolor niger* is described based on pelagic larvae (4.8–10 mm) from western Pacific plankton hauls, settlement-stage larvae (17–19 mm) from Great Barrier Reef light-trap catches and Solomon Island reef-crest net catches, and settled juveniles (26–32 mm) from the western Pacific. The larvae possess all the characteristics of lutjanids (24 myomeres; elongate dorsal spine 2 and pelvic spine; pelvic ray 1 longer than spine; postcleithral spine; extensive, large, smooth head spines; and fin-ray counts of DX, 14–15, AIII, 10–11, P₁ 17–18), and corroborate the inclusion of *Macolor* in the Lutjanidae. The larvae have long, weakly serrate, robust fin spines, with the serrations largely disappearing by settlement at 17–19 mm. Unique meristic values (in particular fin-ray and gill-raker counts) and distinctive colour pattern at settlement confirm the identification. Settled juvenile *M. macularis* (17–20 mm) from the western Pacific are similar to *M. niger*, but are slightly deeper bodied, with much longer elements in the pelvic fin and spiny dorsal fin. Distinctive meristics and pigment patterns separate the two species.

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The perciform fish family Lutjanidae, or tropical snappers, consists of about 125 species of medium to large fishes of great ecological and commercial importance arrayed in five subfamilies (Johnson, 1993; Nelson, 1994). The largest lutjanid subfamily, Lutjaninae, (sensu Johnson, 1980) contains six genera: *Hoplopagrus* (east Pacific, monotypic), *Lutjanus* (worldwide, c. 70 species), *Macolor* (Indo-west-Pacific, two species), *Ocyurus* (west Atlantic, monotypic), *Pinjalo* (Indo-west-Pacific, two species) and *Rhomboplites* (west Atlantic, monotypic). Descriptions of larvae of at least some species in most lutjanine genera have been published or are in preparation. Larvae of several *Lutjanus* species have been described (see summaries in Kojima, 1988; Watson & Brogan, 1996; Leis & Rennis, 2004; Lindeman *et al.*, 2005), and descriptions of seven more Indo-Pacific *Lutjanus* species are in preparation (JM Leis, unpublished).

Larvae of the monotypic genera *Hoplopagrus*, *Ocyurus* and *Rhomboplites* have been described (summarized in Watson & Brogan, 1996; Lindeman *et al.*, 2005), and a description of the larvae of both *Pinjalo* species is in preparation (JM Leis, unpublished). Larvae of *Macolor*, in contrast, have not been described.

The two species of *Macolor* Bleeker—*M. niger* (Forsskål) and *M. macularis* Fowler—are closely associated with coral reefs and are widely distributed in the western Pacific and Indian Oceans (Kishimoto *et al.*, 1987). Once confusion over its marked ontogenetic changes was resolved, *M. niger* was long considered the sole *Macolor* species, and although originally placed in the sciaenid genus *Sciaena* by Forsskål, and occasionally considered a serranid (Günther, 1873) it has been placed in the Lutjanidae by consensus since at least the end of the nineteenth century. Several workers placed

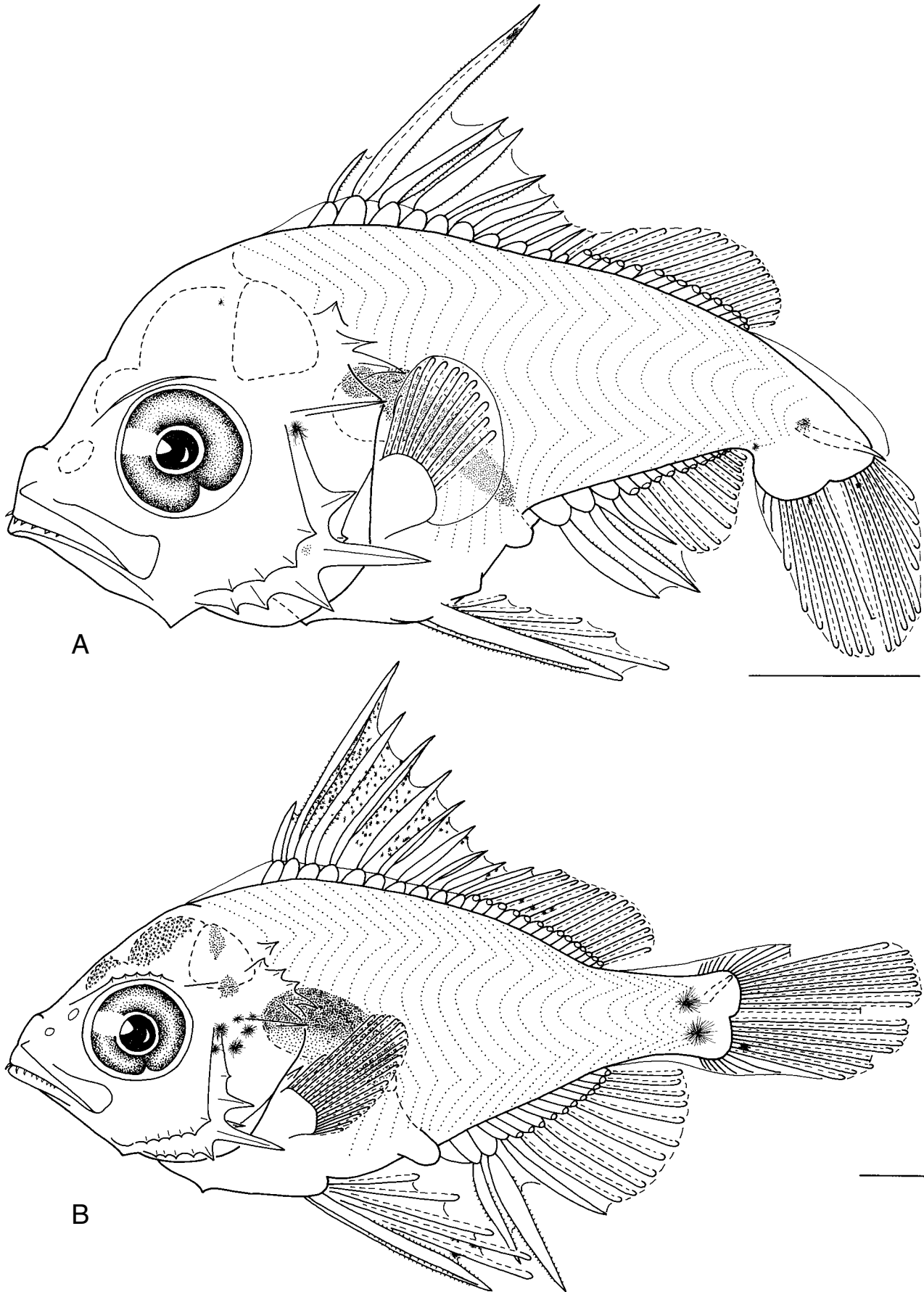


Fig. 1 (continued on facing page). Larval development of *Macolor niger*. Scale bars = 1 mm. (A) 4.8 mm flexion-stage larva from the Western Pacific near the Solomon Islands (NSMT-PL149). (B) 10.0 mm postflexion larva from the Western Pacific near the Bismarck Archipelago (NSMT-PL188). (C) 16.1 mm settlement-stage larva from the Great Barrier Reef (AMS I.43883-002). Eye is missing in the specimen.

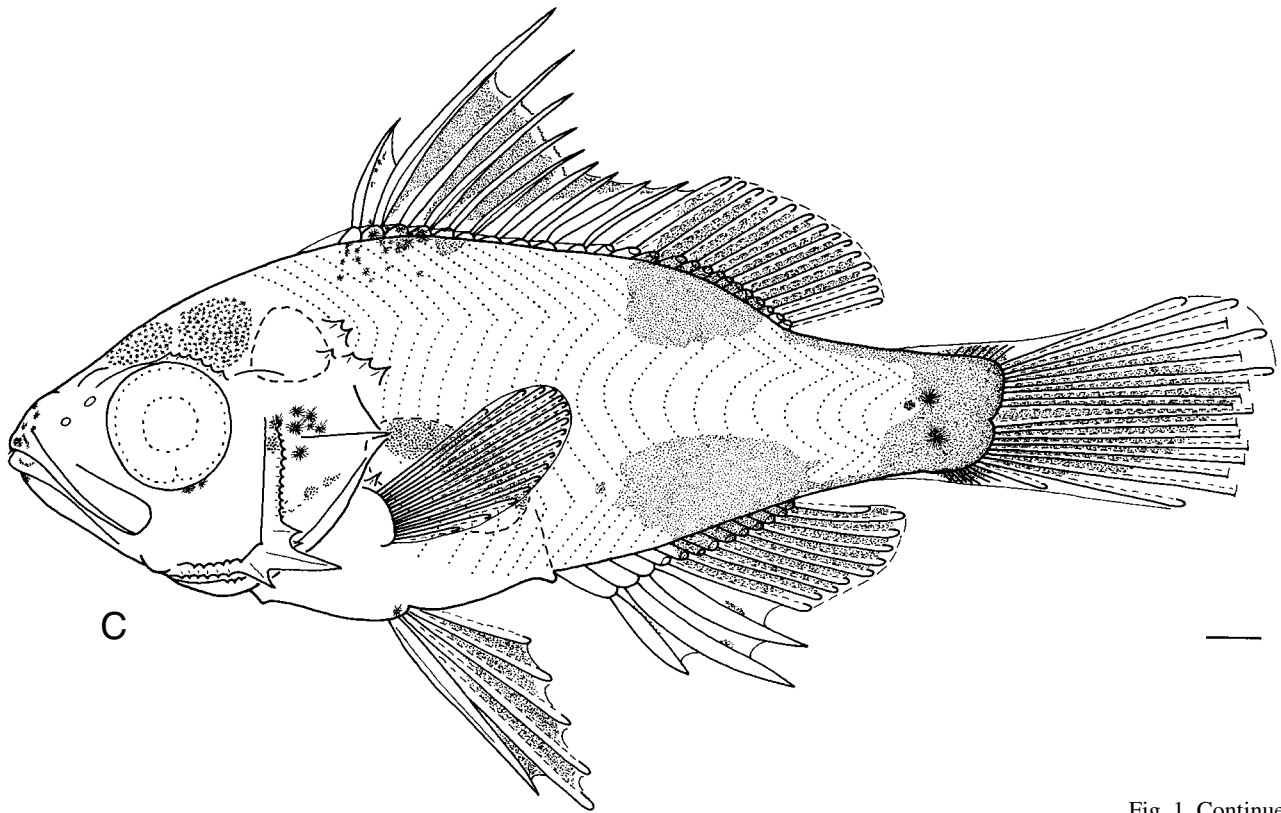


Fig. 1. Continued.

M. niger in the genus *Lutjanus* or its synonyms *Genyrog* or *Mesoprion* (Günther, 1859; Bleeker, 1876; Fowler, 1928, Weber & de Beaufort, 1936), but *Macolor* has been recognized by nearly all workers as a valid genus since the middle of the twentieth century (Schultz, 1953). Kishimoto *et al.* (1987) revised *Macolor* and showed that there are, in fact, two species, both of which undergo marked ontogenetic changes in body shape and colour.

Adult *Macolor* spp reach sizes of over 400 mm SL and are dark-coloured with deep bodies and rounded snouts. They occur singly and in small groups (*M. macularis*) or form large schools (*M. niger*) feeding on zooplankton in high current areas, usually off steep underwater slopes, dropoffs or cliffs, where they can be very abundant (Randall *et al.*, 1997; Myers, 1999; Randall, 2005). Juveniles differ greatly in appearance from adults: they have a contrasting black and white colour pattern that begins to transform to the adult colour pattern at about 200 mm SL (Kishimoto *et al.*, 1987; Randall, 2005). Juveniles live in lagoonal and reef-front habitats where, unlike the adults, they are solitary (Myers, 1999, pers. obs.).

Recently-settled juveniles are distinctively pigmented, and have elongate dorsal-fin spines and pelvic-fin rays, especially *M. macularis* (Kishimoto *et al.*, 1987). The dorsal fin is notched and the black pigment pattern accentuates this, providing, at first glance, a resemblance to some apogonid species (pers. obs.) or to juveniles of some species in the haemulid genus *Plectorhinchus* (Myers, 1999). In spite of the abundance of adult *Macolor* species on coral reefs, larvae are extremely rare in collections. Over the course of some years, I have searched the major larval-fish collections of the world for lutjanid larvae, and have found only a few *Macolor* larvae.

My purpose here is to describe the larval development of *M. niger* based on two pelagic larvae captured by the Japanese research vessel "Shunyo Maru" in the western Pacific, and four settlement-stage larvae captured by light trap on the Great Barrier Reef and crest net in the Solomon Islands. I also provide information on two recently-settled *M. niger* from the Ryukyu Islands and Samoa. Finally, although no larvae of *M. macularis* are available, I describe aspects of three recently settled *M. macularis* from the Ryukyu Islands that may assist in identification of larvae of this species. Larval development in other lutjanid subfamilies is described in the following: Etelinae (Leis & Lee, 1994; Leis, 2005), Apsilinae (Leis *et al.*, 1997), Paradicichthyinae (Leis & Bray, 1995), and Caesioninae (Reader & Leis, 1996).

Materials and methods

Measurements and abbreviations follow Leis & Carson-Ewart (2004). Lengths are Standard Length (SL). Percentages are of SL. Illustrations in Fig. 1 were prepared with the aid of a camera lucida, and Fig. 2 was made with a Leica digital photomicrograph system. Pigment refers to melanophores in preserved specimens. Specimens examined are deposited in the Australian Museum, Sydney (AMS), Institute of Oceanic Research and Development, Tokai University (IORD), and the National Science Museum, Tokyo (NSMT).

Identification. The larvae were identified as lutjanids through the characteristics listed by Leis & Rennis (2004): including 24 myomeres; laterally compressed body and head; very long dorsal-fin spines (particularly the second) and pelvic-fin spines; fin spines that are very weakly serrate to smooth; longest P_2 ray longer than P_2 spine; strong head

Table 1. Meristic characters of *Macolor* species, from Kishimoto *et al.* (1987).

species	dorsal fin	anal fin	pectoral fin	gill rakers	lateral-line scales
<i>Macolor macularis</i>	X, 13–14 ^a	III, 10	17	109–122	50–53
<i>Macolor niger</i>	IX ^c –X, 13, 14, 15 ^c	III, 10 ^b –11	16 ^b , 17, 18 ^b	89–108	49–58

^a in <20% of individuals, ^b in <10% of individuals, ^c in <5% of individuals.

spination without serrations on preopercular spines; head spination includes weak anterior frontal ridge, supraorbital ridge, weak pterotic ridge, and spines on opercle, subopercle (in larger individuals) and interopercle, and on inner and outer borders of preopercle; spines also present on bones of the pectoral girdle, including posttemporal, supracleithrum, and dorsal postcleithrum; no supraoccipital crest or spines; no lachrymal spines or serrations.

The larvae were linked as a series through their meristic values and their pigment pattern, most particularly the pigment on the opercle and urostyle. They were identified as belonging to the genus *Macolor* through their fin-ray counts of DX, 14–15, AIII, 10–11, P₁ 17–18, and high number of gill rakers (c. 55 rakers in settlement-stage larvae of *M. niger*, and c. 70–74 and c. 47–65 in the settled individuals identified as *M. niger* and *M. macularis*, respectively). Among lutjanids, only *Macolor* spp have this combination of meristic values. No Indo-Pacific lutjanines other than *Macolor* spp have more than 30 gill rakers, whereas *Macolor* spp have at least 89 rakers as adults (Allen & Talbot, 1985; Allen, 1985; Kishimoto *et al.*, 1987). Some species of the caesionine lutjanid genera *Caesio* and *Pterocaesio* have fin-ray counts within the range of the larvae described here, but they have fewer gill rakers (<40 as adults: Carpenter, 1987). In any case, their larvae have been described and can be distinguished by other characters, most especially by their strongly serrate fin spines and more slender body (Reader & Leis, 1996).

The larvae were identified as *Macolor niger* by their fin-ray counts of DX, 14–15 (*M. macularis* has DX, 13–14), and AIII, 10–11 (one of eight with 10 rays—*M. niger* rarely has 10 anal-fin rays, whereas *M. macularis* is not known to have 11, Table 1). Further, the pigment pattern of the settlement-stage

larvae matches that of recently settled *M. niger* as described by Kishimoto *et al.* (1987).

Three recently settled *M. macularis* had fin-ray counts of DX, 13 and AIII, 10, confirming their identification. Further, their morphology and pigment pattern match that described for the species by Kishimoto *et al.* (1987).

Descriptions

Macolor niger (Forsskal)

Table 2, Figs 1, 2

Two pelagic larvae, 4.8 & 10.0 mm: NSMT-PL 149 (West Pacific: 7°56'S 161°04'E), NSMT-PL-188 (West Pacific: 3°15.2'S 151°05'E). 4 settlement-stage larvae, 16.1–19.3 mm: AMS I.43883-001, -002, -003 (Great Barrier Reef), AMS I.43869-001 (Nusa Nane Isl, Solomon Isls). 2 recent recruits, 26 & 32 mm: AMS I.34722-001 (Upolu Isl, Samoa), IORD 83-275 (Iriomote Isl, Ryukyu Isls).

Body compressed and deep, but decreasing in depth from 50% at 4.8 mm to c. 37% at settlement. Body deeper at P₁ base than at anus, but this differential decreases with growth (Table 2). Gut coiled and compact, with virtually no gap between anus and anal fin. Prominent gas bladder immediately dorsal to gut. Caudal peduncle of moderate depth and length. Myomeres 24 (10–11+13–14). Gill rakers c. 55 at settlement, c. 70 at 26 mm and c. 75 at 32 mm.

Head bluntly triangular, compressed and large, decreasing in relative size from c. 45% at 4.8 mm to 35–38% at settlement. Snout less than eye diameter and bluntly triangular, becoming rounder following settlement. Mouth large and moderately oblique; tip of maxilla reaching to a

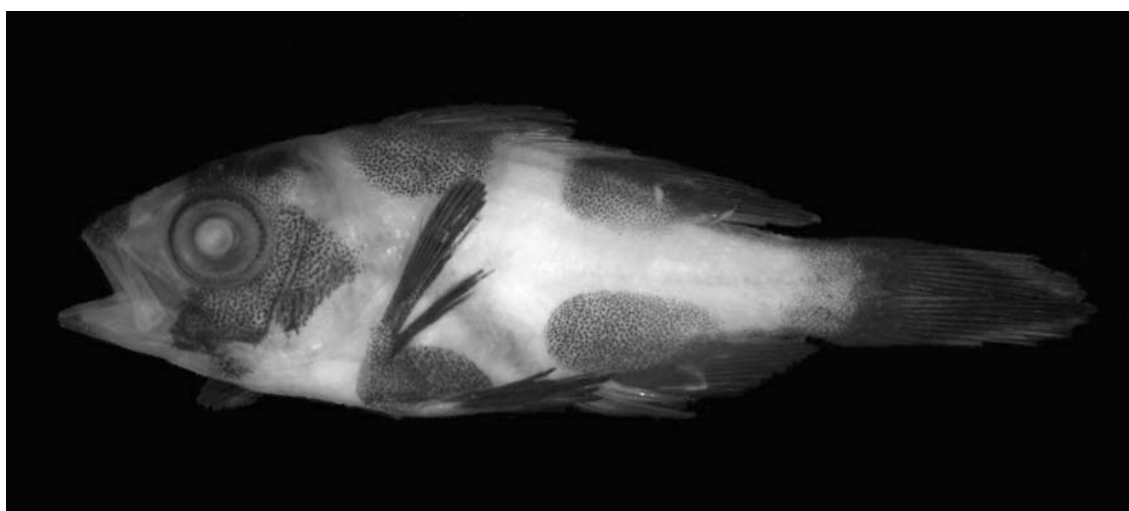


Fig. 2. Settlement-stage larva of *Macolor niger* from the Great Barrier Reef (19.3 mm, AMS I.43883-003). Note that pectoral fin (heavily pigmented) is folded upward. Photo by M. Lockett.

Table 2. Morphometric (in mm) and meristic values for *Macolor* larvae and recently-settled individuals. Abbreviations are: PreAL, preanal length; PreDL, predorsal-fin length; HL, head length; ED, eye diameter; SnL, snout length; BD (P₁), body depth at P₁ base; BD (anus), body depth at anus; PedL, caudal peduncle length; D, A and P₁ refer to dorsal, anal and pectoral fins; sp is spine; PreopAng sp, preopercle angle spine. *d*, damaged; *i*, incipient rays.

	SL	PreAL	PreDL	HL	ED	SnL	BD (P ₁)	BD (anus)	PedL	Dsp1	Dsp 2	Dsp 3	P ₂ sp	P ₂ ray 1	Preop Ang sp	D	A	P ₁
<i>Macolor niger</i> pelagic																		
NSMT PL149	4.8	3.0	2.0	2.2	0.8	0.6	2.4	1.7	1.2	0.5	1.7	1.0	1.2	1.5	0.8	IX(I),15 X,14	III,11 III,11	10+ <i>i</i> 18
NSMT PL-188	10.0	6.0	3.8	4.3	1.5	1.1	4.7	3.8	1.7	1.0	3.3	2.7	3.1	3.1	1.1			
<i>Macolor niger</i> settlement-stage																		
AMS I.43883-002	16.1	8.9	5.8	5.7	2.1	1.6	6.2	5.2	3.7	1.8	4.8	4.2	3.9	4.8	1.4	X,14	III,10	17
AMS I.43869-001	17.4	9.9	6.6	6	2.4	1.5	6.3	5.5	3.8	1.2	3.3	3.5	3.9	4.5	1.3	X,14	III,11	18
AMS I.43883-001	17.6	10.2	6.4	5.9	2.1	1.9	6.6	<i>d</i>	3.3	1.2	4.1	4.1	3.8	4.8	1.2	X,14	III,11	17
AMS I.43883-003	19.3	11.2	7.0	7.4	2.7	2.2	7.2	6.3	3.9	1.3	3.7	4.0	4.0	5.5	1.2	X,14	III,11	18
<i>Macolor niger</i> settled																		
AMS I.34722-001	26.0	16.9	9.7	10.7	3.4	2.7	9.4	8.6	5.3	<i>d</i>	4.5	<i>d</i>	4.9	7.8	1.0	X,14	III,11	18
IORD 83-275	32.3	18.2	11.2	11.5	4.5	2.2	11.1	10.1	7.1	<i>d</i>	<i>d</i>	<i>d</i>	5.5	10.4	0.5	X,14	III,11	17
<i>Macolor macularis</i> settled																		
IORD 82-299B	16.8	9.8	5.9	6.6	2.3	1.5	7.2	6.1	3.5	<i>d</i>	<i>d</i>	<i>d</i>	5.1	10.8	0.8	X,13	III,10	17
IORD 85-316	17.3	9.5	6.5	7.1	2.5	1.6	6.4	5.6	4.2	1.8	6.6	5.2	5.7	10.3	0.9	X,13	III,10	17
IORD 82-299A	20.3	12.4	7.5	8.2	3.1	1.9	8.7	7.4	4.6	1.4	<i>d</i>	4.7	6.5	13.5	0.8	X,13	III,10	18

level between anterior edge of eye and pupil. Canine teeth present in all specimens. Nasal pit unroofed at 4.8 mm, but two nostrils present by 10 mm. Scales start forming over most of the body at about 17 mm, and by 19 mm a full set of scales is present.

Spination on head well developed, and spines smooth. The longest head spine, a strong spine at angle of preopercle, decreases in relative length from 16% at 4.8 mm to c. 6% at settlement, and rapidly after settlement to c. 2% at 32 mm. On outer border of preopercle, two moderate size spines are located immediately adjacent to angle spine, one above and one anterior. Other spines on preopercle outer border are small. On outer, upper limb, there is no small spine at 4.8 mm, but one appears by 10 mm, and settlement-stage larvae have 10–13 small serrations that decrease to c. 8 in the 26 mm recruit. On the lower outer limb, there are 2 small spines at 4.8 mm, increasing to 4 by 10 mm, and 5–6 by settlement: in recruits, the lower, outer limb extensively and finely serrated. Spination on the inner preopercular border smaller and more limited. Lower, inner border with 3 small spines at 4.8 mm, 5 by 10 mm, and 6 by 16 mm, but these become eroded and ultimately lost by 19 mm. Inner, upper border with a single, small spine by 10 mm that is lost by 19 mm. Opercle has a single spine. Subopercle lacks spines until 18 mm, when a single, small spine is present, increasing to 3 small spines at 19 mm: these do not increase in number or size following settlement. Interopercle with a single spine just dorsal to the preopercular angle spine until settlement, when the ventral edge also becomes serrate. The supraorbital ridge smooth at 4.8 mm, with 5–6 weak spines posteriorly by 10 mm. These reduced to 3 eroded spines by 17 mm and absent in the settled individuals.

A small spine present on dorsal postcleithrum in 10 mm and larger individuals (absent in 4.8 mm larva). Two large supracleithral spines present at 4.8 mm, three in 10–17.6 mm larvae, two in the 19.3 mm settlement-stage larva, and only a single, tiny spine in settled individuals. A single dorsal posttemporal spine present in 4.8 and 10 mm larvae, one or two dorsal spines in 16–17 mm settlement-stage larvae, three at 19 mm, and 6–9 in the settled individuals. A single ventral posttemporal spine is present from 10–19 mm, but the settled individuals have 2–4 spines. A pterotic ridge is present by 10 mm, and a frontal ridge by 16 mm.

In 4.8 mm flexion-stage larva, a full complement of 9+8 primary caudal rays present. Based on other lutjanids, flexion probably complete before 6 mm. All elements of D, A and P₂ fins present in the 4.8 mm larva, with last spine of D fin transforming from a soft ray to a spine. P₁ fin of 4.8 mm larva has 11 rays plus incipient rays, but the 10 mm and larger individuals have a full complement of P₁ rays. Fin spines robust and chevron-shaped in cross-section, except P₂ spine which has two leading-edge ridges, and is concavely trapezoidal in cross-section in all specimens. Weak serrations present on the trailing edges of many fin spines. In 4.8 mm larva this includes D spines 1–6, A spines 1–2, and P₂ spine. At 10 mm, trailing edge serrations are present only on D spines 2–4, A spines 1–2 and P₂ spine. A portion of leading edges of fin spines have very weak serrations at 4.8 mm (Dsp 2, P₂) and 10 mm (Dsp 2–3, P₂, Asp 1–2). Fin spines smooth or nearly so in settlement-stage larvae: 16 mm larva has a few inconspicuous, eroded serrations on the trailing edges of Dsp 1 and Asp 1, and barely visible eroded serrations on the leading edge ridges of P₂ sp. At 4.8 and 10 mm, there is

no obvious internal structure in fin spines, but settlement-stage and settled individuals have fine reticulate internal structure in larger fin spines. Dsp 2 is longest fin spine in the two pelagic larvae (32–35% SL), but by settlement, Dsp 2, Dsp3, and P₂sp are of similar length (c. 20–24%SL). A spines become more robust than D spines from about 10 mm. First ray of P₂ fin longer than spine, a disparity that increases with development especially following settlement.

Pigment: Larvae are lightly pigmented, but pigment intensifies as settlement approaches. The 4.8 mm larva has a single, small ventral melanophore on the caudal peduncle. The 10 mm larva has no ventral pigment, but the peduncle melanophore may have moved to an internal position just ventral to the urostyle. Both 4.8 and 10 mm larvae have a single, intense, internal melanophore in a saddle-like position on urostyle. Both melanophores near the urostyle persist in settlement-stage larvae, although they become increasingly difficult to see as external, lateral pigment intensifies (see below). No ventral pigment forms on the abdomen or head until settlement approaches. Similarly, no dorsal pigment forms on tail or trunk until settlement. At 4.8 mm, there is a single dorsal melanophore on the midbrain, but by 10 mm, both mid- and forebrain are largely covered dorsally and laterally by dense, evenly-spaced melanophores: these are retained. The 10 mm larva has internal melanophores on hindbrain both dorsally and ventrally. At the base of opercular spine, the 4.8 mm larva has a prominent melanophore, and the 10 mm larva has a cluster of large, prominent melanophores, which are retained in settlement-stage larvae. The gas bladder and dorsal surface of the gut are covered by a saddle of melanophores. The fins of the 4.8 mm larva lack pigment except for a single, distal melanophore in the trailing-edge chevron groove of Dsp2, and two melanophores, one each at base of two caudal rays. By 10 mm, the spinous dorsal fin is extensively pigmented, with the distal portions of fin membrane and spine chevron groove covered with fine melanophores. The area covered decreases from about two thirds anteriorly to only a few distal melanophores posteriorly (Fig. 1B). In addition, a few melanophores are present basally on membranes near soft rays 3–5. By 10 mm, P₂ fin has a few melanophores on soft rays 1 & 2 and membranes near the spine tip.

As settlement approaches, pigment intensifies and spreads, taking on aspects of the juvenile pigment pattern. The anterior half of the spiny dorsal fin becomes intensely pigmented, and this pigment spreads ventrally onto the lateral surface of the body, eventually forming a large black blotch extending nearly to the lateral line. Similarly, the middle portions of the soft dorsal fin become intensely pigmented, and this pigment spreads ventrally to form a second, large blotch extending to the lateral line. Following settlement, these two blotches merge along the back, leaving unpigmented the middle portion of the dorsal fin. The pigment extends along the dorsal surface of the caudal peduncle to join the caudal pigment. The posterior third of the caudal peduncle becomes heavily pigmented, as does the caudal-fin with the exception of the distal portions of the dorsal-most and ventral-most rays. Pigment also extends along the ventral surface of the caudal peduncle, joining a large blotch extending dorsally from the heavily pigmented soft rays of the anal fin. The pelvic fin becomes heavily pigmented, and this pigment then extends dorsally to the base of the pectoral fin before settlement. The pectoral

fin also becomes heavily pigmented. The heavy brain and opercular pigment present at 10 mm spreads and coalesces and then spreads across the cheek below the eye to form a large blotch extending as far forward as the anterior edge of the eye by settlement. Finally, a separate small cluster of pigment forms at the tip of the snout. In life, the portions of the body that are not black are coloured white, resulting in a striking, and distinctive pattern (in contrast, non-black portions of the fins remain unpigmented). The distinctive post-settlement colour pattern is illustrated by Kishimoto *et al.* (1987) and Randall (2005).

Remarks. Larvae of *M. niger* smaller than 4.8 mm are likely to have more extensive fine serrations on the fin spines, and also more pigment ventrally on the tail, if patterns of development are similar to those of other lutjanine species (Kojima, 1988; Watson & Brogan, 1996; Leis & Rennis, 2004; Lindeman *et al.*, 2005; JM Leis, unpublished). The very limited pigment on the head and fins of the 4.8 mm larva is unusual for a lutjanine species. The distinctive saddle-like melanophore on the urostyle may be present in smaller larvae. The fine serrations of the fin spines if present in smaller larvae, combined with the pigment characters above may assist in the identification of smaller larvae, as will the distinctive fin-ray counts.

Larvae of *M. niger* have all diagnostic characters of lutjanids, thus confirming the placement of *Macolor* as a lutjanid genus. Without access to larvae of *M. macularis*, no larva-based test of *Macolor* monophyly can be made, but there is nothing particularly distinctive about the development of *M. niger* that would support *Macolor* monophyly, considering the range of larval morphology and development evident in other lutjanine genera. In contrast, the fact that both *Macolor* species share similar and otherwise unique ontogenetic changes in colour and body shape following settlement seems to indicate that the two species do form a monophyletic group.

The general morphology of *M. niger* larvae is similar to other lutjanines, but the monophyly of the Lutjaninae remains to be established. Larvae of basal lutjanids (i.e., species in the subfamilies Etelinae and Apsilinae, sensu Johnson, 1980) lack two apparently derived characters present in the other three lutjanid subfamilies (i.e., Paradicichthyinae, Lutjaninae, and also Caesioninae, sensu Johnson [1980], which is clearly a lutjanid subfamily; see also Reader & Leis [1996]). These characters are a second ridge on the leading edge of the P₂ spine and delayed formation of the second and subsequent spines on the outer, upper edge of the preopercle (Leis, 2005). Lutjanines and caesionines have serrations on the supraorbital ridge that is lacking in the other subfamilies, although one of the two paradicichthyine species also has serrations on the supraorbital ridge (Leis & Bray, 1995). These three characters are present in *Macolor niger* larvae, and the second P₂ ridge is present in newly settled juveniles of *M. macularis* (supraorbital serrations are absent, as would be expected following settlement, and it is not possible to determine the sequence of formation of the preopercular spines from settled juveniles alone). This corroborates the placement of *Macolor* with the lutjanines and caesionines, but, as yet no characters of larvae support monophyly of the Lutjaninae.

***Macolor macularis* Fowler**

Table 2

Three recently settled individuals, 16.8–20.3 mm: IORD 82–299A, 82–299B, 85–316, Iriomote Isl, Ryukyu Isls.

Body deep (37–43% at P₁ base: 32–36% at anus), with large head (39–40%); body fully scaled. There are c. 47–65 gill rakers, increasing in number with size.

The longest head spine, a strong spine at the angle of the preopercle, is c. 4–5%. On outer preopercle border, two moderate-size spines located immediately adjacent to the angle spine, one above and one anterior to it. Other spines on the preopercle outer border are small: 12–17 serrations on upper limb, and 4–7 serrations on lower limb. No spination remains on inner preopercle border. Opercle has a single spine. The 16.8 mm specimen has a single, small spine on each of the subopercle and interopercle, whereas the larger specimens lack spination on either bone. The supraorbital ridge is overgrown and no longer visible. A small spine present on dorsal postcleithrum. A single supracleithral spine and 3–5 posttemporal spines present.

Fin spines smooth and robust, with some internal structure. Both Dsp 2 and 3 long (38% and 23–30%, respectively). P₂sp long (30–33%) and P₂ ray 1 very long (60–67%).

Remarks. At settlement, *M. macularis* seems to be a few mm smaller than *M. niger*, with a slightly deeper body and much longer elements in the spiny dorsal and pelvic fins. Head spination is similar in the two species, as is general morphology with the exceptions noted above. Pigment in recently settled *M. macularis* is similar to that of *M. niger*, but differs in detail (Kishimoto *et al.*, 1987).

Based on comparison of recently settled individuals, it is reasonable to expect that pelagic larvae of *M. macularis* will be similar to those of *M. niger*, but possibly somewhat deeper-bodied, and with longer elements in the spiny dorsal and pelvic fins. Probably, *M. macularis* larvae have weak serrations on fin spines similar to those of *M. niger*.

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References

- Allen, G.R., 1985. *Snappers of the World*. FAO Species Catalogue, FAO, Rome 6: 1–208+28 plates.
- Allen, G.R., & F.H. Talbot, 1985. Review of the snappers of the genus *Lutjanus* (Pisces: Lutjanidae) from the Indo-Pacific, with the description of a new species. *Indo-Pacific Fishes* 11: 1–87.
- Bleeker, P., 1876. Percoides II, Bogodoides, Cirrhitoides. *Atlas Ichthyologique* 8: 1–156 + plates 318–362.
- Carpenter, K.E., 1987. Revision of the Indo-Pacific fish family Caesionidae (Lutjanidae), with descriptions of five new species. *Indo-Pacific Fishes* 15: 1–56.
- Fowler, H.W., 1928. Fishes of Oceania. *Memoirs of the Bernice P. Bishop Museum* 10: 1–486.
- Günther, A., 1859. *Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum*, vol. 1. London: British Museum.
- Günther, A., 1873. Andrew Garretts Fische der Südsee. *Journal des Museum Godeffroy* 2: 1–515.
- Johnson, G.D., 1980. The limits and relationships of the Lutjanidae and associated families. *Bulletin of the Scripps Institution of Oceanography* 24: 1–114.
- Johnson, G.D., 1993. Percomorph phylogeny: progress and problems. *Bulletin of Marine Science* 52: 3–28.
- Kishimoto, H., K. Amaoka, H. Kohno & T. Hamaguchi, 1987. A revision of the black-and-white snappers, genus *Macolor* (Perciformes: Lutjanidae). *Japanese Journal of Ichthyology* 34: 146–156.
- Kojima, J.-I., 1988. Lutjanidae. In *An Atlas of the Early Stage Fishes in Japan*, ed. M. Okiyama, pp. 511–517. Tokyo: Tokai University Press.
- Leis, J.M., 2005. A larva of the eteline lutjanid, *Randallichthys filamentosus* (Pisces: Perciformes), with comments on phylogenetic implications of larval morphology of basal lutjanids. *Zootaxa* 1008: 57–64.
- Leis, J.M., & D.J. Bray, 1995. Larval development in the lutjanid subfamily Paradicichthyinae (Pisces): the genera *Symphorus* and *Symphorichthys*. *Bulletin of Marine Science* 56: 418–433.
- Leis, J.M., S. Bullock, D.J. Bray & K. Lee, 1997. Larval development in the lutjanid subfamily Apsilinae (Pisces): the genus *Paracaesio*. *Bulletin of Marine Science* 61: 697–742.
- Leis, J.M., & B.M. Carson-Ewart (eds.), 2004. *The Larvae of Indo-Pacific Coastal Fishes: a Guide to Identification*. Leiden: Brill.
- Leis, J.M., & K. Lee, 1994. Larval development in the lutjanid subfamily Etelinae (Pisces): the genera *Aphareus*, *Aprion*, *Etelis* and *Pristipomoides*. *Bulletin of Marine Science* 55: 46–125.
- Leis, J.M. & D.S. Rennis, 2004. Lutjanidae (Snappers and Fusiliers). In *The larvae of Indo-Pacific coastal fishes: an identification guide to marine fish larvae*, ed. J.M. Leis & B.M. Carson-Ewart, pp. 329–337. Leiden: Brill.

- Lindeman, K.C., W.J. Richards, J. Lyczkowski-Shultz, D.M. Drass, C.B. Paris, J.M. Leis, M. Lara & B.H. Comyns, 2005. Lutjanidae: Snappers. In *Early Stages of Atlantic Fishes. An identification guide for the Western Central Atlantic*, ed. W.J. Richards, pp. 1549–1586. *Early Stages of Atlantic Fishes. An identification guide for the Western Central Atlantic*. Boca Raton, Florida: Taylor and Francis.
- Myers, R.F., 1999. *Micronesian Reef Fishes*, 3rd edition. Guam: Coral Graphics.
- Nelson, J.S., 1994. *Fishes of the World*. New York: Wiley.
- Randall, J.E., 2005. *Reef and Shore Fishes of the South Pacific*. Honolulu: University of Hawaii Press.
- Randall, J.E., G.R. Allen & R.C. Steene, 1997. *Fishes of the Great Barrier Reef and Coral Sea*. Bathurst, NSW, Australia: Crawford House.
- Reader, S.E., & J.M. Leis, 1996. Larval development in the lutjanid subfamily Caesioninae (Pisces): the genera *Caesio*, *Dipterygonotus*, *Gymnocaesio* and *Pterocaesio*. *Bulletin of Marine Science* 59: 310–369.
- Schultz, L.P., 1953. Family Lutjanidae: Snappers. In *Fishes of the Marshall and Marianas Islands. United States National Museum Bulletin* 202: 521–565.
- Watson, W., & M.W. Brogan, 1996. Lutjanidae: Snappers. In *The early stages of fishes in the California Current Region*, ed. H.G. Moser, pp. 977–989. *CalCOFI Atlas*, 33. Lawrence, Kansas: Allen Press.
- Weber, M., & L.F. de Beaufort, 1936. *The Fishes of the Indo-Australian Archipelago* vol. VII. Leiden: E.J. Brill.

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Lord Howe Island Psocoptera (Insecta)

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ABSTRACT. A brief history of collecting Psocoptera on Lord Howe Island is given. One new genus, *Mauropsocus* (Pseudocaeciliidae: Zelandopsocinae), and three new species, *Mauropsocus monteithi*, *Lepolepis trifasciata* (Lepidopsocidae) and *Nimbopsocus huttoni* (Myopsocidae) are described. An additional new genus and species is noted but not formally described and named because adult material has not yet been found. Twentyseven species of Psocoptera are now known from Lord Howe of which fourteen are probably endemic to the island. Of the thirteen non-endemic species eight have widespread distributions beyond the island (some being found in domestic situations); three occur otherwise only in Australia and one is known only from Norfolk Island. One species occurs in Australia, New Caledonia, Norfolk Island and New Zealand. It is anticipated that the fauna is not yet completely known but most of the endemic species are members of the related families Pseudocaeciliidae, Philotarsidae and Elipsocidae. Distribution of the species is summarized in a table.

SMITHERS, C.N., 2007. Lord Howe Island Psocoptera (Insecta). *Records of the Australian Museum* 59(1): 9–26.

The first recorded psocopteran from Lord Howe Island, a female specimen of *Aaroniella howensis* Smithers & Thornton, was collected by Ms Zenta Liepa in 1955 and described in 1975. This and material collected by the author in November 1969, February 1971 and August 1971 and by Geoffrey Holloway in September 1971 and March 1974 formed the basis of the first paper on the Psocoptera of Lord Howe Island (Smithers & Thornton, 1975). The author visited the island again in February 1977 (Smithers, 1979). Between September 1978 and October 1979 Tim Kingston collected Psocoptera as part of a general insect survey and in 1979 Geoff. Monteith, of the Queensland Museum, made what was then the most comprehensive collection of Psocoptera from Lord Howe. Kingston made a small collection in 1980 and Patrick Huber, in 1992–1993, collected a few specimens during a survey of insects associated with the inflorescences of the economically important Thatch Palm, *Howea forsteriana* (C. Moore and F. Muell.) Becc. (Smithers, 1995). The biggest collection to date is that made during the Lord Howe Island Invertebrate Biodiversity Survey in which several collectors, based at the Australian Museum, using

a variety of collecting techniques, amassed a substantial amount of material during several visits. Since then Ian Hutton has provided additional material collected between 2000 and 2003. Some of the material from the Lord Howe Invertebrate Biodiversity Survey has no designated individual collector; in the lists of material studied in this paper these specimens are referred to as being collected by LHIS.

Except where indicated otherwise specimens collected by Monteith will be returned to the Queensland Museum. Other material is in the Australian Museum. Nymphs are not designated as type material.

Full synonymies and references to the species can be found in Smithers (1967, 1996) and Lienhard and Smithers (2002) or other references given in this paper. Plant names used are as in Wilson (1994), with later amendments where necessary. Vegetation types mentioned in association with some of the material collected by Monteith are described by Pickard (1983); these are referred to as Pickard veg on the specimen labels and hence in the text of this paper.

In the species descriptions the following abbreviations are used: F = length of hind femur; T = length of hind tibia; t1,

t2, t3 = lengths of hind tarsal segments; rt = relative lengths of hind tarsal segments; ct: numbers of ctenidiobothria on hind tarsal segments. Eye measurements are carried out using the method of Badonnel, i.e.: IO = interocular distance between compound eyes measured from above; D = anteroposterior measurement of compound eye seen from above; P = transverse measurement of compound eye seen from above; PO = P/D; nymph is abbreviated to *n*.

Comparison with collecting experience on Norfolk Island suggests that it is very likely that there are more species to be recorded from Lord Howe Island. Norfolk Island has about twice the land area of Lord Howe Island (about 34 square kilometres compared to 16 square kilometres for Lord Howe). Although Lord Howe and Norfolk have about the same number of vascular plants (459 and 445 species respectively) Lord Howe has a larger indigenous flora than Norfolk (241 spp. of vascular plants as opposed to

171 spp.) (Wilson, 1994), a much more varied topography (875 metres altitude as opposed to 316 m.) and although subjected to less collecting effort by specialist collectors it has yielded a comparable number of species of Psocoptera (27, of which 14 appear to be endemic) to that obtained on Norfolk (21, of which 11 appear to be endemic). Fifteen species of Psocoptera have been added to the Lord Howe list in this paper whereas only five additional species have been found on Norfolk since 1978, the latest addition (in 1998) being a single, widely distributed tropical species (Smithers, Peters & Thornton, 2000). Despite its greater (but much more disturbed) area it seems likely that most species have now been recorded for Norfolk. On the other hand, circumstances on Lord Howe suggest that more species will be found there. This possibility should be remembered when considering relationships of the Lord Howe fauna to those of other areas (Table 1).

Table 1. Distribution of Lord Howe Island Psocoptera.

Lord Howe species	endemic ³	widespread ⁴	Australia	Norfolk Island	New Caledonia	New Zealand
LEPIDOPSOCIDAE						
<i>Echmepteryx anomala</i>	●	—	—	—	—	—
<i>Echmepteryx howensis</i>	●	—	—	—	—	—
<i>Echmepteryx madagascariensis</i> ¹	—	●	●	●	—	●
<i>Lepolepis trifasciata</i> ¹	●	—	—	—	—	—
TROGIIDAE						
<i>Cerobasis annulata</i> ^{1,2}	—	●	●	—	—	—
<i>Cerobasis guestfalica</i> ^{1,2}	—	●	●	●	—	●
<i>Lepinotus inquilinus</i> ^{1,2}	—	●	●	—	—	—
PSOQUILLIDAE						
<i>Rhyopsocidus niger</i>	●	—	—	—	—	—
PSYLLIPSOCIDAE						
<i>Psocathropos lachlani</i> ^{1,2}	—	●	●	—	—	—
CAECILIUSIDAE						
<i>Stenocaecilius quercus</i>	—	—	●	—	—	—
<i>Paracaecilius lemuris</i> ¹	—	—	●	—	—	—
<i>Valenzuela pteridii</i> ¹	—	—	●	—	—	—
ECTOPSOCIDAE						
<i>Ectopsocus insularis</i> ¹	—	—	—	●	—	—
<i>Ectopsocus petersi</i>	—	●	●	—	—	●
PERIPSOCIDAE						
<i>Peripsocus milleri</i> ¹	—	●	●	●	●	●
<i>Peripsocus similis</i> ¹	—	●	—	—	—	—
PSEUDOCAECILIIDAE						
<i>Howeanum huberi</i>	●	—	—	—	—	—
<i>Mepleres fasciata</i>	●	—	—	—	—	—
<i>Mepleres hollowayi</i>	●	—	—	—	—	—
<i>Mauropsocus monteithi</i> ¹	●	—	—	—	—	—
n.gen. and n.sp. ¹	●	—	—	—	—	—
PHILOTARSIDAE						
<i>Aaroniella howensis</i>	●	—	—	—	—	—
<i>Haplophallus tandus</i>	●	—	—	—	—	—
ELIPSOCIDAE						
<i>Pentacladus marmoratus</i>	●	—	—	—	—	—
<i>Prionotodrilus parvus</i>	●	—	—	—	—	—
MYOPSOCIDAE						
<i>Nimbopsocus huttoni</i> ¹	●	—	—	—	—	—
<i>Nimbopsocus australis</i> ¹	—	●	●	●	●	●
number of species: 27	14	9	11	5	2	5

In the table ● = species is present in the area indicated at the head of the column;

¹ first record for Lord Howe in this paper;

² species frequently associated with human domestic environment;

³ known so far only from Lord Howe Island;

⁴ occurs in areas other than above, in some cases almost cosmopolitan, see text for details.

Systematic treatment of Lord Howe Island Psocoptera

LEPIDOPSOCIDAE

Echmepteryx anomala Smithers & Thornton

Echmepteryx anomala Smithers & Thornton, 1975. *Rec. Aust. Mus.* 29:456.

Material studied. 1♂, 1♀, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., 15–26.ii.2001, M.S. Moulds. 1♀, Base of Round Face (Mt. Lidgbird), Far Flats, broad megaphyllous closed sclerophyll forest, 2–5.xii.2001, C. Reid. 1♂, eastern slope of Dawsons Point Ridge above Old Settlement, litter, closed rain forest, *Drypetes/Cryptocarya* (exposed), 1.xii.2000, L.H.S. 1♀, Stevens Reserve, 5 m, leaf litter, *Howea forsteriana*, 25.ix.1978, T. Kingston. 1♂, Mt. Gower, 350 m, ii.1979, T. Kingston. 2♂♂, 3♀♀, Intermediate Hill, rainforest, 180–250 m, 6.xi.1979, G.B. Monteith. 1♂, Transit Hill, rainforest, pyrethrum knockdown, 18.x.1979, G.B. Monteith. 1♂, 2♀♀, Big Creek at Mountain Inn, pyrethrum knockdown, 11.xi.1979, G.B. Monteith. 1♂, Boat Harbour, rainforest, pyrethrum knockdown, 23.xi.1979, G.B. Monteith. 1♀, Dawsons Ridge Top, rainforest, pyrethrum knockdown, 5.xi.1979, G.B. Monteith. 1♂, Malabar Hill, rainforest, pyrethrum knockdown, 25.xi.1979, G.B. Monteith.

Distribution. Known only from Lord Howe Island.

Echmepteryx (Loxopholia) howensis Smithers & Thornton

Echmepteryx (Loxopholia) howensis Smithers & Thornton. 1975. *Rec. Aust. Mus.* 29:454.

Material studied. 2♀♀, 3nn, c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, *Drypetes deplanchei*, beating, 1.xii.2000, H. Smith. 10♂♂, 6♀♀, 3nn, small swampy area behind dunes at southern end of Lagoon Beach, turnoff to Intermediate Hill, broad sclerophyll swamp scrub, *Aegiceras*, *Lagunaria patersonia* (host H15 in field notes), beating, 8.xii.2000, G. Cassis. 1n, Western slope of Dawsons Point Ridge off North Beach Trail, closed rain forest, *Drypetes/Cryptocarya* (calcarenite), hostplant: *Melicope polybotrya*, beating, 24.xi.2000, P. Flemons, J. Tarnawski. 1n, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, *Cassinia tenuifolia*, beating, 24.xi.2000, L. Wilkie, G. Carter. 1n, Lagoon Beach between rubbish tip and airstrip, closed rain forest, *Drypetes/Cryptocarya*, *Alyxia ruscifolia*, beating, 27.xi.2000, M. Elliott, N. Plunkett-Cole. 1♀, 2nn, eastern end of Boat Harbour beach, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, *Olea paniculata*, beating, 26.xi.2000, P. Flemons, J. Tarnawski. 2♀♀, Little Slope, broad-leaved herb vegetation, mixed ferns/herbs, *Melaleuca howeana*, beating, 30.xi.2000, P. Flemons, J. Tarnawski. 1♂, eastern slope of Dawsons Point Ridge above Old Settlement, closed rain forest, *Drypetes/Cryptocarya* (exposed), pitfall trap, 24.xi.2000 to 1.xii.2000, L.H.S. 1♀, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, *Drypetes deplanchei*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1n, Malabar

Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, *Drypetes deplanchei*, beating, 24.xi.2000, L. Wilkie, G. Carter. 2nn, broad megaphyllous closed sclerophyll forest, *Howea belmoreana*, *Baloghia inophylla*, beating, 30.xi.2000, P. Flemons, J. Tarnawski. 1n, western slope of Transit Hill, broad megaphyllous closed sclerophyll forest, *Howea forsteriana*, 24.xi.2000, M. Elliott, N. Plunkett-Cole. 1n, eastern slope of Malabar Ridge above Neds Beach, closed rain forest, *Drypetes/Cryptocarya*, *Elaeodendron curtispiculum*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1n, just behind beach at Old Gulch on western footslopes, narrow sclerophyll closed scrub, *Melaleuca howeana* beating, 25.xi.2000, L. Wilkie, H. Smith. 3nn, eastern slope of Dawsons Point Ridge above Old Settlement, closed rain forest, *Drypetes/Cryptocarya* (exposed), *Drypetes deplanchei*, beating, 24.xi.2000, P. Flemons, J. Tarnawski. 1n, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, *Howea belmoreana*, beating, 1.xii.2000, C. Reid, H. Smith. 1♀, north bank of Rocky Run Creek where coastal trail to Boat Harbour intersects, broad megaphyllous closed sclerophyll forest, *Pandanus*, *Alyxia ruscifolia*, beating, 30.xi.2000, C. Reid, H. Smith. 1♂, on Boat Harbour walking trail, c. 200 m before harbour, broad megaphyllous closed sclerophyll forest, *Pandanus*, *Atractocarpus stipularis*, beating, 30.xi.2000, C. Reid, H. Smith. 2nn, eastern slopes of Roach Island, sclerophyll tall grass, *Cyperus*, 29.xi.2000, *Lagunaria patersonia*, beating, 30.xi.2000, C. Reid, H. Smith. 29 specs. eastern end of Old Settlement Beach, broad sclerophyll swamp scrub, *Aegiceras*, *Araucaria heterophylla* (host H32 in field notes), beating, 11.xii.2000, G. Cassis. 1♂, southern end of Old Settlement Beach, 7.xii.2000, *Cassinia tenuifolia*, sweep sampling, 11.xii.2000, G. Cassis. 1♂, Goat House walking track, c. 550 m from junction with Erskine Valley track, Intermediate Hill, *Pandanus forsteri*, hand collected, 6.xii.2000, G. Cassis. 2nn, c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, *Drypetes deplanchei*, beating, 1.xii.2000, H. Smith. 1♂, Research Station backyard, 24–26.ii.2001, surrounded by *Drypetes/Cryptocarya*, closed rain forest. M.S. Moulds. 1n, southern face of Mt. Lidgbird, at base of summit tabletop, closed rain forest, *Drypetes/Cryptocarya* (calcarenite), leaf litter, 3.xii.2000, L.H.S. 1♂, 2♀♀, near airport terminal, 15–26.ii.2001. M.S. Moulds. 1n, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp. *Olea paniculata*, beating, 13.xii.2000, R. Harris. 2♂♂, 2♀♀, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., 15–26.ii.2001, M.S. Moulds. 1n, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., *Howea forsteriana*, beating, 13.xii.2000, R. Harris. 1♂, 1♀, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, 4–8.xii.2001, C. Reid. 1♂, base of Round Face (Mt. Lidgbird), Far Flats, broad megaphyllous closed sclerophyll forest, *Howea belmoreana*, 2–5.xii.2001, C. Reid. 1♀, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, *Drypetes deplanchei*, beating, 1.xii.2000, C. Reid, H. Smith. 1♀, North Hummock (trail to Intermediate Hill), lowland mixed rain forest, *Cleistocalyx/Chionanthus*, *Atractocarpus stipularis*, beating, 3.xii.2000, P. Flemons, J. Tarnawski. 1♀, 2♂♂, Site 8, beating fallen branches, Intermediate Hill, 100 m, leaf litter, *Cleistocalyx fullagarii*, *Chionanthus*

quadrastamineus, 24.i.1979, T. Kingston. 1 ♀, Balls Pyramid, 24.i.1980, No collector. 1 ♂, 2 ♀ ♀, Intermediate Hill, rainforest, 180–250 m, 6.xi.1979, G.B. Monteith. 3 ♂ ♂, 1 ♀, North Bay, scrub, pyrethrum knockdown, 19.xi.1979, G.B. Monteith. 2 ♂ ♂, Erskine Valley, rainforest, pyrethrum knockdown, 24.xi.1979, G.B. Monteith. 1 ♂, Smoking Tree Ridge, pyrethrum knockdown, 11.xi.1979, G.B. Monteith. 2 ♀ ♀, Mountain Inn, Big Creek, pyrethrum knockdown, 11.xi.1979, G.B. Monteith. 1 ♀, Malabar Hill, pyrethrum knockdown, 25.xi.1979, G.B. Monteith.

Distribution. Known only from Lord Howe Island.

Echmepteryx (Thylacopsis) madagascariensis (Kolbe)

Thylax madagascariensis Kolbe, 1885. *Berl. ent. Ztschr.* 1885: 184.
Thylacopsis madagascariensis (Kolbe). Enderlein, 1911. *Palaeontographica* 58: 348.
Echmepteryx costalis Banks, 1931. *Proc. Hawaii. ent. Soc.* 7: 439.
Lepidopsocus costalis (Banks). Zimmerman, 1948. *Insects of Hawaii* 2: 224.
Thylacopsis albidus Badonnel, 1949. *Rev. franc. Ent.* 16: 25.
Echmepteryx (Thylacopsis) madagascariensis (Kolbe). Smithers, 1967. *Aust. Zool.* 14: 8.

Material studied. 1 ♂, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., 26.ii.2001, M.S. Moulds.

Distribution. First record for Lord Howe Island. Previously known from Madagascar, Réunion, Isle Glorieuse, Seychelles, East Africa, Ivory Coast, Bioko Is., South America, North America, Australia, Hawaii, Bonin Is., Marianas, Kermadecs, Chagos Archipelago, New Zealand, Norfolk Island, Galapagos, Tonga, Society Islands, Indonesia, Bermuda, Jamaica, Fiji, Diego Garcia, Chile, Hong Kong, Germany (introduced, in greenhouse).

Lepolepis trifasciata n.sp.

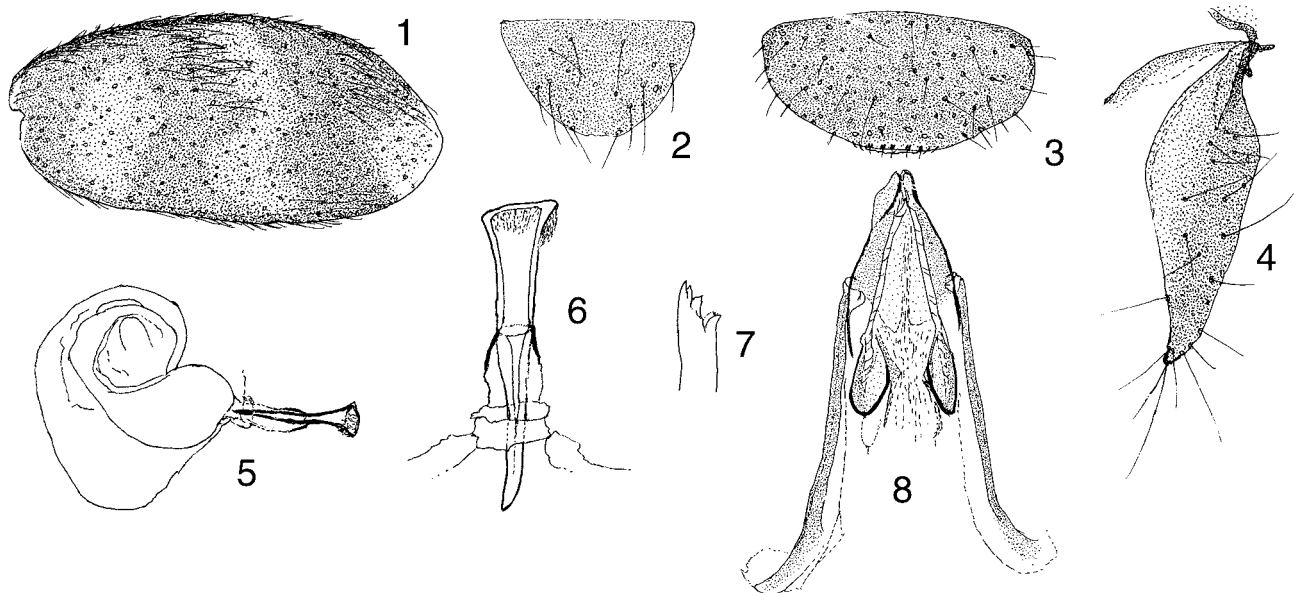
Material studied. 1 ♀ (HOLOTYPE) (K232557), Lagoon Beach between rubbish tip and airstrip, litter, closed rain forest, *Drypetes/Cryptocarya*, 27.xii.2000, LHS. PARATYPES: 12 ♂ ♂, 6 ♀ ♀, Lagoon Beach between rubbish tip and airstrip, litter, closed rain forest, *Drypetes/Cryptocarya*, leaf litter, 27.xi.2000, LHS. 2 ♀ ♀, ridge top, northern end of Roach Island. broad-leaved herb layer, *Ipomoea/Carpobrotus*, pitfall trap, 29.xi–7.xii.2000, LHS. 1 ♀, Eastern slope of Dawsons Point Ridge above Old Settlement, closed rain forest, *Drypetes/Cryptocarya* (exposed), pitfall trap, 24.xi–1.xii.2000, LHS. 2 ♂ ♂, southeastern aspect of Transit Hill near summit, closed rain forest, *Cleistocalyx/Chionanthus*, pitfall trap, 24.xi–1.xii.2000, LHS. 1 ♂, western slope of Transit Hill, broad megaphyllous closed sclerophyll forest, *Howea forsteriana*, pitfall trap, 24.xi–1.xii.2000, LHS. 1 ♀, western face of Mt. Lidgbird, at base of summit tabletop, broad closed sclerophyll scrub, *Dracophyllum/Metrosideros*, pitfall trap, 25.xi–2.xii.2000, LHS. 1 ♂, on Boat Harbour walking trail, closed rain forest, *Cleistocalyx/Chionanthus*, pitfall trap, 26.xi–3.xii.2000, LHS. 1 ♀, point where

walking trail first enters Erskine Valley from coast, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, pitfall trap, 25.xi–2.xii.2000, LHS. 1 ♀, western face of Mt. Lidgbird, at base of summit tabletop, broad closed sclerophyll scrub, *Dracophyllum/Metrosideros*, pitfall trap, 25.xi–2.xii.2000, LHS. 1 ♂, 1 ♀, 4nn, Little Island, coastal track to Erskine Valley, palm litter, 13.xii.2000, G. Cassis. 1 ♂, 1n, on Boat Harbour walking trail, leaf litter, closed rain forest, *Cleistocalyx/Chionanthus*, 21.xi.2000, LHS. 3nn, Walking trail through Erskine Valley, leaf litter, closed rain forest, *Cleistocalyx/Chionanthus*, LHS. 1 ♂, 3 ♀ ♀, 3nn, on walking track to Erskine Valley, adjacent to Salmon Beach, leaf litter, collected at night, 10.xii.2000, G. Cassis. 1 ♂, 2nn, Eastern aspect of Transit Hill near summit, leaf litter, narrow closed sclerophyll scrub, 19.xi.2000, LHS. 2 ♂ ♂, 4nn, ridge below Intermediate Hill, Boat Harbour walking trail, leaf litter, 12.xii.2000, G. Cassis. 4 ♂ ♂, 1n, on Boat Harbour walking trail, c. 200 m before harbour, leaf litter, broad megaphyllous closed sclerophyll forest, *Pandanus* habitat, 21.xi.2000, LHS. 7 specs., point where walking trail first enters Erskine Valley from coast, leaf litter, narrow closed sclerophyll scrub *Melaleuca/Cassinia*, 2.xii.2000, LHS. 4 ♂ ♂, 2 ♀ ♀, 16nn, LHI—site 9. 10 specs., southeastern aspect of Transit Hill near summit, leaf litter, closed rain forest, *Cleistocalyx/Chionanthus* habitat, 24.xi.2000, LHS. 2 ♀ ♀, Malabar Hill, on path to Kims Lookout, leaf litter, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, 24.xi.2000, LHS. 2 ♂ ♂, 2 ♀ ♀, western slope of Malabar Ridge S of Kims Lookout trail, leaf litter, broad megaphyllous closed sclerophyll forest, *Howea belmoreana*, 24.xi.2000, LHS. 2 ♀ ♀, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., 15–26.ii.2001, M.S. Moulds. 6 ♂ ♂, 3 ♀ ♀, 10nn, eastern slope of Malabar Ridge above Neds Beach, leaf litter, closed rain forest, *Drypetes/Cryptocarya*, 19.xi.2000, LHS. 1 ♂, 3nn, North Hummock (trail to Intermediate Hill), leaf litter, lowland mixed rain forest, *Cleistocalyx/Chionanthus*, 3.xii.2000, LHS. 1 ♂, 1n, western slope of Dawsons Point Ridge off North Beach Trail, leaf litter, closed rain forest, *Drypetes/Cryptocarya* (basalt), 20.xi.2000, LHS. 4 ♂ ♂, 2nn, Malabar Hill, on path to Kims Lookout, leaf litter, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, 24.xi.2000, LHS. 1 ♂, 1 ♀, Little Island, coastal track to Erskine Valley, palm litter, 13.xii.2000, G. Cassis. 1 ♂, 1 ♀, eastern end of Boat Harbour beach, leaf litter, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, 3.xii.2000, LHS. 1 ♀, Goat House walking track, c. 1km from junction with Erskine Valley track, Intermediate Hill, leaf litter, *Pandanus*, 6.xii.2000, G. Cassis. 1 ♀, southern end of Salmon Beach, Little Island, 27.xi.2000, broad megaphyllous closed sclerophyll forest, *Howea forsteriana* leaf litter, LHS. 4 ♂ ♂, 3 ♀ ♀, 5nn, eastern aspect of Transit Hill near summit, narrow closed sclerophyll scrub, *Melaleuca/Cassinia* leaf litter, 19.xi.2000, LHS. 1 ♀, near Goat House Cave, various mosses, lichens and liverworts, leaf litter, 23.ii.2001, J. Tarnawski. 2 ♂ ♂, eastern slope of Dawsons Point Ridge above Old Settlement, closed rain forest, *Drypetes/Cryptocarya* (exposed), leaf litter, 1.xii.2000, LHS. 2 ♂ ♂, 1 ♀, western face of Mt. Lidgbird, at base of summit tabletop, broad closed sclerophyll scrub, *Dracophyllum/Metrosideros*, pitfall trap, 25.xi–2.xii.2000, LHS. 1 ♂, 4nn, southeastern aspect of Transit Hill near summit, closed rain forest, *Cleistocalyx/Chionanthus* leaf litter, 24.xi.2000, LHS. 1n, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, pitfall trap, 25.xi–2.xii.2000, LHS. 3 ♂ ♂, 1 ♀, 5nn, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, leaf litter, 24.xi.2000, LHS. 1 ♂, point where walking trail first enters Erskine Valley from coast, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, pitfall trap, 25.xi–2.xii.2000, LHS. 1 ♂, 1 ♀, on walking track to Erskine Valley, adjacent to Salmon Beach, leaf litter, collected at night, 10.xii.2000, G. Cassis. 3 ♂ ♂, 5nn, Little Island, coastal track to Erskine Valley, palm leaf litter, 13.xii.2000, G. Cassis. 2 ♂ ♂, Mt. Gower, north face, near creek crossing of walking track, leaf litter, *Chionanthus quadrastamineus*, *Guioa coriacea*, *Drypetes deplanchei*, 19.v.2002, I. Hutton. 1 ♀,

Mt Gower summit on ridge between creeks 3 (most western) and 2 (middle), *Pittosporum erioloma*, *Zygogynum*, *Metrosideros nervulosa*, leaf litter, 25.vi.2001, Ian Hutton. 1 ♀, Lagoon Beach between rubbish tip and airstrip, closed rain forest, *Drypetes/Cryptocarya*, pitfall trap, 27.xi.–4.xii.2000, LHI. 1 ♀, western slopes of Roach Island, orthophyll short grass, *Poa*, pitfall trap, 29.xi.–7.xii.2000, LHI. 1 ♀, Transit Hill, 60 m, leaf litter, *Chionanthus quadristamineus*, *Cleistocalyx fullagarii*, 26.x.1979, T. Kingston. 2 ♀♀, same data, 10.x.1978, T. Kingston. 1, same data, 26.x.1979, T. Kingston. 1 ♀, same data, 8.iv.1979, T. Kingston. 1 ♂, 1 ♀, Clear place, leaf litter, 6.i.1980, T. Kingston. 1 ♂, south end, Settlement Beach, under bark, *Lagunaria*, 7.viii.2000, No collector. 1 ♀, 2nn, Transit Hill, north slope, Queensland Museum berlesate 151, volcanic soil, Pickard veg DaCt, 18.xi.1979, G.B. Monteith. 1 ♂, 1 ♀, 2nn, same data, Queensland Museum berlesate 152, volcanic soil, Pickard veg DaCt, sieved litter, 18.xi.1979, G.B. Monteith. 1 ♂, same locality, west base, Queensland Museum berlesate 118, volcanic soil, 5 m, Pickard veg DaCt, sieved litter, 4.xi.1979, G.B. Monteith. 1 ♂, same locality, north slope, Queensland Museum berlesate 137, Pickard veg CfLq, sieved litter, 18.xi.1979, G.B. Monteith. 1 ♂, 3 ♀♀, North Bay, 5 m, leaf litter, *Howea forsteriana*, 15.xi.1978, T. Kingston. 1 ♂, North Bay, west end, 5 m, Queensland Museum berlesate 156, Pickard veg Hf, sieved litter, volcanic soil, 19.ix.1979, G.B. Monteith. 3 ♂♂, 2 ♀♀, Old Settlement, 80 m, litter, *Drypetes deplanchei*, *Cryptocarya triplinervis*, 18.iv.1979, T. Kingston. 3 ♂♂, 5 ♀♀, same data, 2.vi.1979, T. Kingston. 1 ♀, same data, 8.iv.1979, T. Kingston. 1 ♂, 1 ♀, Stevens Reserve, 5 m, leaf litter, *Howea forsteriana*, 1.x.1978, T. Kingston. 1 ♂, 1 ♀, same data, LHI 168, No 8, 25.ix.1978, T. Kingston. 1 ♂, same data, LHI 191, No 8, T. Kingston. 1 ♂, 2 ♀♀, same data, 30.ix.1978, T. Kingston. 1 ♂, Intermediate Hill, leaf litter, *Cleistocalyx fullagarii*, *Chionanthus quadristamineus*, LHI 327, No 8, 24.i.1979, T. Kingston. 2 ♀♀, same locality, LHI 316, No 8, 19.i.1979, T. Kingston. 5 ♂♂, 1 ♀, same locality, North Hummock, Queensland Museum berlesate 125, volcanic soil, 180 m, Pickard veg CfLq, sieved litter, 6.xi.1979, G.B. Monteith. 1 ♂, 1 ♀, Intermediate Hill, *Cleistocalyx fullagarii*, *Chionanthus*

quadristamineus, 100 m, LHI 347, No 8, 24.i.1979, T. Kingston. 9 ♂♂, 11 ♀♀, 31nn, S of Clear Place, 6.ii.1980, T. Kingston. 1 ♂, Mt. Gower, leaf litter, 100 m, no date, T. Kingston. 1 ♀, Mt. Gower, 350 m, ii.1979, T. Kingston. 1 ♂, 1 ♀, Lord Howe Island Stations: 007–0037, no date, T. Kingston. 1 ♂, Erskine Valley, leaf litter, no date, T. Kingston. 1 ♂, Erskine Valley, 175 m, leaf litter, *Drypetes deplanchei*, *Cryptocarya triplinervis*, LHI 454, No 8, 1.viii. T. Kingston. 4 ♂♂, 1 ♀, 10nn, Broken Banyan Apartments, leaf litter, 7.x.1994, D.S.Horning and D.Horning. 3 ♀♀, Lord Howe Island, no date, D. Horning. 1 ♂, Smoking Tree Ridge summit, Queensland Museum berlesate 130, volcanic soil, 150 m, Pickard veg DaCt, sieved litter, 7.xi.1979, G.B. Monteith. 1 ♂, same locality, east face, Queensland Museum berlesate 163, volcanic soil, Pickard veg CfLq, sieved litter, 23.xi.1979, G.B. Monteith. 2 ♂♂, Gully at Catalina crash, Queensland Museum berlesate 169, volcanic soil, 20 m, Pickard veg Hb, sieved litter, 25.xi.1979, G.B. Monteith. 1 ♂, 1 ♀, Lagoon Road, opposite museum, Queensland Museum berlesate 122, alluvial soil, Pickard veg DaCt, sieved litter, 5.xi.1979, G.B. Monteith. 5 ♂♂, 10 ♀♀, Lagoon Road, opposite hospital, Queensland Museum berlesate 119, alluvial soil, 2 m, Pickard veg DaCt, sieved litter, 4.xi.1979, G.B. Monteith. 1 ♂, 1 ♀, Malabar summit, Queensland Museum berlesate 168, volcanic soil, 200 m, Pickard veg DaCt, sieved litter, 25.xi.1979, G.B. Monteith. 1 ♀, Boat Harbour, Queensland Museum berlesate 161, 10 m, volcanic soil, Pickard veg CfLq, sieved litter, 23.xi.1979, G.B. Monteith. 1 ♂, Mount Eliza summit, Queensland Museum berlesate 154, volcanic soil, 150 m, Pickard veg MnCa, sieved litter, 19.xi.1979, G.B. Monteith. 1 ♂, Dawsons Point Ridge summit, 150 m, Queensland Museum berlesate 120, Pickard veg DaCt, sieved litter, 5.xi.1979, G.B. Monteith. 1 ♂, Little Slope, 50 m, leaf litter, *Howea forsteriana*, LHI 355 No. 8, 22.xi.1979, T. Kingston. 4 ♂♂, 5 ♀♀, Behind Leanda Lei, Queensland Museum berlesate 127, calcareous soil, Pickard veg Hf, sieved litter, 6.xi.1979, G.B. Monteith.

Specimens collected by other than G.B.Monteith are in the Australian Museum; specimens collected by G.B.Monteith are deposited in the Queensland Museum.



Figs 1–8. *Lepolepis trifasciata* n.sp. Female: (1) fore wing; (2) epiproct; (3) labrum; (4) gonapophyses; (5) structure associated with spermatheca; (6) same, enlarged; (7) lacinia. Male: (8) phallosome.

Description

Female. *Coloration* (in alcohol). This species exhibits extreme variation in depth of colour, ranging from pale testaceous to specimens which are almost black. The variation may be age-related; nymphs are very pale. Parts are consistently relatively darker than one another through the series of specimens. Vertex, postclypeus, labrum and maxillary palps a little darker than the frons, genae darkest. Antennae very pale to dark brown. Eyes black. Thoracic nota variable, pleura darker. Legs variable with tarsi always paler than other segments. Fore wings (Fig. 1) pale with basal, middle and preapical irregular brown bands, the colour varies in depth to similar degree as other parts of the body of the same specimen. Abdomen dorsally pale in basal half, where it is covered by the reduced wings, distally darker where it is exposed. Terminal structures dark.

Morphology. Brachypterous. Length of body: 2.0 mm. Median epicranial suture distinct, anterior arms very short, evanescent near origin. Vertex sharp. Postclypeus very slightly bulging. Head strongly pubescent, genal setae especially long and stout. Top of eyes about level with vertex. IO/D: 2.3; PO: 0.8. Ocelli absent. Labrum (Fig. 3) with five distal inner labral sensilla. Lacinia (Fig. 7). Measurements of hind leg: F: 0.62 mm; T: 0.73 mm; t1: 0.29 mm; t2: 0.07 mm; t3: 0.06 mm; rt: 4.1:1:0.85. No ctenidiobothria. Fore wing length: 1.2 mm; width: 0.5 mm. Fore wing (Fig. 1) somewhat elytriiform, veinless. Costal and hind margins with thickened band in basal half of wing. Wing surface with vestiture of very narrow scale-like setae as well as fairly dense cover of well-developed, erect, setae (nearly all lost in preservative). Wings reach to about three quarters of length of the abdomen. Hind wings reduced to a small, membranous, flap. Epiproct (Fig. 2) simple, rounded behind, sparsely setose. Paraproct simple, two trichobothria with ornamented alveoli and a few setae in distal half. Posterior spine slightly downwardly curved. Subgenital plate simple, wider than long, sparsely setose. Gonapophyses (Fig. 4). Spermathecal sac membranous, apparently without dentate sclerotic ring and without maculae. Associated with the sac is a large, strongly sclerotized, partly hollow, peg-like structure (Fig. 5, Fig. 6 [enlarged]). The structure is pointed at one end, widened at the other and hollow almost to the pointed end. The wider end of the funnel thus formed is open along one side. The peg-like structure appears to arise in and be an integral part of the otherwise thin, membranous wall of the sac. It lies in an outwardly-directed tube-like extension of the wall the mouth of which is firmly attached to the peg about half way along it so that part of the peg appears to be inside and part outside the sac tube. There are folds at the base of the tube which suggest that the peg is capable of being moved inwards and outwards along the lumen of the tube whilst being attached to its inner wall. The structure is seen in various positions through the abdominal wall, depending on the position occupied by the spermathecal sac and is possibly equivalent to the sheath of the spermathecal duct opening of Mockford (Mockford, 2005). It is large enough to be seen as a sclerotized, peg-like rod in the undissected abdomen.

Male. *Coloration* (in alcohol). As in female, equally variable.

Morphology. General morphology as in female. Length of body 2.2 mm. IO/D: 2.4; PO: 0.86. Fore wing length: 0.98 mm; width: 0.46 mm. Measurements of hind leg: F: 0.60 mm.; T: 0.68 mm; t1: 0.29 mm; t2: 0.07 mm; t3: 0.06; rt: 4.1:1:0.85. Ctenidiobothria absent. Epiproct as in female, simple, rounded behind, sparsely setose. Paraproct simple, two trichobothria with ornamented alveoli and a few setae in distal half. Hypandrium simple, rounded behind, setose. Phallosome (Fig. 8).

Discussion

There are now seven species described in the genus *Lepolepis* Enderlein: *L. bicolor* Broadhead (England (on introduced ground nuts from Africa), Ile Glorieuse, Réunion, India), *L. ceylonica* Enderlein (Sri Lanka, Taiwan), *L. columbiensis* Badonnel (Colombia), *L. graemei* Smithers (Norfolk Is.), *L. pateriformis* New (Aldabra), *L. picta* Thornton (Hawaii), and *L. trifasciata* (Lord Howe Island). The wings of *L. graemei* and *L. trifasciata* are longer than in the other species. When *L. graemei* was described no mention was made of the conspicuous peg-like structure associated with the spermatheca and reexamination of the dissection of the genitalia of a female paratype did not reveal any such organ. Having found the organ in the obviously similar *L. trifasciata* I reexamined further material of *L. graemei* and found that an almost identical structure was, in fact, present. The spermathecal sac in this genus is very delicate, was probably damaged and the peg-like structure lost when the earlier paratype was dissected. The peg-like structure is not easily homologized with part of the reproductive organs of any other female psocopterans but, as mentioned above, there is a possibility of it being homologous to the sheath of the spermathecal duct opening of Mockford (Mockford, 2005). The spermatheca has not been described for all species of *Lepolepis* but *L. graemei* and *L. trifasciata* share several significant features with each other which they do not share with other members of the genus for which the spermatheca has been described, such as a lesser degree of wing reduction, similarities in wing pattern, the presence of the peg-like structure associated with the spermatheca and the lack of spermathecal maculae, which are present in some of the other species. This suggests that the two species are closely related and stand apart from the others of which the spermatheca has been described. Given that the presence of the peg-like structure is very likely a shared apomorphy it may be reasonable to erect a new genus for their accommodation. I hesitate to do this until further information is available on the nature of the spermatheca in those species for which it has not yet been described.

Etymology. The specific name refers to the three broad transverse dark bands across the wings.

Distribution. Known only from Lord Howe Island.

TROGIIDAE

Cerobasis annulata (Hagen)

- Clothilla annulata* Hagen, 1865. *Ent. mon. Mag.* 2: 122.
Atropos annulata (Hagen). Kolbe, 1880. *Jber. westf. Prov. Ver. Wiss. Kunst.* 8: 135.
Myopsocnema annulata (Hagen). Enderlein, 1905. *Jagersk. Exped.* 18: 17.
Cerobasis annulata (Hagen). Badonnel, 1955. *Pub. cult. Comp. Diam. Angola* 26: 32.
Zlinia multispinosa Obr, 1948. *Pub. Fac. Sci. Univ. Masaryk* 306: 93, 104.
Cerobasis multispinosa (Obr.). Badonnel, 1955. *Pub. cult. Comp. Diam. Angola* 26: 32.
Cerobasis bundyi Turner, 1977. *J. nat. Hist.* 11: 283.

Material studied. 1 ♀, Mount Gower, litter, 850 m, mossy forest, 27.ix.1978, T. Kingston. 1 ♀, Erskine Valley, 175 m, litter, *Drypetes*, *Cryptocarya*, 12.viii.1979, T. Kingston.

Distribution. First record for Lord Howe Island. Previously known from Europe, North America, Australia (in stored products), St Helena, Robinson Crusoe Island, Hawaii, Azores, Morocco, Madeira. In the wild and in domestic situations.

Cerobasis guestfalica (Kolbe)

- Hyperetes guestfalicus* Kolbe, 1880. *Jber. westf. Prov. Ver. Wiss. Kunst.* 8: 132.
Hyperetes pinicola Kolbe, 1881. *Ent. Nachr.* 7: 255.
Cerobasis muraria Kolbe, 1882. *Ent. Nachr.* 8: 212.
Tichobia alternans Kolbe, 1882. *Ent. Nachr.* 8: 212.
Hyperetes tessulatus Hagen, 1883. *Stettin. ent. Z.* 44: 316.
Albardia alternans (Kolbe). Jacobson & Bianchi, 1904. *Orthop. Pseudoneuropt Russ. Reich* p. 496.
Cerobasis guestfalica (Kolbe). Roesler, 1943. *Stettin. ent. Z.* 104: 13.

Material studied. 1 ♀, near airport terminal. 15–26.ii.2001, M.S. Moulds. 1 ♀, North Bay, 5 m, litter, *Howea forsteriana*, 15.xi.1978, T. Kingston.

Distribution. First record for Lord Howe Island. Previously known from North America, Europe, Canary Is., Azores, Israel, Saudi Arabia, Sardinia, Morocco, Tunisia, Japan, Mexico, Java, Australia, Norfolk Is., New Zealand, Hawaii, Bermuda, Kenya, South Africa, Robinson Crusoe Is., Argentina, Brazil, Chile, St. Helena, St. Paul Is., Jamaica, Kermadecs, Mauritius. In the wild and in domestic situations.

Lepinotus inquilinus v. Heyden

- Lepinotus inquilinus* Heyden, 1850. *Stettin. ent. Z.* 11: 84.
Paradoxides psocoides Motschulsky, 1851. *Bull. Soc. Imp. Nat. Moscou* 24(2): 510.
Paradoxenus psocoides (Motschulsky). Motschulsky, 1852. *Etudes entomologiques de 1852* p. 19.
Clothilla inquilina (Heyden). Brauer & Löw, 1857.
Neuroptera austriaca. Wien. p. 32.
Clothilla picea Hagen, 1861. *Smithsonian miscellaneous collections* 4: 8.
Synonymy: Enderlein, 1905. *Res. Swedish Exp. Egypt and White Nile* p. 25.
Atropos inquilina (Heyden). Kolbe, 1880. *Jber. westf. Prov. Ver. Wiss. Kunst.* 8: 132.
Atropos sericea Kolbe, 1883b. *Stettin. ent. Z.* 44: 86.

- Lepinotus piceus* (Hagen). Hagen, 1883. *Stettin. ent. Z.* 44: 314.
Atropos distincta Kolbe, 1888. *Jaresb. Ver. f. Naturk. Zwickau* 1887: 190, 191.
Atropos picea (Hagen). Kolbe, 1888. *Jaresb. Ver. f. Naturk. Zwickau* 1887: 190, 191.
Clothilla distincta (Kolbe). Tetens, 1891. *Ent. Nachr.* 17: 372.
Lepinotus sericeus (Kolbe). Tetens, 1891. *Ent. Nachr.* 17: 373, 384.
Cuixa canaria Navas, 1927. *Bol. Soc. ent. ital.* 59: 151.
Synonymy: Broadhead, 1949. *Ent. mon. Mag.* 85: 80.

Material studied. 6 ♂♂, 8 ♀♀, Mt. Gower, 850 m, leaf litter, mossy forest, 2.ii.1979, T. Kingston. 4 ♂♂, 9 ♀♀, Intermediate Hill, 100 m, leaf litter, *Chionanthus quadristamineus*, *Cleistocalyx fullagarii*, 24.i.1979, T. Kingston. 2 ♂♂, 6 ♀♀, same data, 19.i.1979, T. Kingston. 1 ♂, Old Settlement, 80 m, leaf litter, *Drypetes deplanchei*, *Cryptocarya triplinervis*, 18.iv.1979, T. Kingston. 2 ♂♂, 3 ♀♀, Little Slope, 50 m, leaf litter, *Howea forsteriana*, 7.i.1979, T. Kingston. same data, 20.xii.1979, T. Kingston. 2 ♀♀. Big Slope, 20 m, leaf litter, *Howea forsteriana*, 28.iii.1979, T. Kingston. 1 ♀, Stevens Reserve, 5 m, leaf litter, *Howea forsteriana*, 30.ix.1978, T. Kingston. 1 ♀, North Bay, 5 m, leaf litter, *Howea forsteriana*, 15.xi.1979, T. Kingston. 1 ♂, North End Big Pocket, Mt. Gower, ex leaf litter, *Hedyscepe canterburyana*, *Dysoxylum pachyphyllum*, 26.iv.2002, I. Hutton. 1 ♀, Little Island, below Far Flats, 10.viii.2001, I. Hutton. 1 ♂, Malabar Hill track, half way to Kims Lookout, 10.viii.2001, I. Hutton.

Distribution. First record for Lord Howe Island. The large number of previously published records indicate an almost cosmopolitan distribution for this species which is found indoors and in the wild.

PSOQUILLIDAE

Rhyopsocidus niger (Smithers)

- Trogium nigrum* Smithers, 1995. *Gen. appl. Ent.* 26: 2.
Rhyopsocidus niger (Smithers). Smithers and Mockford, 2004. *Ent. mon. Mag.* 140: 314.

Material studied. 1 ♀, just behind beach at Old Gulch on western footslopes, narrow sclerophyll closed scrub, *Melaleuca*, leaf litter, 20.xi.2000, LHIS. 1 ♂, on Boat Harbour walking trail, c. 200 m before harbour, broad megaphyllous closed sclerophyll forest, *Pandanus*, pitfall trap, 26.xi–3.xii.2000, LHIS. 1 ♂ (much damaged specimen), Stephens Reserve, New Settlement, *Howea forsteriana*, beating, 9.xii.2000, G. Cassis.

Distribution. Recorded only from Lord Howe Island (as *Trogium nigrum* Smithers).

PSYLLIPSOCIDAE

Psocathropos lachlani Ribaga

- Psocathropos lachlani* Ribaga, 1899. *Riv. Pat. Veg.* 8: 157.
Psocinella slossonae Banks, 1900. *Entom. News* 11: 432.
 Synonymy: Gurney, 1949. *J. Acad. Wash. Acad. Sci.* 39: 63.
Axinopsocus microps Enderlein, 1903. *Zool. Jb. Abt. Syst.* 19: 3.
 Synonymy: Lienhard & Halperin, 1988. *Israel J. Ent.* 22: 15.
Psoquilla microps (Enderlein). Enderlein, 1908. *Zool. Anz* 33: 782.
Vulturops floridensis Corbett & Hargreaves, 1915. *Psyche* 22: 142. Synonymy: Mockford, 1993. *North American Psocoptera*. Gainesville. p. 51.
Psocathropos [sic] *lesnei* Badonnel, 1931. *Ann. sci. nat., Zool.* (10)14(16): 254.
Psocathropos microps (Enderlein). Badonnel, 1932. *Bull. Soc. zool. Fr.* 57: 117.
 Synonymy: Badonnel, 1944. *Rev. franc. Ent.* 11: 59.

Material studied. 1 ♂, 5 ♀ ♀, Mt. Gower, 850 m, leaf litter, mossy forest, 2.ii.1979, T. Kingston. 1 specimen, Little Slope, leaf litter, *Howea forsteriana*, 7.i.1979, T. Kingston. 2 ♂ ♂, 3 ♀ ♀, Intermediate Hill, 100 m, leaf litter, *Cleistocalyx fullagarii*, *Chionanthus quadristamineus*, 19.i.1979, T. Kingston. 1 specimen, Big Slope, 20 m, leaf litter, *Howea forsteriana*, 28.iii.1979, T. Kingston.

Distribution. First record for Lord Howe Island. Also known from Australia, Europe, Morocco, North America, Cuba, Jamaica, Nicaragua, Mozambique, Angola, Congo, Nigeria, Madeira, Madagascar, Réunion, Thailand, Taiwan, Hawaii. Found in the wild and in domestic situations.

CAECILIUSIDAE

Stenocaecilius quercus (Edwards)

- Caecilius quercus* Edwards, 1950. *Pap. Proc. R. Soc. Tasm.* (1949): 131.
Stenocaecilius quercus (Edwards). Mockford, 2000. *Trans. Amer. ent. Soc.* 125(4): 357.

Material studied. 4 ♂ ♂, 3 ♀ ♀, Mt Gower summit; ridge between creeks 2 (middle) and 1 (most easterly), *Hedyscepe canterburyana*, *Zygogynum howeanum*, *Cryptocarya gregsonii*, leaf litter, 25.vi.2001, Ian Hutton. 1 ♀, Muttonbird Point booby colony area, under native grass, *Poa poiformis*, leaf litter, 22.vi.2001, Ian Hutton. 1 ♂, 1 ♀, Track to Malabar Hill, 50 m N summit, ex leaf litter, 10.viii.2001, I. Hutton. 1 ♂, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, leaf litter, 24.xi.2000, LHIS. 2 ♂ ♂, c. 25 m above coastal trail to Boat Harbour, 750 m from start, close rain forest, *Drypetes/Cryptocarya*, *Baloghia inophylla*, beating, 26.xi.2000, P. Flemons, J. Tarnawski. 1 ♂, eastern slope of Dawsons Point, ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, leaf litter, 24.xi.2000, LHIS. 1 ♀, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, *Olea paniculata*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1 ♂, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, *Olea paniculata*, beating, 25.xi.2000, L. Wilkie, H. Smith. 2 ♂ ♂, 2 ♀ ♀, eastern aspect of Transit Hill near summit, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, leaf litter, 19.xi.2000,

LHIS. 1 ♂, Mt Lidgbird SE end in dip between Pimple and main cliff, 21.v.2001, leaf litter caught in Birds Nest Fern, *Asplenium goudeyi*, 1.5 m off ground. Ian Hutton. 1 ♂, Mt Gower N face, following cliff base along from Eddies Cave, on ridge between gullies 1 and 2, 26.v.2001, *Metrosideros nervulosa*, *Dysoxylon pachyphyllum*, *Cleistocalyx fullagarii*, leaf litter, Ian Hutton. 2 ♂ ♂, 2 ♀ ♀, Muttonbird Point Booby colony area, 22.vi.2001, litter underneath Kikuyu grass, Ian Hutton. 1 ♂, Little Slope, broad-leaved herb vegetation, mixed ferns/herbs, leaf litter, 7.xii.2000, LHIS. 1 ♀, c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, leaf litter, 20.xi.2000, LHIS. 2 ♂ ♂, Mt Gower N face, base of waterfall, off summit (east one), 26.v.2001, *Boehmeria calophleba*, *Machaerina insularis*, *Elatostema grande*, *Blechnum howeanum*, *Blechnum geniculatum* leaf litter, Ian Hutton. 1 ♂, eastern slope of Dawsons Point Ridge above Old Settlement, closed rain forest, *Drypetes/Cryptocarya* (exposed), leaf litter, 1.xii.2000, LHIS. 2 ♂ ♂, just behind beach at Old Gulch on western footslopes, narrow sclerophyll closed scrub, *Melaleuca*, leaf litter, 20.xi.2000, LHIS. 1 ♂, eastern end of Boat Harbour beach, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, *Drypetes deplanchei*, beating, 26.xi.2000, P. Flemons, J. Tarnawski. 1 ♂, in forest behind Research Station, palm and banyan litter, 22.ii.2001, J. Tarnawski. 1 ♂, Get Up Place, trail to Mt. Gower, broad closed sclerophyll scrub, *Dracophyllum/Metrosideros*, leaf litter, 2.xii.2000, LHIS. 2 ♂ ♂, southern end of Old Settlement Beach, sweep sampling, 7.xii.2000, G. Cassis. 1 ♂, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, 1–4.xii.2001, C. Reid. 1 ♀, Goat House walking track, c. 550 m from junction with Erskine Valley track, Intermediate Hill, *Cryptocarya triplinervis*, hand collected, 6.xii.2000, G. Cassis. 1 ♀, bottom of track from Capella to Boat Harbour, 15.xii.2000. 1 ♂, Mt Lidgbird, SE ridge leading to Pimple, 20 m down track SE of Pimple summit, 23.v.2001, *Alyxia squamulosa*, *Coprosma huttoniana*, *Xylosma parvifolium* leaf litter, Ian Hutton. 2 ♀ ♀, c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, *Drypetes deplanchei*, beating, 1.xii.2000, H. Smith. 1 ♂, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, *Pouteria myrsinoides*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1 ♂, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, 1–4.xii.2001, C. Reid. 2 ♂ ♂, 1 ♀, Rocky Run Creek, leaf litter, *Cleistocalyx fullagarii*, *Pandanus forsteri*, *Coprosma putida*, 18.v.2002, I. Hutton. 1 ♂, Mt. Lidgbird, W side valley, between Pimple and summit, litter, *Hedyscepe canterburyana*, *Macropiper hooglandii*, *Coprosma huttoniana*, 11.iv.2002, I. Hutton. 1 ♂, Rocky Run Creek, Intermediate Hill crossing, litter, *Cleistocalyx fullagarii*, *Drypetes deplanchei*, 18.v.2002, I. Hutton. 1 ♂, 10 m NW Malabar Hill track in forest at beginning, leaf litter, *Drypetes deplanchei*, *Pouteria myrsinoides*, *Xylosma maidenii*, *Alyxia ruscifolia*, 10.viii.2001, I. Hutton. 1 ♂, Creek gully behind Lord Howe Island Board Office, litter, *Howea forsteriana*, *Drypetes deplanchei*, *Cryptocarya triplinervis*, 9.viii.2001, I. Hutton. 1 ♂, Mount Gower, north face, near creek crossing of track, litter, *Chionanthus quadristamineus*, *Guioa coriacea*, *Drypetes deplanchei*, 19.v.2002, I. Hutton.

Distribution. Previously recorded from Lord Howe Island, Tasmania and Australia.

***Paracaecilius lemuris* Smithers**

Paracaecilius lemuris Smithers, 1994b. *Rec. Aust. Mus.* 46: 126.

Material studied. 1 ♀, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, *Pouteria myrsinoides*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1 ♂, southern face of Mt. Lidgbird, at base of summit tabletop, closed rain forest, *Drypetes/Cryptocarya* (calcarenite), *Chionanthus quadristamineus*, beating, 26.xi.2000, P. Flemons, J. Tarnawski. 1 ♂, west of walking trail to Mt. Gower, at base of Scaly Bark Ridge, closed rain forest, *Cleistocalyx/Chionanthus*, beating, 25.xi.2000, M. Elliott, N. Plunkett-Cole. 1 ♀, eastern face of Mt. Lidgbird, closed rain forest, *Cryptocarya gregsonii*, *Zygogynum howeanum*, beating, 26.xi.2000. M. Elliott, N. Plunkett-Cole. 1 ♀, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, *Baloghia inophylla*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1 ♂, southern face of Mt. Lidgbird, at base of summit tabletop, closed rain forest, *Drypetes/Cryptocarya* (calcarenite), *Arthropteris tenella*, beating, 26.xi.2000, P. Flemons, J. Tarnawski. 1 ♀, Little Slope, broad megaphyllous closed sclerophyll forest, leaf litter, 30.xi.2000, L.HIS. 2 ♂ ♂, 4 ♀ ♀, southern face of Mt. Lidgbird, at base of summit tabletop, closed rain forest, *Drypetes/Cryptocarya* (calcarenite), *Zygogynum howeanum*, beating, 26.xi.2000, P. Flemons, J. Tarnawski. 1 ♂, walking trail through Erskine Valley, closed rain forest, *Cleistocalyx/Chionanthus*, *Xylosma maidenii*, beating, 25.xi.2000, P. Flemons, J. Tarnawski. 2 ♂ ♂, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, *Drypetes deplanchei*, beating, 1.xii.2000, C. Reid, H. Smith. 1 ♀, Research Station backyard, surrounded by *Drypetes/Cryptocarya*, closed rain forest. 1 ♂, 1 ♀, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, 4–8.xii.2001, C. Reid. 1 ♂, Little Island, below Far Flats, ex litter, *Howea forsteriana*, 10.viii.2001. I. Hutton. 1 ♀, Run Creek, Intermediate Hill track crossing, litter, *Pandanus forsteri*, *Cleistocalyx fullagarii*, *Coprosma putida*, 18.v.2002, I. Hutton.

Distribution. First record for Lord Howe Island. Previously recorded from Australia.

***Valenzuela pteridii* (Smithers)**

Caecilius pteridii Smithers, 1977. *Rec. Aust. Mus.* 31: 257.

Valenzuela pteridii (Smithers). Mockford, 2000. *Trans. Amer. ent. Soc.* 125(4): 353.

Material studied. 1 ♀, Rocky Run Creek, where Intermediate Hill track crosses, litter, *Cleistocalyx fullagarii*, *Pandanus forsteri*, *Coprosma huttoniana*, 18.v.2002, I. Hutton.

Distribution. First record for Lord Howe Island. Previously recorded from the Australia and Tasmania (as *Caecilius pteridii*).

ECTOPSOCIDAE***Ectopsocus petersi* Smithers**

Ectopsocus punctatus Thornton & Wong, 1968. *Pacific Ins. Monogr.* 19: 137 (♂).

Ectopsocus petersi Smithers, 1978. *Irish Nat. J.* 19(5): 144.

Ectopsocus australis Schmidt & Thornton, 1993. *Mem. Mus. Vict.* 53(2)(1992): 162.

Synonymy: Smithers, 2003. *Ent. mon. Mag.* 139: 5.

Material studied. 2 ♀ ♀, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, *Dodonaea viscosa*, beating, 24.xi.2000, L. Wilkie, G. Carter. 1 ♀, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., M.S. Moulds. 1 ♂, Mt Gower summit, ridge between creeks 2 (middle) and 1 (most easterly), *Hedyscepe canterburyana*, *Zygogynum howeanum*, *Cryptocarya gregsonii*, leaf litter, 25.vi.2001, Ian Hutton. 1 ♂, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., *Drypetes deplanchei*, beating, 13.xii.2000, R. Harris. 1 ♂, 1 ♀, corner Lagoon Rd. and Middle Bay Rd., 15–26.ii.2001, M.S. Moulds. 1 ♀, Lagoon Beach, rubbish tip/airstrip, beating, *Ochrosia elliptica*, 27.xi.2000, M. Elliott and N. Plunkett-Cole. 1 ♀, walking trail through Erskine Valley, closed rain forest, *Cleistocalyx/Chionanthus*, leaf litter, 2.xii.2000, L.HIS. 1 ♀, Lagoon Beach, between rubbish tip and airstrip, ex *Ochrosia elliptica*, beating, 27.xi.2000, M. Elliott, N. Plunkett-Cole. 1 ♀, Little slope, 50 m, leaf litter, *Howea forsteriana*, 7.i.1979, T. Kingston. 1 ♀, Transit Hill summit, Berlesate No 153, Pickard Veg DaCt, sieved litter, 18.xi.1979, G.B. Monteith. 3 ♀ ♀, North Bay, scrub, pyrethrum knockdown, 19.xi.1979, G.B. Monteith.

Distribution. Previously recorded from Lord Howe Island (as *Ectopsocus punctatus* Thornton and Wong). Also recorded from Great Britain, Europe, North America (introduced?), Egypt, Australia, New Zealand. Common on dead leaves.

***Ectopsocus insularis* Smithers & Thornton**

Ectopsocus insularis Smithers & Thornton, 1974a. *Rec. Aust. Mus.* 29(8): 221.

Material studied. 2 ♂ ♂, Mount Lidgbird, east side of valley between Pimple and summit, ex litter, *Cryptocarya gregsonii*, *Hedyscepe canterburyana*, 11.iv.2002, I. Hutton.

Distribution. First record for Lord Howe Island. Previously recorded from Norfolk Island.

PERIPSOCIDAE

Peripsocus milleri (Tillyard)

Peripsocopsis milleri Tillyard, 1923. *Trans. N. Z. Inst.* 54: 195.
Peripsocus reductus Badonnel, 1943. *Faune de France* 42: 98.
Peripsocus eucalypti Edwards, 1950. *Pap. Proc. R. Soc. Tasm* (1949): 122.
Peripsocus milleri (Tillyard). Smithers, 1967. *Aust. Zool.* 14: 70.
Peripsocus nitens Thornton & Wong, 1968. *Pacific Ins. Monogr.* 19: 129. Synonymy: Smithers, 1994a. *Aust. Entomol.* 21: 7.
 Synonymy: New, 1973. *J. Aust. ent. Soc.* 12: 346.

Material studied. 1 ♀, Mt. Gower, leaf litter, mossy forest, 27.ix.1978, T. Kingston. 3 ♀ ♀, Transit Hill (Nicholls), 60 m, leaf litter, 26.x.1979, T. Kingston. 1 ♀, North Bay, scrub, pyrethrum knockdown, 19.xi.1979, G.B. Monteith. 1 ♀, Erskine Valley, rainforest, pyrethrum knockdown, 24.xi.1979, G.B. Monteith.

Distribution. First record from Lord Howe Island. Previously recorded from Tasmania, Australia, New Zealand, Auckland Island, Kermadecs, Norfolk Island, Hawaii, Europe, Canary Islands, Madeira, North America. It is also known to occur in New Caledonia (unpublished material in the Australian Museum). Corticolous.

Peripsocus similis Enderlein

Peripsocus similis Enderlein, 1903. *Ann. hist.-nat. Mus. Hung.* 1: 290.
 [Not *Peripsocus similis* Badonnel, 1955. *Pub. cult. Comp. Diam. Angola* 26: 180].
 Redescription of female: Thornton, 1959. *Proc. R. ent. Soc. Lond. (B)* 28: 37.

Material studied. 1 ♀, Mt Lidgbird, SE corner above Pimple; ridge above last cliff leading to summit, *Metrosideros nervulosa*, *Macropiper hooglandii*, *Hedyscepe canterburyana*, *Coprosma putida*, leaf litter, 23.vi.2001, Ian Hutton.

Distribution. First record from Lord Howe Island. Previously recorded from Singapore, Hong Kong, Fiji, Tonga, Hawaii, Krakatau, Moorea, China.

PSEUDOCAECILIIDAE

Howeanum huberi Smithers

Howeanum huberi Smithers, 1995. *Gen. Appl. Ent.* 26: 5.

Material studied. 1 ♂, western slope of Dawsons Point Ridge off North Beach Trail, closed rain forest, *Drypetes/Cryptocarya* (calcarene), *Drypetes deplanchei*, beating, 24.xi.2000, P. Flemons, J. Tarnawski. 1 ♀, southern end Salmon Beach, vic. Little Island, *Xylosoma maidenii*, beating, 27.xi.2000, C. Reid, H. Smith. 2 ♀ ♀, Mt. Gower summit, mossy forest, pyrethrum knockdown, 9.xi.1979, G.B. Monteith. 1 ♀, Big Creek, Mountain Inn, rainforest, pyrethrum knockdown, 11.xi.1979, G.B. Monteith.

Note. In the female from the southern end of Salmon Beach the tibiae are white and stand out in starker contrast to the very dark brown of the body and other parts of the legs than in the other specimens.

Distribution. Known only from Lord Howe Island.

Mepleres fasciata (Smithers & Thornton)

Pseudoscottiella fasciata Smithers & Thornton, 1975. *Rec. Aust. Mus.* 29: 459.
Meniscopsocus fasciatus (Smithers & Thornton). Li Fasheng, 1993. *Sci. Tech. Publ. House. Guandong Prov. China* p. 382.
Mepleres fasciata (Smithers & Thornton). Yoshizawa, 2000. *Ent. Sci.* 3(4): 674.

Material studied. 1 ♂, Little Slope, broad megaphyllous closed sclerophyll forest, *Howea belmoreana*, *Howea forsteriana*, beating, 30.xi.2000, P. Flemons, J. Tarnawski. 1 ♂, Little Island, coastal track to Erskine Valley, palm leaf litter, 13.xii.2000, G. Cassis. 1 ♂, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., 15–26.ii.2001, M.S. Moulds. 1 ♂, Mt Lidgbird, SE ridge leading to Pimple, 100 m down track SE of Pimple summit, *Dracophyllum fitzgeraldii*, *Macropiper hooglandii*, *Metrosideros nervulosa*, leaf litter, 23.v.2001, Ian Hutton.

Distribution. Known only from Lord Howe Island.

Mepleres hollowayi (Smithers & Thornton)

Pseudoscottiella hollowayi Smithers & Thornton, 1975. *Rec. Aust. Mus.* 29: 460.
Meniscopsocus hollowayi (Smithers & Thornton). Li Fasheng, 1993. *Sci. Tech. Publ. House. Guandong Prov. China* p. 382.
Mepleres hollowayi (Smithers & Thornton). Yoshizawa, 2000. *Ent. Sci.* 3(4): 674.

Material studied. 1 ♂, Little Slope, broad-leaved herb vegetation, mixed ferns/herbs, *Pennisetum clandestinum*, beating, 30.xi.2000, P. Flemons, J. Tarnawski. 2 ♂ ♂. Mt Gower summit; ridge between creeks 2 (middle) and 1 (most easterly), *Hedyscepe canterburyana*, *Zygogynum howeanum*, *Cryptocarya gregsonii*, leaf litter, 25.vi.2001, Ian Hutton. 1 ♂, west end of Mt Gower summit on south edge, *Metrosideros nervulosa*, *Zygogynum*, *Dracophyllum fitzgeraldii*, *Hedyscepe canterburyana*, leaf litter, 15.v.2001, Ian Hutton. 2 ♂ ♂, Saddle between Kings Beach and Rocky Rd, 20 m below on E side, grass/vine gap in rainforest, 4–8.ii.2001, C. Reid. 1 ♂, Little Island, coastal track to Erskine Valley, palm leaf litter, 13.xii.2000, G. Cassis. 1 ♂, 1 ♀, Transit Hill (Nicholls), 60 m, leaf litter, *Cleistocalyx*

fullagarii, *Chionanthus quadristamineus*, 10.x.1978, T. Kingston. 1♂, Rocky Run Creek, where Intermediate Hill track crosses, litter, *Metrosideros nervulosa*, *Pandanus forsteri*, 18.v.2002, I Hutton.

Distribution. Known only from Lord Howe Island.

Mauropsocus n.gen.

Belonging to the Pseudocaeciliidae: Zelandopsocinae. Females micropterous. Tarsi 3-segmented. Claws with a minute denticle on one claw of each pair. Subgenital plate incipiently bilobed, each lobe with one large posteriorly directed seta near hind margin. Ventral valve and dorsal valve of gonapophyses with large, pointed apophysis. Setae on head, thorax and abdomen (other than genitalia) include many seated in large, raised alveoli and have distal ends truncate, expanded or extended on one side at the apex. No ocelli. Apical antennal segment distally narrow. Abdominal terga each with well sclerotized posterior transverse band and a more lightly sclerotized anterior band.

Type species: *Mauropsocus monteithi* n.sp.

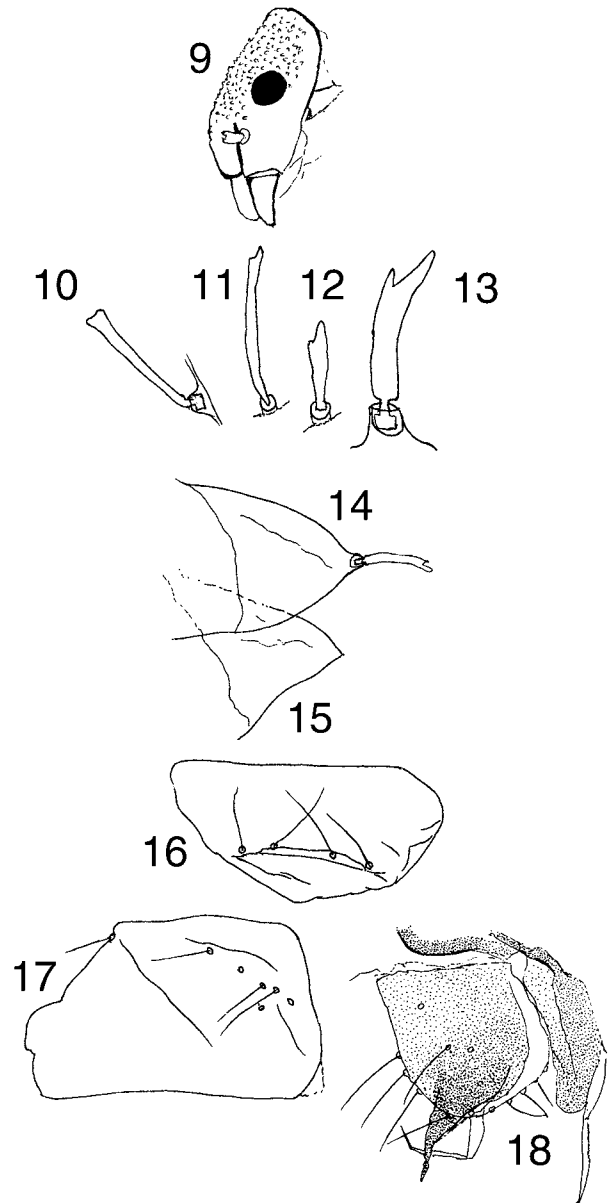
Mauropsocus differs significantly from other genera of the subfamily in having many of the setae conspicuously modified. They arise from greatly exaggerated, raised alveoli and many have the apex of unusual form. The apex of some setae is simply truncate, in others it is distally expanded or the apex is modified so that one side of the apex is extended beyond the other (Figs 10–14). The modified setae are also much thicker than normal setae and in many the base is also modified, being narrowed, neck-like, at the attachment to the alveolus (Fig. 13). The male of *M. monteithi* is not known but on the basis of the female characters alone its nearest relatives appear to be *Zelandopsocus*, *Austropsocus* and *Howeanum*. *Howeanum* is known from two species, *H. costale* (Thornton and New) (Australian) and *H. huberi* Smithers (Lord Howe Island). The former is macropterous in both sexes and the latter is macropterous in the male and micropterous in the female.

Mauropsocus monteithi n.sp.

Material studied. 1 ♀ (HOLOTYPE), QM T99350, Big Creek, Mountain Inn, rainforest, pyrethrum knockdown, 11.xi.1979, G.B. Monteith. Holotype in the Queensland Museum.

Etymology. Mauros = Gr. dark, referring to the dark colour of the species. This species is named for Dr Monteith in recognition of his immense contribution to Australian entomology.

Distribution. Known only from Lord Howe Island.



Figs 9–18. *Mauropsocus monteithi* n.gen. and n.sp. Female: (9) head, lateral (setae not shown); (10, 11, 12) modified setae; (13) large modified seta at wing apex; (14) fore wing; (15) hind wing; (16) epiproct; (17) paraproct; (18) gonapophyses.

Description

Female. *Coloration* (in alcohol). Head dark brown, a paler spot in middle of front of head, in position usually occupied by ocelli. A darker mark from eye to antenna base, lateral and anterior transverse margin of postclypeus very dark brown. Median epicranial suture almost black; anterior arms absent. Postclypeus with indistinct, irregular, almost transverse, slightly converging dark stripes. Labrum pale. Antennae brown. Eyes black. Maxillary palps brown. Prothorax dorsally dark. Meso- and metanotum each with

dark brown transverse band across posterior part of tergum in which dark spots are arranged in irregular transverse rows, the spots being large alveoli from which arise strong setae. Anterior part of tergum paler. Legs dark brown except for distal half of hind tibia and tarsus, which are slightly paler. Abdominal terga banded in similar way to thoracic terga i.e. each tergum darker in posterior part than in anterior part. A fine, pale, median longitudinal line from front of mesonotum to hindmost abdominal tergum.

Morphology. Micropterous. Length of body: 1.7 mm. Median epicranial suture very distinct, finer anteriorly, anterior arms absent. Head capsule with raised, enlarged alveoli giving most of head a rough appearance. Vertex narrow but rounded. Front of head flat. Frons poorly delimited because of lack of anterior arms of epicranial suture and posterior part of epistomial suture. Head from side (Fig. 9, setae not shown) short, postclypeus hardly protruding. Labrum without lateral styli on anterior margin. Five inner sensilla, two trichoid, three placoid. Genae glabrous, without enlarged alveoli, therefore having a smoother appearance than rest of head capsule. Antennae 13-segmented but short; apical segment strongly narrowed distally. Length of flagellar segments: f1: 0.055 mm.; f2: 0.045 mm. Eyes very small, round, of about 20 spaced ommatidia, placed on side of head slightly nearer to base of antenna than vertex. No ocelli. Fourth segment of maxillary palp short, width two-thirds of length. Thoracic and abdominal terga each with sclerotized transverse band in posterior part giving the dorsal view of the insect its strongly banded appearance. Integument of each segment anterior to the sclerotized band less heavily sclerotized. More heavily sclerotized part of the terga bears rows of strongly developed, variously modified setae (Figs 10–12) each arising from an enlarged alveolus. Mesonotum with one posterior row of setae and two single setae representing an anterior row. Integument in heavily sclerotized posterior areas bears more or less evenly spaced tiny papillae. Abdominal terga as thoracic but surface papillae arranged roughly in transverse rows in some areas. Modified setae in two irregular rows, those of the posterior row on each segment larger than those of anterior row. Measurement of hind leg: F: 0.26 mm.; T: 0.39 mm.; t1: 0.07 mm.; t2: 0.02 mm.; t3: 0.04 mm.; rt: 3.5:1:2. No ctenidiobothria. Claws with one minute denticle on one claw of each pair. Outer side of femora sparsely setose, setae fine. Fore tibia bearing fine, normal setae overall, outer side with a row of a few larger, blunt-ended setae arising from larger raised alveoli. Mesotibia as front tibia but the row of setae on the outer side has expanded truncate tips. Metatibia as mesotibia but larger setae with expanded truncate apices in a row on the outer side arise from large alveoli. Pulvillus broad. No coxal organ. Fore wing (Fig. 14) reduced to a very small lobe with a single, very large, modified apical seta (Figs 13, 14). Hind

wing (Fig. 15) smaller, simple, without seta. Epiproct (Fig. 16) a simple, lightly sclerotized lobe with a transverse ridge bearing a few long, fine setae. Paraproct (Fig. 17) lightly sclerotized, with a few setae. Subgenital plate (damaged in preparation) apparently incipiently bilobed behind with a large seta on each lobe. Gonapophyses (Fig. 18). Ventral and dorsal valves each with well-developed, long, fine, preapical apophysis.

Male. Unknown.

Discussion

Mockford (1984) reassessed and characterized the genera then included in the Philotarsidae and some of the genera in the Pseudocaeciliidae. As a result he made some redistribution of the genera between the families and erected the family Bryopsocidae (for *Bryopsocus* Thornton, Wong and Smithers) which he considered to be intermediate between the other two families.

Mauropsocus monteithi is clearly a micropterous pseudocaeciliid belonging to the subfamily Zelandopsocinae and it is appropriate to compare it with the five genera of the family which have 3-segmented tarsi, namely, *Zelandopsocus* Tillyard, *Austropsocus* Smithers, *Novopsocus* Thornton, *Howeanum* Smithers and *Trimerocaecilius* Meinander, although the last is not considered a member of the Zelandopsocinae and may not even be a true pseudocaeciliid (Lienhard, 1998).

Pseudocaeciliidae n.gen. and n.sp.

The collection includes two remarkable nymphs which cannot readily be associated with any adults so far collected from Lord Howe Island. They certainly represent an undescribed genus and species. The most likely family to which they belong is the Pseudocaeciliidae. As adults are not yet available this placing must be considered tentative.

Material studied. 1n, Southern end of Salmon Beach, vic. Little Island, *Xylosoma maidenii*, beating, 27.xi.2000, C. Reid, H. Smith. 1n, Stephens Reserve, New Settlement, *Drypetes deplanchei*, beating, 13.xii.2000, R. Harris. (Originally preserved on points these two specimens have been removed and are now stored in alcohol).

Description

Nymph. The following brief description is based mainly on the larger specimen.

Coloration. Head pale straw-coloured, with slightly darker, irregular, band adjacent to the inner margin of the compound eyes; a similar band on either side of the median

epicranial suture from vertex to position usually occupied by the ocellar tubercle. Postclypeus, genae and labrum straw-coloured. Eyes colourless. Antennae coloured as head. Mesonotum mottled, irregularly straw-coloured; metanotum pale with a brownish spot on each side of midline. Legs colourless except for black claws. Abdominal tergites 4–6 brownish, other tergites pale.

Morphology. Antennal flagellar segments with well-developed, pectinate setae, many longer than segment diameter. Head almost circular in frontal view; front of head, including frons and postclypeus, strongly **concave** so that the front of the head appears hollowed out or bowl-shaped. When viewed from the side the head is very short, the anterior and posterior margins almost parallel to one another, the head as a whole thus somewhat discoid. Epistomial suture not obvious. Rim of bowl-shaped frontal depression and anterior margin of mesonotum with a row of large, forwardly-directed setae. Eyes situated very low on sides of head, their lower margin almost in contact with antennal socket. Upper margin of eyes well below level of the rounded vertex. Basal segment of abdomen with a transverse row of setae; long setae present laterally on either side of posterior end of abdomen.

Note. The very unusual shape of the head suggests that it is adapted for some biological activity unusual for a psocopteran. The circular outline of the head and the fact that it has an unusual arrangement of forwardly-directed setae (sensory?) suggests the possibility of phragmosis. This habit is confirmed for only one genus of wood-boring Psocoptera and suspected in another. Further observations on this species are needed to determine the function of the unusual head shape.

The larger of the two specimens (that from Salmon Beach) is in its final nymphal instar. This is indicated by two crescentic black marks on the front of the head in the position usually occupied by the ocellar tubercle in adults and the size of the wing buds, which extend to about half the length of the abdomen. The smaller specimen (from Stephens Reserve) is probably in the third instar, judging by the very short wing buds. The wing buds of the larger are brown. The sex of the larger specimen cannot be determined because the hind end of the abdomen is very membranous and pale and there is no obvious indication of genitalic structures. It is likely that the adults are macropterous (at least in one sex) and that the adult wings are coloured or patterned in some way. Full description and naming must await the collection of adults which, because of the unusual morphological features of the head, should be easily recognized as such, assuming that the adult resembles the nymphs in the unusual head shape described above.

Distribution. Known only from Lord Howe Island.

PHILOTARSIDAE

Aaroniella howensis Smithers & Thornton

Aaroniella howensis Smithers & Thornton, 1975. *Rec. Aust. Mus.* 29: 466.

Material studied. 1n, eastern slope, Malabar Ridge, above Neds Beach, beating, 25.xi.2000, L. Wilkie, H. Smith.

Distribution. Known only from Lord Howe Island. The only other known specimen is a single female, the first psocopteran collected on the Island.

Haplophallus tandus Smithers & Thornton

Haplophallus tandus Smithers & Thornton, 1975. *Rec. Aust. Mus.* 29: 468.

Material studied. 1 ♂, 3 ♀, Lagoon Beach between rubbish tip and airstrip, closed rain forest, *Drypetes/Cryptocarya*, *Alyxia ruscifolia*, beating, 27.xi.2000, M. Elliott, N. Plunkett-Cole. 1 ♀, Lagoon Beach between rubbish tip and airstrip, closed rain forest, *Drypetes/Cryptocarya*, *Ochrosia elliptica*, beating, 27.xi.2000, M. Elliott, N. Plunkett-Cole. 2 ♀, North Bay, pyrethrum knockdown, 19.xi.1979, G.B. Monteith. 1 ♀, Lord Howe Island, 3–8.ii.1977, C.N. Smithers.

Distribution. Known only from Lord Howe Island.

ELIPSOCIDAE

Pentacladus marmoratus Smithers & Thornton

Pentacladus marmoratus Smithers & Thornton, 1975. *Rec. Aust. Mus.* 29: 462.

Material studied. 2♂♂, western slope of Transit Hill, broad megaphyllous closed sclerophyll forest, *Howea forsteriana*, *H. belmoreana*, beating, 24.xi.2000, M. Elliott, N. Plunkett-Cole. 1♂, on walking track between Salmon and Kings Beach, dune vegetation, orthophyll short grass, (host H27 in field notes), beating, 10.xii.2000, G. Cassis. 1♀, Research Station backyard, surrounded by *Drypetes/Cryptocarya*, closed rain forest. 2♂♂, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp. M.S. Moulds. 1♀, Lord Howe Island, 3–8.ii.1977, C.N. Smithers.

Distribution. Known only from Lord Howe Island.

Prionotodrilus parvus (Smithers & Thornton)

Spilopsocus parvus Smithers & Thornton, 1975. *Rec. Aust. Mus.* 29: 465.

Prionotodrilus parvus (Smithers). Schmidt and New, 2004. *Invert. Syst.* 18: 161.

Material studied. 3♂♂, 1♀, c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, *Cassinia tenuifolia*, beating, 1.xii.2000, H. Smith. 1♀, point where walking trail first enters Erskine Valley from coast, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, *Melaleuca howeana*, beating, 28.xi.2000, C. Reid, H. Smith. 4♀♀, c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, *Drypetes deplanchei*, beating, 1.xii.2000, H. Smith. 2♀♀, eastern slope of Dawsons Point Ridge near top, closed rain forest, *Cleistocalyx/Chionanthus*, *Drypetes deplanchei*, beating, 1.xii.2000, C. Reid, H. Smith. 2♂♂, 4♀♀, c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, *Drypetes deplanchei*, beating, 1.xii.2000, H. Smith. 1♀, southern face of Mt. Lidgbird, at base of summit tabletop, closed rain forest, *Drypetes/Cryptocarya* (calcarenite), *Dysoxylum pachyphyllum*, beating, 26.xi.2000, P. Flemons, J. Tarnawski. 1♂, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, *Cassinia tenuifolia*, beating, 24.xi.2000, L. Wilkie, G. Carter. 1♀, western slope of Malabar Ridge S of Kims Lookout trail, broad megaphyllous closed sclerophyll forest, *Howea belmoreana*, beating, 24.xi.2000, L. Wilkie, H. Smith. 1♂, 1♀, eastern slope of Dawsons Point Ridge above old settlement, closed rain forest, *Drypetes/Cryptocarya* (exposed), *Alyxia ruscifolia*, beating, 24.xi.2000, P. Flemons, J. Tarnawski. 2♂♂, 2♀♀, eastern slope of Phillip Point (North Head), closed rain forest, *Drypetes/Cryptocarya*, *Drypetes deplanchei*, beating, 24.xi.2000, P. Flemons, J. Tarnawski. 1♀, north bank of Rocky Run Creek where coastal trail to Boat Harbour intersects, broad megaphyllous closed sclerophyll forest,

Pandanus, *Metrosideros sclerocarpa*, beating, 30.xi.2000, C. Reid, H. Smith. 1♀, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, *Cassinia tenuifolia*, beating, 24.xi.2000, L. Wilkie, G. Carter. 4♀♀, small swampy area behind dunes at southern end of Lagoon Beach, turnoff to Intermediate Hill, broad sclerophyll swamp scrub, *Aegiceras*, *Lagunaria patersonia* (host H15 in field notes), beating, 8.xii.2000, G. Cassis. 1♀, Lagoon Beach between rubbish tip and airstrip, closed rain forest, *Drypetes/Cryptocarya*, *Alyxia ruscifolia*, beating, 27.xi.2000, M. Elliott, N. Plunkett-Cole. 1♂, southeastern aspect of Transit Hill near summit, closed rain forest, *Cleistocalyx/Chionanthus*, *Xylosma maidenii*, beating, 24.xi.2000, M. Elliott, N. Plunkett-Cole. 1♀, southeastern aspect of Transit Hill near summit, closed rain forest, *Cleistocalyx/Chionanthus*, *Xylosma maidenii*, beating, 24.xi.2000, M. Elliott, N. Plunkett-Cole. 1♂, western slope of Malabar Ridge S of Kims Lookout trail, broad megaphyllous closed sclerophyll forest, *Howea belmoreana*, beating, 24.xi.2000, L. Wilkie, H. Smith. 2♂♂, junction of Kims Lookout trail and North Beach trail, closed rain forest, *Drypetes/Cryptocarya*, *Drypetes deplanchei*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1♀, eastern slope of Malabar Ridge above Neds Beach, closed rain forest, *Drypetes/Cryptocarya*, *Dodonaea viscosa*, beating, 25.xi.2000, L. Wilkie, H. Smith. 1♀, base of Round Face (Mt. Lidgbird), Far Flats, broad megaphyllous closed sclerophyll forest, *Howea belmoreana*, leaf litter, 27.xi.2000, L.HIS. 3♀♀, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, *Drypetes deplanchei*, beating, 24.xi.2000, L. Wilkie, G. Carter. 1♂, eastern aspect of Transit Hill near summit, narrow closed sclerophyll scrub, *Melaleuca/Cassinia*, leaf litter, 19.xi.2000, L.HIS. 1♂, Malabar Hill, on path to Kims Lookout, narrow sclerophyll closed scrub, *Dodonaea/Cassinia*, leaf litter, 24.xi.2000, L.HIS. 1♂, 1♀, near airport terminal, 15.ii.2001, M.S. Moulds. 1♂, Get Up Place, trail to Mt. Gower, broad closed sclerophyll scrub, *Dracophyllum/Metrosideros*, *Pimelea congesta*, beating, 28.xi.2000, C. Reid, H. Smith. 1♂, Goat House walking track, c. 550 m from junction with Erskine Valley track, Intermediate Hill, *Howea forsteriana*, leaf litter, 23.i.2001, J. Tarnawski and M. Shea. 1♀, Stephens Reserve, New Settlement, megaphyllous broad sclerophyll forest, *Howea* spp., *Drypetes deplanchei*, beating, 13.xii.2000, R. Harris. 1 spec. c. 50 m S of summit of Mt. Eliza on western face, orthophyll short grass, *Poa*, *Cassinia tenuifolia*, beating, 1.xii.2000, H. Smith. 1♂, 1♀, Erskine Valley, rainforest, pyrethrum knockdown, 24.xi.1979, G.B. Monteith. 7♂♂, 12♀♀, North Bay, pyrethrum knockdown, 19.xi.1979, G.B. Monteith. 1♀, Intermediate Hill, 180–250 m, rainforest, 6.xi.1979, G.B. Monteith. 1♂, 1♀, Malabar Hill, pyrethrum knockdown, 25.xi.1979, G.B. Monteith. 1♀, Creek gully crossing Transit Hill walking track, litter, *Cryptocarya triplinervis*, *Cleistocalyx fullagarii*, 9.viii.2001, I. Hutton. 1♀, Stephens Reserve, New Settlement, litter under hoop pine, *Araucaria cunninghamii*, 30.ix.2001, I. Hutton.

Distribution. Known only from Lord Howe Island.

MYOPSOCIDAE

Nimbopsocus huttoni n.sp.

Material studied. ♀ HOLOTYPE (K232524), 4♀♀ (not designated paratypes as they are in poor condition), 8 nymphs, on rocks, northern Little Slope, 30.xi.2000, I. Hutton.

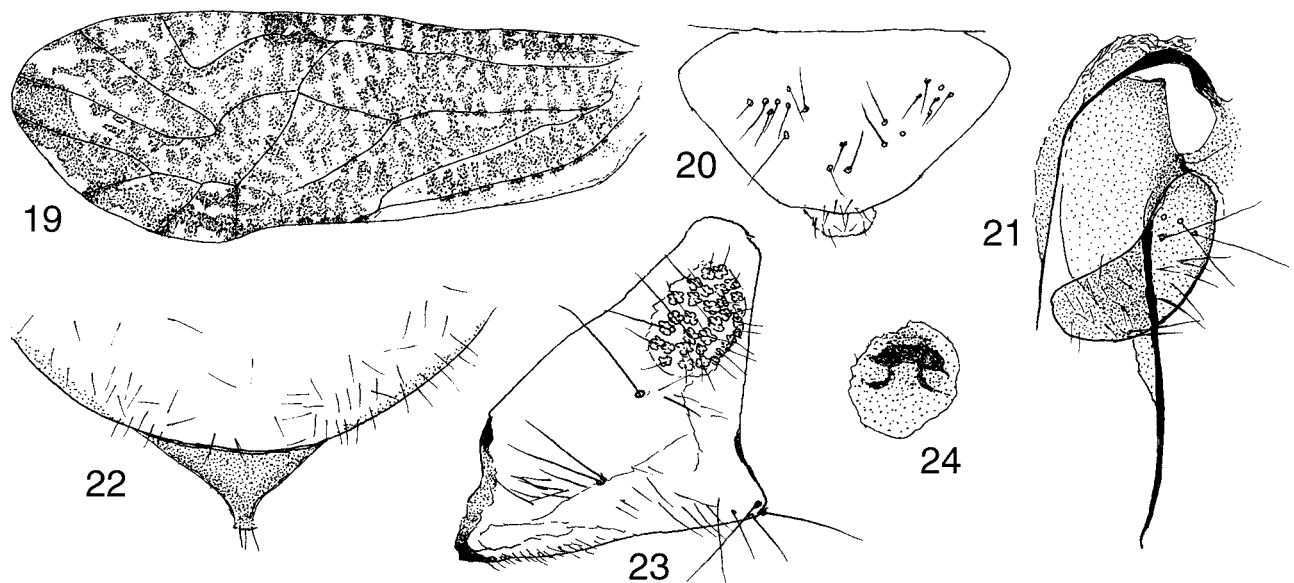
Etymology. This species is named for Dr Ian Hutton in recognition of his contribution to knowledge of the natural history of Lord Howe Island.

Description

Female. *Coloration* (in alcohol). Head pale brown with pattern of well defined, irregularly-shaped, dark, brown spots. Median epicranial suture pale, flanked on vertex by two rows of spots on each side. Four or five curved rows of spots on each epicranial plate, running almost parallel with inner margin of compound eye. Position of anterior arms of epicranial suture indicated by brown line (anterior arms themselves evanescent). Small brown spot below lower margin of eye behind which is a much larger spot which extends to occupy much of the gena near antenna base. Frons with a dark brown circle. Postclypeus with seven anteriorly converging brown stripes on each side of midline. Anteclypeus and labrum pale except for two small but obvious dark spots on anterior margin of latter. Scape, pedicel and first flagellar segment of antenna pale (antennae incomplete on all specimens). Eyes black. Ocelli black, integument between posterior ocelli pale. Maxillary palps

pale except for light brown fourth segment. Mesothoracic antedorsum brown with pale median line; dorsal lobes pale with brown, ovoid area occupying middle part of lobe, median line very dark brown. Mesepisternum mostly dark brown, mesepimeron dark in dorsal part, pale in ventral part. Mesothoracic pleuron mostly pale except for darker area above coxa. Prothoracic legs with pale coxa, femur dark dorsally, irregularly marked laterally; tibia pale, basally and distally brown. Basal tarsal segment pale; second and third segments brown; claws very dark brown. Meso- and metathoracic legs similar to prothoracic legs but coxae laterally dark in basal half. Fore wing (Fig. 19) membrane mostly finely speckled with brown spots; main veins in basal half of wing, other than Cu2, with alternating lengths of dark and pale sections. Pattern on membrane is of denser spotting near marginal parts of cells R5, M1, M2, and M3. Hind wing membrane very faintly tinged with brown. Small spots at end of veins R1, R2+3; some sections of wing margin between end of R2+3 and M slightly darker than rest of margin. Abdomen ventrally pale, dorsally with strongly developed pattern of irregular, segmentally arranged, very dark brown spots of various sizes.

Morphology. Length of body not measured as all specimens have shrunken abdomens. Median epicranial suture distinct; anterior arms evanescent. Labrum with 8 external proximal sensilla and 7 marginal sensilla. Marginal sensilla consist of 4 trichoid and 3 placoid sensilla. Eyes small, not reaching level of vertex when seen from side. IO/D: 2.46; PO: 0.61. Ocelli small, anterior ocellus not obvious. Apex of lacinia with smaller inner tooth and bigger, broad outer tooth, apex of which is equipped with several small



Figs 19–24. *Nimbopsocus huttoni* n.sp. Female: (19) fore wing; (20) epiproct; (21) gonapophyses; (22) subgenital plate; (23) paraproct; (24) entrance to spermatheca.

terminal rounded protuberances. Measurements of hind leg: F: 1.17 mm.; T: 1.87 mm.; t1: 0.62 mm.; t2: 0.08 mm.; t3: 0.1 mm.; rt: 7.75:1:1.25; ct. 22, 1, 1. Fore wing length: 5.0 mm.; fore wing width: 1.7 mm. Fore wing (Fig. 19) with Sc present as small, inconspicuous vestige, ending in costal cell. Rs and M meet in a point or are fused for a short length. Hind wing with Rs distal to separation from M strongly curved towards hind margin of wing then curving forward to division into R2+3 and R4+5; R2+3 reaches wing margin at wing apex. Rs and M fused for a length. M very strongly sinuous. End of Cu1 strongly recurved near wing margin. Epiproct (Fig. 20) with transverse band of irregularly spaced setae running more or less parallel to curved hind margin and a group of sorter, finer setae near middle of hind margin. Paraproct (Fig. 23). Subgenital plate (Fig. 22, drawn from non-type specimen) with short median posterior lobe bearing 3 terminal setae. Posterior part of plate glabrous, anteriorly plate with fine, scattered setae. Gonapophyses (Fig. 21) with ventral valve short, tapering distally to very fine point. Dorsal valve long, tapering, curved near distal end. Ninth sternite with simple sclerite at entrance to spermatheca (Fig. 24).

Male. Unknown.

Nymphs. Large nymphs are easily recognisable by their head pattern, which is similar to that of adults, the large, characteristic dark spot on the gena below the eye being obvious also in the nymphs. Knobbed glandular setae are present on abdomen and head.

Distribution. Known only from Lord Howe Island.

Discussion

Despite the lack of information on the male of *N. huttoni* it is placed in the genus *Nimbopsocus* by virtue of the close similarity of the female genitalia to those of the other species of the genus, especially the form of the sclerifications of the 9th abdominal sternite at the entrance to the spermatheca. The overall mottled wing pattern of *N. huttoni* is made up of much more evenly sized and spaced dark patches than any of the other species in the genus. The black genal patch is large and conspicuous in this species. It has a wing length similar to that of *N. australis* and *N. thorntoni* (female wing length: 5.0 mm) which both have longer wings than the smallest species of the genus, *N. hickmani* (female wing length: 3.4–3.6 mm).

Nimbopsocus australis (Brauer)

- Psocus australis* Brauer, 1865. *Ver. zool.-bot. Ges. Wien* 15: 908.
Psocus griseipennis McLachlan, 1866. *Trans. ent. Soc. Lond. (3rd Series)* 5: 348.
Myopsocus griseipennis (McLachlan). McLachlan, 1866. *Trans. ent. Soc. Lond. (3rd Series)* 5: 352.
Myopsocus australis (Brauer). Kolbe, 1883a. *Ent. Nachr.* 9: 145.
Myopsocus novaezealandiae Kolbe, 1883a. *Ent. Nachr.* 9: 145.
Psocus zealandicus Hudson, 1892. *Manual of N.Z. Entomology*. London. p. 107.
Phlotodes griseipennis (McLachlan). Enderlein, 1910. *Sitzb. Ges. naturf. Fr. Berlin* 1910 (2): 67.
[Not *Myopsocus australis* (Brauer). Tillyard, 1923. *Trans. N. Z. Inst.* 54: 187].
[Not *Myopsocus australis* (Brauer). Hickman, 1934. *Pap. Proc. R. Soc. Tasm.* 1933: 85].
[Not *Myopsocus griseipennis* (McLachlan). Edwards, 1950. *Pap. Proc. R. Soc. Tasm.* (1949): 122.: 104].
Phlotodes australis (Brauer). Smithers & Thornton, 1974b. *Trans. R. ent. Soc. Lond.* 126: 125.
Phlotodes novaezealandiae (Kolbe). Smithers & Thornton, 1974b: 125.
Nimbopsocus australis (Brauer). Smithers, 2004. *Thorntoniana, Pub. Espec. UNAM*. 20: 159.

Material studied. 1 ♀, Stevens Reserve, nr. Signal Point, yellow pan trap, 8–12.xii.1988, D.C.F. Rentz. Specimen in Australian National Insect Collection.

Distribution. First record for Lord Howe Island. Previously known from Australia, Tasmania, Norfolk Island, New Zealand, Solomon Islands, Kermadecs, ?India. The presence of this species in India requires confirmation. Found mainly on bark, cut timber and paling fences carrying algal and fungal growth.

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References

- Badonnel, A., 1931. Contribution à l'étude de la faune du Mozambique. Voyage de M. P. Lesne (1928–1929). 4e note. Copéognathes. *Annales des Sciences naturelles, Zoologie* (10)14(16): 229–260, 37 figs.
- Badonnel, A., 1932. Contribution à l'étude de la faune du Mozambique. Voyage de M.P. Lesne (1928–1929). 7e note. Supplément aux Copeognathes. *Bulletin de la Société zoologique de France*. 57: 105–117, 14 figs.
- Badonnel, A., 1943. Psocoptères. *Faune de France* 42: 1–164, 375 figs.
- Badonnel, A., 1944. Contribution à l'étude des Psocoptères de l'Atlantide. *Revue française d'Entomologie* 11: 47–60, 22 figs.
- Badonnel, A., 1949. Psocoptères de la Côte d'Ivoire. Mission Paulian-Delamare (1945). *Revue française d'Entomologie* 16: 20–46, 61 figs.
- Badonnel, A., 1955. Psocoptères de l'Angola. *Publicações culturais da Companhia de Diamantes de Angola* 26: 1–267, 625 figs.
- Banks, N., 1900. A new genus of Atropidae. *Entomological News* 11: 431–432, figs (not numbered) on p. 431.
- Brauer, F., 1865. Vierter Bericht über die auf der Weltfahrt der kais. Fregatte Novara gesammelten Neuropteren. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 15: 903–908.
- Brauer, F., & F. Löw, 1857. Neuroptera austriaca. *Wien*. XXIII+80 pp., 5 pls (Psoc.: pp. 32–34).
- Broadhead, E., 1949. On the identity of the psocid *Cuixa canaria* Navás. *Entomologists Monthly Magazine* 85: 80.
- Corbett, G.H., & E. Hargreaves, 1915. *Vulturops floridensis*, a new member of the psocid subfamily Vulturopinae from the United States. *Psyche* 22(4): 142–143, pl. XI.
- Edwards, B.A.B., 1950. A study of the Tasmanian Psocoptera with descriptions of new species. *Papers and Proceedings of the Royal Society of Tasmania* (1949): 93–134, 117 figs.
- Enderlein, G., 1903. Neue Copeognathen aus Kamerun. *Zoologische Jahrbücher (Abteilung Systematik)* 19: 1–8, pl. 1.
- Enderlein, G., 1905. Morphologie, Systematik und Biologie der Atropiden und Troctiden, sowie Zusammenstellung aller bisher bekannten recenten und fossilen Formen. *Results of the Swedish Zoological Expedition to Egypt and the White Nile, 1901*. No.18. 58 pp., 11 figs, 4 pls.
- Enderlein, G., 1908. Über die Variabilität des Flügelgeädels der Copeognathen. *Zoologischer Anzeiger* 33: 779–782, 12 figs.
- Enderlein, G., 1910. Eine Dekade neuer Copeognathengattungen. *Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin* 1910(2): 63–77, 10 figs.
- Enderlein, G., 1911. Die fossilen Copeognathen und ihre Phylogenie. *Palaeontographica* 58: 279–360, figs A–S; pls XXI–XXVII (figs 1–103).
- Gurney, A.B., 1949. Distributional and synonymic notes on psocids common to Europe and North America, with remarks on the distribution of Holarctic insects (Corrodentia). *Journal of the Washington Academy of Sciences* 39(2): 56–65.
- Hagen, H., 1861. Synopsis of the Neuroptera of North America; with a list of South American species. *Smithsonian Miscellaneous Collections* 4: XX+347 pp. (Psoc.: pp. 7–14, 302).
- Hagen, H., 1865. Synopsis of the Psocina without ocelli. *Entomologists Monthly Magazine* 2: 121–124.
- Hagen, H., 1883. Beiträge zur Monographie der Psociden. *Stettiner Entomologische Zeitung* 44: 285–332.
- Hickman, V.V., 1934. A contribution to the study of Tasmanian Copeognatha. *Papers and Proceedings of the Royal Society of Tasmania* 1933: 77–89, 6 figs.
- Hudson, G.V., 1892. *An elementary Manual of New Zealand Entomology*. London. 122 pp., frontis., 20 pls (Psoc.: p. 107, pl. XVI, figs 2, 2a).
- Jacobson, G.G., & W.L. Bianchi, 1904. *Die Orthopteren und Pseudoneuropteren des Russischen Reiches und der angrenzenden Länder*. Petersburg. (Psoc.: pp. 482–496, 48 figs).
- Kolbe, H.J., 1880. Monographie der deutschen Psociden mit besonderer Berücksichtigung der Fauna Westfalens. *Jahresbericht des Westfälischen Provinzial-Vereins für Wissenschaft und Kunst* 8: 73–142, pls I–IV.
- Kolbe, H.J., 1881. Psocidologische Berichtigungen. *Entomologische Nachrichten, Berlin* 7: 254–256.
- Kolbe, H.J., 1882. Neue Psociden der paläarktischen Region. *Entomologische Nachrichten, Berlin* 8: 207–212.
- Kolbe, H.J., 1883a. Ueber das Genus *Myopsocus* und dessen Species. *Entomologische Nachrichten, Berlin* 9: 141–146.
- Kolbe, H.J., 1883b. Neue Psociden des Königl. zoologischen Museums zu Berlin. *Stettiner Entomologische Zeitung* 44: 65–87.
- Kolbe, H.J., 1885. Zur Kenntniss der Psociden-Fauna Madagaskars. *Berliner Entomologische Zeitschrift* 29: 183–192, pl. IVB.
- Kolbe, H.J., 1888. Psocidae. In *Neuroptera germanica. Die Netzflügel Deutschlands, mit Berücksichtigung auch einiger ausser-deutschen Arten nach der analytischen Methode unter Mitwirkung von H. Kolbe bearbeitet*, M. Rostock. *Jahresbericht des Vereins für Naturkunde zu Zwickau* 1887: 1–198, pls I–X.
- Lienhard, C., 1998. Psocoptères euro-méditerranéens. *Faune de France* 83: xx+517 pp., 148 figs, 11 pls.
- Lienhard, C., & J. Halperin, 1988. Preliminary list of Psocoptera from Israel with description of two new species. *Israel Journal of Entomology* 22: 13–25, 7 figs.
- Lienhard, C., & C.N. Smithers, 2002. Psocoptera (Insects). *World Catalogue and Bibliography. Instrumenta Biodiversitatis* 5: xli+745 pp. Muséum d'Histoire naturelle, Genève.
- Li Fasheng, 1993. Psocoptera from National Chebaling Nature Reserve (Insecta: Psocoptera). In *Collected Papers for Investigation in National Chebaling Nature Reserve*, pp. 313–430, 104 figs, col. pl. 2: figs 1–3. Science and Technology Publishing House of Guangdong Province. (In Chinese, with English summary).
- McLachlan, R., 1866. New genera and species of Psocidae. *Transactions of the Entomological Society of London (Third Series)* 5: 345–352.
- Mockford, E.L., 1984. Relationships among Philotarsid and Pseudocaeciliid genera and a proposed new family Bryopsocidae (Psocoptera). *Psyche, Cambridge, Massachusetts* 91(3–4): 309–318, 3 figs.
- Mockford, E.L., 1993. North American Psocoptera (Insecta). *Flora and Fauna Handbook* 10: XVIII+455 pp., 953 figs. Gainesville, Florida: Sandhill Crane Press.
- Mockford, E.L., 2000. A classification of the psocopteran family Caeciliusidae (Caeciliidae auct.). *Transactions of the American Entomological Society* 125(4) (1999): 325–417, 238 figs. [Publication date: January 2000].
- Mockford, E.L., 2005. A new genus of Perientomine Psocids (Psocoptera: Lepidopsocidae) with a review of the Perientomine genera. *Transactions of the American entomological Society* 131: 201–215, 32 figs.
- Motschulsky, V. von, 1851. Énumérations des nouvelles espèces des Coléoptères rapportés par M. Victor Motschulsky de son dernier voyage. *Bulletin de la Société Impériale des Naturalistes de Moscou* 24(2): 479–511, 1 fig. (Psoc.: pp. 510–511).
- Navas, L., 1927. Insetti raccolti nel Porto di Genova sulle Banane delle Canarie. *Bolletino della Società Entomologica Italiana* 59: 150–152, 2 figs.
- New, T.R., 1973. New species and records of *Peripsocus* Hagen (Psocoptera, Peripsocidae) from south east Australia. *Journal of the Australian Entomological Society* 12: 340–346, 16 figs.

- Obr, S., 1948. A la connaissance des Psocoptères de Moravie (Tchécoslovaquie). *Spisy vydavane Prirodovedeckou Fakultou Masarykovy University* M2 306: 108 pp., 196 figs. (Publications de la Faculté des Sciences de l'Université Masaryk).
- Pickard, J., 1983. Vegetation of Lord Howe Island. *Cunninghamia* 1: 133–266.
- Ribaga, C., 1899. Descrizione di un nuovo genere e di una nuova specie di Psocidi trovato in Italia. *Rivista di Patologia Vegetale* 8: 156–159, pl. 7.
- Roesler, R., 1943. Über einige Copeognathengenera. *Stettiner Entomologische Zeitung* 104: 1–14, 13 figs.
- Schmidt, E.R., & T.R. New, 2004. A systematic and phylogenetic revision of the family Elipsocidae (Insecta: Psocoptera), with the erection of two new families: Lesniidae and Sabulopsocidae. *Invertebratae Systematics* 18: 157–213, 113 figs, 2 Appendices.
- Schmidt, E.R., & C.N. Smithers, 2004. The genus *Howeanum* Smithers (Psocoptera: Elipsocidae) transferred to the Family Pseudocaeciliidae. *General and applied Entomology* 33: 13–14.
- Schmidt, E.R., & I.W.B. Thornton, 1993. The Psocoptera (Insecta) of Wilsons Promontory National Park, Victoria, Australia. *Memoirs of the Museum of Victoria* 53(2) (1992): 137–220, 249 figs.
- Smithers, C.N., 1967. A Catalogue of the Psocoptera of the World. *Australian Zoologist* 14(1): 1–145.
- Smithers, C.N., 1977. The Psocoptera of Muogamarra Nature Reserve. *Records of the Australian Museum* 31(7): 251–306, 98 figs.
- Smithers, C.N., 1978. A new species and new records of Psocoptera (Insecta) from Ireland. *Irish Naturalists Journal* 19(5): 141–148, 8 figs.
- Smithers, C.N., 1979. An additional record and key to the Psocoptera (Insecta) of Lord Howe Island. *Australian entomological Magazine* 6(2): 21–22.
- Smithers, C.N., 1994a. A note on the Peripsocidae (Psocoptera) of Tuglo Wildlife Refuge, Hunter Valley, New South Wales. *Australian Entomologist* 21(1): 7–10, 4 figs.
- Smithers, C.N., 1994b. Generic positions of Australian Psocoptera currently placed in *Paracaecilius* Badonnel and *Enderleinella* Badonnel (Insecta: Psocoptera: Caeciliidae). *Records of the Australian Museum* 46: 125–129, 12 figs.
- Smithers, C.N., 1995. Psocoptera from the inflorescences of *Howea forsteriana*. (Moore and F.J. Muell.) Becc. (Arecaceae) (Thatch Palm) on Lord Howe Island. *General and applied Entomology* 26: 2–8. 20 figs.
- Smithers, C.N., 1996. Psocoptera. In *Zoological Catalogue of Australia*, ed. A. Wells, 26: 1–79, 363–372 (index). Melbourne, Australia: CSIRO Publishing.
- Smithers, C.N., 2003. The identity and nomenclature of some species of *Ectopsocus* McLachlan (Psocoptera: Ectopsocidae) common to the Palaearctic, Nearctic and Australasian Regions. *Entomologists monthly Magazine* 139: 1–6.
- Smithers, C.N., 2004. A new genus for three species of Australian Myopsocidae (Psocoptera). In: *Thorntoniana. A commemorative volume for Ian W.B. Thornton. Publicaciones Especiales*, ed. A.N. Garcia Aldrete, C. Lienhard and E.L. Mockford, 20. Mexico: Instituto de Biología, UNAM.
- Smithers, C.N., & E.L. Mockford, 2004. A new genus of Psoquilidae (Psocoptera) for *Trogium nigrum* Smithers. *Entomologists monthly Magazine* 140: 313–315, 3 figs.
- Smithers, C.N., J.V. Peters & I.W.B. Thornton, 2000. The Psocoptera (Insecta) of Norfolk and Phillip Islands: Occurrence, Status and Zoogeography. *Proceedings of the Linnean Society of New South Wales* 121: 101–111. (An errata sheet correcting important printer's errors made after proof-reading, appeared in *Proceedings of the Linnean Society New South Wales* 122: page not numbered [2000]).
- Smithers, C.N., & I.W.B. Thornton, 1974a. The Psocoptera (Insecta) of Norfolk Island. *Records of the Australian Museum* 29(8): 209–234, figs 1–67.
- Smithers, C.N., & I.W.B. Thornton, 1974b. The Myopsocidae (Psocoptera) of New Guinea and New Caledonia. *Transactions of the Royal entomological Society of London* 126(1): 91–127, 95 figs.
- Smithers, C.N., & I.W.B. Thornton, 1975. The Psocoptera (Insecta) of Lord Howe Island. *Records of the Australian Museum* 29(16): 453–472, 54 figs.
- Tetens, H., 1891. Zur Kenntnis der deutschen Psociden. *Entomologische Nachrichten, Berlin* 17: 369–384.
- Thornton, I.W.B., 1959. New species of *Peripsocus* Hagen, 1866 (Corrodentia: Peripsocidae) from Hong Kong Island, with further descriptions of *Peripsocus similis* Enderlein, 1903 and *Peripsocus quercicola* Enderlein, 1906. *Proceedings of the Royal Entomological Society of London (B)* 28(3/4): 37–48, 18 figs.
- Thornton, I.W.B., & S.K. Wong, 1968. The Peripsocid fauna (Psocoptera) of the Oriental region and the Pacific. *Pacific Insects Monographs* 19: 1–158, 302 figs.
- Tillyard, R.J., 1923. A monograph of the Psocoptera, or Copeognatha, of New Zealand. *Transactions of the New Zealand Institute* 54: 170–196, 20 figs, pl. 18.
- Turner, B.D., 1977. Moroccan Psocoptera—a new *Cerobasis* species and a redescription of *Ectopsocus strauchii* Enderlein. *Journal of Natural History* 11: 281–287, 6 figs.
- Wilson, A.G., ed., 1994. *Flora of Australia*, vol. 49, Oceanic Islands 1. Canberra: Australian Government Publishing Service.
- Yoshizawa, K., 2000. Redescription of *Mepleres suzukii* (Okamoto), with comments on synonymy among *Mepleres*, *Pseudoscottiella* and *Meniscopsocus* (Psocodea: Psocoptera: Pseudocaeciliidae). *Entomological Science* 3(4): 669–674, 2 figs.
- Zimmerman, E.C., 1948. Insects of Hawaii. *Honolulu*. [Psoc. (Corrodentia): vol. 2, pp. 217–252, figs 121–137].

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The Surge Flies (Diptera: Canacidae: Zaleinae) of Australasia and Notes on Tethinid-Canacid Morphology and Relationships

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ABSTRACT. The morphology, relationships, and classification of the Tethinidae and Canacidae are considered, with special reference to the Zaleinae. Homologies of bristles near the vertex of the head are critically appraised, and the origin of the sclerite known as the prelabrum or anteclypeus is considered. The family Canacidae Jones, 1906 is classified into the following six subfamilies: Apetaeninae Mathis & Munari, 1996; Canacinae s.str.; Horaismopterinae Sabrosky, 1978; Pelomyiinae Foster, 1976; Tethininae Hendel, 1916; Zaleinae D. McAlpine, 1985. The family name Tethinidae thus becomes a new subjective synonym of Canacidae. The subfamily Nocticanacinae Mathis, 1982 becomes a tribe Nocticanacini n.stat. of Canacinae. *Tethinosoma* Malloch is transferred from the Tethininae to the Horaismopterinae. A key to subfamilies of Canacidae s.l. is given. A revised characterization of Zaleinae is given and its two genera and c. 16 species are keyed. Revised characterizations of *Suffomyia* Freidberg and *Zalea* D. McAlpine are given. The following new species are described: *Suffomyia sabroskyi* (Caroline Islands); *Suffomyia ismayi* (New Guinea); *Zalea earlyi*, *Zalea johnsi*, *Zalea lithax*, *Zalea mathisi*, *Zalea ohauorae*, *Zalea uda*, *Zalea wisei* (New Zealand); *Zalea clava* (Western Australia); *Zalea dayi* (New South Wales). Two doubtful species represented by inadequate material are assigned provisional numbers. Adults of these maritime flies were found on shoreline rocks or on stranded “seaweed”. Parasitism of four *Zalea* spp. by laboulbenian fungi is recorded. Collection techniques for zaleines are mentioned.

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As explained below, the family concepts Canacidae and Tethinidae are here combined as a single family, the former (as Canacinae Jones, 1906) having nomenclatural priority over the latter (first given as Tethinidae Hendel, 1916). See Sabrosky (1999) for details. The family name Tethinidae is therefore no longer used except in reference to older usage. To avoid confusion, I here refer to the new expanded concept of Canacidae as “Canacidae s.l.”, and to the narrower traditional concept of Canacidae, excluding the “tethinid” taxa and the Zaleinae (i.e. the Canacinae plus the Nocticanacinae sensu Mathis, 1992), as the subfamily Canacinae s.l. The subfamilies of “Tethinidae” used by Mathis & Munari (1996), viz. Apetaeninae, Horaismopterinae, Pelomyiinae, Tethininae, and Zaleinae, are

retained as a further five subfamilies of Canacidae s.l.

This paper records an increase in the number of known species of Zaleinae from four to about 17, though two of these remain unnamed because of inadequate material. New Zealand has a remarkably high representation with about 10 species seen so far, though the collections are meagre. Numerous species have probably been overlooked here and elsewhere in the Pacific because of their small size and specialized habitat. It is hoped that a New Zealand resident will undertake a major study of zaleines using ample material. Even in Australia there are still no species recorded for Queensland and South Australia, though they are very probably present.

Zaleine flies should be sought on intertidal rock-outcropping in the splash zone. We use a strong sweep net with nylon-voile bag and protective calico skirt. This is swept particularly in or over wet rock crevices or likely surfaces. The flies are extracted with an aspirator while wearing a low-power binocular magnifier. They may be collected directly into 80% ethanol. However, experience shows that dry specimens are more suitable for permanent record. These specimens are collected into dry glass containers, and, immediately after killing (e.g., with chloroform vapour or by freezing), the abdomens of both sexes must be fully extended with fine forceps to enable taxonomic study. Hazards of collecting in this habitat are the same as for rock-fishermen.

Terminology and abbreviations

In descriptions I generally follow a traditional terminology with minimal use of terms implying doubtful, unproved, or, for present purposes, irrelevant homologies. Details are given by D. McAlpine (1973), and for the male postabdomen by D. McAlpine (1985b). Most terms are also explained by Harrison (1959), Crosskey (1973), and Colless & D. McAlpine (1991). Paired structures are described in the singular, except where the context makes this inappropriate. The antenna is treated as a six-segmented appendage, and the segments (including those of the arista) are numbered consecutively from the base. Cell-4 index is defined as the ratio of the length of the antepenultimate section of vein 4 to the full length of the discal cell along vein 4. Other terms are explained below.

The Canacinae *s.l.* have been called “beach flies” in some modern literature, in contrast to the “shore flies” (Ephydriidae), with which these were usually conflated in older literature. The tethinids have also been called “beach flies” (e.g., by Munari, 2000), so that the term has application to the more inclusive concept of Canacidae *s.l.*, although some species do not inhabit beaches. I believe that such vernacular group names, if consistently applied, can be useful in communicating with non-specialists and non-entomologists, especially those concerned with research funding and conservation ecology. I introduce the term “surge flies” (German Brandungsfliegen) for the Zaleinae, in reference both to their habits and to the derivation of the scientific name (Greek *zale* = the surge of the sea).

Institutions housing specimens are abbreviated as follows:

AM	Australian Museum, Sydney
AMNZ	Auckland War Memorial Museum, Auckland
ANIC	Australian National Insect Collection, CSIRO, Canberra
BM	The Natural History Museum, London
BPB	B.P. Bishop Museum, Honolulu
CMC	Canterbury Museum, Christchurch
CNC	Canadian National Collection, Agriculture Canada, Ottawa
MCV	Museo Civico di Storia Naturale, Venice
NAT	Natal Museum, Pietermaritzburg
NZAC	New Zealand Arthropod Collection, Landcare Research, Auckland
TAU	Department of Zoology, Tel Aviv University, Tel Aviv
TDA	Department of Primary Industries, New Town, Tasmania
USNM	National Museum of Natural History, Washington, D.C.
ZMC	Zoological Museum, Copenhagen

Morphological study for this paper has been performed using a stereo light microscope (SLM), compound light microscope (CLM), and scanning electron microscope (SEM).

The following collectors' names are abbreviated to the initials: D.J. Bickel, B.J. Day, J.W. Early, D.S. Horning, J.W. Ismay, D. Mathis, W.N. Mathis, D.K. McAlpine, R. Meier, C.W. Sabrosky, K.A. Wise.

Notes on biology and ecology

The Zaleinae, like most other canacid flies, are restricted to the sea shore. I have been involved in the collection of seven species of *Zalea*, and these were on shoreline rocks, never on beaches or nearby vegetation. I previously gave habitat notes for adult *Zalea*, based mainly on observations of *Z. minor* (D. McAlpine, 1982). These are confirmed by my subsequent observations on this and other species, except that a general association of *Z. minor* or other *Zalea* spp. with calcareous worm tubes is not confirmed. On one occasion *Z. major* was found to be particularly numerous on intertidal rocks encrusted with barnacles and splashed by the incoming tide at “The Ruins”, Booti Booti National Park. Numbers of *Z. clava* were swept from the roof of a tunnel-like overhanging rock, continuously wet from heavy wave action, at the foot of cliffs near Cable Beach, S of Albany. They were associated in this habitat with the coelopids *Chaetocoelopa sydneyensis* (Schiner) and *Lopa convexa* D. McAlpine. The rocks from which *Zalea* spp. have been obtained were almost always wet from wave action or occasionally from rain. Numbers of *Z. minor* were once found at Kurnell, near Sydney, under a rock overhang above high tide level, during high tide when the intertidal rock platform was submerged. These habitat preferences would ensure that the flies are not subjected to even moderately high temperatures or low humidity. They also indicate that the flies are uninjured by heavy splash from waves.

Habitat data from *Suffomyia* spp. indicate less strict association with rock surfaces than for *Zalea*. Freidberg (1995) states for *S. scutellaris*: “All the specimens were swept at sandy or rocky beaches, usually covered in part with algal mats or other organic debris. They were confined to the immediate vicinity of the water (within half a meter) at the ‘intertidal zone’”. Label data for *S. ismayi* say: “swept decaying seaweed”. All specimens of *S. sabroskyi* were collected “at light”, so the natural habitat is not recorded.

Ectoparasitic fungi of the order Laboulbeniales are frequent on *Zalea minor*, *Z. major*, and *Z. dayi* at some localities in New South Wales, and also occur on *Z. clava* in Western Australia (see Figs 46, 47). The fungal ascomata are most frequently attached to the ventral surface of the basal third of the wing, also commonly to the legs, and one specimen of *Z. minor* has a cluster of ascomata on one halter. Heavy infestations must hamper some of the flies' movements, but, as the fungus does not attack internal organs, it is not normally fatal.

Attempts to obtain larvae of zaleines have so far been unsuccessful. It is probable that they live in a sheltered microhabitat in the intertidal zone.

Morphology

I treat here the comparative morphology of certain structures, particularly those which have value in the classification of the Canacidae *s.l.* or of the Chloropoidea, *sensu* Colless & D. McAlpine (1991).

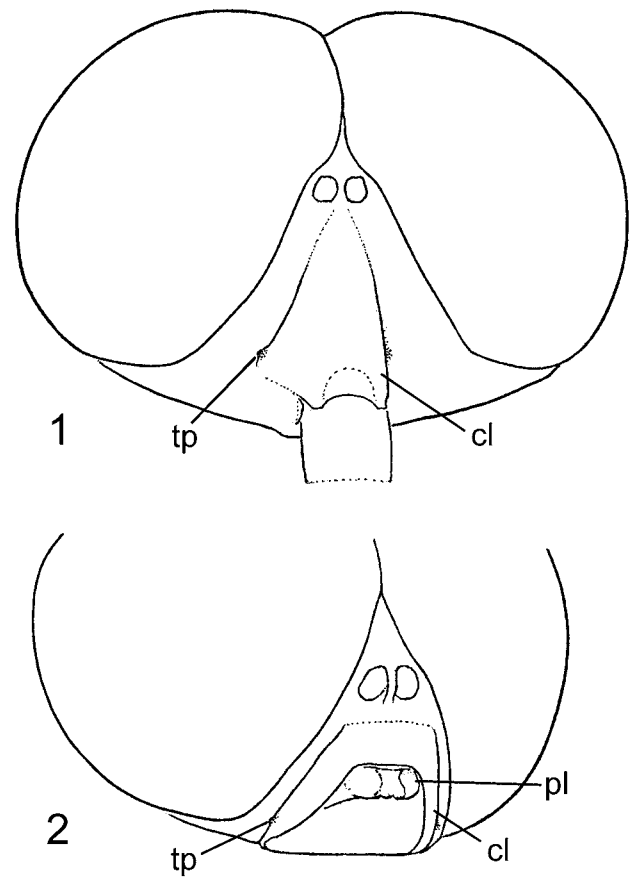
The prelabrum or anteclypeus. I here maintain the term prelabrum for the transverse (on each side posterolaterally extended) sclerite between the face and the labrum, in most cyclorrhaphans. This is because I cannot decide from the evidence immediately available whether it is a part of the clypeus or a sclerite of separate origin. The sclerite was termed anteclypeus by Crampton (1942), although, according to his hypothesis, it should be a posterior element of the clypeus, being farther from the antennae (which represent the primitive segment 1 of the insect head). It was unfortunately termed simply clypeus by J. McAlpine (1981), following several precedents.

The study of the facial region of the Brachycera has been inadequately considered in major works on morphology and phylogenetic classification. My own brief comparative study leaves little room for doubt that the clypeus, either wholly or in substantial part, is incorporated into the area of the cyclorrhaphous head capsule called the face by modern dipterists. If the cyclorrhaphous prelabrum is of clypeal origin, then it represents a small ventral section of the original clypeus which has become more or less detached from or hinged with the rest of the clypeus in the formation of the flexible proboscis. This appears to be the view of Crampton (1942), but no substantial evidence has been offered for preferring this interpretation over that of independent sclerotization.

In orthorrhaphous brachycerans, possession of a sclerite resembling the prelabrum is of restricted occurrence, and such sclerite is possibly absent in the groundplan of the Brachycera. Such groundplan condition probably resembled that of the rhagionid genus *Atherimorpha* White (Fig. 1). An obvious sclerite resembling the prelabrum is visible in most taxa of Stratiomyidae which I have examined, including the rather plesiomorphic chiromyzines (see Crampton, 1942: fig. 1L, ac). A sclerite resembling this to a variable extent is present in some taxa of Bombyliidae. It may be considered that these are isolated occurrences in taxa phylogenetically remote from the Cyclorrhapha, so that any similarity to the latter is likely to be convergent. The nearest outgroups to Stratiomyidae, according to recent sources (e.g., Sinclair, 1992) are the Pantophthalmidae and particularly the Xylomyidae. In my limited material of these two families, I can detect no distinct prelabrum.

Among the Empidoformae (formerly Empidoidea), the prelabrum is absent in many taxa. In *Syneches* spp. (Hybotidae) there is an apparent prelabrum, which forms a flat sclerite on the subcranial membrane and is anteriorly joined to the lower margin of the face. Krystoph (1961: fig. 1) figured such a sclerite for *Empis* sp. (Empididae), which he identified as the clypeus. More prominent structures sometimes resembling a prelabrum in certain empidoforms are apparently the true labrum (Krystoph, 1961).

The primitive cyclorrhaphan *Ironomyia nigromaculata* White (Ironomyiidae, Fig. 2) probably shows the face and prelabrum in a condition close to that of the groundplan of the Cyclorrhapha, or the prelabrum in a condition transitional between such groundplan and that of the higher



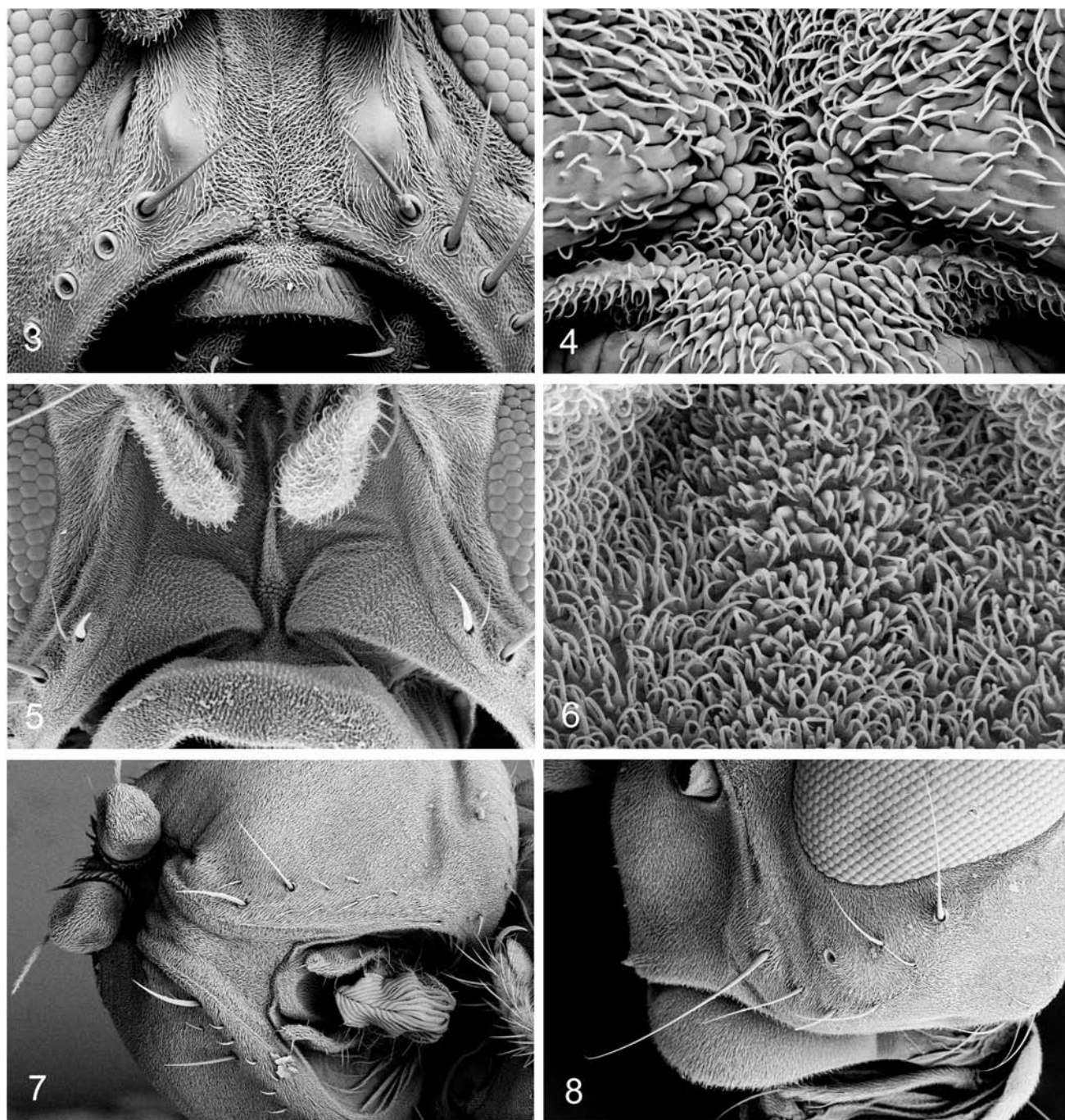
Figs 1–2. (1) *Atherimorpha* sp., outline of head of male. (2) *Ironomyia nigromaculata* White, outline of lower part of head of male. *cl*, clypeus; *pl*, prelabrum; *tp*, tentorial pit.

cyclorrhaphans (including Syrphidae and Schizophora). Most other taxa of the grade Aschiza have undergone partial desclerotization, suture reduction, or other modifications. *Ironomyia* retains the primitive clypeal sutures with a little modification in position, in addition to having a distinct prelabrum, but the latter is very weakly sclerotized medially. I therefore regard it as a significant indicator of at least some homologies between schizophoran and lower brachyceran structures as indicated in Fig. 2. J. McAlpine (1981: 19) stated: “Peterson (1916) wrongfully interpreted the reduced clypeus [i.e. the prelabrum] in the Muscomorpha [i.e. Cyclorrhapha] as tormae.” Perhaps the bipartite nature of the prelabrum of such primitive cyclorrhaphans as *Ironomyia*, *Melanderomyia* Kessel, and *Sciadocera* White provides evidence of its origin from a pair of sclerites such as the tormae.

There is a tendency in the Cyclorrhapha for the tentorial pit, located on the lateral arm of the fronto-clypeal suture, to move on to the ventral surface of the head capsule, carrying with it a ventral extension of the suture. The part that I have designated the hypofacial in *Zalea* (D. McAlpine, 1982: fig. 3) and many other schizophoran taxa is perhaps a lateroventral extension of the clypeus.

Facial structure. The structure of the face in the canacid-tethinid taxa can be classified in three main categories.

Type 1. In the Apetaeninae, Zaleinae, and most genera of Tethininae (e.g., *Pseudorhinoessa*, Fig. 3) the face is generally rather weakly sclerotized, almost vertical, not



Figs 3–8. (3) *Pseudorhichnoessa* sp., face and adjacent parts. (4) the same, detail of lower margin of face, showing bulbulate cuticle. (5) *Apetaenus* (*Macrocanace*) *australis* (Hutton), face and adjacent parts. (6) the same details of lower margin of face. (7) *Tethinosoma fulvifrons* (Hutton), head, ventral-oblique view. (8) *Canace salonitana* Strobl, cheek, face, and adjacent parts, lateral view.

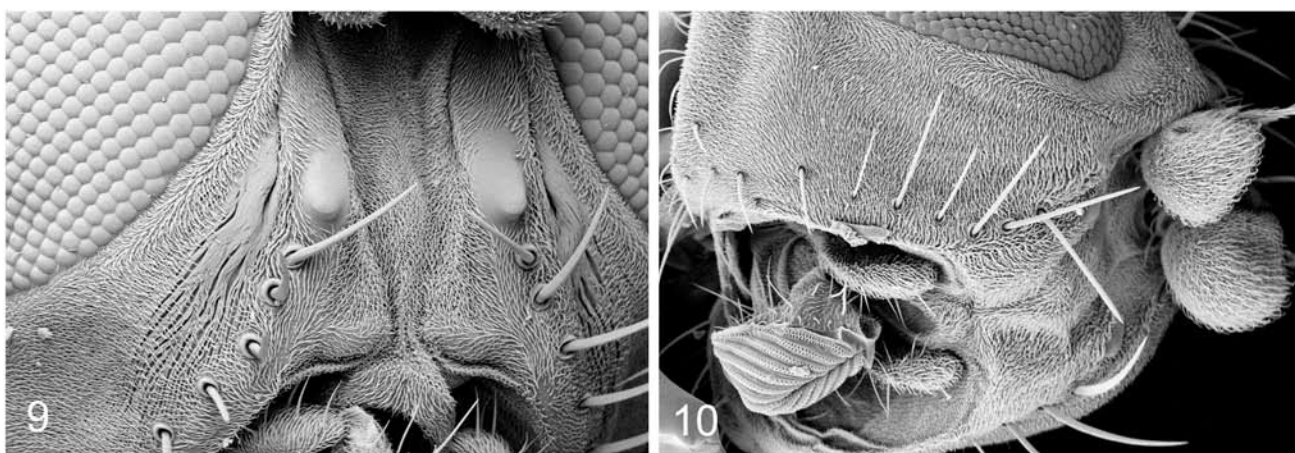
noticeably convex, and terminates ventrally at the junction of the anterior and ventral surfaces of the head capsule. Its surface thus has no more or less ventrally facing component, and the prelabrum (always close to its defined lower or epistomal margin) is not displaced posteriorly. Also the face is narrowly desclerotized on the median ventral part, so that the visible lower margin is interrupted medially to a variable extent (see Hennig, 1971: fig. 73, and my Figs 4–6).

Type 2. In the Pelomyiinae and Horaismopterinae (e.g., *Tethinosoma*, Fig. 7) the face is uniformly rather weakly sclerotized (or in *Horaismoptera* quite strongly so), with its lower margin entirely defined and displaced on to ventral surface of head, so that the prelabrum is also posteriorly

displaced. The face may be relatively narrow (*Pelomyia*, *Tethinosoma*) or extremely narrow (*Pelomyiella*). The face of *Neopelomyia* seems atypical of the Pelomyiinae, but without more material I cannot interpret all the details.

Type 3. In the Canacinae *s.l.* (Fig. 8) the face is uniformly strongly sclerotized and convex in horizontal section, so that in profile its median line forms part of the outline of the head. The sharply defined lower margin does not recede on to the ventral surface of the head, so that the prelabrum is situated well forward as in type 1.

In the genus *Tethina* *s.l.* (including *Rhichnoessa*) there is much variation in facial structure in the limited available material. In *T. carioca* Prado & Taveres, the face is more



Figs 9, 10. (9) *Tethina nigriseta* Malloch, face and adjacent parts. (10) *Tethina pallidiseta* Malloch, cheek region and adjacent parts.

uniformly sclerotized than in *Pseudorhinoessa* spp., its surface largely approximating to a vertical plane, with a slight median carina from a little above centre to near lower margin, which becomes broader and more tumid below and is defined by a shallow groove on each side. Only a very narrow ventral marginal zone is reflexed so as to face ventrally, and the prelabrum is not markedly displaced posteriorly. In *T. horripilans* (Melander) the facial structure is similar to the above, but the paired grooves are broader and apparently desclerotized, delimiting a convex, subtriangular median sclerite immediately above lower margin, which is narrowly prolonged above. The above description is based on a female specimen in which the median sclerite is particularly well defined and pigmented. In a male of *T. horripilans* the median sclerite is smaller and less defined, but there remains the sharp distinction between the sclerotized lateral facial plates and the desclerotized paramedian zones. In *Tethina pallidiseta* Malloch, from examination of numerous well sclerotized specimens in which no part of the face has collapsed in drying, (SLM and SEM) there is not only departure from structural type 1 but also from that of most available *Tethina* spp. (see Fig. 10). Instead of having almost the whole depth of the face almost vertical, it has a substantial ventral area of the face receding on to the ventral surface, or at least the anteroventral surface of the head. Thus, the distinctly visible ventral margin of the face and the prelabrum are located well back on the ventral surface of the head. The c. vertical anterior surface of the face is very similar to that of *T. carioca* described above, with low, ventrally widened median carina flanked by a pair of grooves, and with largely nearly uniform weak sclerotization; but in *T. carioca* this vertical surface forms almost the whole surface of the face. In *T. nigriseta* Malloch (Fig. 9) the facial structure is, to some extent intermediate between that of *T. carioca* and *T. pallidiseta*. The lower part of the face recedes only slightly, so that posterior displacement of the prelabrum is correspondingly slight. The median carina is relatively weakly developed. The unifying feature through all available *Tethina* spp. is the presence of the median carina, not seen in other genera of Tethininae.

Determination of phylogenetic polarity in facial characters is difficult in the canacid-tethinid complex because the probable outgroups, Chloropidae (e.g., Fig. 11) and Milichiidae, are themselves variable. However, with reference to what are likely to be cladistically stepped

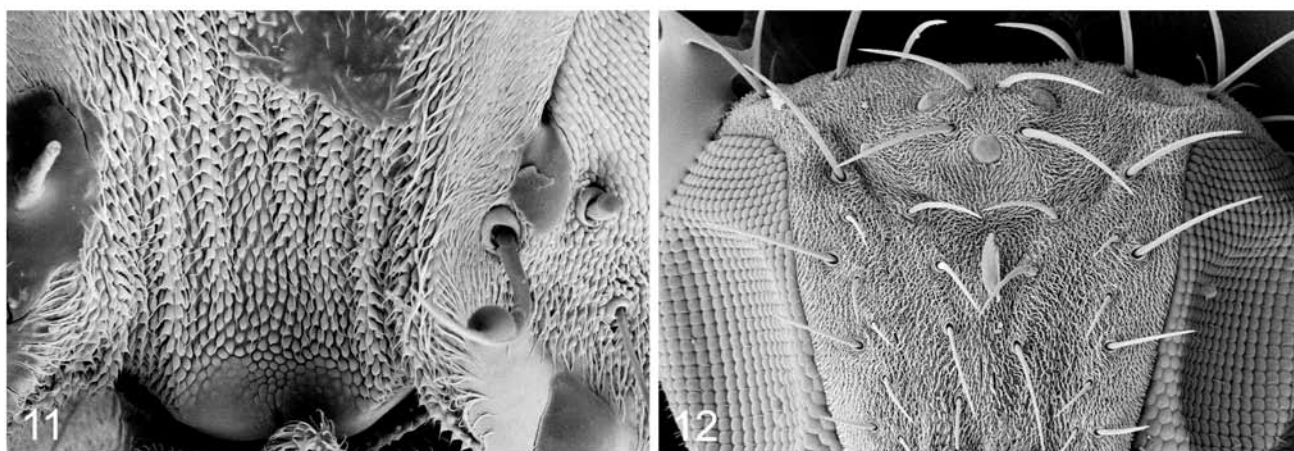
outgroups, and with elimination of those with probably autapomorphic facial conditions, a groundplan condition for both Chloropoidea and Canacidae *s.l.* (assuming monophyly for both categories) is likely to include the following features: face almost uniformly moderately sclerotized, not markedly convex or protuberant, in profile nearly vertical or, perhaps, slightly concave, not receding below, with well defined ventral margin, which is quite narrowly separated from prelabrum.

On this basis, none of the above three types of facial structure is entirely plesiomorphic. Type 1 is apomorphic in the ventromedian desclerotized zone and associated discontinuity of the ventral margin. Type 2 is apomorphic in the markedly receding lower part of the facial surface, and associated posterior displacement of the lower margin. Type 3 is apomorphic in being strongly convex in horizontal section. Thus facial structure supports to some extent the subfamily classification here followed.

The cuticle of the sclerotized lower lateral areas of the face in *Pseudorhinoessa*, etc. is microtrichose and partly crazed (cf. that of the diopsid *Centrioncus* Speiser, see D. McAlpine, 1997), but, on the median emargination of the face and the area immediately below, the sclerotization is broken into many separate bulblet-like structures each bearing one microtrichium (Fig. 4). This relatively flexible type of cuticle I term bulbulate, from botanical Latin *bulbulus*, a small bulb or bulblet, as occurs in the axils of some plants. Such bulbulate cuticle occurs on much of the face in *Apotropina* sp. (Chloropidae, Siphonellopsinae, Fig. 11) and, in a slightly modified form, in *Cadrema* sp. (Chloropidae, Oscinellinae).

On the assumption that the bulbulate cuticle is homologous in both Tethininae and Chloropidae, its presence in the groundplan of the Chloropoidea is inferred. Unfortunately face microstructure, has not been investigated in most other schizophoran families.

In *Tethina* and several other genera of Tethininae there is a shining tubercle on the facial ridge (sensu Crosskey, 1973) just above the vibrissa. In *Horaismoptera* there is no such separate tubercle, but the vibrissal socket is located on a shining convexity. Shining, glabrous prominences or ridges on the facial or cheek region occur in numerous fly taxa, notably in *Apotropina* Hendel (Chloropidae), *Coelopella* Malloch, *Dasycoelopa* Malloch, *Malacomysia* Westwood, *Rhis* D. McAlpine (Coelopidae), *Hecamede* Curtis



Figs 11, 12. (11) *Apotropina* "sp. M" (in AM), detail of lower part of face. (12) *Tethina pallidisetia* Malloch, postfrons. Postvertical bristle indicated.

(Ephydriidae), *Helcomyza* Curtis, *Maorimyia* Tonnoir & Malloch (Helcomyzidae), *Heterocheila* Rondani (Heterocheilidae). These genera all live in sandy habitats, though perhaps this does not apply to all species of *Apotropina*.

I have found adults of *Apotropina exquisita* (Malloch) and *A. ornatipennis* (Malloch) on loose sand of coastal dunes. Some other species of the genus are associated with burrowing Hymenoptera (Ferrar, 1988), where they probably also face risk of burial. Perhaps these shining prominences are used by flies in pushing their way through sand, as occasional accidental burial must occur in these habitats. Adults of *Rhis whitleyi* D. McAlpine burrow in sand below stranded kelp, when disturbed (author's observations).

Bristles on the upper back of the head. Hendel (1916) made a useful comparative study of what he called the *Postvertikalborsten* in acalyptrate Diptera, and indicated their importance in family classification, though the English term "post-vertical" was used for the same bristle pair as early as 1884 by Osten-Sacken. General usage of the term postvertical bristle continued until Steyskal (1976) proposed to substitute the term postocellar bristle, on grounds that are no more than a personal preference. Unfortunately Steyskal's substitution was adopted in the influential Manual of Nearctic Diptera (see J. McAlpine, 1981), contrary to most usage over the previous 90 years. I propose to continue usage of postvertical bristle for these bristles among such families as Drosophilidae, Heleomyzidae, Lauxaniidae, Piophilidae, and Sciomyzidae, where their homology is not in dispute.

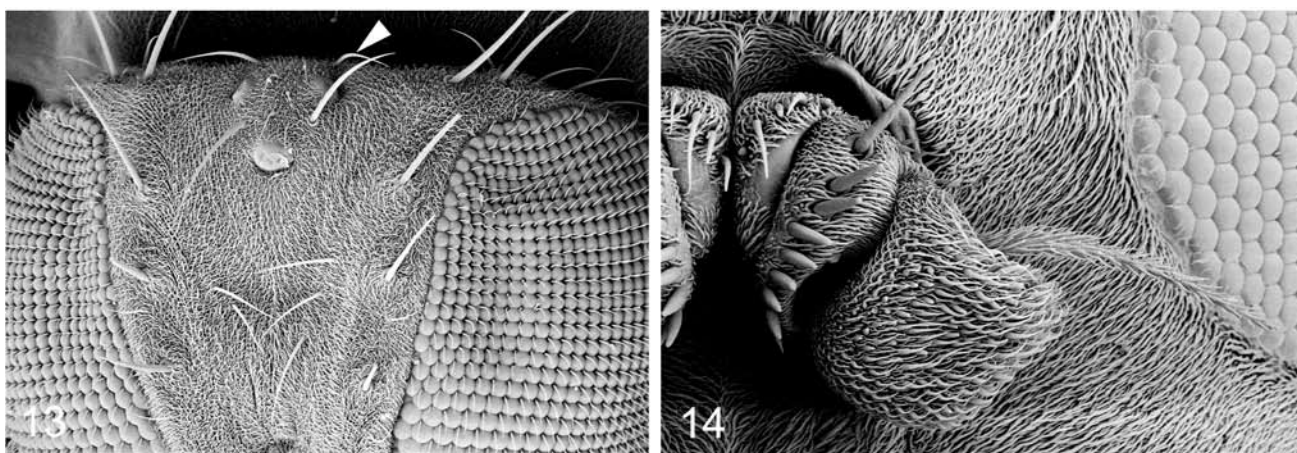
There is currently a problem with the identification of the postvertical bristle (syn. postocellar sensu Steyskal) in the tethinid-canacid complex.

For *Tethina cinerea* (Loew), Hendel (1928: fig. 179) labelled the pseudopostocellar bristles (of later authors) as postocellars (poc), and he labelled the convergent bristle pair (here interpreted as postverticals) as inner occipitals (occi), without recognizing any postvertical bristles. For numerous other families, including Carnidae and Milichiidae, he labelled the one pair of bristles directly behind the ocelli as postverticals (pvt). In the absence of any discussion of these points in Hendel's work, it seems that his reticence in applying the term postvertical to any bristle of the head of *Tethina* may have been due to indecision as to which bristle pair is homologous with the postverticals of other families. Probably the only recognized tethinids to which Hendel had

access in 1928 were relatively few species of Tethininae and Pelomyiinae.

Vockeroth (1987) stated for the Tethinidae: "postocellar bristles absent; inner occipital bristles moderately strong to minute, slightly to strongly convergent." Wirth (1987) stated for the Canacidae: "postocellar bristles absent, but often replaced by pseudopostocellar bristles, i.e. specialized ocellar setulae." Munari (1999, following J. McAlpine, 1989) stated for the Tethinidae: "paraverticals (pavt = poc or pvt of some authors) very weakly developed to relatively strong, usually widely separated and convergent (divergent only in Zaleinae) simulating true postocellars [sic] setae;" ... "ocellar setae ... sometimes combined with a posterior pair of additional, widely divergent hairs (pseudopostocellars setae, sensu J. McAlpine, 1989)." Hendel's and Vockeroth's "inner occipital bristles" and Munari's "paraverticals" are the same concept. Steyskal (1976) introduced the term paraverticular bristle for a bristle placed laterad of the postocellar (postvertical) and mesad of the inner vertical, occurring in certain calyptrate and pseudopomyzid flies.

I have examined all major groups of the tethinid-canacid complex to test the viewpoint that postvertical bristles are uniformly absent and generally replaced by paraverticular bristles in these taxa. The taxa of this complex have at most one pair of bristles in this region (i.e. excluding the pseudopostocellars), which are convergent except in some (not all) Zaleinae, and which range from far apart (in *Horaismoptera* and *Pseudorhinoessa*) to quite close together (in *Tethinosoma*), through a range of intermediate positions in *Tethina* (Fig. 12), *Dasyrhinoessa*, *Pelomyia*, *Macrocanace*, and *Zalea* (Fig. 13). There is much evidence of variation in position of insertion of the bristle, but none of separate origin of such a bristle in different taxa. It is therefore logical to treat these as the same homologous bristle pair through all these taxa. But I can find no shred of evidence for regarding them as non-homologous with bristles identified as postverticals (or postocellars) in such outgroups as Chloropidae, Coelopidae, and Lauxaniidae. Paraverticular bristles sensu Steyskal possibly occur in no family closer than the Pseudopomyzidae and certain Heleomyzidae (e.g., *Borboroides* Malloch) and Sphaeroceridae, where they may have arisen independently and occur beside typical postverticals. I therefore dismiss as a fallacy, based in inadequate comparative study, the claim that paraverticular bristles are present in the tethinid alliance, and I revert to the



Figs 13, 14. (13) *Zalea dayi* n.sp., postfrons. Postvertical bristle indicated. (14) *Tethinosoma fulvifrons*, antenna.

formerly used term postvertical. Postvertical bristles, in this sense, are absent in the Canacinae *s.l.* and in some species or specimens of Apetaeninae.

I know of no better term than pseudopostocellar bristles, as used by Wirth (l.c.), for the pair of closely placed, divergent bristles in front of the postverticals, which are evidently derived from setulae of the ocellar region. These are distinct in many taxa of Canacinae (*s.l.*) and Tethininae, in the latter group in addition to convergent postverticals (see Fig. 12).

Previously (D. McAlpine, 1982), I described the postvertical bristles of *Zalea* as “widely spaced, proclinate, divergent or subparallel”, and compared them with the divergent “postvertical” bristles of the Canacidae *s.str.* Freidberg (1995) described *Suffomyia scutellaris* Freidberg as having “pseudopostocellar setae”, but “postocellar, paraverticlar and inner occipital setae lacking”, again homologizing this bristle pair through Zaleinae and Canacinae, though using a different term. I am now satisfied that both our interpretations are incorrect. The pseudopostocellars when present in Canacinae *s.l.* are closely approximated, and often tend to be only slightly differentiated from the relatively numerous and irregular ocellar setulae, often not transversely aligned, and sometimes duplicated. What I regard as postvertical bristles in the Zaleinae are at least as far apart as the posterior ocelli, well removed from the small ocellar setulae, and generally quite regularly placed. But for the fact that they are commonly divergent, they are similar to the postvertical bristles of the Pelomyiinae. I therefore identify these bristles of Zaleinae as true postverticals, in contrast to the pseudopostocellar bristles of Canacinae *s.l.*

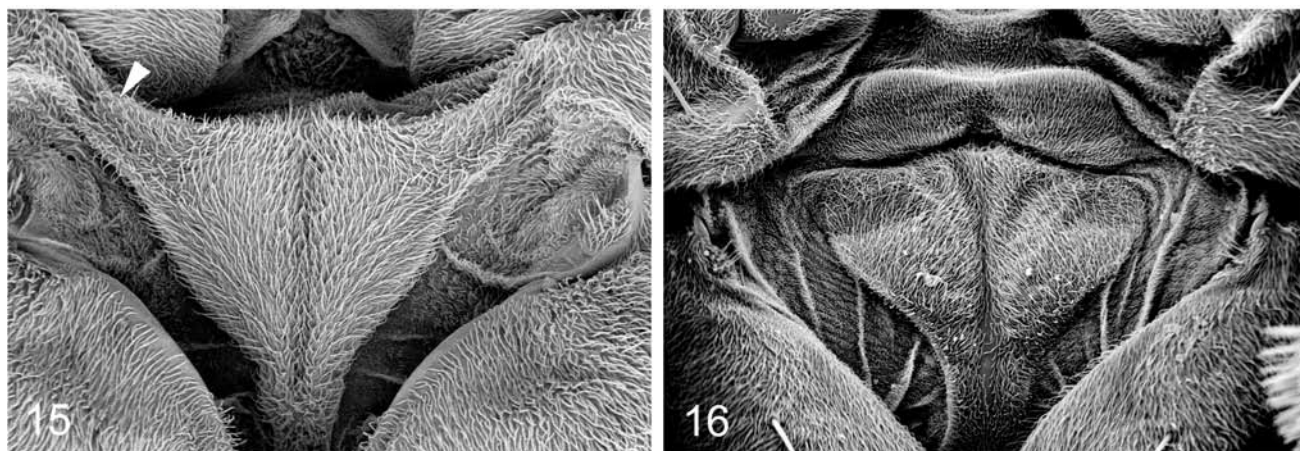
Zalea horningi and some closely related species differ from other zaleines in that the postvertical bristles are convergent. This is the normal condition in other subfamilies of Canacidae *s.l.* and of the outgroups Milichiidae and Chloropidae, and is the probable groundplan condition for the Canacidae *s.l.* But if *Z. johnsi* is closely related to the *Z. horningi* alliance, it appears that the non-convergent condition is a groundplan autapomorphy for Zaleinae and that the state in *Z. horningi* is a reversal, on the evidence of three stepped outgroups, viz. *Zalea johnsi*, other species groups of *Zalea*, the genus *Suffomyia*.

The antenna. In *Horaismoptera* and *Tethinosoma* antennal segment 2 (the pedicel) is remarkably short and robust, with

a series of short, stout spines or spinescent setulae on the distal margin of the inner surface (Fig. 14). The antennae are directed outwards from their bases, and thus diverge more markedly than in such possibly related genera as *Pelomyia*, so that the group of spines or stout setulae is prominently exposed. In the specimen of *Tethinosoma fulvifrons* examined with SEM, the apices of these bristles appear to be abraded. Here we have a similar condition to that of the platystomatid *Rhytidortalis averni* D. McAlpine and related species (D. McAlpine, 2000), where, in the female only, there is a well-developed comb on antennal segment 2, of which the spinescent bristles can show similar apical abrasion. The equal development of the antennal modification in both sexes of *Tethinosoma* perhaps makes its primary use here in intraspecific agonistic behaviour improbable. It is reminiscent of the rastellum on the chelicera of certain spiders, which is generally considered to be a digging organ. The term rastellum, as used in Arachnology, may therefore be applied to this rake-like group of spines in *Tethinosoma* and *Rhytidortalis* spp. As both *Tethinosoma* and the relevant *Rhytidortalis* spp., probably also *Horaismoptera* spp., are restricted to sandy coastal habitats, the antennal rastellum in these may have the common function of digging through or extrication from loose sand, as surmised above for certain facial modifications. Perhaps the particular development of the rastellum in the female only of *Rhytidortalis* spp. is due to more frequent or intimate contact with sand during oviposition, as the larvae are strongly suspected of being associated with roots of dune plants.

The prosternum. The prosternum in the Schizophora is commonly represented by two sclerites—the small anterior presternum and the larger posterior basisternum (Speight, 1969: fig. 12). The basisternum is often simply called “prosternum” in the literature, because it is often more readily viewed in dried material without decapitation (Figs 15–22).

The presternum in what is probably the primitive condition for the Chloropoidea (sensu Colless & D. McAlpine, 1991) is a small rounded sclerite close to or connected to the middle of the anterior margin of the basisternum (Figs 17, 18). Such a presternum occurs in *Tethina pallidiseta* Malloch, *Tethinosoma fulvifrons* (Hutton), and various other taxa of Canacidae *s.l.* In the subfamily Canacinae the presternum is often vestigial. In the Zaleinae the presternum is variable, but is always well developed. In



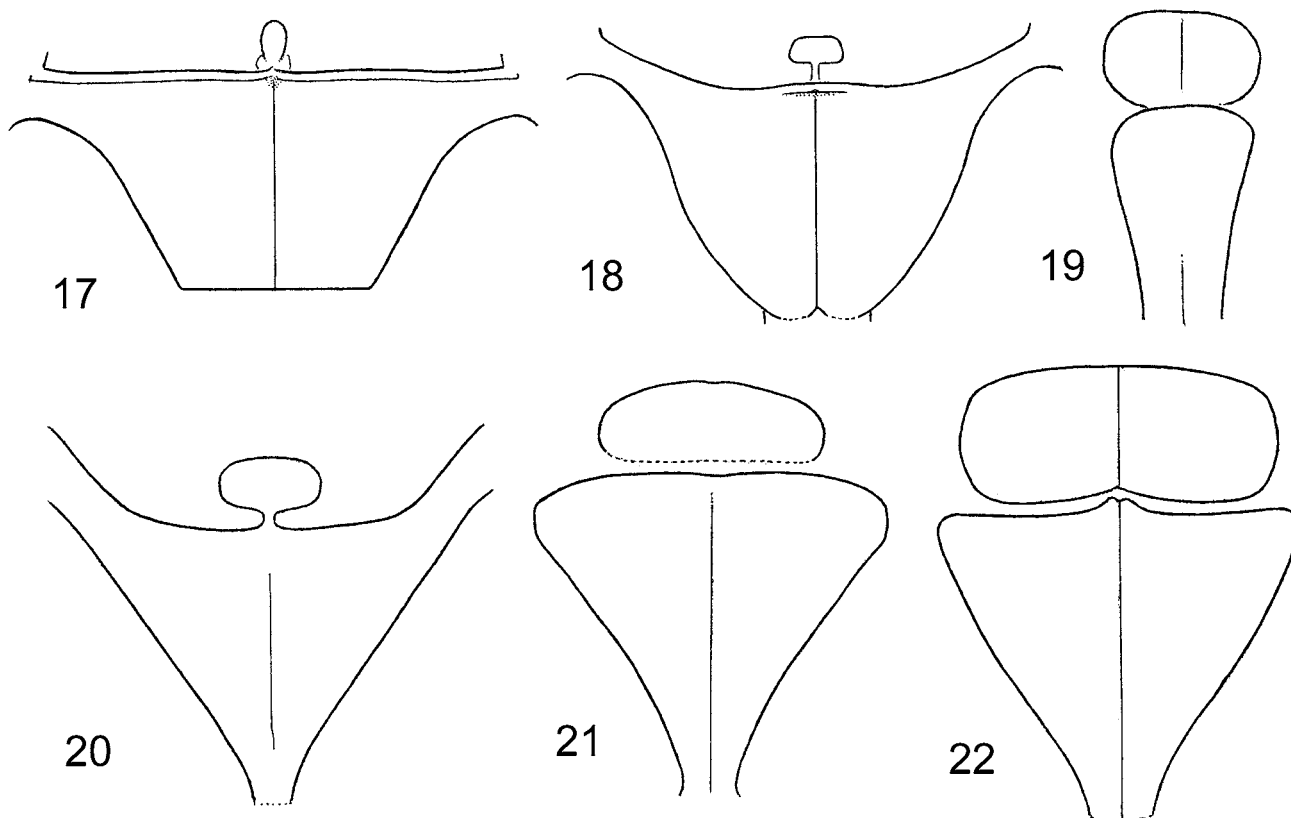
Figs 15–16. (15) *Zalea johnsi*, prosternum showing precoxal bridges, presternum concealed. (16) *Z. minor*, prosternum (unbridged) and adjacent parts.

Zalea horningi (Fig. 20), *Z. johnsi* (Fig. 15), and *Z. lithax* the presternum is small, though notably broader than in *Tethina*. In *Z. wisei* and *Z. sp. 1* (Fig. 21) it is broader. In the four Australian *Zalea* spp. (e.g., *Z. major*, Fig. 22; *Z. minor*, Fig. 16) the presternum is very broad, with a median groove, and there is a narrow transverse membranous zone separating it from the basisternum. I studied the prosternal region in *Z. major* and *Z. minor* in freshly killed specimens in which the membranous cuticle was still fully flexible and the degree of separation of sclerites could be satisfactorily demonstrated. The above description is therefore more accurate than my previous statement, based on dried specimens, that the prosternum of *Zalea* has “median and transverse sutures forming a cruciate complex” (D. McAlpine, 1982). Although

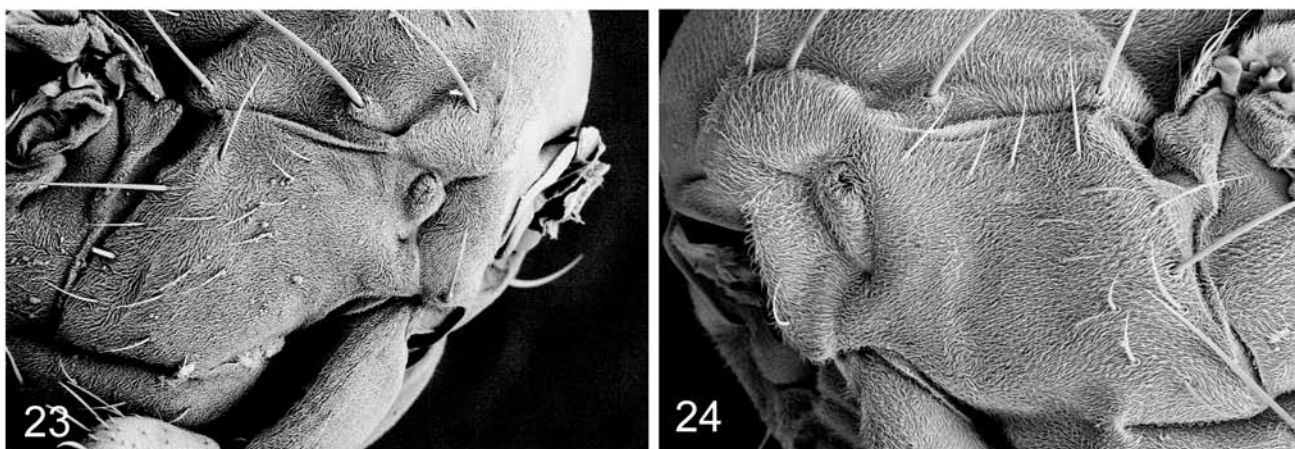
the prosternum of *Suffomyia sabroskyi* is in general narrowed, the presternum is not particularly so, being about as broad as the basisternum, judging from my limited dried material (Fig. 19).

Even if the prosternum of *Z. horningi* presents the most plesiomorphic condition present in *Zaleinae*, it is probable that the presternum in the groundplan of the subfamily has undergone some broadening relative to that of other canacid groups.

The basisternum in the great majority of taxa included in the Chloropoidea (sensu Colless & D. McAlpine, 1991) is connected to the propleuron on each side by a sclerotized cuticular band, the precoxal bridge. The taxa of Milichiidae, however, are variable in this respect, as some have the



Figs 17–22. Prosternal sclerites of: (17) *Apotropina* sp.; (18) *Tethina pallidiseta*; (19) *Suffomyia sabroskyi* n.sp.; (20) *Zalea horningi*; (21) *Zalea* sp. 1; (22) *Z. major*.



Figs 23, 24. (23) *Tethinosoma fulvifrons*, right mesopleuron and adjacent parts. (24) *Zalea johnsi*, left propleuron and mesopleuron.

prosternum unbridged and completely separated from the propleuron on each side by a membranous zone. The only examples of Canacidae *s.l.* known to me with the latter condition are included in the Zaleinae. It is clear from the pattern of occurrence of the precoxal bridge, that it must have evolved several times in the Schizophora. Very probably its presence is a groundplan condition of the Chloropoidea, but it is uncertain if it is an autapomorphy for this taxon. The Carnidae *s.l.*, which are hypothesized to be the sister group to the Chloropoidea (in approximately my sense) by J. McAlpine (1989), consistently have the prosternum unbridged.

I originally described the genus “*Zale*” as having the prothoracic precoxal bridge “desclerotised”. Freidberg (1995, table 1) gave the precoxal bridge as “reduced” in *Zalea* and “absent” in *Suffomyia*. My detailed studies of many specimens of the Australian *Zalea* spp., including fresh specimens, dried specimens with head removed, and alcohol specimens, show that in all these there is no precoxal bridge, the well sclerotized median plate of the prosternum (basisternum) being isolated from the propleuron by a wide membranous zone on each side (see Figs 16, 22). The condition is thus similar to that in the three known *Suffomyia* spp. However several New Zealand species, including *Z. horningi* and *Z. johnsi* (but not *Z. wisei*), have a distinctly sclerotized precoxal bridge connecting each side of the basisternum to the propleuron (see Figs 15, 20).

This very limited occurrence of the precoxal bridge in Zaleinae raises the question as to whether its possible loss in the groundplan of the subfamily has been reversed for the seven species of the *Zalea horningi* group, which could be monophyletic, or whether this group alone retains the general chloropoid condition, lost in all other zaleine taxa.

The paired subcoxal sclerites, present in many cyclorhaphous taxa between each fore-coxal base and the basisternum, are not distinguishable in taxa treated in this paper.

Mesopleural chaetotaxy. The mesopleuron or anepisternite of the Canacidae *s.l.* shows a characteristic bristle pattern which is present in some or all constituent taxa of each of the six subfamilies (see Figs 23, 24). There are one or two posteriorly directed bristles very near the central part of the posterior margin, and an upwardly directed bristle near the posterodorsal angle of the sclerite, which is smaller than the largest of the posterior bristles. In addition there is a number

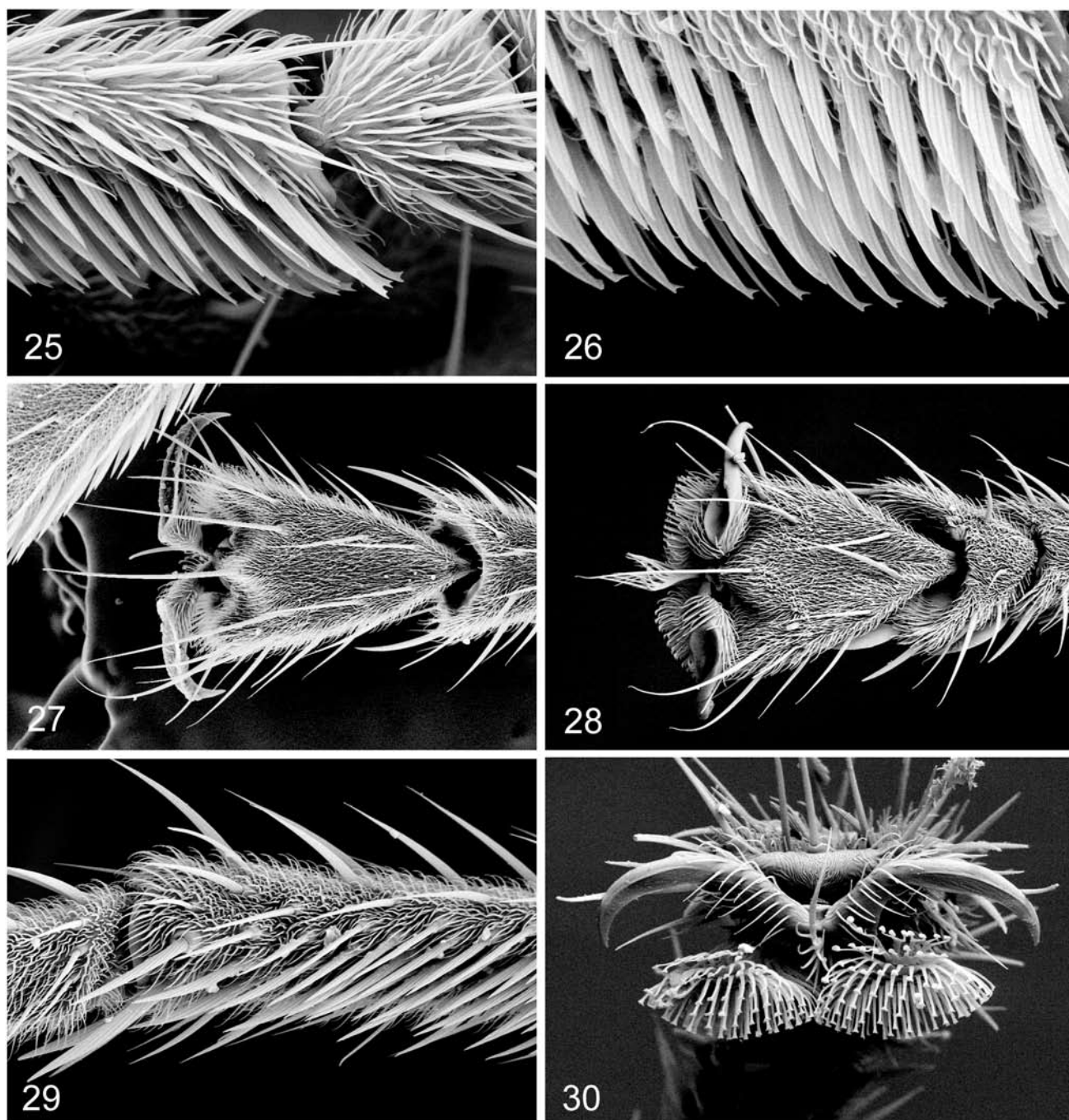
of more or less scattered setulae, the majority of which are posteriorly directed, but those on the upper part of the sclerite are directed upwards.

This arrangement of posteriorly directed and upwardly directed bristles is taken as a groundplan condition of the Canacidae *s.l.*, and is absent in the related families Chloropidae and Milichiidae. In the carnid subfamily Carninae (e.g., *Hemeromyia* Coquillett and *Meoneura* Rondani) there is a similar arrangement of major mesopleural bristles with the addition of a large lower mesopleural. If the Carnidae are a closely related outgroup to the Chloropoidea, then it is just possible that the mesopleural chaetotaxy should be considered as a homologous condition in the two groups. The carnid subfamily Australimyziinae (given family rank by J. McAlpine, 1989, but as the probable sister group of Carnidae) has a bare mesopleuron, as has also the genus *Neomeoneurites* Hennig, which is perhaps closer to the Carninae (see Wheeler, 1994). Therefore there must be considerable doubt as to whether the mesopleural chaetotaxy of typical Carninae is anything but a special derived condition, on the basis of comparison with two stepped outgroups. Also I maintain my view that the Carnidae do not otherwise share sufficiently distinctive apomorphies with the Chloropoidea to support the hypothesis of close relationship.

On this basis, I consider that the pattern of mesopleural chaetotaxy in the Canacidae *s.l.* represents a probable autapomorphy for the family.

Tarsal structure. In *Suffomyia scutellaris* (see Freidberg, 1995), *Zalea johnsi* (Fig. 25), and *Z. minor* (Fig. 26) some of the longer ventral setulae on the fore basitarsus are shortly bifid apically. Because this condition can usually only be confirmed by SEM study, I am uncertain of its distribution, but I suspect that it is the general condition for the genus *Zalea*. SEM study shows it to be absent in other canacid genera examined, viz. *Dasyrhicnoessa*, *Pseudorhichnoessa*, *Tethina*, *Pelomyia*, *Tethinosoma*, *Apetaenus* (Fig. 29), *Isocanace*, and *Nocticanace*. Available evidence seems to indicate that presence of bifid basitarsal setulae may be restricted to the Zaleinae, and, because it occurs in at least some species of each probably monophyletic genus, it is probably an autapomorphy for this subfamily.

In *Apetaenus* and some taxa of Canacinae *s.l.* the terminal tarsomere has the dorsal median terminal bristle on a broad prominence and the terminal margin excavated on each



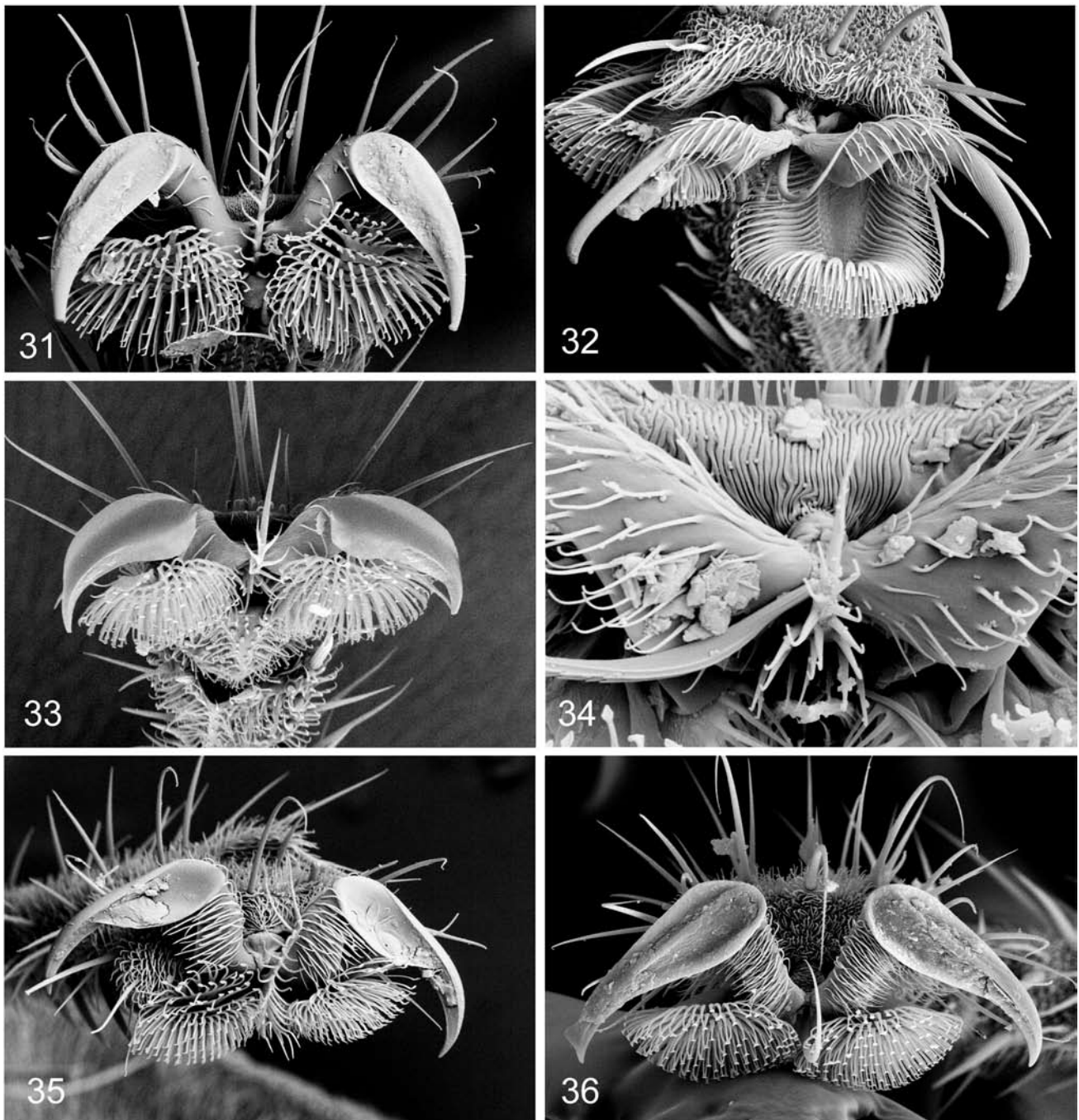
Figs 25–30. (25) *Zalea johnsi*, distal part of fore basitarsus. (26) *Z. minor*, setulae on ventral surface of fore basitarsus. (27) *Apetaenus* (*Macrocanace*) *australis*, terminal tarsomere, dorsal view. (28) *Nocticanace arnaudi* Wirth, the same. (29) *Apetaenus* (*Macrocanace*) *australis*, distal part of fore basitarsus. (30) *Tethina nigriseta* Malloch, claws and associated structures.

side (Figs 27, 28). In the Zaleinae there is no such median setiferous prominence, but the terminal margin may be slightly excavated.

Pretarsal structures. Pretarsal structures, including especially the claw and empodium, show morphological variation which suggests significant taxonomic characters in the Chloropoidea, but they have been little studied to date. Only limited information can be obtained with the SLM, and as yet I have had limited time and opportunity for work with the SEM.

In the tethinine genera *Dasyrhicnoessa*, *Pseudorhicnoessa*, *Tethina*, and *Thitena* the empodium has a slender

shaft with well-developed lateral branches. A similar empodium exists in the canacine genera *Canace* Haliday and *Nocticanace* Malloch. In *Pelomyia* the empodium has well-developed lateral and ventral branches (Fig. 34). In *Apetaenus litoralis* Eaton, *A. australis* (Hutton) (Fig. 36), *Neopelomyia*, and *Horaismoptera* the well-developed empodium appears to be simple, unless there are branches near the base that are not easily seen. *Tethinosoma* (Fig. 32) has apparently two unequal lateral branches from near the base of the empodium. In *Zalea minor* the empodium has well-developed lateral branches which are absent on the distal third (Fig. 33). In *Suffomyia ismayi* the branches are restricted to c. the basal third; the more distal branches are



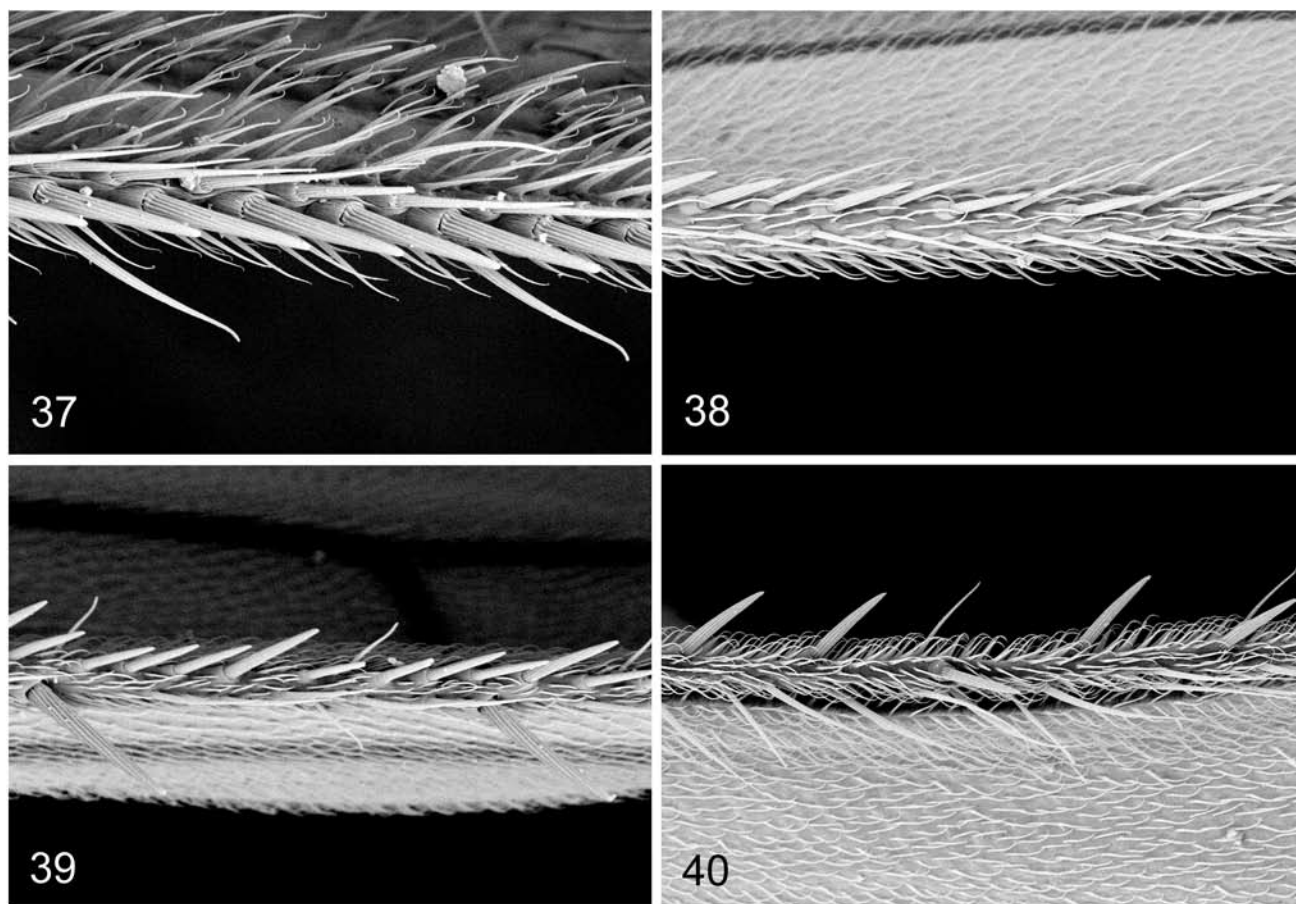
Figs 31–36. (31) *Dasyrhicnoessa* sp., claws and associated structures. (32) *Tethinosoma fulvifrons*, the same. (33) *Zalea minor*, the same. (34) *Pelomyia coronata* (Loew), empodium and bases of claws. (35) *Nocticanace arnaudi*, claws and associated structures. (36) *Apetaenus* (*Macrocanace*) *australis*, the same.

much longer than in *Z. minor*, but those near the base become progressively much shorter (CLM in glycerol). It cannot yet be stated whether these characters provide a generic difference between *Zalea* and *Suffomyia*.

The claw in *Tethina* (Fig. 30) is elongate, falcate, and slightly broadened near base, with a pair of weak longitudinal ridges on distal surface. In *Tethinosoma* (Fig. 32) and *Pelomyia* (Fig. 34) the essential structure is very similar. The claw of these taxa does not show a differentiation into basal shaft and distal falx (as defined by D. McAlpine, 1991). In *Dasyrhicnoessa* (Fig. 31) and *Zalea* (Fig. 33) the distal part of the claw (falx) is set apart from the basal part (shaft) in being broadened with a somewhat explanate inner

surface bearing a narrow to quite broad longitudinal ridge but no microtrichia. The claw of *Suffomyia ismayi*, viewed under higher magnification of CLM, is uniformly slender and falcate, with basal ventral tubercle and finely pointed apex; there is no differentiation into shaft and falx. The claw of *Suffomyia sabroskyi*, viewed only with SLM, appears essentially similar to that of *Zalea minor*, but the apex is more finely acuminate. It is thus very different from the claw of *S. ismayi*. Freidberg (1995) states for *S. scutellaris*: “claws widened and flattened centrally”. Claws studied of *Nocticanace* and *Isocanace* (subfamily Canacinae s.l.) are complex with some of the attributes of *Dasyrhicnoessa*.

Comparison with the outgroup Chloropidae (e.g.,



Figs 37–40. (37) *Dasyrhicnoessa* sp., part of costa of left wing beyond end of vein 1. (38) *Zalea dayi*, the same. (39) *Tethinosoma fulvifrons*, the same. (40) *Apetaenus* (*Macrocanace*) *australis*, the same.

Apotropina sp. and *Cadrema* sp., my studies with SEM suggests that the relatively simple claw type as in *Pelomyia* and *Tethinosoma* may be nearest the groundplan condition for Chloropoidea, that *Dasyrhicnoessa* and *Zalea* have a more derived claw type, and that the claw type of *Suffomyia ismayi* may be the result of reversal. This hypothesis needs testing from study of a greater range of taxa, preferably with SEM.

Costal chaetotaxy. The arrangement of the different categories of macrotrichium (sensu D. McAlpine, 1973) shows significant taxonomic variation in the Canacidae s.l. I attempt to use the terminology of Hackman & Väisänen (1985) both for the different kinds of macrotrichia and for their arrangement patterns, particularly for those on the section of the costa bordering the marginal cell (between veins 1 and 2).

The Tethininae (e.g., *Dasyrhicnoessa*, Fig. 37, *Pseudorhicnoessa*, and *Tethina*) have, in addition to seriate hairs and bristles, an anteroventral series of regular, closely placed spinules. This arrangement should comply with the description of type B2 by Hackman *et al.*, but they categorize the Tethinidae under group B1 which should have costal macrotrichia of uniform type. In *Pelomyia* and *Pelomyiella* the spinules are more weakly developed, especially in the latter, though they still form a regular series.

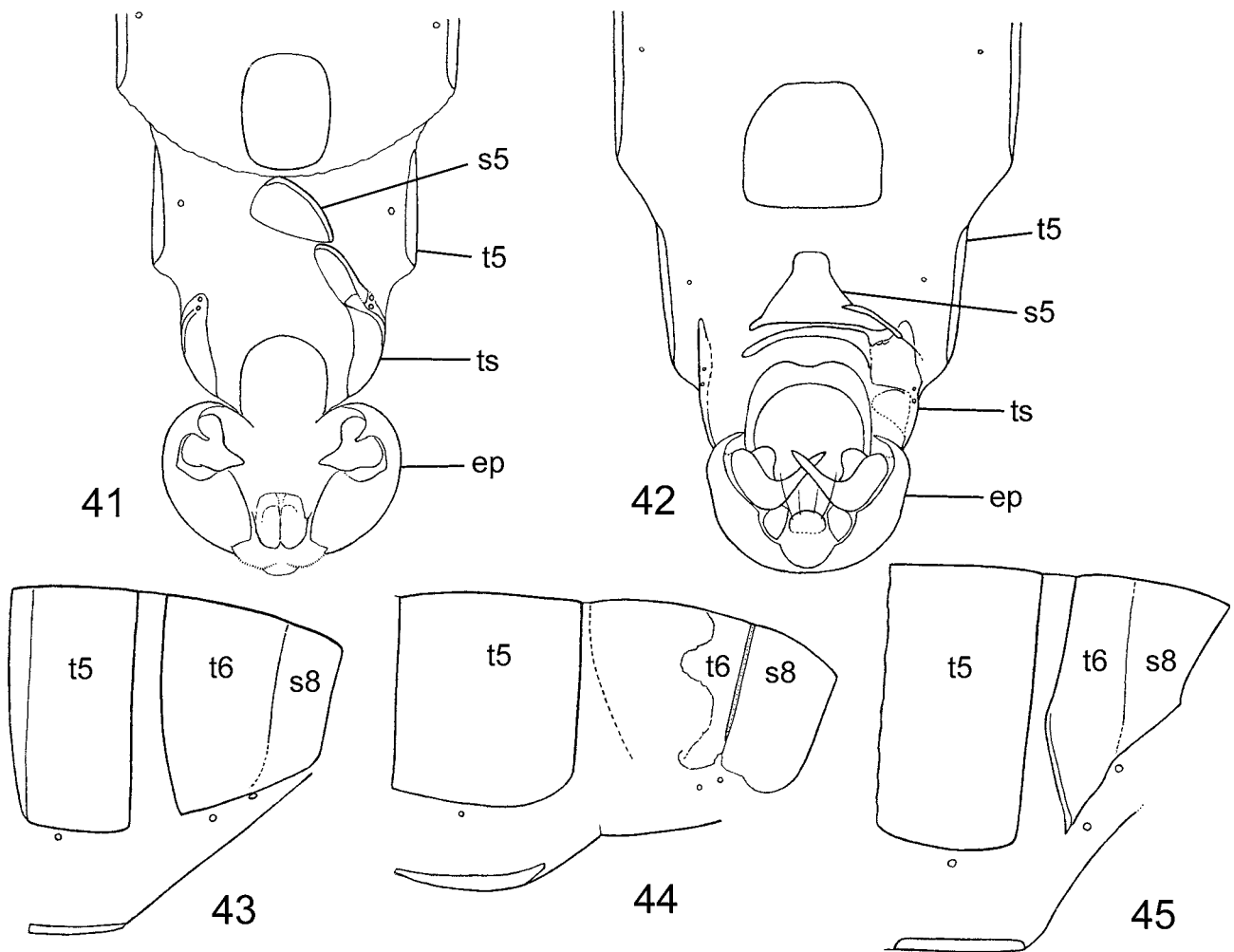
Tethinosoma and *Horaismoptera* differ from other canacids (s.l.) in that the section of the costa on marginal cell bears a relatively small number of large widely spaced spines, but the pattern is slightly different in the two genera.

The costa of *Tethinosoma* (Fig. 39) has an irregular series of anterodorsal spinules, and a series of short anteroventral hairs, in addition to non-seriate microtrichia; there are widely spaced anterodorsal spines, but these are much smaller and more irregular in size and placement than the prominent anteroventral spines. *Horaismoptera* differs in having the anterodorsal spinules stronger and more regularly placed, and the anterodorsal spines much larger than the anteroventral ones. Also, *Horaismoptera* has a very large costal spine immediately preceding the subcostal break, and an even longer spine preceding the humeral break. Both the humeral break and the associated spine are absent in other taxa of Canacidae s.l.

In *Zalea* (Fig. 38) and *Suffomyia* the costa has a series of anterior spinules, which are interspersed with more numerous hairs or short bristles. The spinules are thus more widely spaced than in the Tethininae. Even in the smallest zaleine species, *Suffomyia ismayi*, I find these spaced spinules to be well differentiated, c. 17 being present on the section of costa along the marginal cell.

Apetaenus (*Macrocanace*) *australis* (Hutton) (Fig. 40) has a series of anterodorsal costal spines on the marginal cell, but these are much smaller and less spaced than in *Horaismoptera*. In *A. (M.) littoreus* (Hutton) these spines are less developed.

In the Canacinae s.l. the arrangement of costal spinules varies. Often they are interspersed with hairs as in the Zaleinae (e.g., in *Isocanace* Mathis), or they may be in two series (e.g., in *Xanthocanace* Hendel and *Procanace* Hendel).



Figs 41–45. (41) *Apotropina* sp., male postabdomen, ventral view, hypandrium and associated parts omitted. (42) *Siphonellopsis lacteibasis* Strobl, the same. (43) *Zalea major*, segment 5 and protandrium. (44) *Tethinosoma fulvifrons*, the same. (45) *Pseudorhinoessa* sp., the same; *ep*, epandrium; *s5*, *s8*, sternites 5 and 8; *t5*, *t6*, tergites 5 and 6; *ts*, fused tergite 6 and sternite 8.

The veins of the anal region. In the Chloropoidea the veins of the anal region are reduced, by comparison with those of such superfamilies as Sciomyzoidea and Tephritoidea. In the groundplan of the Chloropidae the venation of this part is especially reduced but the probable groundplan condition of the superfamily is indicated by study of the other included families. The anal cell (cup or CuP) is enclosed, but small and compact. Its posterodistal angle probably gives rise only to a very short, stump-like sclerotized vein (vein 6 or CuA_2+A_1), as in Canacinae *s.l.* and Tethininae. Vein 7 (A_2 or $2A$) is visible as a curved crease in the membrane with little or no pigment or sclerotization, and does not reach the wing margin. The Carnidae do not agree with this pattern in that their groundplan (as indicated by *Hemeromyia* and *Neomeoneurites*) includes a well sclerotized distal section of vein 6, which is more posteriorly directed than that of any canacid (*s.l.*), and no visible trace of vein 7. In these points they more closely resemble the Odiniidae, Agromyzidae, and Clusiidae.

The groundplan of the Canacidae *s.l.* agrees with that of the Chloropoidea in the above character states. An apomorphy of the Zaleinae (probable autapomorphy for

the subfamily) is the absence of sclerotization of the anal crossvein (transverse section of vein CuA_2 or CuA), which leaves the anal cell open distally. Although the distal section of vein 6 is vestigial in the groundplan of the superfamily, as typified by the Canacinae *s.l.*, Zaleinae, and Tethininae, in the other canacid subfamilies there is a visible crease of variable length in the membrane beyond the anal cell, which appears to follow the old course of vein 6. In the Pelomyiinae the anal crease is rather short but rendered visible by a tract of denser microtrichia. In the Apetaeninae (macropterous forms) and the Horaismopterinae the anal crease is better developed and may reach the wing margin, for example, in *Horaismoptera* and subgenus *Macrocanace*. In *Horaismoptera* the crease is distinctly separated from the anal cell at its base. There is no such separation in *Macrocanace* where the crease is pigmented and looks rather like a genuine vein. However, it is much less sclerotized and less distinctly tubular than all other veins.

I regard the anal crease in the last three subfamilies as probably a secondary development, but I am not convinced that it is a synapomorphy for the three taxa.

Microtrichiation of wing membrane. The Canacidae *s.l.* have generally finer and much denser microtrichiation of the wing membrane than in the probably related families Chloropidae and Milichiidae. This condition is particularly developed in Apetaeninae (macropterous forms), the Canacidae *s.l.*, and the Zaleinae, and is less marked in the Tethininae, especially in *Dasyrhicnoessa*. In the Milichiidae, *Leptometopa* Becker approaches the canacid condition more closely than do other available genera. In the chloropid genus *Apotropina* Hendel, the dune-living *A. exquisita* (Malloch) has fine, dense, canacid-like microtrichiation, but the forest-living *A. nudiseta* (Becker) has very different coarse, spaced microtrichiation as in many other chloropid genera.

The correlation of fine, dense wing microtrichiation with sandy habitat may prove significant in some groups, but I do not find it to be consistent. In the Coelopidae, similarly-sized adults of *Baeopterus philpotti* (Malloch), *Chaetocoelopa sydneyensis* (Schiner), *Coelopa frigida* (Fabricius), and *Gluma musgravei* D. McAlpine all have coarser, less dense microtrichiation than that of *Rhis whitleyi* D. McAlpine. *Rhis whitleyi* is the only one of these species known to burrow actively in sand, and is perhaps more strictly confined to beach habitats in the adult stage. There seems to be a parallel here with *Apotropina* spp. By contrast, among the Canacinae *s.l.*, *Xanthocanace nigrifrons* Malloch, which lives on tidal sand-flats, has markedly coarser, less dense microtrichiation than *Nocticanace australis* Mathis, which inhabits rock pools.

The general presence of the fine, dense form of microtrichiation on the wings of canacids probably indicates that it is a groundplan condition for the family Canacidae *s.l.* The fact, that in the outgroups Chloropidae and Milichiidae this condition occurs in only a few, probably more derived taxa, probably indicates that the condition is an autapomorphy for the Canacidae *s.l.*, although the degree of its manifestation in the component taxa is a little variable.

The protandrial sclerites. Following Crampton (1942: 78) I use the term protandrium for the complex of segments between the preabdomen and the genital (ninth) segment in male Cyclorrhapha. In the Schizophora the term is best standardized to mean segments 6 to 8 of the male abdomen inclusively. Through misunderstanding, a particular sclerite in this region has sometimes been termed "protandrium".

In the groundplan of the Schizophora the sclerites of the protandrium have a very asymmetrical arrangement (Crampton, 1942), probably approximated by some modern Coelopidae (D. McAlpine, 1991: fig. 30). However, there are in the Schizophora many reduction series apparent in protandrial morphology and many of these have led to approximate or complete symmetry of the remaining sclerites.

In all but the most derived cyclorrhaphans, a large dorsal sclerite of the protandrium immediately in front of the genital segment is considered to represent the inverted sternite 8 (Crampton, 1942; Griffiths, 1972). However, J. McAlpine (1981) stated: "Also, sternite 7, tergite 8, and sternite 8 usually become more or less fused into a single syntergosternite that occupies a more or less dorsal position". Following this interpretation, many subsequent chapters in that manual (e.g., Vockeroth, 1987) designate this dorsal sclerite as syntergosternite 7 + 8. My own comparative studies of the protandrial sclerites in numerous

schizophoran families (e.g., D. McAlpine, 1985b, 1988, 1991) reveal no evidence that this dorsal sclerite generally incorporates tergite 8, which has probably generally been lost by desclerotization. Incorporation of sternite 7 in the dorsal sclerite has probably occurred in some lineages (see numerous diagrams in D. McAlpine, 1985b), but in many schizophoran taxa sternite 7 is only narrowly attached to sternite 8 or is quite separate. I do not therefore accept as a generalization for the Schizophora that sternite 7 forms part of this dorsal sclerite, and I continue the designation as sternite 8, except in those taxa where actual evidence for the compound nature of this sclerite is available.

In those families considered to constitute the superfamily Chloropoidea (sensu Colless & D. McAlpine, 1991, which includes families Chloropidae, Tethinidae, Canacidae, and possibly Milichiidae, but excludes the Carnidae) the only dorsal sclerite of the protandrium appears to be compounded of tergite 6 and sternite 8, on the evidence of (a) the presence of a visible trace of a transverse suture often accompanied by difference in texture between the usually short anterior and larger posterior parts of the sclerite; (b) the absence of any other sclerite conceivably representing tergite 6; and (c) the presence of two pairs of spiracles near its lateral margins (either in pleural membrane below margins of sclerite, or enclosed in sclerite). I treat this condition as a probable autapomorphy for the Chloropoidea. The condition has not been attained in the groundplan of Carnidae which, for this and other reasons, are excluded from the superfamily.

The inclusion of the Milichiidae in the Chloropoidea is ambiguous as it shows variation in some of the supposedly diagnostic characters, but the venation in the anal region of the wing is more like that of the Canacidae than that of the Carnidae. There is the well known modification of the spermathecae shared by the Chloropidae and Milichiidae sometimes considered to be a synapomorphy, but not by J. McAlpine (1989). Any attempt to associate the Acartophthalmidae with the Chloropoidea is likely to be erroneous in view of the complex and fundamental differences in venation, which include both plesiomorphic and apomorphic conditions in this family. Venational characters in the Schizophora are generally among the more stable characters, compared particularly with those of the male postabdomen, and possibly those of the spermathecae.

The most complete and plesiomorphic disposition of protandrial sclerites found in the Chloropoidea is apparently that occurring in certain taxa of the chloropid subfamily Siphonellopsinae, e.g., *Apotropina* Hendel, *Siphonellopsis* Strobl (Figs 41 and 42, see also Nartshuk, 1987: pl. 20). In these flies the protandrium is asymmetrical because of the positions of sternite 6 and the more reduced sternite 7, and the shape of sternite 5 is also asymmetrical. Most chloropid taxa of other subfamilies probably have segment 5 and the protandrium externally symmetrical or almost so. A species perhaps referable to *Psilacrum* Becker (subfamily Oscinellinae) is intermediate, having segment 5 symmetrical and no distinct sclerites representing sternites 6 and 7, but the compound dorsal protandrial sclerite is asymmetrical and much extended on to the pleural region on the left side. This condition is presumed to indicate that a vestige of sternite 7 and perhaps also of sternite 6 has become merged with the lateral margin of the dorsal sclerite. In *Batrachomyia nigratarsis* Skuse (subfamily Oscinellinae, author's observations) the dorsal sclerite is symmetrical,

with no sclerotization extending below the spiracles on either side, a condition indicating the elimination of the laterally placed sternite vestiges. Such a dorsal sclerite is deemed to consist of tergite 6 and sternite 8 only.

Zalea has the dorsal protandrial sclerite large, symmetrical, and evidently compound, (Fig. 43) much as in *Batrachomyia*. This is also the case in typical Canacinae *s.l.* (see Griffiths, 1972).

The Tethinidae have been characterized as having the protandrium symmetrical (Griffiths, 1972; Vockeroth, 1987), with the dorsal sclerite short (D. McAlpine, 1982; Munari, 1999). With further study of tethinid taxa, I no longer consider either condition to be either invariably present or present in the groundplan of the Tethinidae (in so far as a probably paraphyletic group can have a groundplan). The dorsal sclerite is asymmetrical in *Tethina nigriseta* Malloch, being distinctly produced downwards on the left side. Thus it resembles to some extent that of *Psilacrum* sp. mentioned above in apparently retaining evidence of sternite 7 merged with the dorsal sclerite. In *Tethina pallidiseta* Malloch this asymmetry is very slight, though discernible in well cleared specimens. Reduction in size of the tergite 6 component of the compound sclerite is evident in these tethinine taxa examined, including *Pseudorhinoessa* (Fig. 45).

It thus appears that in the groundplan of Canacinae *s.l.* the relatively short tergite 6 is fused to the larger sternite 8, to which a vestige of sternite 7 is fused on the left side. In the Canacinae *s.l.*, in *Masoniella* Vockeroth (see Vockeroth, 1987: figs 13, 14), and particularly in the Zaleinae (Fig. 43), tergite 6 is much larger in proportion to sternite 8. In *Tethinosoma fulvifrons* (Fig. 44) it shows evidence of late reduction from a relatively large sclerite by anterior desclerotization.

Small, often symmetrically placed sclerites on the ventral surface of the protandrium of Canacinae *s.l.*, including some zaleines, (see Papp, 1983: fig. 2; Griffiths, 1972: fig. 147) are probably secondary and not to be identified with particular sternites, from what is known of the reduction stages of these sternites.

The larval cuticle. The larvae remain undescribed for a majority of subfamilies of Canacinae *s.l.*, but are known for a few species of Apetaeninae and Canacinae *s.l.* (Ferrar, 1988, under Coelopidae and Canacidae; Womersley, 1937, under Phycodromidae). In *Procanace* Hendel, *Canaceoides* Cresson, and *Apetaenus* (including *Listriomastax*) a considerable area of cuticle in instar III is densely covered with processes, variously described as spicules, spines, scales, or sclerotized plates. These are quite distinct from the spinose or spiculate segmental creeping pads present in the majority of schizophoran taxa, but the little that is recorded of other tethinid-canacid larvae suggests that they may not be uniformly present in these larvae. Such processes are of infrequent occurrence among acalyptrate taxa, but somewhat similar, often finer processes occur in some taxa of Ephydriidae, Periscelididae, etc. where they have almost certainly arisen independently.

If, as appears probable, the cuticular processes are homologous in Apetaeninae and Canacinae *s.l.*, then their presence is probably a synapomorphy indicating relationship between these groups but not necessarily, on my present understanding, excluding other “tethinid” subfamilies from this alliance.

Classification

I have previously placed the Canacidae and Tethinidae in the superfamily Chloropoidea (see D. McAlpine, 1982; Colless & D. McAlpine, 1991). The Chloropoidea included the families Tethinidae, Canacidae, ?Milichiidae, and Chloropidae. Any broader superfamily concept is, I believe, very difficult to justify on the basis of conceived autapomorphies. The evidence for monophyly of the superfamily Carnoidea as constituted by J. McAlpine (1989) is unconvincing. I find no more evidence for synapomorphy between Carnidae and Chloropoidea (sensu Colless & D. McAlpine, 1991) than between Carnidae and Odiniidae-Agromyzidae.

Since I established the subfamily Zaleinae (D. McAlpine, 1982, 1985), doubtfully referring it to the Canacidae, the problem of its systematic position has been mentioned by several authors, for example, J. McAlpine (1989), Mathis (1989), Freidberg (1995). These authors did not offer a resolution to the problem, but considered the Zaleinae to be intermediate between the families Tethinidae and Canacidae, a view that is not phylogenetically meaningful. However, Munari (1999) took the step of transferring Zaleinae to the Tethinidae, referring to Freidberg (1995) as his basis for this action; but Freidberg concluded: “The Zaleinae, however, do not sufficiently match the synapomorphies of either the Canacidae or the Tethinidae and, therefore, cannot be assigned with confidence to either of these families as at present characterized”. All of the above authors have mentioned the possibility that the families Canacidae and Tethinidae might be united as a single family, but none appears to have made this family-level synonymy.

Griffiths (1972: 258) considered that the structure of the female postabdomen in the Canacidae *s.str.* was difficult to reconcile with the hypothesis of close relationship between this family and the Tethinidae. He pointed particularly to the elongation of segments 7 and 8 which he thought to be a synapomorphy connecting the Tethinidae with the tephritoid families (his prefamily Tephritoinea—a group no longer considered to have phylogenetic coherence). The female postabdomen of the Canacinae *s.l.* (typically as shown by Wirth, 1987: fig. 5) has distinctive apomorphies, but I see no reason why its structure should not have been ultimately derived from a type resembling that of the “tethinid” *Masoniella* (see Vockeroth, 1987: fig. 8). Griffiths (loc. cit.) commented on the resemblance of the female cercus of the heleomyzid genus *Dihoplopyga* Malloch to that of canacids. *Dihoplopyga* is a junior subjective synonym of *Blaesochaetophora* Czerny (D. McAlpine, 1985b), and has features of the wing and protandrium which exclude it from the Chloropoidea. The resemblance in the cercus (see Malloch, 1933: 191) is due to convergence.

Previously (D. McAlpine, 1982) I referred the Zaleinae with doubt to the Canacidae (as distinct from the Tethinidae), because I thought that the condition of the postvertical bristles and the protandrium in both groups involved exclusive synapomorphies. As indicated in the above discussion of these structures, I am no longer of that opinion.

I am now unable to identify any synapomorphy likely to unite all five subfamilies of the Tethinidae, as given by Mathis & Munari (1996) to the exclusion of the Canacidae *s.str.* For this reason and because of some possible groundplan synapomorphies for Tethinidae and Canacidae *s.str.* (possible

autapomorphies for Canacidae *s.l.*) and some less decisive cross-resemblances between included taxa, I take the step of synonymizing the Canacidae and Tethinidae n.syn. the former having nomenclatural priority.

The following three character states (discussed separately above) are here hypothesized as autapomorphies for the Canacidae *s.l.*

- 1 Mesopleuron (anepisternite) with an upwardly directed bristle on dorsal part, in addition to one or more posterior marginal bristles.
- 2 Wing membrane with unusually fine, dense microtrichiation.
- 3 Much of cuticle of larva (instar III) with covering of fine spicules.

Within the superfamily Chloropoidea the Canacidae *s.l.* are excluded from the apparent clade Chloropidae + Milichiidae by the presence of a pair of unmodified spermathecae. The latter clade was given by Hennig (1973), but, apparently without knowledge of the spermathecae in Carnidae, he was doubtful about the inclusion of the latter in the Milichiidae. The inclusion of the Risidae and Cryptochetidae in an otherwise similarly constituted clade by J. McAlpine (1989) is rejected by D. McAlpine (2002). *Risa* Becker was transferred to the Ephyridae by Griffiths (1990), and its position therein affirmed by Mathis & Zatwarnicki (1999).

I divide the Canacidae *s.l.* into six subfamilies, all of which have previously been recognized as such, though the Canacinae have generally been given separate family status in modern literature. The other five subfamilies were treated as subfamilies of Tethinidae by Mathis & Munari (1996).

In briefly treating these subfamilies below, I give their apparent autapomorphies, which provide the strongest evidence for monophyly of each, plus apomorphies which are shared with some other canacid taxa. The shared apomorphies are not necessarily to be interpreted as synapomorphies (homologous character states through the taxa mentioned), though some of them may be such. I do not now have the opportunity for a thorough cladistic study of the family.

Subfamily Tethininae Hendel, 1916 (as Tethinidae)

Included genera. *Afrotethina* Munari; *Dasyrhicnoessa* Hendel (including *Sigaloethina* Munari); *Pseudorhicnoessa* Malloch; *Tethina* Haliday (including *Rhicnoessa* Loew); *Thitena* Munari; ?*Plesiotethina* Munari.

Autapomorphy: frontal orbit with a series of proclinate-inclinate setulae.

Shared apomorphies: all fronto-orbital bristles strongly curved outwards (shared with Canacinae); humeral callus with at least two differentiated bristles (shared with Horaismopterinae).

Distribution. Most tropical and warm-temperate coasts of the world.

Subfamily Zaleinae D. McAlpine, 1985

syn. Zalinae D. McAlpine, 1982

Included genera. *Zalea* D. McAlpine; *Suffomyia* Freidberg.

Autapomorphies: postvertical bristles more or less divergent; prothoracic presternum broadened; fore basitarsus with some bifurcate ventral setulae; anal crossvein ($CuA_2 + A_1$) obsolete.

Shared apomorphies: claws differentiated into slender basal shaft and broadened distal falx (shared with *Dasyrhicnoessa*, condition reversed in *Suffomyia ismayi*); in compound protandrial sclerite, area of tergite 6 markedly greater than area of sternite 8 (shared with Canacinae). Possible apomorphy (relative to groundplan of Chloropoidea): eye with well-developed ommatrichia, c. as numerous as ommatidia (shared with some Tethininae).

Distribution. Australasia—tropical to cool temperate; Middle East.

Subfamily Horaismopterinae Sabrosky, 1978

Included genera: *Horaismoptera* Hendel; *Tethinosoma* Malloch.

Autapomorphies: antennae widely divergent from bases; antennal segment 2 with seriate short, stout spines or spinescent setulae on medial surface; one to three inclinate fronto-orbital bristles all situated below eclinate fronto-orbitals; costa with oblique, incised notch at subcostal break; costa, beyond subcostal break, with well spaced series of anterodorsal and anteroventral spines.

Shared apomorphies: distal section of vein 6 long and distinct (shared with Apetaeninae and, to some extent, with Pelomyiinae); humeral callus with at least two differentiated bristles (shared with Tethininae).

Distribution: New Zealand; shores of Indian Ocean; Middle East; Namibia.

Subfamily Apetaeninae Mathis & Munari, 1996

Included genus: *Apetaenus* Eaton. See Mathis & Munari (1996) for bibliographic data and list of species.

Autapomorphies: mid one of three fronto-orbital bristles further from eye than others; costa curved just before subcostal break (apparent only in macropterous forms); facial sclerotization sharply divided by complete median membranous strip (partial desclerotization only in some Tethininae and Zaleinae); area of wing membrane behind vein 6 and distad of alula reduced (apparent only in macropterous forms); syntergite 1 + 2 in female longer than rest of abdomen (condition approached in a few Canacinae).

Shared apomorphies: prelabrum enlarged (shared with Canacinae); terminal tarsomere triangular with median terminal bristle on a tubercle, with broad excavation on each side which forms a depression on dorsal surface (see Fig. 27; this condition approximated in some Canacinae, e.g., *Nocticanace arnaudi* Wirth, Fig. 28); vein 6 long and conspicuous (shared with Horaismopterinae); membranous strip separating tergites 1 and 2 in mid-dorsal region lost (shared with most Canacinae); cercus of female shining, without pruinescence (microtrichia) between setulae or almost so (shared with some Canacinae; cercus extensively pruinose in all other subfamilies).

Distribution: oceanic islands south of 45°S.

Listriomastax Enderlein was synonymized under *Apetaenus* by Hennig (1971), but Papp (1983) said that these two genera “are not closely related,” without giving reasons. *Macrocanace* Tonnoir & Malloch was synonymized under *Apetaenus* by Mathis & Munari (1996).

Macrocanace can be retained as a subgenus of *Apetaenus* to include *A. (Macrocanace) australis* (Hutton) and *A. (Macrocanace) littoreus* (Hutton). The subgenus includes consistently macropterous flies, with a series of long dorsal setulae on vein 1, the humeral bristle relatively large, and the setulae on abdominal tergites relatively short and inconspicuous—all character states contrasting with those of *Apetaenus* (*Apetaenus*) *litoralis* Eaton, the type species of *Apetaenus*. I do not have material for deciding if there are grounds for retention of *Listriomastax* as a subgenus. *Apetaenus littoreus* (Enderlein, 1909) is a secondary junior homonym of *Apetaenus littoreus* (Hutton, 1902) under Article 58.7 of ICZN (1999). I prefer not to introduce a replacement name for the former, until I feel assured of the stable congeneric status of the two species.

Subfamily Pelomyiinae Foster, 1976

Included genera: *Pelomyia* Williston; *Pelomyiella* Hendel; *Neopelomyia* Hendel; *Masoniella* Vockeroth. *Neopelomyia* differs from typical genera in facial structure, probably as a specially derived condition in this genus in connection with elongation of the proboscis. *Masoniella* has been placed in the Tethininae, but Foster & Mathis (2003) confirmed its placement in the Pelomyiinae.

Autapomorphies: fore coxa elongate; discal and second basal cells (dm and bm) confluent.

Shared apomorphies: lower margin of face and prelabrum displaced posteriorly on ventral surface of head (condition

shared with Horaismopterinae, approached in few Tethininae; condition probably reversed in *Neopelomyia*; condition unknown to me in *Masoniella*); distal section of vein 6 sharply defined (but quite desclerotized and not nearly reaching margin, condition in *Masoniella* unrecorded; this condition much more developed in Horaismopterinae and Apetaeninae).

Distribution: Americas; Palaearctic Region; temperate Australia. Unlike most canacids (*s.l.*), these flies are not restricted to coastal habitats.

Subfamily Canacinae Jones, 1906

Included genera: these were catalogued by Mathis (1992) under subfamilies Canacinae and Nocticanacinae (i.e. Canacidae *s.str.*). Australian genera were keyed by Mathis (1996).

Autapomorphies: postvertical bristle absent; face prominent, extensively visible in profile; prementum of proboscis very broad, deeply cleft distomedially; cercus of female basally thickened and fused with epiproct, distally with one or two thickened bristles.

Shared apomorphies: fronto-orbital bristles strongly curved outwards (shared with Tethininae); subcranial cavity and anteclypeus enlarged (shared with Apetaeninae); abdominal tergites one and two with intervening membranous strip in mid-dorsal region weakly developed or absent (consistently absent in Apetaeninae); compound dorsal sclerite of protandrium with tergite 6 markedly larger in area than sternite 8 (shared with Zaleinae).

Distribution: mainly tropical and warm temperate coasts of world; few cool temperate records, e.g., British Isles; few species found inland.

Key to subfamilies of Canacidae *s.l.*

- 1 Frontal orbit with three to five major outwardly inclined bristles, of which foremost is near level of ptilinal fissure, in addition to an inner series of three or more proclinate-inclinate shorter bristles or setulae; proclinate-inclinate interfrontal bristles in two distinct series; pair of convergent, often widely spaced postverticals present; costa along marginal cell with a continuous series of closely placed short black anterior spinules, and no series of longer, widely spaced spines; discal and second basal cells separate; anal cell closed; vein 6 not extending distinctly beyond anal cell, even as a sharp fold in membrane Tethininae
- Fronto-orbital bristles not arranged as above; if biseriate interfrontal bristles present, then either convergent postvertical bristles absent or anal cell open distally; other characters variable 2
- 2 Face, at least on lower part, almost vertical, not receding on to ventral surface; prelabrum thus located approximately as far forward as anterior surface of head capsule 3
- Face, in profile, convex below, markedly receding on to ventral surface of head; prelabrum thus markedly displaced posteriorly 5

Neopelomyia, probably referable to Pelomyiinae, disagrees in these characters, but differs from other subfamilies in having discal and second basal cells confluent.

- 3 Wing either vestigial, or with long vein 6 extending to margin; fronto-orbital bristles normally three, of which middle one is reclinate and further from eye than others; female: syntergite 1 + 2 longer than rest of abdomen *Apetaeninae*
- Wing unreduced, with vein 6 scarcely extending beyond anal cell; if three fronto-orbital bristles present, then middle one not further from eye than others; syntergite 1 + 2 not normally as long as rest of abdomen 4
- 4 Anal cell closed; face prominent, extensively visible in profile, entirely sclerotized; prelabrum large and very broad; prementum very broad, deeply cleft distomedially; tergites 1 and 2 without or with quite indistinct weak line of demarcation mid-dorsally; cercus of female basally thickened and fused with epiproct, distally tapered, with one or two spinescent bristles *Canacinae*
- Anal cell open distally; face not prominent; prelabrum of moderate size, c. half width of surrounding subcranial membrane, and not over one quarter width of head; prementum not much broader than long, nor deeply cleft; tergites 1 and 2 separated in mid-dorsal region by distinct membranous strip, fused at sides; cercus of female basally articulated, distally blunt, without spinescent bristles *Zaleinae*
- 5 Antennae widely divergent from bases; antennal segment 2 short, collar-like, with series of short, stout spines or spinescent setulae on medial surface; one to three incurved fronto-orbital bristles located below the two upper ecline fronto-orbitals; upper postocular bristle (behind outer vertical) present; scutellum dorsally setulose; fore coxa broad, less than $\frac{2}{3}$ as long as fore femur; costa with obliquely incised notch at subcostal break, beyond break with a well spaced series each of anterodorsal and anteroventral long spines; discal cell closed basally by well sclerotized vein *Horaismopterinae*
- Antennae subparallel; antennal segment 2 not remarkably short, with few fine setulae on medial surface; incurved fronto-orbital bristles absent; upper postocular bristle absent; scutellum without setulae; fore coxa elongate, at least $\frac{2}{3}$ as long as femur; costa with simple subcostal break, beyond break without such spaced spines; discal cell basally confluent with second basal cell *Pelomyiinae*

Subfamily *Zaleinae*

Diagnostic description

Head. Pseudopostocellar bristles absent; postvertical bristles proclinate, usually more or less divergent, at bases at most slightly closer to nearest inner vertical than to each other; fronto-orbital bristles three, all reclinate or posterior one variably curved outwards; vibrissa located either at anterior extremity of cheek (as seen in profile) or distinctly behind this point; facial ridge not prominent, without tubercle; face not prominent, usually nearly vertical, lightly sclerotized except on lower median part; eye with many well-developed ommatrichia, c. as numerous as ommatidial facets. Antennae subparallel, decumbent; segment 2 with any setulae on medial surface inconspicuous or absent; segment 5 usually stout, microtrichose; segment 6 with moderately dense short to moderate hairs. Subcranial area not enlarged; prelabrum well developed but not broad, not set back from anterior surface of head; proboscis of moderate dimensions; prementum longer than wide, not cleft distomedially; labella not posteriorly prolonged.

Thorax. Dorsocentral bristles four pairs; one humeral bristle differentiated; scutellum with two pairs of major bristles, sometimes also with one or two pairs of smaller bristles, but without dorsal setulae; prosternum with presternum at least moderately developed, basisternum with or without precoxal bridge. Costa on marginal cell with a series of anterior spinules interspersed at short intervals among more numerous hairs or short bristles; discal cell separate from second basal cell; anal cell open distally; distal section of vein 6 represented only by indistinct crease in membrane.

Abdomen. Tergites 1 and 2 separated in mid-dorsal region by narrow membranous strip, their combined length much less than that of rest of abdomen. Male: dorsal protandrial sclerite symmetrical (i.e. without visible vestige of sternite 7), remarkably large because of large tergite 6 component; epandrium with at least one pair of basally fully articulated surstyli; hypandrium (so far as known) with at least one comb of three bristles on each side. Female: postabdominal segments very extensile; cercus simple, straight, blunt, basally articulated, without spines.

Key to genera of *Zaleinae*

- 1 Postfrons without setulae between anterior ocellus and anterior margin; distal section of subcosta (beyond humeral crossvein) well sclerotized on c. middle third, obsolete and unpigmented on c. distal third, and much weakened towards base; first basal cell not separated from second basal cell by any sclerotized vein; ♂: only one pair of surstyli present; ♀: abdominal tergite 7 without anterior apodeme (♀ unknown in *S. ismayi*) *Suffomyia*
- Postfrons with several setulae on central anterior part; distal section of subcosta almost uniformly sclerotized from humeral crossvein to termination at subcostal break of costa; first and second basal cells almost or completely separated by a sclerotized vein; ♂: two pairs of surstyli present; ♀: abdominal tergite 7 with median, posteriorly forked apodeme attached to its anterior margin (Figs 56, 71–74, not yet investigated for *Z. wisei* etc.) *Zalea*

Genus *Zalea* D. McAlpine

Zale D. McAlpine, 1982: 108–110. (Preocc. Hübner 1818.) Type species (original designation) *Z. minor* D. McAlpine.

Zalea D. McAlpine, 1985: 82. Replacement name for *Zale* D. McAlpine.

Diagnostic description. Small to very small flies; wing c. 1.4–3.0 mm long. Arista three-segmented; antennal segment 4 distinct but small.

Head. Postvertical bristles proclinate, divergent to convergent; postfrons with several setulae on central part in front of ocelli, often tending to form a double series, like rudimentary interfrontal bristles, also with few smaller setulae on frontal orbits and between ocelli.

Thorax. Prothoracic precoxal bridge present or absent; acrostichal setulae biseriate, extending posteriorly to the distinct prescutellar acrostichal bristle; scutellum with two major bristle pairs and, in most species no other bristles or setulae. Mid femur with distal posteroventral comb of short suberect bristles in male (sometimes blunt and incrassate, always absent in female). Distal section of subcosta almost uniformly sclerotized from humeral crossvein to termination in subcostal break; anterior crossvein meeting vein 4 near or distad of mid-length of discal cell, except in *wisei* group; basal section of vein 4 separating first and second basal cells slender but well sclerotized; alula scarcely narrowed distally, with largely transverse distal margin, with marginal setulae much shorter than maximum width of alula.

Abdomen of male. Dorsal protandrial sclerite c. twice as long as tergite 5 or slightly less; two pairs of basally articulated surstyli present; hypandrium on each side with two combs of three closely placed setulae each, one comb much larger than the other (Fig. 53, setulae of smaller group not yet observed in some species though possibly present); distiphallus subcylindrical, elongate, but not very long, largely membranous, encircled by three prominent papillae (one posterior and two anterior).

Abdomen of female. Tergite 7 with median anterior posteriorly forked apodeme, which is incorporated in floor of pouch below margin of tergite 6 (not investigated for some New Zealand spp.)

Distribution. Australia: temperate coasts, but not yet recorded for Queensland and South Australia. New Zealand: North Island; South Island; Snares Islands.

Notes

The following two apparent autapomorphies, not present, so far as known, in *Suffomyia*, support the monophyletic status of *Zalea*: in male, base of distiphallus encircled by three membranous papillae; in female, tergite 7 with median, anterior, posteriorly forked apodeme. The aedeagal details have not been fully checked for the *wisei* group, but, in the only microscopic preparation of *Z. wisei*, there appear to be structures in the nature of membranous papillae. Although the presence of the internal apodeme is not yet confirmed for females of some New Zealand species, the doubtful species are closely related to better known ones, or others in which the external features of sternite 7 are consistent with the presence of an apodeme (as in the *wisei* group). The complex hypandrium in such diverse species as *Z. johnsi*, *Z. clava*, and *Z. minor* is so uniform and distinct from that of *Suffomyia scutellaris* as figured by Freidberg (1995), that it may provide further cladistic data when a better range of material is available.

The known species of *Zalea* are divisible into three morphologically well defined groups. It is uncertain if these are monophyletic, because of doubt as to the state of certain characters in the groundplan of the genus, e.g., orientation of postvertical bristles, prosternal structure, and presence/absence of certain bristles.

- 1 *Horningi* group: *Zalea johnsi*, *Z. mathisi*, *Z. uda*, *Z. ohauorae*, *Z. lithax*, *Z. horningi*, *Z. earlyi* (New Zealand).
- 2 *Wisei* group: *Zalea* sp. 1, *Z. wisei* (New Zealand).
- 3 *Minor* group: *Zalea clava*, *Z. minor*, *Z. major*, *Z. dayi* (Australia), ?*Zalea* sp. 2 (New Zealand).

These groups are characterized below in the key to species. It is added that the *horningi* group is the only one with bridged prosternum.

Key to species of *Zalea*

- 1 Scutellum with shorter pair of bristles at apex, in addition to two major pairs; anterior crossvein meeting vein 4 well before mid length of discal cell; posterior fronto-orbital bristle strongly curved outwards, not reclinate, in contrast to other fronto-orbitals; upper postgenal setulae forming an almost vertical series; wing typically over 2.1 mm long; habitat New Zealand (*wisei* group) 2
- Scutellum with two pairs of major bristles only; anterior crossvein meeting vein 4 at or beyond mid-length of discal cell; posterior fronto-orbital bristle reclinate and slightly curved outwards, its orientation not markedly different from mid fronto-orbital; upper postgenal setulae usually absent or little developed (except in *Z. earlyi*); habitat Australia or, if New Zealand, then wing under 2.1 mm long 3
- 2 Triangle formed from joining centres of ocelli broader than equilateral triangle; antennal segment 5 less than 2.5× as long as wide; palpus not extending anteriorly beyond prelabrum when proboscis is withdrawn; cheek region descending in outline and most prominent posteriorly (Fig. 70) *Zalea* sp. 1
- Triangle formed by joining centres of ocelli not broader than equilateral triangle; antennal segment 5 more than 3.5× as long as wide; palpus extending distinctly beyond prelabrum when proboscis is withdrawn; cheek region not more ventrally prominent posteriorly than anteriorly (Fig. 68) *wisei*
- 3 Prosternum with precoxal bridge on each side (Fig. 15); male (where known): posterior surstylus extensively microtrichose on outer surface; habitat New Zealand (*horningi* group) 4
- Prosternum without precoxal bridge (Fig. 16); male (unknown in sp. 2): posterior surstylus almost devoid of microtrichia; habitat mostly Australia, but see also sp. 2 (northern New Zealand) (*minor* group) 10
- 4 Postgenal setulae forming an almost vertical series; postvertical bristles slightly divergent to subparallel; female: tergite 7 with pair of separate broad lateral plates detached from T-shaped apodeme *earlyi*
- Postgenal setulae absent or little developed; postvertical bristles variable; female (where known): tergite 7 and its anterior apodeme forming a single, lobed sclerite 5
- 5 Postvertical bristles divergent; male: anterior surstylus much longer than posterior surstylus, strongly curved so that apex is directed posteriorly; posterior surstylus broad, with enlarged anterior setulae near mid-length *johnsi*
- Postvertical bristles convergent or rarely parallel; male: anterior surstylus variable, but usually not markedly longer than posterior surstylus; posterior surstylus without such large anterior setulae 6

In this section, only males are identifiable at present, but South Island and Snares Islands populations studied so far are probably referable to *Z. horningi*.

- 6 Anterior surstylus much compressed, subspatulate, nearly straight; posterior surstylus subovate, less than 3× as long as width near mid-length, without coarsely setulose sub-basal prominence *horningi*
- Anterior surstylus curved, slender or somewhat distally compressed; posterior surstylus variable 7
- 7 Posterior surstylus not over c. 2× as long as maximum width 8
- Posterior surstylus c. 4× as long as width near mid-length 9

- 8 Anterior surstylus very slender, rod-like, with few small setulae only; posterior surstylus subovate, very oblique basally, broadly rounded apically (Fig. 52) *mathisi*
- Anterior surstylus less slender, slightly compressed; its inner surface with numerous stout setulae, some of which are short and subconical; posterior surstylus subtriangular, with basal articulation transverse and apex subacute to narrowly obtuse (Fig. 54) *uda*
- 9 Anterior surstylus with all setulae fine, minute; posterior surstylus apically broadly rounded and compressed, gradually incurved *lithax*
- Anterior surstylus with some large setulae on inner surface, those near base relatively stout, distal ones quite long; posterior surstylus subangularly bent inwards near mid length, straight beyond, distally attenuated, its apex as slender as that of anterior surstylus *ohauorae*
- 10 Palpus much swollen distally, where more than half as deep as cheek; fore tibia with one posterodorsal bristle or outstanding setula slightly beyond mid-length, which is at least as long as tibial diameter; mid tibia with similar dorsal bristle near mid-length; female: paired sclerites of sternite 7 broad, separated by much less than width of each; habitat southwestern Australia *clava*
- Palpus slightly swollen distally, where less than half as deep as cheek; fore and mid tibiae with no such long dorsal or posterodorsal bristle; female: paired sclerites of sternite 7 narrower and separated by more than width of each; habitat eastern Australia 11
- 11 Males 12
- Females 14
- 12 Width of epandrium at least 0.38 mm (even in dried specimens); anterior surstylus broadest at base, markedly tapering from just beyond base; length of wing usually over 2.0 mm *major*
- Width of epandrium not over 0.32 mm; anterior surstylus not broadened at base; length of wing usually less than 2.0 mm 13
- 13 Mid femur with short, thick posteroventral bristles of distal comb all with finely pointed apices; anterior surstylus broad and scoop-like distally; posterior surstylus with finely pointed apex *dayi*
- Mid femur with short posteroventral bristles of distal comb mostly very blunt; anterior surstylus rod-like, though distally compressed; posterior surstylus with obtuse apex *minor*
- 14 Abdominal sternites 3, 4, 5 broad, all broader than long; paired sclerites of sternite 7 very narrow, separated by more than four times width of each (Fig. 85) *dayi*
- Abdominal sternites 3, 4, 5 narrow; paired sclerites of sternite 7 not attenuated, separated by less than three times width of each (Fig. 84) 15
- 15 Tergite 6 markedly desclerotized on middle of posterior margin, markedly broader than tergite 5 and encroaching on pleural region on posterolateral angles, sternite 6 medially notched, not divided; tergite 7 divided in two by extensive median desclerotization (Fig. 78), connected only by forked apodeme; length of wing usually over 2.0 mm *major*
- Tergite 6 not or only slightly desclerotized on posterior margin, scarcely broader than tergite 5; sternite 6 divided in two; tergite 7 imperfectly divided, sclerotized on almost full width of posterior margin (Fig. 76); length of wing usually less than 1.9 mm *minor*



Figs 46, 47. (46) fungal ascomata on ventral surface of wing of *Zalea minor*. (47) fungal ascomata on hind tibia of *Z. minor*.

***Zalea johnsi* n.sp.**

Figs 15, 24, 25, 48, 50, 51

Material examined. HOLOTYPE ♂, New Zealand (South Island): Kaikoura Peninsula [East Head on some maps], 26–28.i.2000, D.K.M., R.M. (NZAC). Dry-mounted on triangular card. PARATYPES. South Island: 5 ♂♂, 2 ♀♀, same data as holotype (AM, CMC, USNM); 6 ♂♂, 2 ♀♀, Paratai Point, Kaikoura district, 26–27.i.2000, D.K.M., R.M. (AM, NZAC, ZMC).

Other material. South Island: 2 ♀♀, Jackson's Bay, near Haast (AM).

Description (♂, ♀). Appearance and habitus resembling those of *Z. minor*, *Z. horningi*, etc.

Coloration. Head predominantly grey-brown; anterior margin of postfrons narrowly rather yellowish brown; parafacial and much of cheek yellowish with covering of pale grey pruinescence; hypofacial and posterior extremity of cheek darker, greyish. Antenna tawny-brown; segment 3 darker distally than basally; arista blackish. Prelabrum grey-brown; palpus greyish tawny. Thorax with blackish ground colour; mesoscutum and scutellum with brown pruinescence; pleura with grey to greyish brown pruinescence. Legs, including tarsi, dark greyish brown. Wing membrane uniformly smoky grey; veins dark brown. Halter yellow, with pale creamy capitellum. Abdomen dark grey-brown, almost entirely pruinose; in male, anterior surstylus shining brown, darkest towards base; in female, tergite 7 extensively shining black anteriorly, pruinose dark grey towards posterior margin; cercus of female brown.

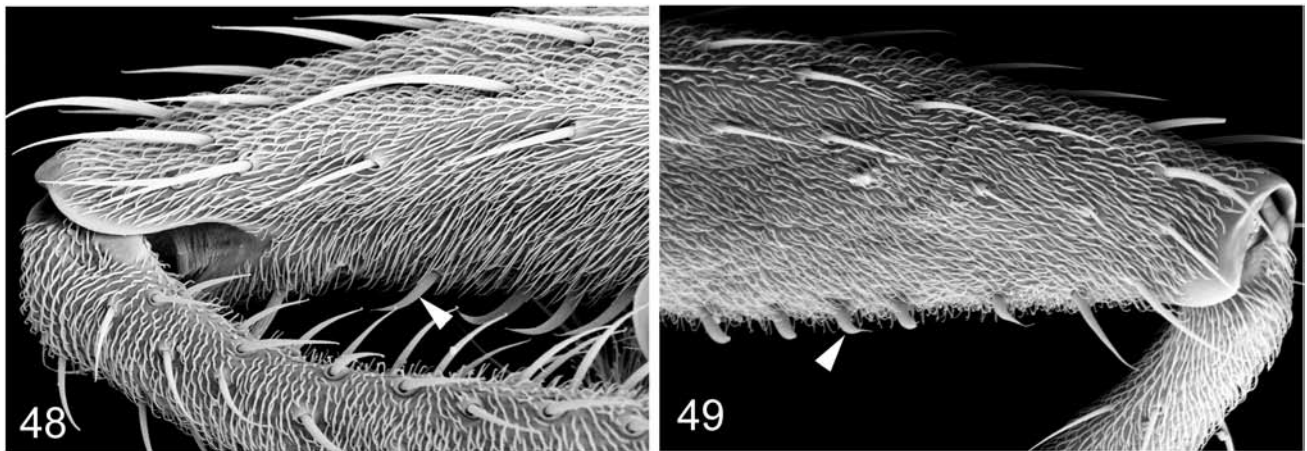
Head and eye both much higher than long; height of cheek c. 0.23–0.27 of height of eye; face almost flat and vertical (when uncollapsed), but recessed between parafacials on upper part; vibrissal region of cheek less anteriorly produced than in *Z. major* and *Z. minor*, so that the moderately short vibrissa is situated almost at its anterior extremity, as seen in profile; postgenal setulae absent; postvertical bristles divergent, much smaller than ocellars and fronto-orbitals. Palpus shorter than in Australian species, slightly widened distally.

Thorax. Prosternum with well sclerotized precoxal bridge; scutellum without setulae, with only the two pairs of major bristles. Mid femur of male with a mostly sparse series of

posteroventral bristles, those just beyond mid-length shorter, slightly thickened, more closely placed, with curved sharp apices, forming ill defined comb; in female posteroventral bristles of mid femur absent or little differentiated from setulae; fore tibia generally with three or more dorsal to posterodorsal setulae or bristles, as long as or longer than tibial diameter; mid and hind tibiae also with some moderately long dorsal setulae or bristles. Wing: cell-4 index = 0.50–0.58.

Abdomen. Sternite 1 divided into two small, widely separated sclerites; sternite 2 without accessory sclerites. Male: epandrium coarsely setulose, without any distinct bristle pairs; anterior surstylus slender, much curved so that slender but compressed apical part is directed posteriorly, with scattered setulae longest on posterior surface of basal half, and with few microtrichia restricted to inner surface near apex; posterior surstylus broad, narrowly rounded at apex, strongly incised posteriorly at base to produce sub-basal prominence, very extensively microtrichose except near anterior margin, outer surface with scattered small setulae and longer ones towards anterior margin, inner surface with large, stout setulae particularly developed towards base; each anterior papilla of aedeagus with lightly pigmented longitudinal strip, distally slender, smooth, tapering to fine point; posterior papilla stout, only gradually tapering to obtuse apex; distiphallus smooth, rather abruptly contracted before acuminate apex; cercus smaller than in *Z. horningi*. Female: sternites 2 to 6 not longer than wide; sternite 4 distinctly divided in two, but others entire or imperfectly divided; tergite 6 not markedly desclerotized on posterior margin; tergite 7 rather similar to that of *Z. minor*, weakly sclerotized rather than desclerotized medially, broad with much of posterior margin transverse (rather than narrowly rounded on each side as in *Z. horningi* and *Z. sp. 1*), with anterior part of tergite extensively shining black and glabrous, with posterior margin (often the only part visible in dried specimens) grey-pruinose, with anterior apodeme not distinctly forked as it merges with thickened anterior margin of tergite; sternite 7 with pair of sclerites separated by c. twice width of each.

Dimensions. Total length, ♂ 1.3–1.5 mm, ♀ 1.5–1.6 mm; length of thorax, ♂ 0.6–0.7 mm, ♀ 0.6–0.8 mm; length of wing, ♂ 1.5–1.7 mm, ♀ 1.7–1.9 mm.



Figs 48, 49. (48) *Zalea johnsi*, male, part of right mid femur, posteroventral comb indicated. (49) *Z. minor*, the same.

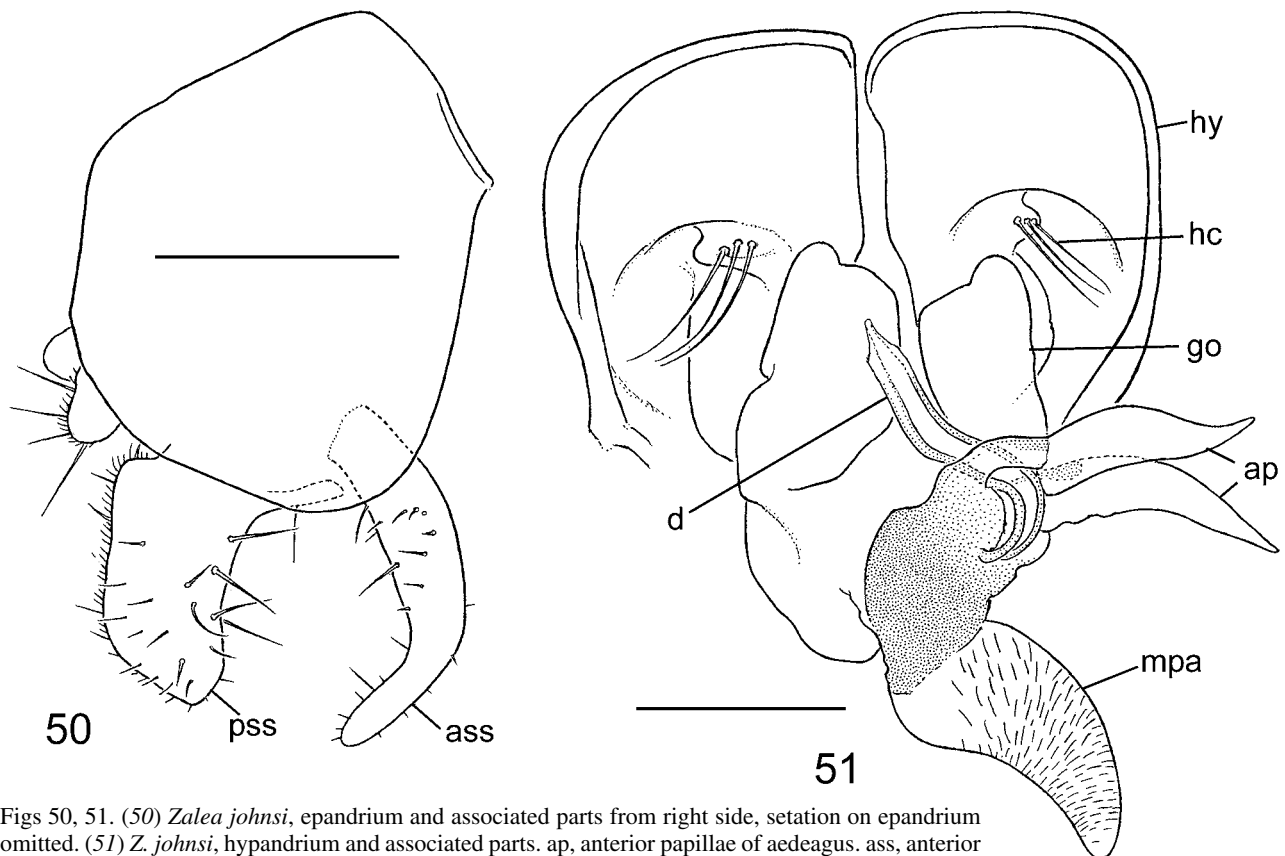
Distribution. New Zealand: South Island—northeast coast and apparently west coast. Only females are available from Jackson's Bay on the west coast. It is desirable that males be obtained from this population to confirm its specific identity.

Notes

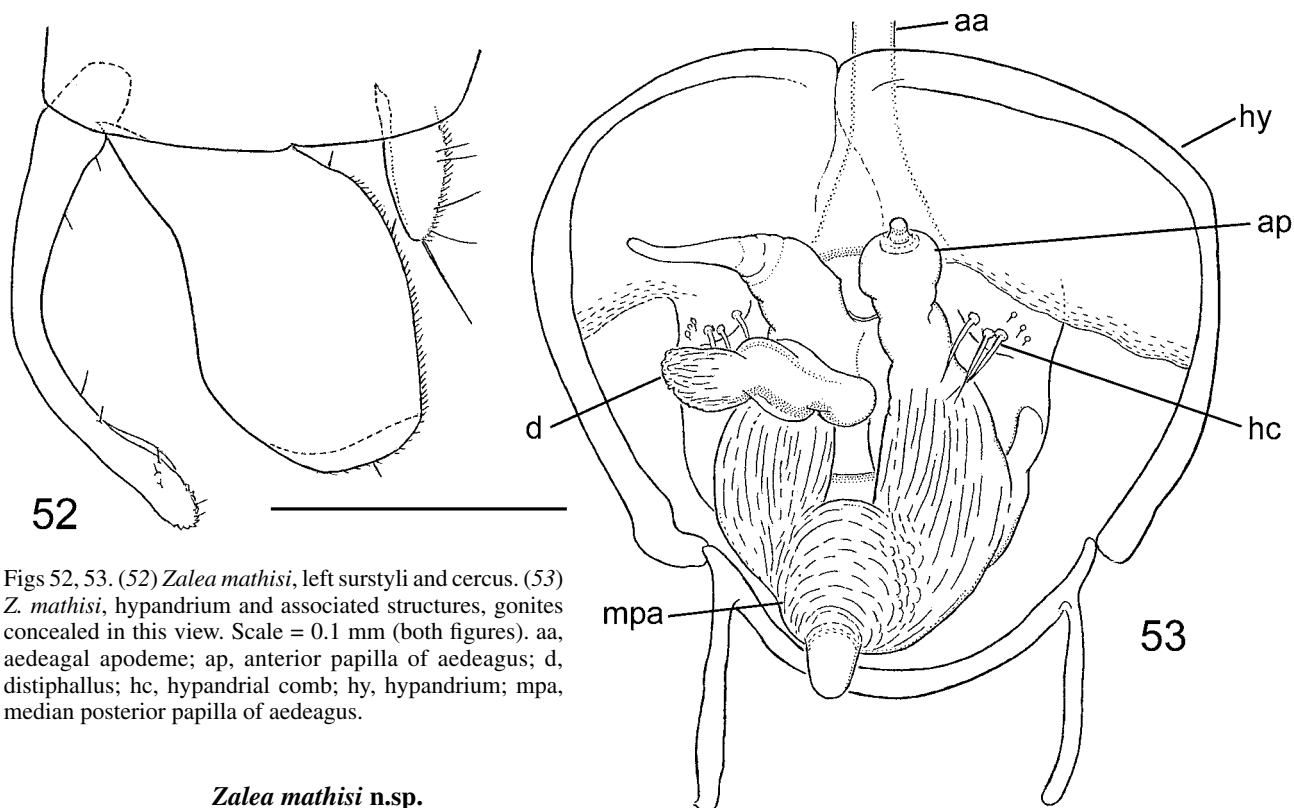
Zalea johnsi is very similar to *Z. horningi* which it resembles especially in the well-developed prothoracic precoxal bridge (often not easily visible in dried specimens), the position of the vibrissa very close to anterior extremity of cheek, the

relatively long dorsal setulae on the tibiae, and, in the male, the broad, densely microtrichose posterior surstylus. *Zalea johnsi* is most readily distinguished from *Z. horningi* by the characters given in the key, also by those of the aedeagal papillae, distiphallus, and female abdominal sternites, as given in the descriptions. For comparison with other species of the *horningi* group see under those species, and particularly compare the figures of postabdominal structures.

The specific epithet refers to Peter M. Johns in recognition of his generous help and sharing of field knowledge during my field work in New Zealand.



Figs 50, 51. (50) *Zalea johnsi*, epandrium and associated parts from right side, setation on epandrium omitted. (51) *Z. johnsi*, hypandrium and associated parts. ap, anterior papillae of aedeagus. ass, anterior surstylus. d, distiphallus. go, gonite. hc, hypandrial comb. hy, hypandrium. mpa, median posterior papilla. pss, posterior surstylus. Both scales = 0.1 mm.



Figs 52, 53. (52) *Zalea mathisi*, left surstyli and cercus. (53) *Z. mathisi*, hypandrium and associated structures, gonites concealed in this view. Scale = 0.1 mm (both figures). aa, aedeagal apodeme; ap, anterior papilla of aedeagus; d, distiphallus; hc, hypandrial comb; hy, hypandrium; mpa, median posterior papilla of aedeagus.

***Zalea mathisi* n.sp.**

Figs 52, 53

Material examined. HOLOTYPE ♂, New Zealand: Whanaki South (35°31.1'S 174°27.2'E), North Island, 6–8.x.2002, D.M., W.N.M. (NZAC by agreement from USNM, 00184020). Dry-mounted on micro-pin through polyporus pith. PARATYPES New Zealand: 12 ♂♂, same data as holotype but some 19.ii.1998 (NZAC, AM, USNM); 3 ♂♂, Sandy Bay (35°33.4'S 174°28.5'E), 6.x.2002, D.M., W.N.M. (USNM).

Description (♂, ♀ unknown). Very similar to *Z. johnsi*, agreeing with description of that species, except as indicated below.

Coloration. Agreeing with that of *Z. johnsi*.

Head. Height of cheek = 0.20–0.28 of height of eye; postvertical bristles generally convergent and proclinate, parallel in one specimen.

Thorax. Wing: cell-4 index = 0.49–0.57.

Abdomen. Anterior surstylus very attenuated but with similar curvature to that of *Z. johnsi*, with scattered, fine setulae, apparently without microtrichia, but densely minutely denticulate on small apical area; posterior surstylus broadly subovate, its distal margin broadly rounded, with no armature on anterior margin, nearly all setulae being scattered on inner surface but not particularly developed towards base, with central to posterior and apical parts of outer surface pruinose, anterobasal part bare; each anterolateral papilla of aedeagus with slender obtuse apical section; posterior papilla massively swollen and rugose at sides where it overlies basiphallus, tapering to rounded apex; distiphallus rugose distally, not tapered.

Dimensions. Total length 1.2–1.4 mm; length of thorax 0.55–0.67 mm; length of wing 1.3–1.6 mm.

Distribution. New Zealand: North Island, Northland.

Notes

Identification of North Island species in the *horningi* group (other than *Z. earlyi*) relies mainly on male postabdominal characters, especially the shape and armature of the surstyli. Associated females for these are largely absent, but there are indications that the female postabdomen may provide diagnostic characters for at least some species. Males of *Z. mathisi* are distinguished by the very attenuated, weakly setose anterior surstylus and the broadly subovate posterior surstylus with oblique base and very few or no setulae on its outer surface.

The specific epithet refers to Wayne N. Mathis, who collected the type series.

***Zalea uda* n.sp.**

Figs 54, 55

Material examined. HOLOTYPE ♂, New Zealand: Sandy Bay (35°33.4'S 174°28.5'E), 6.x.2002, D.M., W.N.M. (NZAC). Dry-mounted on micro-pin through polyporus pith, genitalia in microvial. PARATYPE 1 ♂, New Zealand, same data as holotype (USNM).

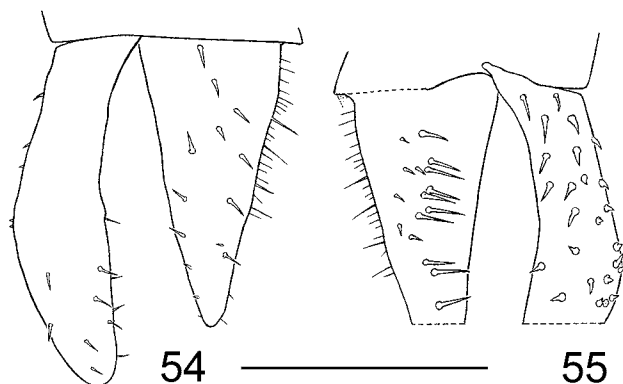
Description (♂, ♀ unknown). Very similar to *Z. johnsi*, agreeing with description of that species, except as indicated.

Coloration. Agreeing with that of *Z. johnsi*.

Head. Height of cheek = 0.18–0.21 of height of eye; postvertical bristles convergent.

Thorax. Wing: cell-4 index = 0.46–0.48.

Abdomen. Anterior surstylus moderately elongate, compressed, broadest slightly beyond mid-length, very



Figs 54, 55. (54) *Zalea uda*, left surstyli, outer aspect. (55) *Z. uda*, left surstyli, part, inner aspect. Scale = 0.1 mm.

obtuse apically, sparsely setulose on distal half of outer surface, on basal two thirds of inner surface with numerous stout setulae, some of which are short and subconical; posterior surstylus subtriangular, broadest at base, subacute to narrowly obtuse apically, its width at base slightly over half its length, with pruinescence restricted to posterior part of outer surface, with scattered moderately small setulae on outer surface, on inner surface with much larger setulae as well as some small ones, not restricted to basal part; hypandrium and aedeagus with general features of *Z. mathisi*; gonite broad; cercus resembling that of *Z. mathisi*.

Dimensions. Total length c. 1.3 mm; length of thorax 0.57–0.64 mm; length of wing 1.4–1.5 mm.

Distribution. New Zealand: North Island, Northland.

Notes

At present *Z. uda* can only be distinguished from related species of the *horningi* group by the shape and armature of the surstyli. It is conceivable that the female postabdomen may also provide diagnostic characters.

The specific epithet is a Latin adjective meaning wet, in reference to the habitat.

Zalea ohauorae n.sp.

Figs 56, 57

Material examined. HOLOTYPE ♂, New Zealand: Ohauora (or Rocky Point), White Island, North Island vicinity, 6.xii.1966, K.A.W. (AMNZ). "Swept shore landing". Dry-mounted on subtriangular card, genitalia in microvial.

Other material. 1 ♀, same data as holotype (AMNZ).

Description (based on ♂, except where indicated). Very similar to *Z. johnsi*, agreeing with description of that species, except where indicated.

Coloration. Anterior part of postfrons tending to yellowish brown, but not on a defined zone. Palpus tawny.

Head (slightly collapsed in holotype) probably essentially similar to that of *Z. lithax*; vibrissa longer than *Z. lithax* and *Z. johnsi* (see comments below); postvertical bristles probably convergent (displaced in holotype, strongly convergent in associated female).

Thorax. Wing: cell-4 index = 0.55 (0.53 in associated female).

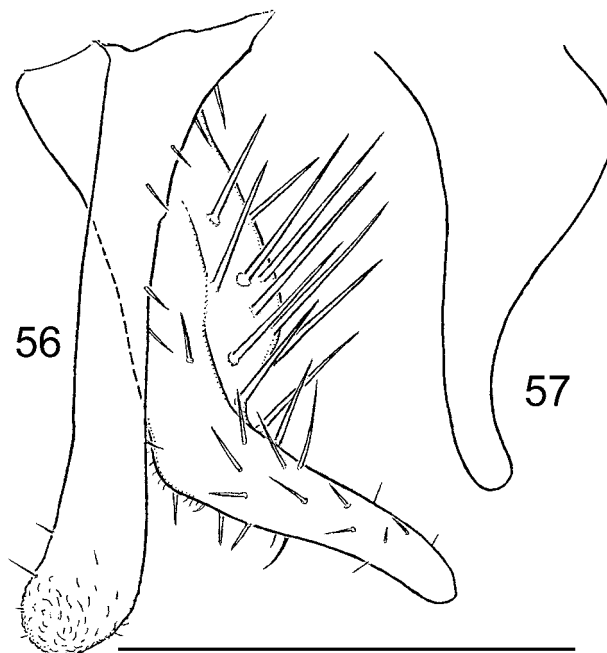
Abdomen. Epandrium with pair of distinct bristles near anterior margin; anterior surstylus slender, rod-like, its apex rounded, slightly expanded, compressed, and curved posteriorly, with some moderately large setulae on inner surface, those near base relatively stout, distal ones slender and quite long, with short microtrichia confined to roughened area at apex; posterior surstylus relatively broad basally with posterior gibbosity, distally slender and scarcely compressed, basal part with irregular group of very large setulae, particularly on posterior part of inner surface, distal part with smaller scattered setulae, with microtrichia concentrated near middle of outer surface; cercus small, with few setulae.

Dimensions. Total length, ♂ c. 1.4 mm (♀ 1.6 mm); length of thorax, ♂ 0.62 mm (♀ 0.68 mm); length of wing, ♂ c. 1.3 mm (♀ c. 1.5 mm); length of vibrissa, ♂ 0.10 mm (♀ 0.11 mm).

Distribution. New Zealand: North Island vicinity. There has been little collecting on White Island, an active volcano, c. 50 km from the shore of North Island in the Bay of Plenty and difficult of access (see Parham, 1973: 19, 119). The habitat of *Z. ohauorae* may have been altered recently by ash clouds (K.A.W. in litt.). There is at present no reason to assume that *Z. ohauorae* is endemic to White Island.

Notes

As with other New Zealand species having convergent postvertical bristles, this species can only be recognized reliably by male genitalia characters. The holotype and one of the two females from the same locality have longer vibrissae than most specimens I assign to *Z. lithax* (measurements given above), but this measurement is not consistent in other species. As indicated above, female abdominal characters are useful for separating *Z. johnsi*, *Z. lithax* and *Z. horningi*, but good fresh material with abdominal segments extended has



Figs 56, 57. (56) *Zalea ohauorae*, right surstyli, anterior view, scale = 0.1 mm. (57) the same, left posterior surstylus, approximate outline, outer surface view, not to scale.

not been available for this and some other species.

The specific epithet refers to the type locality and is treated as a Latin noun in the genitive case.

***Zalea lithax* n.sp.**

Figs 58, 59

Material examined. HOLOTYPE ♂, New Zealand: Whangaparapara Harbour, Great Barrier Island, North Island vicinity, 21.iii.1973, K.A.W. (AMNZ). "Swept stony beach W. side." Dry-mounted on subtriangular card, genitalia in micro-vial. PARATYPES. North Island vicinity: 2♂♂, 1♀, same data as holotype (AM, AMNZ); 3♂♂, 5♀♀, Medlands Beach, Great Barrier Island, 4.xi.2001, J.W.E. (AM, AMNZ), in alcohol; 3♂♂, 3♀♀, Awana Bay, Great Barrier Island, 19.ii.2002, J.W.E. (AM, AMNZ), in alcohol; 1♂, Takou Bay (35°6.3'S 173°56.7'E), 7.x.2002, D.M., W.N.M. (NZAC); 5♂♂, Whananaki South (35°31.1'S 174°27.2'E), 6–8.x.2002, D.M., W.N.M. (NZAC, USNM, AM); 1♂, Sandy Bay (35°33.4'S 174°28.5'E), 6.x.2002, D.M., W.N.M. (USNM).

Other material. South Island: 4♂♂, Cable Bay, Nelson district (41°09.6'S 173°24.9'E), 13.ii.1998, W.N.M. (NZAC, USNM, AM).

Description (♂, ♀). Very similar to *Z. johnsi*, agreeing with description of that species, except where indicated.

Coloration. Hypofacial only indistinctly darkened. Palpus dull yellow. Thorax and abdomen as described for *Z. johnsi*. Female: tergite 7 lightly pigmented, with only the narrow apodeme dark.

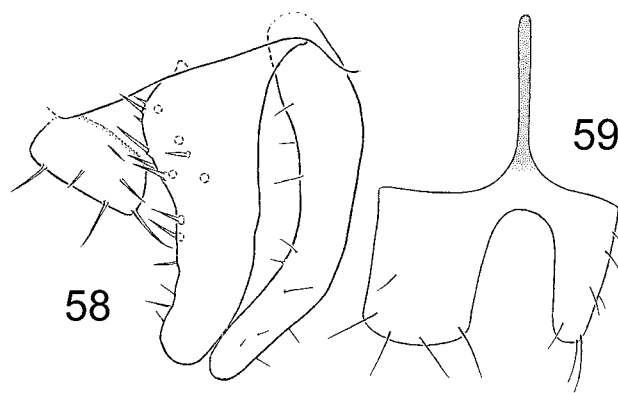
Head. Height of cheek 0.15–0.22 of height of eye; postvertical bristles rather small, strongly convergent; vibrissa rather short, but not much shorter than anterior peristomial bristles.

Thorax. Wing: cell-4 index = 0.52–0.56.

Abdomen. Male: epandrium with pair of moderately distinct, widely spaced bristles near anterior margin; anterior surstylus slender, rod-like, curved, rounded and compressed at apex, not as long nor as markedly posteriorly directed on distal part as in *Z. johnsi*, with only very fine scattered setulae, except for one or two longer ones on inner surface near base, with microtrichia restricted to inner surface near apex; posterior surstylus extensively microtrichose, more elongate than in *Z. johnsi* and *Z. horningi*, about as long as anterior surstylus (though appearing shorter in Fig. 58), very obtuse at apex, with posterior sub-basal gibbosity, with very few fine setulae anteriorly, and coarser setulae posteriorly, including some on and near posterior gibbosity; cercus short. Female: sternite 1 vestigial; sternites 4 to 6 medially little sclerotized and more or less divided in two; tergite 7 with relatively small anterior apodeme, spreading into broad rami posteriorly, each of which is confluent with a rather broad posterolateral plate; sternite 7 forming pair of plates, each separated from tergite by narrow pleural membrane.

Dimensions. Total length, ♂ 1.3–1.5 mm, ♀ 1.5 mm; length of thorax, ♂ 0.55–0.61 mm, ♀ 0.57–0.68 mm, length of wing, ♂ 1.2–1.5 mm, ♀ 1.5–1.6 mm.

Distribution. New Zealand: North Island vicinity—Great Barrier Island and Northland. South Island—far north.



Figs 58, 59. (58) *Zalea lithax*, right surstyli and cercus, slightly posterior of lateral view, posterior surstylus slightly foreshortened apically through curvature, scale = 0.1 mm. (59) *Zalea lithax*, tergite 7 of female, precise dorsal view, but left lateral plate spread flat, right plate shown in round.

Notes

Recognition of this species depends largely on postabdominal characters in both sexes, but there is no evidence of such closely related species as *Z. mathisi* and *Z. ohauorae* inhabiting Great Barrier Island or the vicinity.

The specific epithet is a Greek adjective meaning stony, in reference to the habitat.

***Zalea earlyi* n.sp.**

Figs 60, 61

Material examined. HOLOTYPE ♀, New Zealand: Medlands Beach, Great Barrier Island, North Island vicinity, 4.xi.2001, J.W.E. (AMNZ). "Intertidal rocks ... swept L11022." In alcohol. PARATYPE. 1♀, New Zealand: Ike Island, Noisies Islands, Hauraki Gulf, North Island vicinity, 9.xii.1979, K.A.W. (AMNZ). Dry-mounted on card.

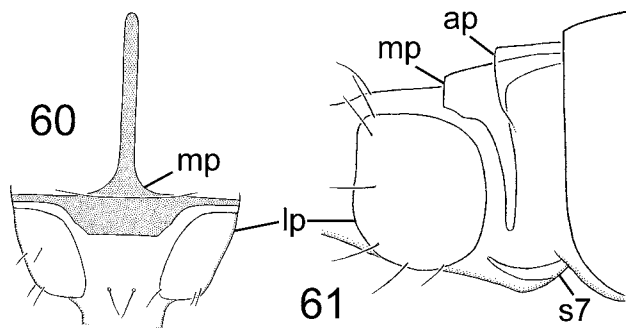
Description (♀, ♂ unknown). Somewhat similar to *Z. johnsi*, agreeing with description of that species, except as indicated.

Coloration (based mainly on dry-mounted paratype). Postfrons rusty-brown, with orbits and frontal triangle dark greyish; face, parafacial and cheek pale yellowish; hypofacial and prelabrum pale grey. Palpus tawny-yellow. Halter dull yellowish. Abdomen: anterior section of tergite 7 quite black, its lateral plates grey-brown; cercus grey-brown.

Head and eye both higher than long; height of cheek c. 0.30 of height of eye; face slightly concave; vibrissal angle not prominent in profile; postgenal setulae well developed, c. four of them forming an almost vertical series; postvertical bristles slightly divergent to almost parallel, a little smaller than ocellars and larger fronto-orbitals. Palpus slightly clavate.

Thorax. Prosternum with narrow, distinct precoxal bridge. Mid femur without differentiated posteroventral bristles; fore tibia with several dorsal setulae almost as long as tibial diameter; those on mid and hind tibiae shorter. Wing: cell-4 index = 0.54–0.59.

Abdomen. Sternite 1 divided into two well developed but widely separated plates; sternites 3 to 6 well sclerotized, undivided; tergite 6 not noticeably sinuate or desclerotized



Figs 60, 61. (60) *Zalea earlyi*, female, dorsal view of abdominal segment 7, showing tripartite tergite. (61) the same, right lateral view of segment 7. *ap*, pouch containing apodeme; *lp*, lateral plate of tergite 7; *mp*, anteromedian plate of tergite 7 with apodeme; *s7*, sternite 7.

on posterior margin; tergite 7 with separate anteromedian and paired posterolateral plates; anteromedian plate smooth with long anterior apodeme and pair of slender lateral arms arising from short central plate; each lateral plate rather short, about as broad as long, setulose; dorsal membrane between lateral plates with pair of setulae; sternite 7 apparently divided into two plates but details not observed.

Dimensions. Total length 1.8 (dried, abdomen deflexed)–2.3 mm; length of thorax 0.93–0.98 mm; length of wing 2.0 mm.

Distribution. New Zealand: North Island vicinity—Great Barrier Island and Hauraki Gulf.

Notes

Zalea earlyi resembles other New Zealand *Zalea* species with prothoracic precoxal bridge (e.g., *Z. horningi*, *Z. johnsi* etc.), but these all lack the well-developed set of postgenal setulae, and the females, where known, do not have tergite 7

divided into three separate plates. *Zalea wisei* and sp. 1 have similar postgenal setulae, but lack the precoxal bridge and have apical scutellar setulae and much smaller C-4 index; the latter species has female sternite 7 in one piece, though deeply lobed.

Although the male is unknown and female material is minimal, there is adequate evidence that the species is distinct, and the unusual postabdominal characters should ensure reidentification of females.

The specific epithet refers to John W. Early who collected the holotype and other useful material of *Zalea* for this project.

Zalea horningi (Harrison)

Figs 20, 62–65

Tethina horningi Harrison, 1976: 143, fig. 3.

Zalea horningi (Harrison).—D. McAlpine, 1985: 82.

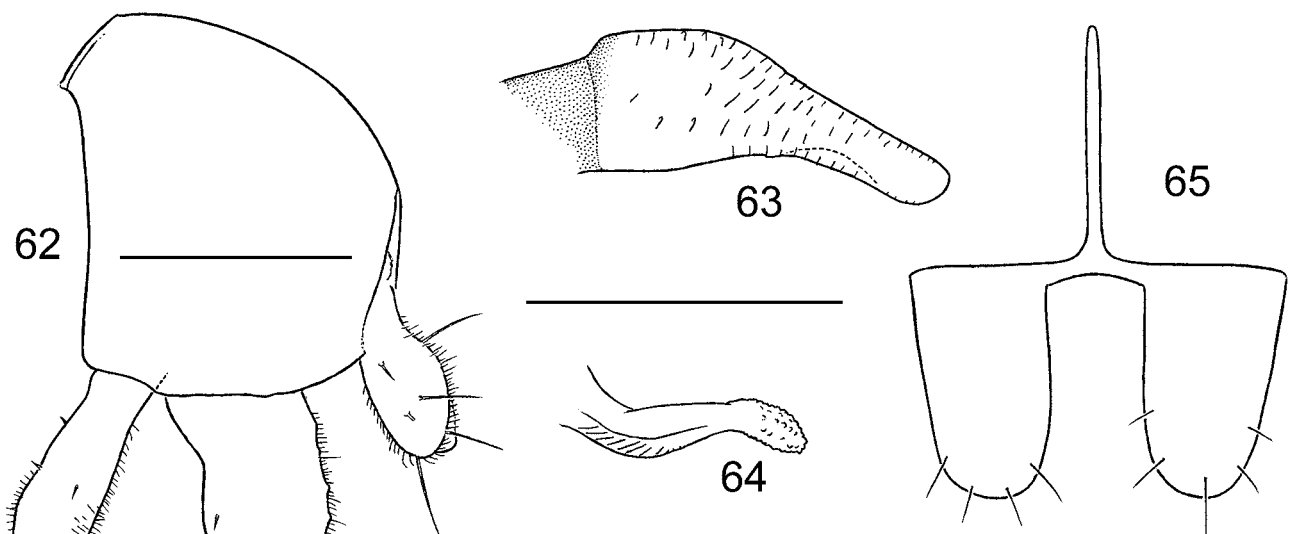
Material examined. HOLOTYPE ♂, New Zealand: Seal Cove, Snares Islands, 2.1.1972, D.S.H. (NZAC). Dry-mounted on card-point, postabdomen now placed in microvial attached to pin. PARATYPES. As listed by Harrison. I examined 2 ♂♂, 2 ♀♀ from NZAC in 1982 but details of the postabdomens were not then studied.

Other material (localities only). South Island: Kaikoura Peninsula (AM); Sumner, near Christchurch (AM, BM); Laverick's Bay, near Akaroa (AM, NZAC); Otanerito Bay, near Akaroa (AM, NZAC); Pilot Beach, Otago Peninsula (USNM).

Supplementary description

Very similar to *Z. johnsi* and agreeing with description of that species except as indicated below.

Coloration. Abdomen of female: paired sclerites of tergite 7 dull yellowish, black anteriorly, dull grey on small posterior zone.



Figs 62–65. (62) *Zalea horningi*, epandrium and associated parts, scale = 0.1 mm. Setulae on epandrium omitted. (63) *Z. horningi*, posterior papilla of aedeagus, left lateral view, scale = 0.1 mm. (64) *Z. horningi*, left anterior papilla of aedeagus, to same scale as last. (65) *Zalea horningi*, tergite 7 of female, part of lateral outline approximate only.

Head. Postvertical bristles small, convergent.

Thorax. Wing: cell-4 index = 0.50 (holotype), 0.53–0.59 (South Island material).

Abdomen. Male: anterior surstylus, almost straight but slightly incurved, rounded and compressed apically, with short setulae mainly on inner surface, with no particularly developed setulae on posterior surface, extensively microtrichose, mainly on inner surface of distal half; posterior surstylus broadly rounded apically, with at most only slight posterior basal incision, microtrichose on large part of inner and outer surfaces, with few small setulae on outer surface, with larger setulae in inner surface, of which a few more basal ones are particularly large; each anterior aedeagal papilla not smooth and evenly tapering as in *Z. johnsi*, but with zone of transverse ridges near mid-length, and slender, obtuse, roughly pustulose apical part; posterior papilla with many short, transverse surface ridges, slightly narrowed well before apex to form somewhat transversely compressed distal part with anterior concavity and rather thick rounded apex; distiphallus a little broader distally than in *Z. johnsi*, with less finely pointed, slightly irregularly incised apical part. Female: sternites generally as in *Z. johnsi*; sternites 2 to 6 all divided in two or almost so; tergite 7 (Fig. 65) very deeply divided, somewhat like that of *Z. dayi* but with more elongate anterior apodeme.

Distribution. New Zealand: South Island; Snares Islands.

Notes

The key to species and the above comparative description gives all the points of difference from *Z. johnsi* that I am able to confirm. The convergent postvertical bristles of this species provide a remarkably consistent difference from *Z. johnsi*, and associate *Z. horningi* with the four species *Z. lithax*, *Z. mathisi*, *Z. uda*, and *Z. ohauorae*, which are recorded at present only from North Island vicinity.

The above description of postabdominal characters is based mainly on South Island specimens. I have examined the epandrium and surstyli of the holotype which resemble those of South Island material. As further dissection of this specimen may have proved destructive, details of the hypandrium and aedeagus have not been checked for the Snares Island population.

Zalea wisei n.sp.

Figs 66, 67, 71

Material examined. HOLOTYPE ♂, New Zealand: Otata Island, Noisies Islands, Hauraki Gulf, North Island vicinity, 8.xii.1979, K.A.W. (AMNZ). “Swept at low tide. Intertidal rocks, N. coast.” Mounted on card point impaled directly on pin. PARATYPE. 1 ♂, identical data to holotype (AMNZ). Mounted on card point glued to square card on pin.

Description (♂, ♀ unknown). Size larger than that of most New Zealand *Zalea* spp.; habitus rather stout.

Coloration. Head dark grey to greyish brown; postfrons without yellowish or other pale zones; parafacial, face, and cheek grey-pruinescent. Antenna greyish-tawny. Prelabrum grey or partly blackish; palpus tawny yellow. Thorax dark grey-pruinescent, brown-pruinescent dorsally. Legs dark grey-brown; tarsi more tawny-brown, mostly darker apically. Wing membrane tinged with smoky-grey; veins brown. Halter yellow. Abdomen dark grey-brown.

Head higher than long; eye, in profile, obliquely oval, 1.25–1.27 times as high as long; triangle formed by joining centers of ocelli not broader than equilateral triangle; postfrons narrowed anteriorly so that minimum separation of eyes = 0.36 of total width of head; face concave; vibrissal region not very prominent; cheek 0.25–0.26 of height of eye; postvertical bristles strongly divergent; ocellar bristles very slightly closer together than are posterior ocelli; posterior fronto-orbital bristle not at all reclinate, curved outwards; vibrissa smaller than anterior peristomial bristles; postgenal region with vertical series of four or five setulae. Antenna: segment 5 3.6 times as long as wide; palpus extending beyond prelabrum when proboscis withdrawn.

Thorax. Prosternum without bridge, widely separated from propleuron on each side; proepisternal bristle well developed (compared with *horningi* group); mesopleuron with two large bristles near posterior margin; scutellum with pair of setulae between bristles of apical pair, each c. half as long as apical bristle. Fore tibia usually with three posterodorsal bristles longer than tibial diameter; mid and hind tibiae with several long dorsal setulae or bristles. Wing: cell-4 index = 0.39–0.43.



Figs 66, 67. (66) *Zalea wisei*, head. (67) the same, left surstyli and cercus, scale = 0.05 mm.

Abdomen. Epandrium broad, rounded, with two pairs of large dorsal bristles and smaller setulae; surstyli (Fig. 67) with short setulae and no apparent microtrichia; hypandrium and associated structures not elucidated.

Dimensions. Total length 2.2–2.3 mm; length of thorax 1.1 mm; length of wing 2.2–2.4 mm; width of epandrium (dried) 0.34 mm.

Distribution. Only known from the Noisies (or Noises) Islands in Hauraki Gulf, North Island vicinity, New Zealand. These are a group of islets and rocks near Auckland. "Otata Island" is 38°42'S 174°58'E in Gazetteer.

Notes

Zalea wisei and the closely related "sp. 1" differ from other New Zealand *Zalea* spp. in the non-reclinate posterior fronto-orbital bristle, absence of the prothoracic precoxal bridge, longer proepisternal bristle, presence of a pair of setulae between the apical scutellar bristles, presence of two large posterior mesopleural bristles, and smaller C-4 index. For comparison with sp. 1 see under that species.

The specific epithet refers to Keith A.J. Wise, who collected the type material and other significant material of *Zalea*.

Zalea sp. 1

Figs 21, 68–70

Material examined. 1 ♀, New Zealand: Otanerito Bay [north side of beach, on shoreline rocks], near Akaroa, South Island, 1.ii.2001, B.J.D., D.K.M. (AM). Otanerito Bay is also known as Long Bay, but there is another Long Bay, also on Banks Peninsula.

Description (♀, male unknown). The only known specimen resembles *Z. wisei* in many characters but is larger and more elongate.

Coloration. Head grey-black to brown-black. Antenna dark grey to brown black. Prelabrum blackish, with grey pruinescence; palpus brownish, with grey pruinescence. Halter tawny, with creamy capitellum. Abdomen brown-

black; paired sclerites of tergite 7 shining black, grey-brown-pruinescent on short posterior section.

Head much higher than long; eye, in profile, subcircular, but for slight ventral extension, 1.1 times as high as long; triangle formed by joining centres of ocelli broader than equilateral triangle; cheek most prominent posteroventrally, height of cheek 0.25 of height of eye; postvertical bristles rather long, c. as long as anterior fronto-orbital, perhaps nearly parallel (one slightly displaced); ocellar bristles more closely placed than in other species. Palpus moderately short and thick, not extending anteriorly beyond prelabrum when proboscis withdrawn.

Thorax. Prosternum without precoxal bridge; anterior dorsocentral and proepisternal bristles longer than in other species. Wing: cell-4 index = 0.35.

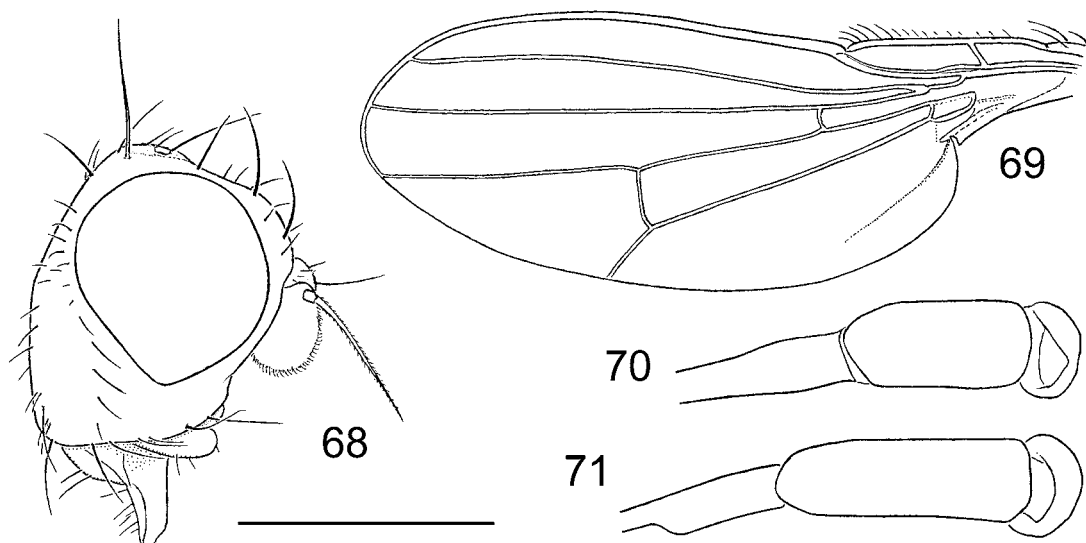
Abdomen. Sternites 1 to 5 all broad and well sclerotized, undivided; tergite 7 rather like that of *Z. dayi*, medially divided to c. as far forward as fork of anterior apodeme (which is not exposed to view), each of paired sclerites somewhat elongate, rounded posteriorly, with several long setulae.

Dimensions. Total length (abdomen extended) 3.0 mm; length of thorax 1.2 mm; length of wing 2.9 mm.

Distribution. New Zealand: only known from Banks Peninsula, South Island.

Notes

Because of the similarity between this species and *Z. wisei* and the paucity of material, which prevents comparison between the same sex of each species, I refrain from naming this species at present. The extent of the differences between the samples seems to indicate specific distinction, but I have had to use subjective judgement in providing key characters. The single specimen of species 1 differs in having the eye in profile 1.12 times as high as long (1.25–1.27 in *Z. wisei*), triangle formed by joining centres of ocelli broader than equilateral triangle (not broader than such in *Z. wisei*), postfrons not much narrowed anteriorly, so that minimum separation of eyes = 0.40 of width of head (postfrons more narrowed anteriorly, so that minimum separation of eyes =



Figs 68–71. (68–70) *Zalea* sp. 1, (68) head; (69) wing; (70) base of arista. (71) *Z. wisei*, base of arista, scale (for Figs 70, 71 only) = 0.05 mm.

0.36 of width of head in *Z. wisei*), cheek region, in outline, descending and most prominent posteriorly (cheek region not more ventrally prominent posteriorly than anteriorly in *Z. wisei*), postvertical bristles at most slightly divergent (strongly divergent in *Z. wisei*), ocellar bristles markedly closer together than are posterior ocelli (very slightly closer together than are posterior ocelli in *Z. wisei*), antennal segment 3 blackish, brown on small part of ventral margin only (antennal segment 3 brown to tawny-brown above, tawny-yellow below in *Z. wisei*), antennal segment 5 2.2 times as long as wide (3.6 times as long as wide in *Z. wisei*), palpus brownish, not projecting anteriorly beyond prelabrum when proboscis withdrawn (palpus deep yellow, projecting distinctly beyond prelabrum in *Z. wisei*), cell-4 index = 0.35 (0.39–0.43 in *Z. wisei*).

Zalea sp. 2

Material examined. 1 ♀, New Zealand: Beach, N end Mitimiti, N of Hokianga Harbour, North Island, 4.ii.1988, R.F. Gilbert (AMNZ).

Description. The single specimen in moderate condition is inadequate for a formal description.

Notes

This specimen is distinct from any other available New Zealand specimens and tends to run near *Z. minor*, which it superficially resembles, in the key. Prothoracic precoxal bridges appear to be absent, and the postvertical bristles are divergent. However, in the presence of two longer

posterodorsal bristles on the fore femur and less prominent vibrissal angle it more closely resembles such New Zealand species as *Z. johnsi*. The separation of the two lateral plates of tergite 7 from each other seems to be more complete than in *Z. minor*. Without better material, it has not been possible to place it satisfactorily in the key to species.

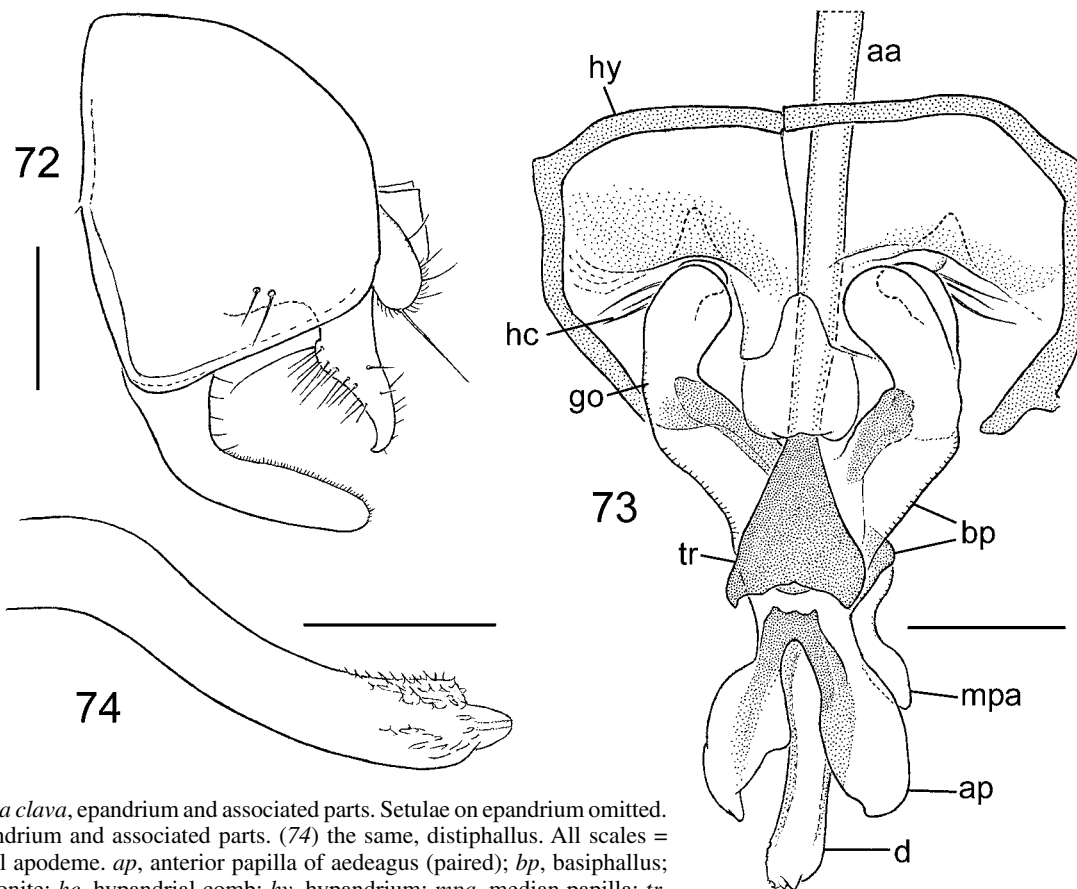
Zalea clava n.sp.

Figs 72–75

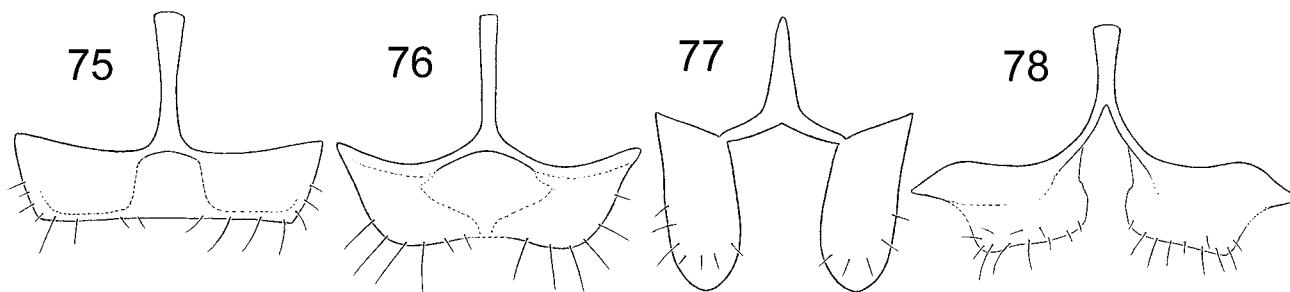
Material examined. HOLOTYPE ♀, Western Australia: Cable Beach (foot of cliffs W of beach), S of Albany (35°07'02"S 117°53'51"E), 29–30.xi.1998, B.J.D., D.K.M. (WAM). PARATYPES. Western Australia: 4 ♂♂, 3 ♀♀, same data as holotype (AM, USNM); 1 ♂, 2 ♀♀, Canal Rocks, near Yallingup, 33°39'42"S 115°00'35"E, 23.xi.1998, B.J.D., D.K.M. (AM); 1 ♂, Ellensbrook Beach, near Margaret River, 33°54'17"S 114°59'16"E, B.J.D., D.K.M. (AM).

Description (♂, ♀). General characters as given for subfamily and for genus *Zalea*.

Coloration generally as given for *Z. dayi*. Thoracic pleura greyer than in *Z. dayi*; mesopleuron with little or no brown suffusion. Legs, especially femora, greyer than in *Z. dayi*; tarsi brown to tawny-brown. ♂: anterior surstylus tawny, more shining on outer surface than in *Z. minor* and *Z. dayi*, through more restricted pruinescence. ♀: paired sclerites of sternite 7 predominantly black, grey-pruinescent only at posterior extremities; tergite 7 pruinescent, brownish grey; sternite 7 largely shining black; cercus brownish, usually darker both apically and near base.



Figs 72–74. (72) *Zalea clava*, epandrium and associated parts. Setulae on epandrium omitted. (73) the same, hypandrium and associated parts. (74) the same, distiphallus. All scales = 0.1 mm. aa, aedeagal apodeme. ap, anterior papilla of aedeagus (paired); bp, basiphallus; d, distiphallus; go, gonite; hc, hypandrial comb; hy, hypandrium; mpa, median papilla; tr, triangular sclerite of basiphallus.



Figs 75–78. Tergite 7 of *Zalea* females, semi-diagrammatic. (75) *Z. clava*. (76) *Z. minor*. (77) *Z. dayi*. (78) *Z. major*.

Head. Height of cheek c. 0.26–0.32 of height of eye; postvertical bristles subparallel to slightly divergent. Antenna similar to that of *Z. minor* and *Z. dayi* in proportions. Palpus clavate, much more thickened distally than in other *Zalea* spp., and usually distinctly more than half as deep as cheek or antennal segment 3 (though depth of both these rather variable).

Thorax. Chaetotaxy and most leg characters as for genus. Mid femur of male with loose distal comb of variably short, thick posteroventral bristles, either all quite blunt or some pointed; mid femur of female without differentiated posteroventral bristles. Fore tibia with one long dorsal bristle slightly beyond mid-length; mid tibia with one long dorsal bristle near mid-length; hind tibia often with few irregular long setulae or fine bristles. Vein 2 usually more strongly arched than in *Z. minor*; cell-4 index = 0.58–0.65.

Abdomen. Male: anterior surstylus very elongate, pruinose, but extensively smooth and shining on outer surface; posterior surstylus not pruinose, narrowly obtuse at apex, with long-setulose anterior gibbosity beyond base; hypandrium and aedeagus resembling those of *Z. minor*; posterior papilla of aedeagus smaller; distiphallus with denticles finer and less dense, and without distinctly pigmented longitudinal strips. Female: sternites 3 to 6 broader than in *Z. minor* and *Z. major*, but much less so than in *Z. dayi*, all undivided; tergite 7 undivided, somewhat sclerotized and pigmented across whole width, but weakly sclerotized centrally and on posterior margin, with broad, strongly sclerotized plate on each side, and with lateral arms of anterior apodeme short; paired sclerites of sternite 7 much broader than in *Z. minor* and *Z. major*, quite narrowly separated medially.

Dimensions. Total length, ♂ 1.8–1.9 mm, ♀ 2.1–2.4 mm; length of thorax, ♂ 0.77–0.90 mm, ♀ 0.86–0.96 mm; length of wing, ♂ 1.8–2.0 mm, ♀ 2.0–2.2 mm.

Distribution. Western Australia: southern coast, S of 33°30'S.

Notes

Zalea clava is distinguishable from all other *Zalea* spp. by its very strongly clavate palpus. It is the only known Australian species with a long dorsal bristle on the fore and mid tibia, and, unlike the New Zealand, species this is an isolated bristle near or slightly beyond mid-length.

The specific epithet is a Latin noun referring to the clavate palpus.

Zalea minor (D. McAlpine)

Figs 16, 26, 33, 49, 76

Zalea minor D. McAlpine, 1982: 110–112, figs 4–9.

Zalea minor (D. McAlpine).—D. McAlpine, 1985: 82.

Material examined. HOLOTYPE ♂, New South Wales: Bottle and Glass Rocks, Vaucluse, near Sydney [Nielsen Park, Sydney Harbour], 25.i.1964, D.K.M. (AM).

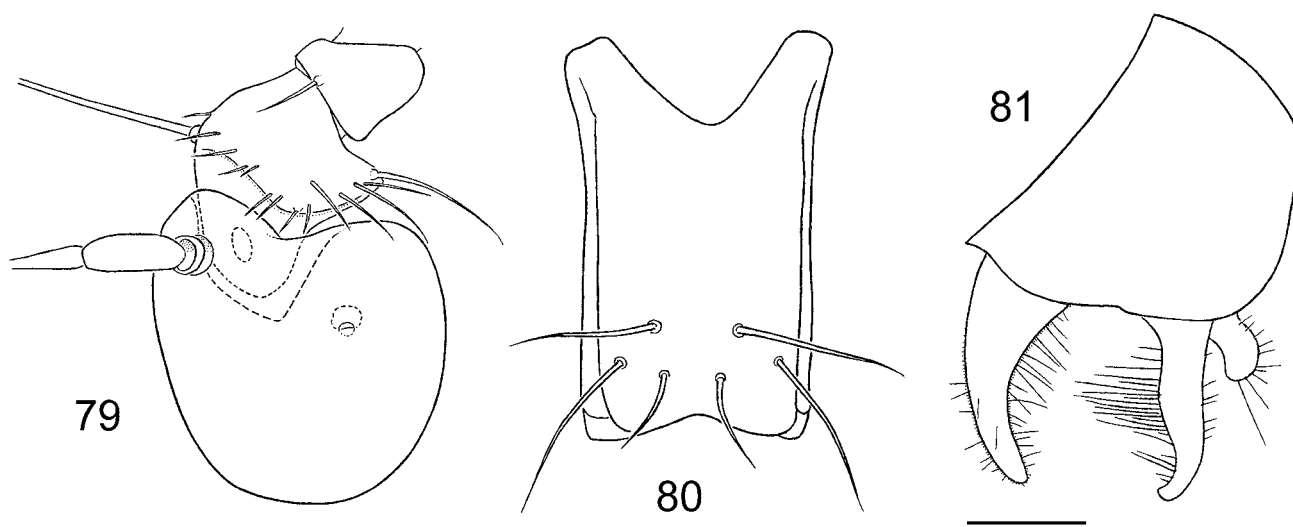
Other material (localities only). New South Wales: Wategos Beach, Cape Byron (AM); Broken Head, near Byron Bay (AM, ANIC, MV); Woolgoolga (AM); Smoky Cape, near South West Rocks (AM); Black Head (Holiday's Point), Taree district (AM); The Ruins, Booti Booti National Park, Forster district (AM); Seal Rocks (headland) (AM, NZAC, BPB, MCV, ZMC); Forrester's Beach, near Terrigal (AM); Grotto Point, Sydney Harbour (AM); Currarong (AM); Broulee Beach (ANIC). Victoria: Walkerville (AM); Bunnarong Cliffs, near Inverloch (AM). Tasmania: Binalong Bay, near Saint Helen's (AM, TDA); Spring Beach, near Orford (AM); Stapleton Beach, near Orford (AM); Tesselated Pavement, Eaglehawk Neck (AM); Gilham's Beach, Research Bay (AM, ANIC, TDA). See also paratype list of D. McAlpine (1982, material from Sydney district).

Supplementary description

Thorax. Mid femur of male with inconspicuous posteroventral comb of few short, thick, very blunt bristles beyond mid-length, and generally with a separate series of few fine, longer posteroventral bristles mostly before mid-length; that of female without differentiated posteroventral bristles.

Abdomen. Sternite 1 undivided; sternite 2 with deep anterior incision somewhat as in *Z. major*. Male: hypandrium on each side with compact comb of three long bristles and group of three minute slender setulae, not shown in my previous figure (D. McAlpine, 1982: fig. 8) because of partial concealment by gonites. Female: sternites 2 to 5 narrow; sternite 6 completely or incompletely divided into two sclerites which diverge posteriorly; tergite 7 (Fig. 76) with lightly sclerotized or almost desclerotized central zone extending only narrowly to posterior margin, which is broadly transverse; paired sclerites of sternite 7 elongate-oval, broadened and more approximated on anterior margins.

Dimensions. In the original description, for "width of hypandrium", read "width of epandrium".



Figs 79–81. *Zalea major*. (79) left antenna, scale = 0.1 mm. (80) prementum of proboscis. (81) epandrium and associated parts, left lateral view, scale = 0.1 mm. Setulae on epandrium omitted.

Distribution. New South Wales: coasts generally. Victoria: coasts east of Port Phillip. Tasmania: widely distributed on east coast, and probably other coastal districts which have not yet been searched for intertidal flies.

Notes

Zalea minor is the most abundant species of *Zalea* in New South Wales and Tasmanian habitats. It is distinguished as indicated in the above key.

Zalea major (D. McAlpine)

Figs 22, 43, 78–84

Zalea major D. McAlpine, 1982: 112, figs 1–3.

Zalea major (D. McAlpine).—D. McAlpine, 1985: 82.

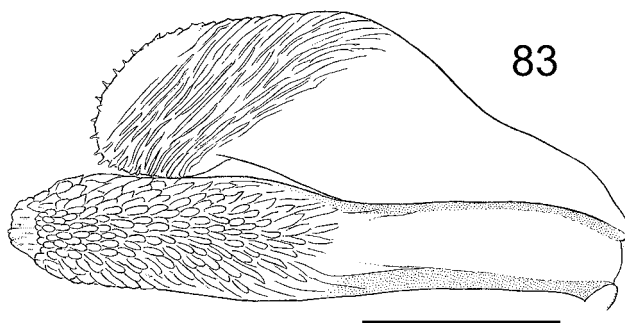
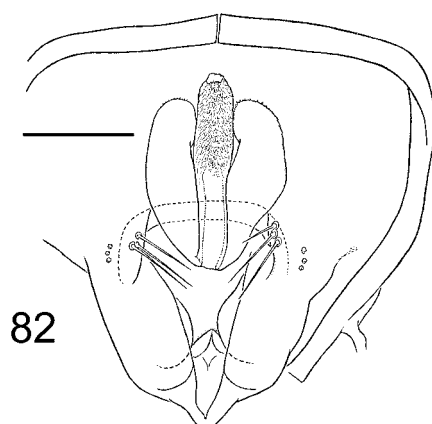
Material examined. HOLOTYPE ♀, New South Wales: Bundeena, Port Hacking, 10.xii.1966, D.K.M. (AM). The statement (D. McAlpine, 1982) that the holotype is a male is a typographical error.

Other material (localities only). New South Wales: Watagos Beach, Cape Byron (AM); Broken Head, near Byron Bay (AM, ANIC); Smoky Cape, near South West Rocks (AM); The Ruins, Booti Booti National Park, Forster district (AM, BPB, MCV, USNM); Seal Rocks (headland) (AM, ANIC); Forrester's Beach, near Terrigal (AM); Grotto Point, Sydney Harbour (AM); Kurnell, Botany Bay. Tasmania: Binalong Bay, near Saint Helen's (AM, TDA); Ironhouse Point, near Falmouth (AM). See also paratype list of D. McAlpine (1982, material from Gosford and Sydney districts).

Supplementary description

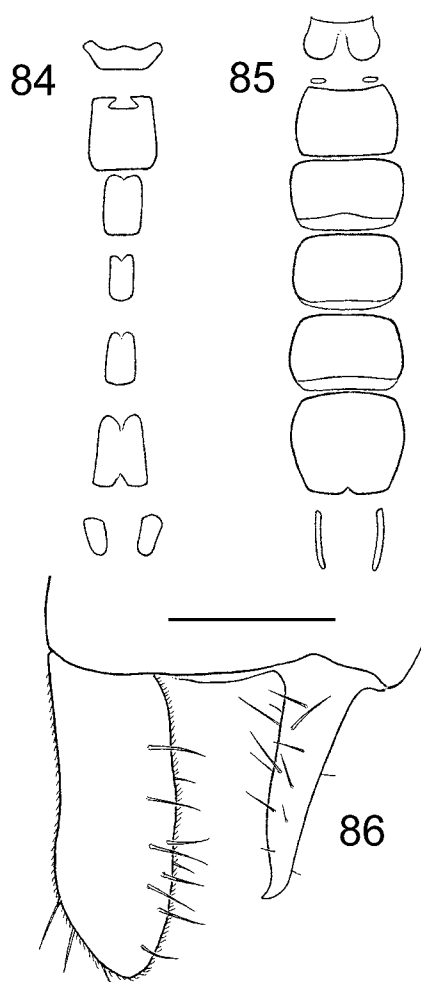
Antenna. Segment 3 and palpus plain yellow in male, usually slightly suffused with brown in female.

Legs. Mid femur of male with strong distal posteroventral comb of short, thick, blunt bristles, with fewer longer posteroventral bristles near and before middle; mid femur of female with no differentiated posteroventral bristles; tibiae without differentiated long bristles.



Figs 82, 83. *Zalea major*. (82) hypandrium and associated parts, scale = 0.1 mm. (83) distiphallus and left anterior papilla of aedeagus, scale = 0.05 mm.

Abdomen. Male: epandrial structures resembling those of *Z. minor* including extensively pubescent anterior surstylus and non-pruinulent posterior surstylus; anterior surstylus expanded at base, gradually narrowed distally; posterior surstylus relatively thick on basal half, tapering beyond, subtruncate at apex, with group of long dense setulae anteriorly near mid-length; ventral plate of epandrium with two well separated setulae on each side; hypandrium on each side with group of three large bristles, of which sockets are contiguous, and three small stumpy setulae laterad of



Figs 84–86. (84) *Zalea major*, abdominal sternites 1–7 of female, semi-diagrammatic. (85) *Zalea dayi*, the same. (86) *Z. dayi*, left surstyli, scale = 0.1 mm.

these; each anterior papilla of aedeagus with numerous parallel ridges, pustulose distally, apically with pustules becoming slender and thorn-like; median posterior papilla very small; distiphallus on posterior surface pustulose from near mid-length almost to apex, pustules becoming crowded distally, mostly rounded, some lateral ones obtusely pointed, forming extensive file-like surface. Female: sternite 1 not deeply divided; sternites 3 to 5 narrow, longer than broad; sternite 6 medially notched on both anterior and posterior margins; tergite 6 desclerotized on posterior margin medially, broader than tergite 5, with posteroventral part more strongly produced; tergite 7 (Fig. 78) divided in two, each sclerite broader than long, grey pruinose, black only where it joins lateral arm of anterior apodeme; paired sclerites of sternite 7 not very narrow, separated from each other by less than 3× width of each, each with c. three posterior setulae; cercus slightly shorter than in *Z. minor* and *Z. dayi*.

Dimensions. In the original description, for “width of hypandrium”, read “width of epandrium”.

Distribution. Coastal New South Wales, from Byron Bay district to Port Hacking (Bundeena). Tasmania: east coast, north from Falmouth district.

Notes

Most specimens of *Z. major* can be distinguished from the sympatric *Z. minor* and *Z. dayi* by their larger size. Males can further be distinguished by the much broader epandrium and differently shaped surstyli, and females can be distinguished by the differently shaped tergites 6 and 7.

Zalea dayi n.sp.

Figs 13, 38, 77, 85, 86

Material examined. HOLOTYPE ♀, New South Wales: Seal Rocks (headland, north side), 11.x.2000, D.K.M. (AM). Dry-mounted on triangular point. PARATYPES. New South Wales: 4♂♂, 4♀♀, Black Head (Haliday’s Point), Taree district, 13.ix.2000, B.J.D. (AM, USNM); 11♂♂, 7♀♀, “The Ruins”, Booti Booti National Park, Forster district, 15.ix.2000, B.J.D. (AM, ANIC); 35♂♂, 30♀♀, Seal Rocks, 26.ix.2000, 9–11.x.2000, D.J.B., D.K.M. (AM, ANIC, BM, BPB, CNC, TAU, USNM). Material from Black Head and “The Ruins” in alcohol; that from Seal Rocks mostly dry-mounted on points or micro-pins with abdomens extended.

Other material. New South Wales: 1♀, Vaucluse, Sydney Harbour, 25.i.1964, D.K.M. [AM, originally determined as a paratype of *Z. minor* (D. McAlpine)].

Description (♂, ♀). Very small dull, dark greyish fly, with unmarked wing, with general characters as for genus *Zalea*.

Coloration. Head predominantly brown, with brown to grey pruinescence; anterior part of postfrons yellowish brown; parafacial and upper part of cheek pale yellow to greyish yellow. Antenna yellow; segment 3 often with slight tawny suffusion; arista dark brown. Prelabrum grey; palpus yellow. Thorax with brown-black ground colour, densely covered with grey to brown pruinescence; bristles black. Legs dark grey-brown. Wing membrane uniformly smoky grey; veins brownish. Halter yellow basally, with creamy capitellum. Abdomen dark grey-brown, almost entirely pruinose; in male, anterior surstylus generally (at least in fresh material) dark brown, often more yellowish apically; in female, paired sclerites representing tergite 7 and sternite 7 shining black, each with short grey-pruinose zone at posterior end; cercus of female brown, becoming black apically.

Head. Proportions resembling those of *Z. major* (D. McAlpine, 1982: figs 1–3); height of cheek c. 0.26–0.28 of height of eye; postvertical bristles slightly to strongly divergent. Antenna similar to that of *Z. minor* in proportions; arista c. 1.3–1.6 times as long as rest of antenna. Palpus only slightly thickened distally, where it is not more the c. 0.5 times as deep as cheek and at most very slightly deeper than prelabrum (i.e. very similar to palpus of *Z. minor*).

Thorax. Prosternum without precoxal bridge; chaetotaxy and most leg characters as for genus. Tibiae without any such enlarged dorsal or posterodorsal setulae or bristles as occur in *Z. clava* and *Z. johnsi*. Wing venation very similar to that of *Z. minor*, the little variation in contours and proportions apparently allowing no constant differences; cell-4 index = 0.55–0.61.

Abdomen. Sternite 1 deeply emarginate on posterior margin, almost divided in two; a pair of small sclerites

between sternite 1 and sternite 2 (these form part of segment 2 in *Z. minor* and *Z. major*); other preabdominal sternites broader than in *Z. minor*. Male: anterior surstylus much broader than that of *Z. minor*, neither broadened basally nor significantly tapered distally; posterior surstylus finely pointed at apex, with some long setulae, but these relatively sparse, without anterior gibbosity. Female: sternites 2 to 5 all broader than long; sternite 6 large, undivided; tergite 6 as long as tergite 5, with median desclerotization on posterior margin less extensive than in *Z. major*, and posterolateral angle not produced as in that species; paired sclerites of sternite 7 very narrow, separated by more than 4× width of each; paired sclerites of tergite 7 (Fig. 77) relatively large, each more than twice as long as wide, separated by well defined membranous median zone.

Dimensions (dried, some with abdomen artificially extended, parts behind tergite 6 excluded in ♀). Total length, ♂ 1.7–2.1 mm, ♀ 1.9–2.3 mm; length of thorax, ♂ 0.72–0.86 mm, ♀ 0.75–0.99 mm; length of wing, ♂ 1.8–2.0 mm, ♀ 2.0–2.4 mm; width of epandrium 0.26–0.29 mm.

Distribution. New South Wales: sea coast from Taree district to Sydney Harbour, between c. 32°00'S and 34°02'S. *Zalea dayi* may prove to have a wider distribution, especially as old dried specimens can be difficult to distinguish from *Z. minor*. However, recently made collections of *Zalea* from more northern localities in New South Wales and from eastern Tasmania include no *Z. dayi*.

Notes

Zalea dayi, though similar in size and superficial features to *Z. minor*, is sharply differentiated from all other Australian *Zalea* species in abdominal characters. In the male, the broad, almost parallel-sided dull brown anterior surstylus and apically pointed posterior surstylus are distinctive. In the female, the very narrow, widely separated paired sclerites of sternite 7, and the large, but elongate, largely shining black, well separated sclerites of tergite 7 are also distinctive; the much broader abdominal sternites 2 to 6 differentiate it from the sympatric *Z. minor* and *Z. major*.

The specific epithet refers to Barry J. Day, from whose material I first recognized the distinction of this species.

Genus *Suffomyia* Freidberg

Suffomyia Freidberg, 1995: 448. Type species (original designation) *S. scutellaris* Freidberg.

Diagnostic description. Minute flies; wing c. 0.9–1.5 mm long.

Head. Postvertical bristles proclinate, divergent; postfrons without setulae, except sometimes for a few between ocelli. Arista three-segmented, or two-segmented through loss of segment 4.

Thorax. Prothoracic precoxal bridge absent; posterior acrostichal setulae present or absent; prescutellar acrostichal bristle at most weakly differentiated; scutellum with or without two pairs of minor bristles in addition to two major pairs. Mid femur without posteroventral comb in either sex. Distal section of subcosta (beyond humeral crossvein) well sclerotized on c. middle third, weakened towards base, obsolete and unpigmented on c. distal third, thus ending freely in membrane well before subcostal break of costa; anterior crossvein meeting vein 4 distinctly basad of mid-length of discal cell; basal section of vein 4, separating first basal and second basal cells, quite desclerotized; alula narrowed distally, its terminal margin narrowly rounded, setulae of its marginal fringe c. as long as maximum width of alula.

Abdomen of male. Dorsal protandrial sclerite two to three times as long as tergite 5; only one pair of surstyli present, each with two condyles (one anterior, one posterior) where it hinges with margin of epandrium; distiphallus (only known for *S. scutellaris*) very short, apparently without associated papillae.

Abdomen of female (unknown in *S. ismayi*). Tergite 7 without anterior apodeme.

Distribution. Palaearctic Region: Sinai (Egypt and Israel). Australasian Region: Caroline Islands; New Guinea.

Notes

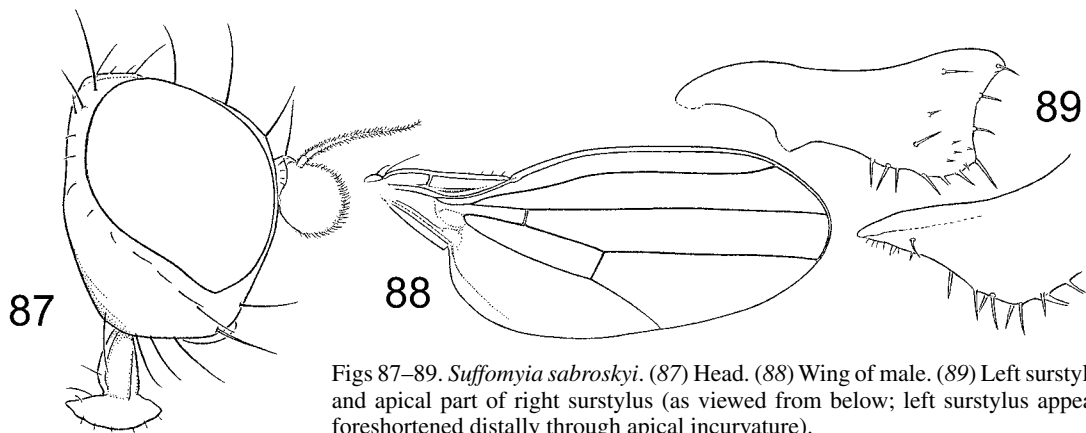
With the addition of two species to the only previously recognized representative, some of the previously used generic characters are seen to have only specific value, e.g., the shape of the head and antenna, the reduction of the acrostichal bristles and setulae, the number of scutellar bristles, some aspects of sclerotization of the female postabdomen, and the degree of proximal narrowing of the wing. As my research has shown additional differences between *Suffomyia* and *Zalea*, some probable differences awaiting confirmation from more material, and differences in range of character variation, I have set these out in the generic descriptions so that they may be readily contrasted.

I have experienced some difficulty in working with the old, dry, and, in one species, meagre material of these minute flies. My specific descriptions are therefore not as detailed as that of the type species given by Freidberg (1995), nor as those of most *Zalea* spp.

The following four apparent autapomorphies, not present in *Zalea*, support the monophyletic status of *Suffomyia*: postfrons without setulae between ocellar region and anterior margin; subcosta desclerotized distally; basal section of vein 4 desclerotized; in male, only one surstylus present, with two basal condyles.

Key to species of *Suffomyia*

- 1 Postgenal region without series of setulae near eye; scutellum with two pairs of bristles only; male: epandrium setulose, but without pair of outstanding bristles; surstylus bilobed *ismayi*
- Postgenal region with a series of setulae near eye margin; scutellum with two pairs of long bristles and two pairs of short bristles; male: epandrium with one pair of long bristles; surstylus not bilobed 2
- 2 Costa with moderate-sized setulae between humeral and subcostal breaks; antennal segment 3 subcircular, not longer than deep; biseriate acrostichal setulae continued nearly to scutellar suture; male: surstylus somewhat elongate and narrowed towards base; female: tergite 7 large and undivided *sabroskyi*
- Costa with one or two very long setulae between humeral and subcostal breaks; antennal segment 3 c. 1.5 times as long as deep; biseriate acrostichal setulae restricted to anterior half of mesoscutum or almost so; male: surstylus subtriangular, widest across base; female: tergite 7 divided into pair of widely separated sclerites *scutellaris*



Figs 87–89. *Suffomyia sabroskyi*. (87) Head. (88) Wing of male. (89) Left surstylus and apical part of right surstylus (as viewed from below; left surstylus appears foreshortened distally through apical incurvature).

Suffomyia scutellaris Freidberg

Suffomyia scutellaris Freidberg, 1995: 448–454, figs 1–18.

Type material. HOLOTYPE ♂, Egypt: 10 km N of Nueiba, Sinai, 12.iv.1992, A.F. (TAU). Not seen by me.

Other material. See list of Freidberg (1995).

Notes

I saw material of this species in 1991 when I was sent specimens for comment, but I have not had further access to material for the present work. Freidberg's description gives excellent detail, and has enabled reasonable comparison with my two new *Suffomyia* spp.

Suffomyia sabroskyi n.sp.

Figs 19, 87–89

Material examined. HOLOTYPE ♂, Caroline Islands (Federated States of Micronesia): Giliman, Yap Island, 10.vi.1957, C.W.S. (BPB). Double-mounted on micro-pin. PARATYPES. Caroline Islands: 1♂, 5♀, same data as holotype (AM, BPB); 5♂♂, 3♀♀, Rumung Island, Yap Group, 19.vi.1957, at light, C.W.S. (AM, BPB).

Description (♂, ♀). General characters as given above for subfamily and for genus *Suffomyia*; somewhat resembling *S. scutellaris* as described by Freidberg (1995).

Coloration (material slightly faded). Head brown, with covering of grey pruinescence, paler on face, anterior part of cheek, and parafacial; anterior margin of postfrons yellow; bristles black. Antenna dull tawny; segment 3 and arista largely brown. Palpus pale yellow, without dark setulae. Thorax grey, with brownish tinge; bristles black. Wing greyish hyaline, slightly darker in costal and marginal cells and part of submarginal cell (this pigmentation perhaps forming a brownish costal band in fresh material). Halter tawny. Abdomen greyish brown, with tergites almost uniformly coloured in male, often with irregular paler zones in female.

Head oval in profile, narrowed below; eye large, oblique, in profile occupying much more than half visible area of head; parafacial very narrow; postfrons c. 1.2–1.5 times as long as width at mid-length, and c. 0.37–0.43 times as wide as head; height of cheek c. 0.2 of height of eye; postgenal bristles forming a series near posteroventral margin of eye. Antenna: segment 3 smaller than in *S. scutellaris*, not distinctly longer than deep; arista two-segmented. Palpus smaller and less strongly clavate than in *S. scutellaris*.

Thorax. Scutellum shorter and more nearly semicircular than in *S. scutellaris*; thoracic chaetotaxy generally as for

other *Zaleinae*; four dorsocentral bristles often not all much larger than adjacent setulae; acrostichal setulae biserate, extending most of length of mesoscutum, often somewhat irregular, one or sometimes two hindmost pairs often (not always) largest so that pair of prescutellar bristles may be differentiated; mesopleuron with one relatively large mid-posterior bristle, dorsally directed posterodorsal setula, and several other slightly variable setulae; scutellum with two pairs of major bristles, pair of somewhat shorter mid-dorsal bristles and pair of still shorter, often crossed apical bristles. Fore femur with two to four posteroventral bristles and shorter or less distinct dorsal bristles; mid femur with several irregularly enlarged anterior setulae and few short, well spaced posteroventral bristles or setulae; hind femur coarsely setulose on anterior surface; all tibiae with some enlarged dorsal setulae, often as long as diameter of tibia; fore basitarsus with some setulae apparently apically bifid, almost straight (SEM not used). Wing not noticeably narrowed across anal region, but generally slightly narrower in female than in male; distal sections of veins 3 and 4 almost parallel; cell-4 index = 0.36–0.47.

Abdomen. Male: dorsal protandrial sclerite as long as tergites 3–5 combined, its anterior section (tergite 6) setulose, more than twice as long as bare posterior section (sternite 8); epandrium compact, rounded, with few setulae and two pairs of longer bristles, produced into small rounded lobe at anterolateral angle; surstylus somewhat elongate, subcrescentic, slightly narrowed towards the very oblique base, apically acute, with anterior margin much thickened on whole length, with setulae of various sizes including a few large, thickened ones on inner surface not shown in Fig. 89; aedeagal apodeme very long, extending into anterior part of abdomen; cercus shorter than in *S. ismayi*. Female: tergite 7 relatively large, undivided; sternite 7 present, apparently divided into two narrow sclerites.

Dimensions. Total length, ♂ 1.0–1.3 mm, ♀ 1.4–1.6 mm; length of thorax, ♂ 0.47–0.58 mm, ♀ 0.55–0.64 mm; length of wing, ♂ 1.1–1.3 mm, ♀ 1.3–1.5 mm.

Distribution. Micronesia: Yap Group, Caroline Islands.

Notes

Suffomyia sabroskyi can be distinguished from *S. scutellaris* by the shorter antennal segment 3, shorter non-spatulate palpus, shorter, more rounded scutellum, and by other characters given in the key.

The specific epithet refers to the late Curtis W. Sabrosky, who collected the type series.

Suffomyia ismayi n.sp.

Figs 90, 91

Material examined. HOLOTYPE ♂, Papua New Guinea: S of Idler Bay, Central Province, 14.xii.1980... "Swept decaying seaweed", J.W.I. (AM). Double-mounted on micro-pin. PARATYPES. 2♂♂, same data as holotype (AM, one to be later placed in a Papua New Guinea institution). One paratype has been cleared in lactic acid, and is now preserved in glycerol.

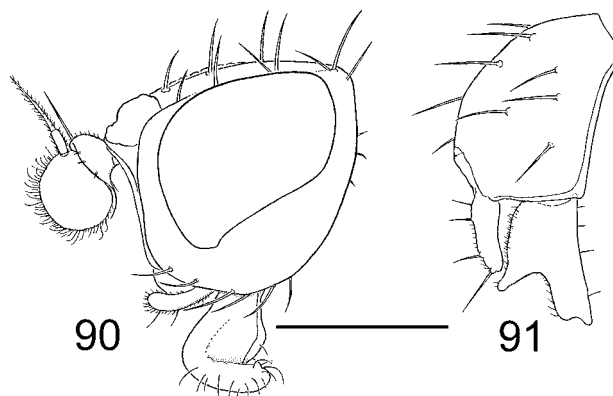
Description (♂, ♀ unknown). Somewhat resembling *S. sabroskyi* and agreeing with description of that species except as indicated below.

Coloration. Head largely grey-pruinescent; postfrons tawny, becoming grey posteriorly; face, parafacial, and cheek (except posterior part) pale yellowish. Antenna tawny; arista dark brown. Wing entirely pale, translucent, without pigmented areas of membrane; veins brownish yellow. Halter yellow.

Head, in profile (Fig. 90) less oval and ventrally narrowed than in *S. sabroskyi*; eye larger than in *S. scutellaris*, but smaller than in *S. sabroskyi*; postfrons broader than in that species; proportions of parts of head capsule approximately as in Fig. 90 (measurements not given because of distortion of all specimens); postgenal region without setulae. Antenna resembling that of *S. sabroskyi*; segment 4 much reduced but visibly sclerotized; segment 5 notably larger than in *S. sabroskyi*.

Thorax. Scutellum similar in shape to that of *S. sabroskyi*, with two bristle pairs only; acrostichal setulae well developed, but hindmost not enlarged, slightly in advance of hindmost dorsocentral; bristling of mesopleuron obscured by pin. Fore femur with one prominent posteroventral bristle near apical quarter, with dorsal setulae not much enlarged, but variable; fore tibia with dorsal setulae only slightly enlarged; mid femur with anterior setulae only slightly enlarged, with few distinct posteroventral bristles; mid and hind tibiae without enlarged setulae; hind femur with few slightly enlarged anterior setulae distally; fore basitarsus apparently without bifid setulae (confirmation with SEM desirable); claws very slender, falcate, not compressed (CLM). Wing slightly more narrowed across anal region than in *S. sabroskyi*; veins 3 and 4 very slightly diverging distally; cell-4 index = 0.34; ultimate section of vein 5 c. 1.2 times as long as penultimate section of vein 4.

Abdomen. Tergites 3, 4, and 5 of approximately similar length; dorsal protandrial sclerite 2.7 times as long as tergite 5; epandrium coarsely setulose, but without pair of outstanding bristles, with thickened ventral and anterior margins, thickening of anterior margin broadly interrupted medially; surstylus unequally bilobed, with larger, anterior lobe asymmetrically emarginate apically, posterior surface of surstylus in part densely pubescent, anterior margin with sparse fine setulae, but spinescent setulae (as in *S. scutellaris*)



Figs 90, 91. *Suffomyia ismayi*. (90) Head (ptilinum partly exposed). (91) Epandrium and associated parts from right side. Scale = 0.1 mm.

absent; basal articulation not oblique, with two condyles (anterior and posterior) as in *S. scutellaris*; cercus moderately long, with pubescence and few long setulae.

Dimensions. Total length 0.91–0.92 mm; length of thorax 0.40–0.47 mm; length of wing 0.88–0.96 mm.

Distribution. New Guinea: southeast coast.

Notes

Suffomyia ismayi is apparently the smallest fly in the Zaleinae, though precise dimensions were not given for *S. scutellaris*. In the absence of seriate postgenal setulae, it resembles most *Zalea* species, rather than the other *Suffomyia* species, but in *Z. earlyi* and *Z. wisei* the unusually long setulae of the (upper) postocular series are continued further ventrally than in other *Zalea* spp., and in *Z. johnsi* there is sometimes a rudimentary upper postgenal series.

In addition to the characters given in the key to species, *S. ismayi* differs from the other *Suffomyia* species and from other known zaleines in its simple, slender claws. As it shares apparent synapomorphies with other *Suffomyia* spp., and as the total number of known species is small, I consider it best to keep it in the same genus.

The specific epithet refers to John W. Ismay, who collected the type series.

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References

- Colless, D.H., & D.K. McAlpine, 1991. Chapter 39. Diptera (flies). *The Insects of Australia* (edn 2): 717–786. Carlton: Melbourne University Press.
- Crampton, G.C., 1942. The external morphology of the Diptera. In *Guide to the Insects of Connecticut. State Geological and Natural History Survey Bulletin* 64: 10–165.
- Crosskey, R.W., 1973. A conspectus of the Tachinidae (Diptera) of Australia, including keys to the supraspecific taxa and taxonomic and host catalogues. *Bulletin of the British Museum (Natural History) Entomology, supplement* 21, pp. 221.
- Ferrar, P., 1988. *A Guide to the Breeding Habits and Immature Stages of Diptera Cyclorrhapha*, pp. 907. Leiden: E.J. Brill and Scandinavian Press.
- Foster, G.A., & W.N. Mathis, 2003. A revision of the genera *Pelomyia* Williston and *Masoniella* Vockeroth (Diptera: Tethinidae). *Smithsonian Contributions to Zoology* 619: iv+3 pp.
- Freidberg, A., 1995. A study of Zaleinae, a taxon transitional between Canacidae and Tethinidae (Diptera), with a description of a new genus and species. *Entomologica Scandinavica* 26: 447–457.
- Griffiths, G.C., 1972. *The Phylogenetic classification of the Diptera Schizophora with Special Reference to the Structure of the Male Postabdomen*. The Hague: W. Junk, 340 pp.
- Hackman, W., & R. Väisänen, 1985. The evolution and phylogenetic significance of the costal chaetotaxy in the Diptera. *Annales Zoologici Fennici* 22: 169–203.
- Harrison, R.A., 1959. Acalypterate Diptera of New Zealand. *New Zealand Department of Scientific and Industrial Research, Bulletin* 128, pp. 382.
- Harrison, R.A., 1976. Arthropoda of the Southern Islands of New Zealand (9) Diptera. *Journal of the Royal Society of New Zealand* 6: 107–152.
- Hendel, F., 1916. Beiträge zur Systematik der Acalyptraten Musciden (Dipt.). *Entomologische Mitteilungen* 5: 294–299.
- Hendel, F., 1928. Zweiflügler oder Diptera. II. Allgemeiner Teil. *Die Tierwelt Deutschlands* 11: 135. Jena: Gustav Fischer.
- Hennig, W., 1971. Neue Untersuchungen über die Familien der Diptera Schizophora (Diptera: Cyclorrhapha). *Stuttgarter Beiträge zur Naturkunde* 226, 76 pp.
- Hennig, W., 1973. 31. Diptera (Zweiflügler). *Handbuch der Zoologie* 4(2)2, 337 pp + 4 unnumbered pp.
- Jones, B.J., 1906. Catalogue of the Ephyridae, with bibliography and descriptions of new species. *University of California Publications in Entomology* 1: 153–198.
- Krystoph, H., 1961. Vergleichend-morphologische Untersuchungen an den Mundteilen bei Empididen. *Beiträge zur Entomologie* 11: 824–872.
- Mathis, W.N., 1982. Studies of Canacidae (Diptera), I: suprageneric revision of the family, with revisions of new tribe Dynomiellini and new genus *Isocanace*. *Smithsonian Contributions to Zoology* 347, pp. iv+29.
- Mathis, W.N., 1992. World catalog of the beach-fly family Canacidae (Diptera). *Smithsonian Contributions to Zoology* 536: 18 pp.
- Mathis, W.N., 1996. Australian beach flies (Diptera: Canacidae). *Proceedings of the Biological Society of Washington* 109: 326–348.
- Mathis, W.N., & L. Munari, 1996. World catalog of the Tethinidae (Diptera). *Smithsonian Contributions to Zoology* 584, pp. 27.
- Mathis, W.N., & T. Zatwarnicki, 1998. Family Ephyridae. In *Contributions to a Manual of Palaearctic Diptera*, ed. L. Papp & B. Darvas, vol. 3, pp. 537–570. Budapest: Science Herald.
- McAlpine, D.K., 1973. The Australian Platystomatidae (Diptera, Schizophora) with a revision of five genera. *The Australian Museum Memoir* 15, pp. 256.
- McAlpine, D.K., 1982. A new genus of Australian littoral flies (Diptera: ?Canacidae). *Memoirs of the Entomological Society of Washington* 10: 108–117.
- McAlpine, D.K., 1985a. Taxonomic notes on the genus *Zalea* McAlpine (Diptera: Canacidae). *Australian Entomological Magazine* 11: 81–82.
- McAlpine, D.K., 1985b. The Australian genera of Heleomyzidae (Diptera: Schizophora) and a reclassification of the family into tribes. *Records of the Australian Museum* 36(5): 203–251. http://www.australianmuseum.net.au/pdf/publications/0000_complete.pdf
- McAlpine, D.K., 1988. Studies in upside-down flies (Diptera: Neurochaetidae). Part II. Biology, adaptations, and specific mating mechanisms. *Proceedings of the Linnean Society of New South Wales* 110: 59–82.
- McAlpine, D.K., 1991. Review of the Australian kelp flies (Diptera: Coelopidae). *Systematic Entomology* 16: 29–84.
- McAlpine, D.K., 2000. Australian signal flies of the genus *Rhytidortalis* (Diptera: Platystomatidae). *Proceedings of the Linnean Society of New South Wales* 121: 147–174.
- McAlpine, D.K., 2002. Some examples of reduced segmentation of the arista in Diptera-Cyclorrhapha, and some phylogenetic implications. *Studia dipterologica* 9: 1–17.
- McAlpine, J.F., 1981. 2. Morphology and terminology—adults. In J.F. McAlpine (editor): *Manual of Nearctic Diptera* 1: 9–63. Hull, Quebec: Canadian Government Publishing Center.
- McAlpine, J.F., 1989. Phylogeny and classification of the Muscomorpha. In *Manual of Nearctic Diptera*, ed. J.F. McAlpine, 3: 1397–1578. Hull, Quebec: Canadian Government Publishing Center.

- Munari, L., 1998. 3.19. Family Tethinidae. In *Contributions to a Manual of Palaearctic Diptera*, ed. L. Papp & B. Darvas, 3: 243–250. Budapest: Science Herald.
- Munari, L., 2000. Beach flies from southwestern coast of Australia, with descriptions of a new genus and two new species (Diptera Tethinidae). *Bollettino della Società Entomologica Italiana* 132: 237–248.
- Munari, L., 2004. Beach flies (Diptera: Tethinidae: Tethininae) from Australia and Papua New Guinea, with descriptions of two new genera and ten new species. *Records of the Australian Museum* 56(1): 29–56.
http://www.australianmuseum.net.au/pdf/publications/1395_complete.pdf
- Nartshuk, E.P., 1987. Cereal flies (Diptera: Chloropoidea) their classification, evolution, and relationship with plants. *Trudy Zoologicheskoy Institut* 136, 279 pp, (in Russian).
- Osten-Sacken, C.R., 1884. An essay on comparative chaetotaxy, or the arrangement of characteristic bristles of Diptera. *The Transactions of the Entomological Society of London* 1884: 497–517.
- Papp, L., 1983. Taxonomic notes on some flies of the Crozet Islands (Diptera). *Folia entomologica Hungarica* 44: 271–281.
- Parham, W.T., 1973. *Island Volcano. White Island, or Whakaari, New Zealand*, 211 pp. Auckland: Collins.
- Sabrosky, C.W., 1999. Family-group names in Diptera. *Myia* 10: 1–360.
- Sinclair, B.J., 1992. A phylogenetic interpretation of the Brachycera (Diptera) based on the larval mandible and associated mouthpart structures. *Systematic Entomology* 17: 233–252.
- Speight, M.C.D., 1969. The prothoracic morphology of the acalyptrates (Diptera) and its use in systematics. *Transactions of the Royal Entomological Society* 121: 325–421.
- Steyskal, G.C., 1976. The terminology of the bristles on the upper back of the head in the higher Diptera. *Journal of the Kansas Entomological Society* 49: 155–159.
- Steyskal, G.C., & L.V. Knutson, 1981. 47. Empididae. In *Manual of Nearctic Diptera*, ed. J.F. McAlpine, 1: 607–624. Hull, Quebec: Canadian Government Publishing Center.
- Vockeroth, J.R., 1987. 101. Tethinidae. In *Manual of Nearctic Diptera*, ed. J.F. McAlpine, 2: 1073–1078. Hull, Quebec: Canadian Government Publishing Center.
- Wheeler, T.A., 1984. A new species of *Neomeoneurites* Hennig (Diptera: Carnidae) from Argentina. *The Canadian Entomologist* 126: 435–441.
- Wirth, W.W., 1987. 102. Canacidae. In *Manual of Nearctic Diptera*, ed. J.F. McAlpine, 2: 1079–1083. Hull, Quebec: Canadian Government Publishing Center.
- Womersley, H., 1937. Diptera. *B.A.N.Z. Antarctic Research Expedition. Report* (B) 4: 59–79.

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New Taxa of Signal Flies (Diptera: Platystomatidae) of New Caledonia

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ABSTRACT. Possible explanations are sought for the distribution patterns of platystomatid genera in Pacific Oceania, with special reference to those of New Caledonia. A key to the eleven known genera of New Caledonia (including the Loyalty Islands) is given. Five of these genera are endemic to this province of the Australasian Region. A key to the known Australasian species of *Naupoda* is given. *Dayomyia molens* n.gen. and n.sp., *Eumeka koghii* n.sp., *Pogonortalis monteithi* n.sp., *Sors wrightae* n.gen. and n.sp., and *Naupoda (Gonga) burwelli* n.sp. are described from New Caledonia (Grande Terre). Abrasion of part of the antenna in *D. molens* is apparently due to some unexplained behavioural trait.

MCALPINE, DAVID K., 2007. New taxa of signal flies (Diptera: Platystomatidae) of New Caledonia. *Records of the Australian Museum* 59(1): 65–77.

Introduction

New Caledonia has a rich fauna of Platystomatidae for such a small and isolated group of islands, and has a high rate of endemism. Ongoing incomplete studies show the presence of at least eleven genera and 47 species. *Lamprogaster* Macquart and *Signa* McAlpine are the genera with the largest representation, but only one New Caledonian species of each is yet described. This paper, dealing with five small, apparently uncommon genera, foreshadows further work on this fauna. The number of available specimens of each new species is small, and recent focused field work by colleagues (2006) has failed to bring to light any more material of these. However, the novel status of the species is not in doubt, and I believe that the two new genera are well founded.

Methods

Morphological terms are those used by me previously (McAlpine 1973). Paired bristles and other structures are described in the singular, except where the context makes this inappropriate. The antenna is treated as a six-segmented appendage and segments are numbered from the base. Segments 4 to 6 constitute the arista. Cell-4 index is defined as the ratio of the length of the antepenultimate section of vein 4 to the full length of the discal cell along vein 4. Width of mesoscutum is measured across the notopleural calli.

The following collectors names are abbreviated to the initials: C.J. Burwell, N.L. Krauss, G.B. Monteith, J. Wright, S.G. Wright, C. Yoshimoto.

The following abbreviations refer to institutions housing specimens:

- AM Australian Museum, Sydney;
 BPB Bernice P. Bishop Museum, Honolulu;
 PM Muséum national d'Histoire naturelle, Paris;
 QM Queensland Museum, Brisbane.

Geographic distribution

Previously (McAlpine, 2001) I referred to New Caledonia as a biogeographic province of the Australasian Region. For the purposes of this paper, I use the terms Grande Terre (main island with its little known small satellites) and Loyalty Islands (les Loyauté) to designate the two principal sub-provinces. This overcomes the dual use of the term New Caledonia for both the province and one of its sub-provinces. So far I have seen no platystomatids from Isle of Pines, a potential third sub-province. Otherwise delimitation of biogeographic provinces is as given by McAlpine (2001).

The following twelve genera of Platystomatidae are restricted to the smaller islands of the Pacific Ocean: *Apactoneura* Malloch, *Apiola* McAlpine, *Montrouzieria* Bigot, *Dayomyia* n.gen., *Par* McAlpine, *Phlyax* McAlpine, *Pseudorichardia* Hendel, *Signa* McAlpine, *Sors* n.gen., *Tarfa* McAlpine, *Terzia* McAlpine, an unnamed Fijian genus. These are without representation on any larger land masses bordering the Pacific, such as Asia, Australia, the Philippines, the major Indonesian islands, New Guinea, and the Americas. The pattern of world distribution of

platystomatid taxa indicates a probable origin of these Pacific taxa ultimately from those lands on the western rim of the Pacific Ocean. The platystomatid fauna of the Americas is too meagre and derived to allow the probability of its having contributed significantly to the Pacific Island fauna, and has no degree of continuity with this fauna unless it be in the almost cosmopolitan genus *Rivellia* Robineau-Desvoidy. On the other hand, the major land masses on the western edge of the Pacific have a very diverse platystomatid fauna, and the initially rich fauna of their nearer islands (especially in the tropics) shows a marked but irregular diminution towards the more remote eastern islands. This tendency is seen in the numbers of genera present in the various provinces of the Pacific tropics listed by McAlpine (2001). Among these are: New Guinea—30 genera (emended since 2001), Bismarck Archipelago—18 genera, Solomon Archipelago—14 genera, New Caledonia—11 genera (here emended), Fiji—5 genera, tropical Polynesia—6 genera (the last including: Samoan Islands—6 genera, French Polynesia—2 genera, Hawaiian Islands—one genus). Of these provinces, New Caledonia has the largest proportion of its genera endemic—five of the eleven genera or 45%, if generic status be maintained for *Montrouzieria* Bigot. The other four endemic genera are *Dayomyia* n.gen., *Signa* McAlpine, *Sors* n.gen. and *Tarfa* McAlpine.

The platystomatids of the Loyalty Islands are poorly known and collected. Nevertheless, these islands have two apparently endemic genera: *Montrouzieria* on Lifou and *Tarfa* on Ouvéa. The most speciose genera of Grande Terre, *Lamprogaster* and *Signa*, are not recorded for the Loyalty Islands.

Key to New Caledonian genera of Platystomatidae

- 1 Vein 2 with conspicuous bend near mid-length; arista bipectinate, with a series each of long dorsal and ventral rays; scutellum brown with u-shaped yellowish marginal stripe; sternopleural bristle large *Scholastes* Loew
- Vein 2 without bend near mid-length; arista with pubescence only or nearly bare; scutellum without yellowish marginal stripe; sternopleural bristle usually absent (present but small in some *Naupoda*) 2
- 2 Facial carina well developed, flat-topped, with abruptly precipitous sides; squama large, its area much greater than that of axillary lobe; fore femur usually with posteroventral bristles poorly differentiated or absent 3
- Facial carina reduced, or rounded at sides, or very narrow and hidden in concavity in profile; squama variably developed, but not much larger in area than axillary lobe (except in *Naupoda*); fore femur with a series of well-developed posteroventral bristles (except in *Tarfa*) 4

- 3 One fronto-orbital bristle large, about as long as outer vertical bristle; arista with numerous moderately short hairs on almost entire length; penultimate section of vein 4 no longer than anterior crossvein *Montrouziera* Bigot
- Fronto-orbital bristles vestigial or absent; arista haired only on basal part; penultimate section of vein 4 usually much longer than anterior crossvein (one exceptional sp.) *Lamprogaster* Macquart
- 4 Second section of vein 4 more than twice as long as third (penultimate) section 5
- Second section of vein 4 less than twice as long as third section 7
- 5 Scutellum with numerous dorsal setulae; mesoscutum broader than long; first basal cell at level of basal crossvein much narrower than discal cell at same level *Sors* n.gen.
- Scutellum without setulae, with only the major bristles; mesoscutum slightly longer than broad; first basal cell at level of basal crossvein not narrower than discal cell at same level 6
- 6 The following bristles all present: inner vertical, fronto-orbital, humeral, anterior notopleural, postalar, mesopleural, three pairs of scutellars; second basal cell less than 0.6 as long as discal cell; abdominal tergite 4 and often other tergites with zones of dense, paint-like white pruinescence *Eumeka* McAlpine
- The above-listed bristles all absent, except for one pair of scutellars; second basal cell at least 0.8 as long as discal cell; abdominal tergites 3 to 5 entirely shining black *Dayomyia* n.gen.
- 7 Scutellar bristles (two pairs) all inserted within posterior fifth of length of scutellum; scutellum with many lateral (as well as dorsal) setulae; second basal cell, measured along vein 5, about as long as discal cell and much larger in area than anal cell; female: abdominal tergites 4 and 5 vestigial or absent *Naupoda* Osten Sacken
- Scutellum with pair of lateral bristles before mid length, without setulae on lateral surface; second basal cell, measured along vein 5, much shorter than discal cell, not of noticeably greater area than anal cell; female: abdominal tergites 4 and 5 well developed 8
- 8 Vein 2, on at least its distal half, running very close to costa; fore femur without posteroventral bristles *Tarfa* McAlpine
- Vein 2 not much approximated to costa before its distal end; fore femur with a series of posteroventral bristles 9
- 9 Second section of vein 4 shorter than first section and than third section; first basal cell entirely covered by blackish mark, without hyaline zones; scutellum without setulae; hind femur with short longitudinal anteroventral ridge at c. distal third of length *Pogonortalis* Hendel
- Second section of vein 4 longer than first section, not shorter than third section; first basal cell not entirely blackish; scutellum generally with setulae; hind femur without such anteroventral ridge 10
- 10 Veins 3 and 4 not apically convergent; second section of vein 4 markedly concavely curved; section of costa on subcostal cell subequal in length to that on second costal cell *Rivellia* Robineau-Desvoidy
- Vein 4 at least slightly curved forward apically to converge with vein 3; second section of vein 4 nearly straight or slightly arched; section of costa on subcostal cell much longer than that on second costal cell *Signa* McAlpine

***Dayomyia* n.gen.**

Type species *D. molens* n.sp.

Description. Male (female unknown). Medium-sized dark flies of moderate to rather stout build with partly infuscated wing.

Head. Parafacial broad; face deeply and extensively concave, so that median facial carina is not visible in profile; outer vertical bristle situated behind and below vertex; no other cephalic bristles differentiated from scattered fine setulae. Antenna of moderate proportions for Platystomatinae, with large, elongate segment 3; arista with minute pubescence less than 0.2 of its maximum diameter in length. Prelabrum reduced, flattened on ventral surface of head (perhaps sexually dimorphic).

Thorax with *only* the following major bristles differentiated: long posterior notopleural, one small dorsocentral, apical scutellar. Legs of moderate length; femora not incrassate; fore femur (but not other femora) with spinescent posteroventral bristles. Wing: stem vein (base of R) setulose dorsally only beyond level of humeral crossvein; veins 3 and 4 not strongly convergent towards apex; anterior crossvein meeting vein 4 well beyond mid-length of discal cell; alula moderately large; squama (lower calypter) forming moderately short lobe, no larger than axillary lobe (upper calypter).

Abdomen broadly ovate. Aedeagus of basic platystomatine structure, with pair of short terminal filaments.

Distribution New Caledonia: far north of Grande Terre.

Notes

The great reduction in chaetotaxy sets *Dayomyia* apart from most other platystomatid genera. The nearest approach to this condition is in *Angitula* Walker, but that genus and its probable sister-group *Terzia* McAlpine form a distinctive clade unlikely to be closely related to *Dayomyia*. *Dayomyia* is distinguished from *Angitula* s.l. by the robust habitus and relatively stout legs, by the short, unmodified prothorax, the extensive covering of many short setulae on the mesoscutum, the absence of the metathoracic postcoxal bridge, and the large alula. The resemblance in chaetotaxy is due to convergence.

The wing venation of *Dayomyia* shows points of resemblance to *Brea* Walker and *Pseudorichardia* Hendel, particularly in the unusually long second basal and anal cells, and there is some resemblance in general features of wing pattern. The course of the subcosta distally is more like that of *Brea*, but I am unable to find enough distinctive character states on which to base a hypothesis of close relationship.

Several features of *Dayomyia* suggest relationship to *Rhytidortalis* Hendel and through this genus to possibly related genera such as *Microepicausta* Hendel and *Scotinosoma* Loew. In the antenna, the strong armature of setulae on the dorsomedial surface of segment 2, and the bulky segment 3 with dorsal convexity basad of the insertion of the arista are reminiscent of males of *Rhytidortalis* *averni* McAlpine and some other *Rhytidortalis* species (see

McAlpine, 2000). These characters are all subject to sexual dimorphism in at least some *Rhytidortalis* species, but female conditions in *Dayomyia* are unknown. The extent of the basal swelling of antennal segment 6 in *Dayomyia* is more like that of *Rhytidortalis* than that of *Brea* and *Pseudorichardia*, as is the minute *decumbent* pubescence towards the base of that segment. The males of *R. averti* and to some extent those of other *Rhytidortalis* species have the prelabrum reduced in depth and its anterior surface receding, a condition approaching that of *D. molens*. The males of *Brea* and *Pseudorichardia* do not have the prelabrum thus reduced. The aedeagus of *Dayomyia* resembles that of *Rhytidortalis*, but is of such a generalized type for the Platystomatinae that no particular synapomorphy can be inferred. *Dayomyia* shows substantial difference from *Rhytidortalis* in venation, chaetotaxy, and facial structure, but these differences mostly involve autapomorphies for the former.

From these observations I put forward the hypothesis of closer relationship of *Dayomyia* to *Rhytidortalis* and related genera than to other (or most other) platystomatine genera, but this view cannot, without further knowledge, be based on well supported synapomorphies, uniquely derived within the Platystomatinae.

The generic name refers to Barry James Day who, over many years, has made significant collections of Diptera, including many new taxa, for the Australian Museum. Most recently these have included New Caledonian platystomatids. The generic name is treated as a feminine noun in the nominative case.

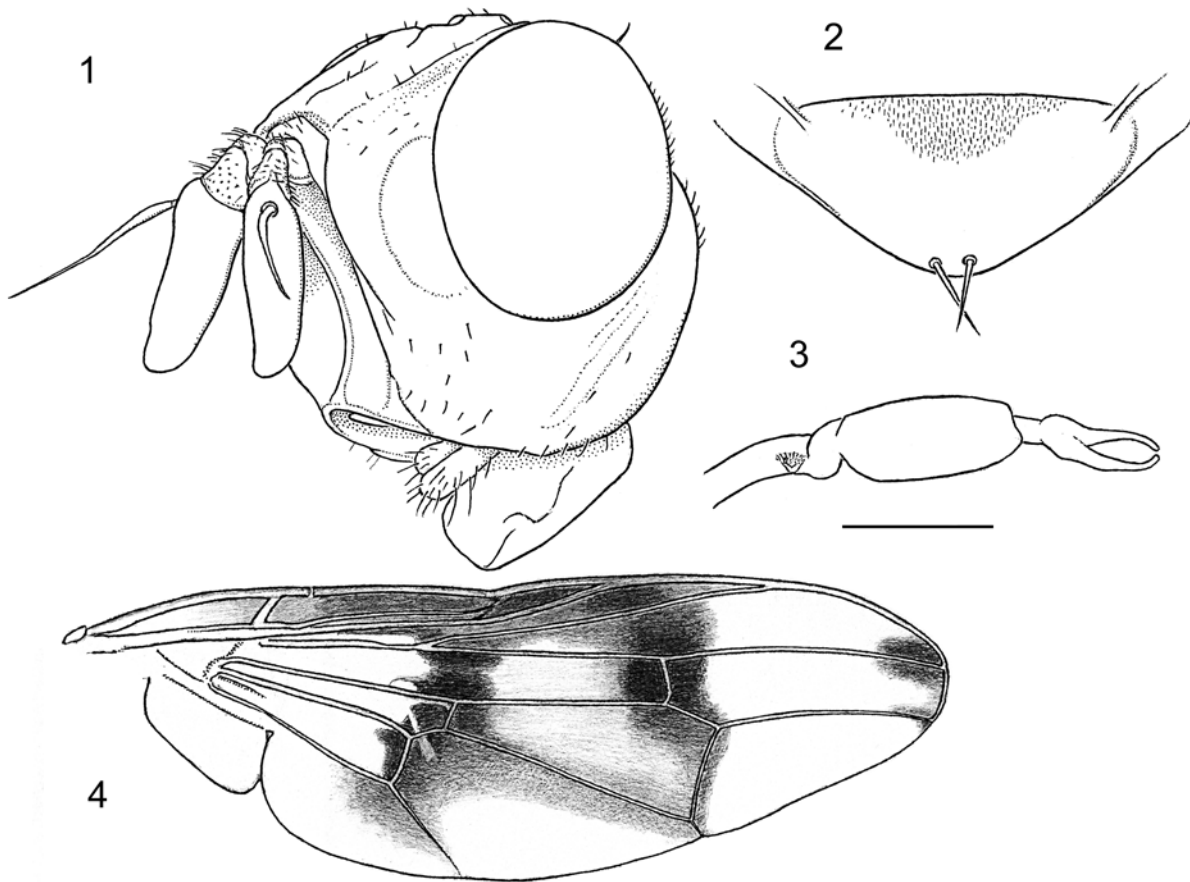
***Dayomyia molens* n.sp.**

Figs 1–4

Types. HOLOTYPE ♂, New Caledonia: 1 km SW of Mandjelia, 750 m, 20°24'S 164°32'E, 5.i.2005, G.B.M, MV light, rainforest (PM). PARATYPE ♂, Mandjelia—lower creek, 580 m, 20°24'S 164°31'E, 4.i.2005, G.B.M. (QM).

Description. Male.

Coloration. Head predominantly tawny-brown; cuticle largely pruinulent or finely sculptured and not shining; parafacial with zone of coarser, dense whitish pruinescence next to eye; face densely white-pruinulent except along summit of median carina and on lower margin; postgenal region and part of occiput with coarse greyish pruinescence. Antenna orange-tawny. Thorax black, largely shining; mesoscutum with small lateral marginal zone of yellowish-grey pruinescence both before and behind notopleural bristle, former extending mesad of humeral callus; posterior parts of pleura and much of postscutellum greyish-pruinulent. Legs largely black to brown-black; apices of all femora and bases of all tibiae narrowly tawny. Wing with brown markings partly diffuse as in Fig. 4; much of membrane on central and basal part of wing suffused with yellow; axillary lobe and squama creamy-white. Halter yellow. Abdomen black; tergites largely shining and with bluish reflections, except for a transverse stripe of grey-brown pruinescence near junction of tergites 1 and 2; sternite 1 largely glossy blackish, with grey-pruinulent zone on each lateral margin.



Figs 1–4. *Dayomyia molens*. (1) Head. (2) Scutellum, dorsal view. (3) Distal part of aedeagus, scale = 0.2 mm. (4) Wing.

Head as wide as mesoscutum and c. $1.3\times$ as wide as high; postfrons narrowest near vertex, where its width is c. 0.4 that of head, rather sparsely finely setulose; parafacial without setulae except towards upper and lower extremities; frontal lunule shortly exposed, with few fine setulae; facial carina extending for almost full height of face, very narrow, but slightly dilated at lower extremity; cheek almost half as high as eye; occiput flattened on c. upper third, strongly swollen on rest of extent except for central depression containing occipital foramen. Antenna: segment 1 short, but prominent in profile; segment 2 moderately short, with many setulae, including field of numerous short, stout setulae (often damaged) on medial surface; segment 3 almost as long as face; arista apparently slightly shorter than segment 3, perhaps slightly damaged apically in all examples; segment 4 visible but extremely reduced; segment 5 separated from segment 6 by membranous ring; segment 6 swollen on basal part, with very inconspicuous pubescence. Palpus of moderate proportions, compressed, setulose; proboscis moderately short and stout; prementum broader than long, with distal margin almost straight.

Thorax stout; mesoscutum almost as broad as long, with many non-seriate setulae; humeral callus with numerous setulae; scutellum rather short, convex, subtriangular but rounded apically; subscutellum small and recessed; mesopleuron, pteropleuron, and sternopleuron finely setulose; prosternum broad, with short setulae and

rudimentary precoxal bridge; metapleural sclerite extending narrowly between hind coxa and abdominal segment 1, but not forming postcoxal bridge. Legs without differentiated bristles, except for the posteroventral series of fore femur; posterior bridge of hind coxa without setulae; mid tibia with one rather short stout apical ventral spur and several stout setulae on each side of it. Wing: venation as in Fig. 4; subcosta not fading distally, meeting costa at acute angle; cell-4 index = 0.76–0.81; membrane, including that of alula, largely microtrichose; pale basal areas of first basal, second basal and anal cells, and zone behind mid-length of anal cell almost bare; squama of moderate size, slightly broader than a semicircle.

Abdomen. Tergites 2 to 5 with numerous, generally distributed small setulae; tergite 2 showing narrow membranous zone along much of posterior margin except at sides; tergite 5 almost as long as tergite 4, without enlarged setulae; at least sternites 1 and 2 with fine setulae. Postabdomen: aedeagus with small terminal tuft of pubescence on stipe; preglans well differentiated from stipe, short, asymmetrical; glans ovoid-cylindrical; bulb short, inconspicuous; paired terminal filaments broadly fused basally, each much shorter than glans.

Dimensions. Total length (abdomen variably flexed) 5.5–7.1 mm; length of thorax 2.7 mm; length of wing 5.9–6.1 mm; length of glans of aedeagus 0.25 mm.

Notes

The male of *D. molens* has a field of short, strong setulae on the dorsomedial surface of antennal segment 2. In both the available specimens there is damage to these setulae which is very unlikely to be the result of collecting or subsequent handling, because this surface of the antennae is less freely exposed than other parts. On the holotype at least eight of these setulae on the right antenna have been snapped off or ground off at or just beyond their bases, while on the left antenna five setulae are similarly damaged. In the paratype about 28 setulae on the right antenna and 26 on the left are damaged, i.e. most of the setulae on this part of the segment. On each antenna the setulae on the rest of the surface of segment 2 are intact.

I have commented on damage to setulae, which appear to be a specialized development on the medial surface of antennal segment 2, in the canacid (or tethinid) *Tethinosoma fulvifrons* Malloch and the platystomatid *Rhytidortalis averni* McAlpine (McAlpine, 2007 [this volume]). I hypothesized that, in these flies of sandy (beach or dune) habitats, the antennae may play a role in digging or extrication from loose sand. I have no information to suggest that any such activity is likely for *Dayomyia*, but the data seem to indicate that some unknown activity of the fly involves abrasion of these setulae.

The specific epithet is a Latin participle, grinding, in reference to the abraded antennal setulae.

Eumeka McAlpine

Eumeka McAlpine, 2001: 145–146. Type species (original designation) *E. hendeli* McAlpine.

Distribution Australia: Queensland. New Guinea. Bismarck Archipelago: Lavongai (or New Hanover). New Caledonia: Grande Terre.

Notes

In my previous treatment of *Eumeka* (McAlpine 2001: table 1) I gave the principal diagnostic characters of the only known New Caledonian species, now described as *E. koghii*.

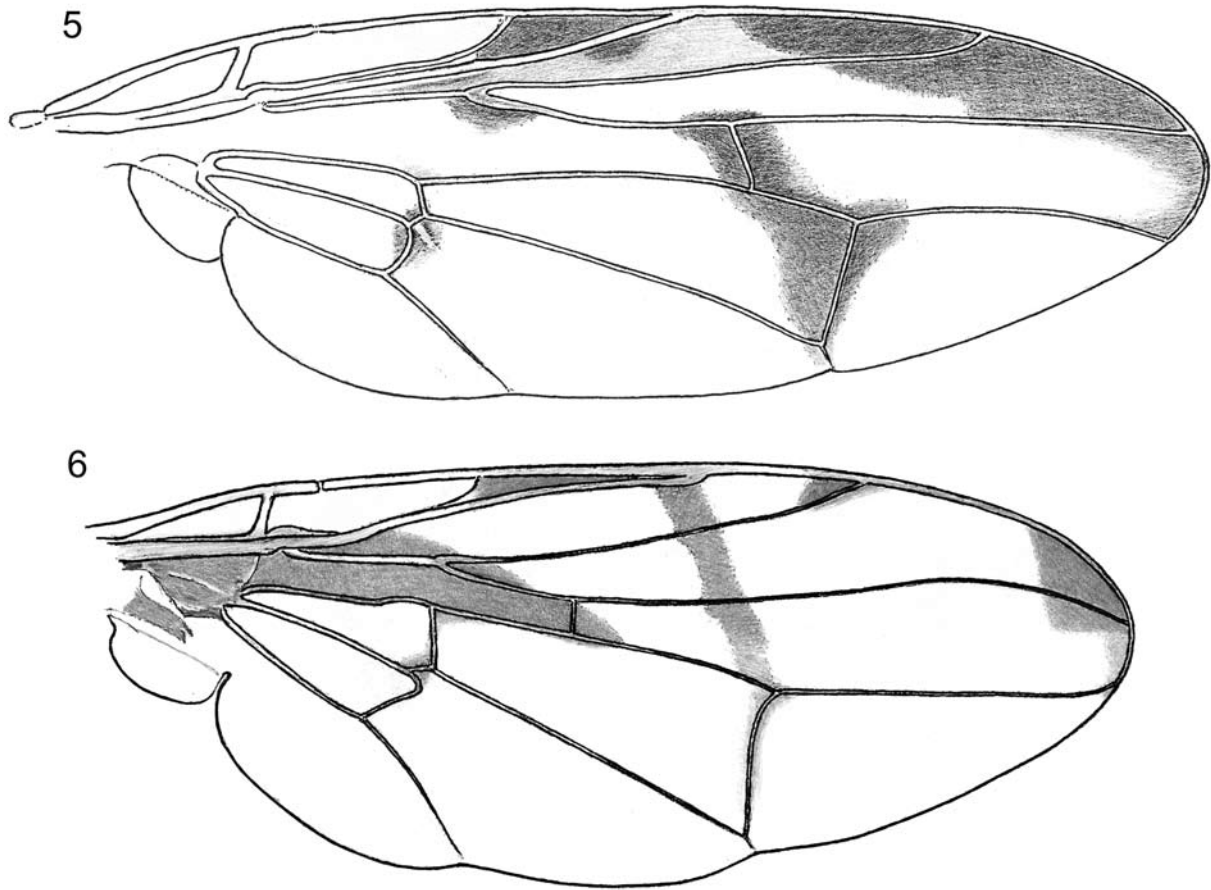
Eumeka koghii n.sp.

Fig. 5

Type. HOLOTYPE ♀ (unique), New Caledonia: Mount Koghi [or Montagnes des Koghis], 600 m, 26–30.i.1963, C.Y., N.L.K., light trap (BPB).

Description. Female (male unknown). Resembling *E. hendeli* McAlpine (see McAlpine, 2001) but smaller.

Coloration. Head with ground-colour largely brown; cheek and lower occiput brownish-tawny; fronto-orbital margin, parafacial, and postgenal region densely silvery-pruinescent; antennal groove more finely and thinly silvery-pruinescent. Palpus brown to tawny-brown. Mesoscutum with blackish ground-colour, becoming brown towards lateral margins, with median silver-grey pruinescent stripe joined to transverse prescutellar pruinescent zone, and with broader lateral pruinescent zone both before and behind transverse suture; humeral callus whitish-pruinescent only towards posterior margin, otherwise shining brown with pale yellowish hairs; scutellum shining blackish, with antero-dorsal zone of thin greyish pruinescence; pleura brown and shining in part; mesopleuron with silvery-pruinescent posterior marginal band narrowed dorsally, ventrally extending broadly across sternopleuron; pleurotergite with silvery-white pubescence-pruinescence. Coxae brown to tawny; fore coxa densely silvery-pruinescent on anterior surface; femora yellow; tibiae and tarsi dark brown to tawny-brown. Wing (Fig. 5) differing from other *Eumeka* spp. in broader brown costal band between veins 1 and 4 and large brown mark enclosing both anterior and discal crossveins; axillary lobe and squama white. Halter with tawny-yellow base and brown capitellum. Abdomen dark brown to tawny brown, largely shining with whitish hairs on tergites 1 and 2, mostly blackish hairs on other tergites; tergite 2 with rather small median whitish-pruinescent zone on posterior margin; tergite 3 with whitish-pruinescent zone on anterior margin which does not extend to lateral margin; tergite 4 with whitish-pruinescent zone on anterior margin, which broadens laterally and extends broadly over whole lateral margin; tergite 5 broadly whitish-pruinescent on lateral margin only; sternite 1 brown, shining, whitish-pruinescent on lateral margin and more narrowly so on posterior margin; sternites 2 and 3 almost entirely whitish-pruinescent; ovipositor sheath dark brown; aculeus yellow.



Figs 5, 6. Wings of signal flies. (5) *Eumeka koghii*. (6) *Pogonortalis monteithi*.

Head of similar shape and proportions to that of *E. hendeli*; facial carina almost flat-topped, depressed near mid-length so that central part is not visible in profile; height of cheek 0.28 of height of eye; fronto-orbital bristles two, reclinate, but posterior one strongly curved outwards; postgenal bristle large; setulae present on parafacial, but those near and just above its mid-height smaller and inconspicuous. Antenna (without arista) slightly shorter than face; arista almost twice as long as rest of antenna; segment 6 with sparse very minute pubescence near base only. Prelabrum moderately developed; its anterior surface almost vertical.

Thorax. Setulae on mesopleuron (perhaps sexually dimorphic) shorter than in either sex of *E. hendeli*, those near posterior margin moderately short, black, moderately thick, those on upper part fine, minute, and pale, those in compact ventral group black, thick and somewhat spinescent; setulae on anterior part of pteropleuron short, rather thick, black; thoracic chaetotaxy as for genus. Legs as for genus; bristles on hind femur rather weak, especially the pale anterior ones on basal half. Wing: vein 1 without ventral setulae; distal section of vein 4 slightly arched, apically slightly diverging from vein 3; cell-4 index = 0.76; first basal cell more extensively microtrichose than in other

Eumeka species, particularly on distal half; alula entirely microtrichose; squama rather narrowly rounded, not at all produced posteriorly (in contrast to *E. hendeli*).

Abdomen rather broad anteriorly, with no tendency towards petiolation; tergite 5 distinctly shorter than tergite 4; aculeus very slender; spiracle 5 apparently situated in pleural membrane below mid-length of tergite 5.

Dimensions. Total length 5.4 mm (abdomen flexed); length of thorax 2.7 mm; length of wing 6.1 mm.

Distribution New Caledonia: mountains in south of Grande Terre.

Notes

From comparison of certain species in the platystomatine genera *Rhytidortalis* Hendel, *Euprosopia* Macquart, and *Pseudocleitamia* Malloch the armature of the mesopleuron seems likely to be sexually dimorphic (see McAlpine, 2000 for *Rhytidortalis*; 1973 for *Euprosopia*; 2001 for *Pseudocleitamia*).

Pogonortalis Hendel

Pogonortalis Hendel, in de Meijere 1911: 370 (footnote).
Type species (monotypy) *Pogonortalis uncinata* de Meijere.

Diagnostic characters for the genus are as given in the above key to genera and the more comprehensive key by McAlpine (2001). In addition, the wing features shown in Fig. 6 are distinctive among New Caledonian flies.

Distribution. Australasian Region: Micronesia—Guam; Australia—southern and eastern parts, including Lord Howe Island and Tasmania (latter a new record—Bruny Island, AM); Norfolk Island; New Caledonia (see below). Oriental Region: Java. Nearctic Region: California (introduced).

Pogonortalis monteithi n.sp.

Fig. 6

Types. HOLOTYPE ♂, New Caledonia: Cap Ndoua site 1, rainforest, 150 m, 22°23'S 166°56'E, 21.xii.2004–8.i.2005, C.J.B., S.G.W., malaise trap (PM). PARATYPE, 1 ♂, Port Boise (Gite Kanua), rainforest, 10 m, 22°21'S 166°58'E, 30.xi.2004–1.xii.2004, C.J.B., S.G.W., J.W. (QM).

Description. Male (female unknown). Rather small to medium-sized dull blackish fly with few black wing markings, of very similar appearance to the familiar Australian *P. doclea* (Walker).

Coloration. Head largely blackish; postfrons tawny-brown anteromedially, with greyish pruinose orbital margins; face pale greyish pruinose on somewhat more than upper half; occiput with grey pruinescence, particularly towards orbital margin and vertex. Antenna: segments 1 and 2 tawny-brown; segment 3 rather dark greyish brown. Prelabrum blackish, sometimes partly tawny; palpus dark greyish brown, with slightly paler apex. Thorax with black ground-colour, largely covered with dark grey to whitish pruinescence; scutellum partly tawny, but with entire dorsal surface covered with grey pruinescence; propleuron with pale-pruinose zone just below spiracle separated from that on posterior margin of coxal foramen. Legs largely dark brown, including fore coxa; segments 1 and 2 of each tarsus yellow, their distal segments tending greyish brown. Wing hyaline, with blackish markings as in Fig. 6. Halter brown, with parts of base and capitellum paler, tawny-brown. Abdominal tergites and sternites black.

Head. Width of postfrons near its mid-length 0.23–0.24 of width of head; height of cheek 0.06–0.08 of height of eye;

lower outline of head capsule not noticeably expanded across cheek regions; single postgenal bristle strongly differentiated from fine postgenal setulae.

Thorax of similar proportions to that of *P. doclea* and related species; scutellum without setulae; the following bristles present (presence of some inferred from position of sockets): scapulars, humeral, 1 + 1 notopleurals, supra-alar, postalar, posterior intra-alar, one dorsocentral, prescutellar acrostichal, two pairs of scutellars, mesopleural. Wing: venation typical of genus; cell-4 index = 0.38–0.39.

Abdomen, in dorsal view, rounded oval, anteriorly narrowed but not prolonged; tergites 2 to 5 with roughened granular surface. Aedeagus very similar to that of *P. doclea* (see Steyskal, 1961) and *P. howei*; distal end of stipe shortly swollen; preglans short, stout, asymmetrical, set off from both stipe and glans by constrictions; glans very shortly ovoid; terminal filaments long, slender, subequal in length, with slightly expanded apices.

Dimensions. Total length 4.4–5.0 mm; length of thorax 1.7–2.0 mm; length of wing 3.6–4.1 mm; length of glans of aedeagus 0.23 mm.

Distribution New Caledonia: southern part of Grande Terre.

Notes

The males of *P. monteithi* differ from those of other known Australasian species of *Pogonortalis* in the absence of broadening of the head capsule and absence of the fascicle of enlarged cheek bristles (see diagrams in McAlpine, 1975). In these respects, even the larger male of *P. monteithi* more closely resembles the females of the other species. *Pogonortalis monteithi* further differs from *P. hians* Schneider and McAlpine in the more restricted wing markings, the more basally located anterior crossvein, and the entirely dull, pruinose dorsal surface of the scutellum. It differs from *P. howei* Paramonov and *P. doclea* (Walker) in having the transverse dark wing stripe from the distal end of vein 1 oblique and meeting vein 4, instead of terminating at vein 3, and in having the whitish-pruinose zone of the propleuron immediately below the spiracle separate from the pruinose zone on the posterior margin of the fore coxal foramen. From *P. howei* it also differs in having antennal segment 3 dark brown, instead of rather bright, deep yellow, in the darker brown fore coxa and femur, and in the absence of a dark blotch at about the basal third of the marginal cell.

The specific epithet refers to Geoffrey B. Monteith, who has encouraged this project and provided much New Caledonian material.

Sors n.gen.**Notes**

Type species *Sors wrightae* n.sp.

Description. Female (male unknown). Small, stout, dark flies; cuticle of head, thorax, and abdomen almost entirely pruinose and non-shining; wing heavily variegated.

Head anteroposteriorly compressed; vertical carina moderately sharp; face without prominent median carina; lower part of occiput convex, c. upper third flat to slightly concave; eye without obvious ommatrichia; the following bristles well developed: inner and outer vertical, upper fronto-orbital, postgenal; ocellar bristles small, hair-like, pale, widely divergent; postvertical bristles small, subparallel or divergent, procurved, inserted well below vertical carina. Antenna moderately short and stout; arista with segment 6 irregularly pubescent on whole length. Prelabrum well developed, broad but shallow; palpus moderately broad.

Thorax. Cuticle with general covering of dense, short, dark microtrichia (typical pruinoscence), but with pale markings indicated by distinctly longer, whitish microtrichia standing out in relief; mesoscutum much broader than long, extensively setulose; scutellum broadly rounded in dorsal view, slightly convex dorsally, with thin but not sharp posterior margin, extensively setulose, with sockets of posterior bristles prominent, tilted upwards so that rims form horizontal circles; mesopleuron only slightly convex; the following thoracic bristles present: humeral, 1 + 1 notopleurals, supra-alar, postalar, posterior intra-alar, one dorsocentral, prescutellar acrostichal, three pairs of scutellars, mesopleural; sternopleural bristle absent. Legs moderately short and stout; fore femur with posterodorsal and posteroventral bristles; mid tibia with one large apical ventral spur and no distinct secondary spurs. Wing rather broad; subcosta gradually approaching costa distally; vein 1 with a rather dense dorsal series of setulae from just beyond level of humeral crossvein, without more basal setulae; vein 2 without kink near mid-length; veins 3 and 4 very slightly divergent distally; vein 3 with numerous dorsal setulae; anterior crossvein as long as penultimate section of vein 4 or almost so; discal cell broad, relative to that of *Platystoma* and *Euprosopia*; anal cell obtusely angular posterodistally; squama forming moderately short rounded lobe.

Abdomen. Tergite 5 moderately large; ovipositor sheath short and broad; aculeus slender.

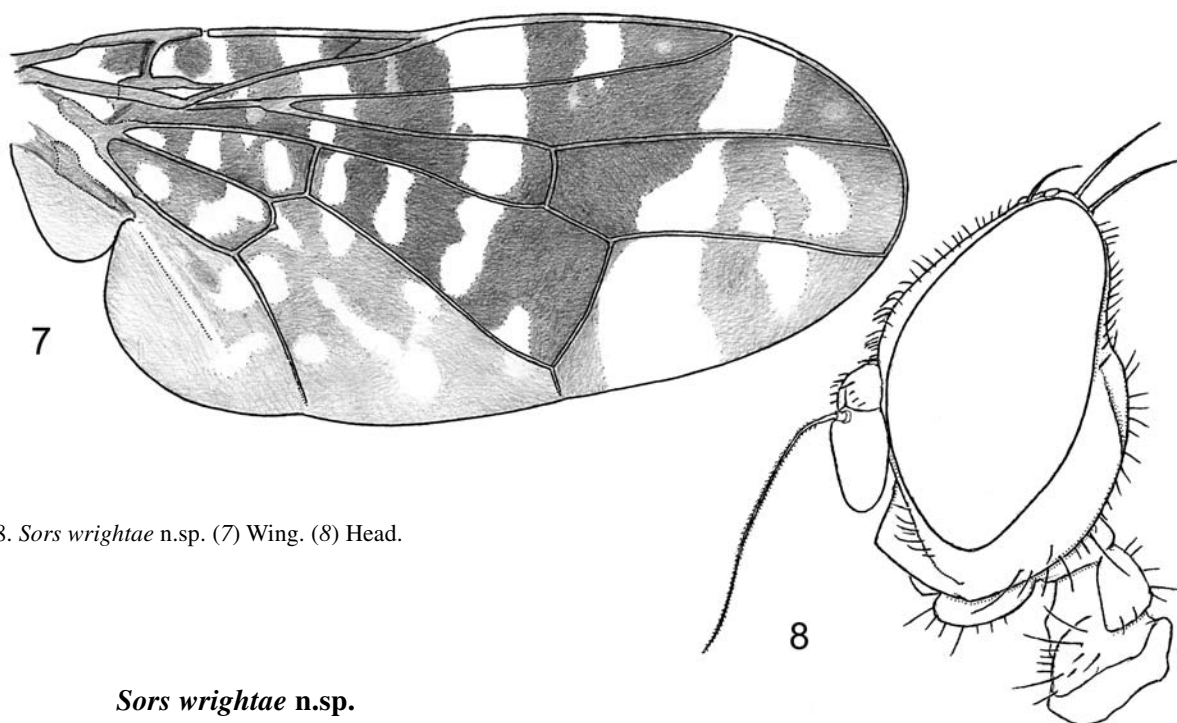
Distribution New Caledonia: only known from southern part of Grande Terre.

Sors resembles *Euthyplatystoma* Hendel (Oriental) and *Platystoma* Meigen (Palearctic). The anteroposteriorly compressed head, slightly but broadly swollen on lower occipital surface, with eye-surface broad, little convex and largely directed forwards, so that the eye appears narrow in profile, is typical of both these genera. The general dense covering of pruinoscence on the mesopleuron and some other parts of the thorax is short and dark, but the whitish flecks are the effect of small zones of significantly longer white microtrichia. This condition agrees with *Euthyplatystoma* and *Platystoma*, and is not present in *Euprosopia* Macquart, an Australasian genus of somewhat similar general coloration though not closely related to the other genera mentioned. The relatively short, ovate antennal segment 3 also agrees with these two northern genera, rather than with a majority of Australasian platystomatine genera.

Sors differs from both *Euthyplatystoma* and *Platystoma* in having the anterior crossvein almost as long as the penultimate section of vein 4 (instead of no more than half as long), in having the section of vein 5 on discal cell arched at most only on its basal half (instead of strongly arched for all or most of its length), in having the length of the discal cell (measured along vein 4) c. 2.2× as great as maximum width (instead of more than 3× as long as wide), and in having the prelabrum markedly shallower. In *Sors* the single stout apical ventral spur of the mid tibia disagrees with the condition in *Platystoma* (five available species), which has one or more secondary spurs, but is more like that of *Euthyplatystoma*. It further differs from *Euthyplatystoma* in its much shorter, broader fore coxa, and in having the posterior margin of the scutellum quite thin, instead of thick and rounded.

In the key to genera of Lamprogastrina and Platystomina by Hendel (1914b), *Sors* runs to *Platystoma*, providing that one knows enough of the keyed genera not to be side-tracked at couplets 10 or 19. There is some difficulty at couplet 10, where, on wing venation, it could tend towards the African *Sphenoprosopa* Loew, but it disagrees in head structure and wing pattern (see Hendel 1914a, fig. 271). At couplet 19, *Sors* may be associated through couplet 20 (instead of the more appropriate couplet 24) with 5 genera belonging to the subfamily Scholastinae, on account of having the mesoscutum much broader than long. In contrast to these genera, *Sors* has a large female tergite 5, no strong gibbosity on the upper part of the mesopleuron, and a much more restricted geno-parafacial area.

The generic name is a Latin noun, *sors* (genitive *sortis*) meaning (among other things) a kind or sort, and is feminine.



Figs 7, 8. *Sors wrightae* n.sp. (7) Wing. (8) Head.

***Sors wrightae* n.sp.**

Figs 7, 8

Types. HOLOTYPE ♀, New Caledonia: Mount Dzumac Road, 700 m, 22°03'S 166°28'E, 31.x.2001–1.xi.2001, G.B.M. (PM). PARATYPES: 1 ♀, same data as holotype (AM); 1 ♀, Forêt Nord, site 2, rainforest, 200 m, 22°19'S 166°55'E, 2–3.xii.2004, C.J.B., S.G.W. (QM); 1 ♀, Port Boise (Gite Kanua), rainforest, 22°21'S 166°58'E, 30.xi.2004–1.xii.2004, C.J.B., S.G.W., J.W. (QM).

Description. Female.

Coloration. Postfrons largely dull brown, with yellow setulae and black bristles; some small whitish-pruinose spots along frontal orbits; geno-parafacial orbit narrowly yellowish-pruinose; face largely blackish, with upper part extensively whitish-pruinose and much of lower margin yellow; occipital region with blackish ground-colour, covered to varying extent with white to greyish pruinescence. Antenna tawny-yellow with brown suffusions. Prelabrum brown; palpus dark grey-brown with tawny-yellow apex. Thorax with blackish ground colour and general covering of dark pruinescence; small whitish-pruinose spots and streaks present on humeral callus, mesoscutum, scutellum, propleuron, and mesopleuron. Legs largely brown-black; tarsal segments 2 to 5 pale yellow; each claw bicoloured, yellow basally, blackish apically. Wing membrane hyaline with extensive heavy brown-black to paler brown blotching, the blotches irregularly coalescing in parts; anterior and discal crossveins enclosed in a large irregular dark zone extending from costa to vein 5; squama creamy-white. Halter tawny-brown basally, with capitellum largely creamy-yellow. Abdominal tergites dull brown to brown-black, without pale markings; ovipositor sheath shining tawny-brown; aculeus yellow.

Head. Width of postfrons near its mid-length c. 0.35 of width of head; height of cheek c. 0.13 of height of eye; narrowest distance between antennal sockets c. 0.2 of width of one socket.

Thorax. Length of mesoscutum c. 0.83 of width; mesopleuron and anterior part of pteropleuron with numerous moderate-sized setulae, latter also with three or four very long pale yellow setulae. Legs: fore tarsus stout, slightly shorter than fore tibia. Wing: cell-4 index = 0.78–0.80; anal crossvein thickened at point of maximum curvature.

Abdomen. Tergites 3 and 4 subequal in size; tergite 5 slightly shorter and narrower; tergite 6 reduced, apparently desclerotized; sternites 1 to 5 compact, well sclerotized; sternite 6 very short and broad; spiracle 5 located in membrane near middle of lateral margin of tergite 5.

Dimensions. Total length 3.4–3.9 mm; length of thorax 1.7–2.0 mm; length of wing 3.3–3.6 mm.

Distribution As for genus.

Notes

The specific epithet refers to Susan G. Wright of the Queensland Museum, who obtained material of this and other interesting platystomatids in New Caledonia.

Naupoda Osten Sacken

Naupoda Osten Sacken 1881: 135. Type species (monotypy)
N. platessa Osten Sacken.

Description (main diagnostic features only). Hairs (rays) on arista (antennal segment 6) all short and non-seriate, or absent; mesoscutum much wider than long; scutellum with only two or three pairs of bristles, all restricted to posterior half of its length or less; mesopleuron largely shining, with pruinescence-pubescent restricted to anteroventral part or absent; sternopleural bristle weakly differentiated from adjacent setulae or absent; mid femur without ventral spines; length of first section of vein 4 more than 0.7 of length of discal cell measured along vein 4; second section of vein 5 usually longer than anal crossvein; squama large; female: abdomen with large tergite 3, tergites 4 and 5 vestigial, often desclerotized; male: aedeagus with complex sclerotized glans, without hollow terminal filaments.

Distribution Australasian Region: New Guinea, Australia (including Lord Howe Island), Solomon Archipelago, New

Caledonia. Oriental Region: Philippines, Sumatra (e.g., *N. imitans* de Meijere), but some species recorded from other countries probably not referable to genus (see McAlpine, 2001). Afrotropical Region: widely distributed in African tropics, Madagascar. New Caledonia apparently represents the eastern limit of the range of the genus, as the Fijian record is an error.

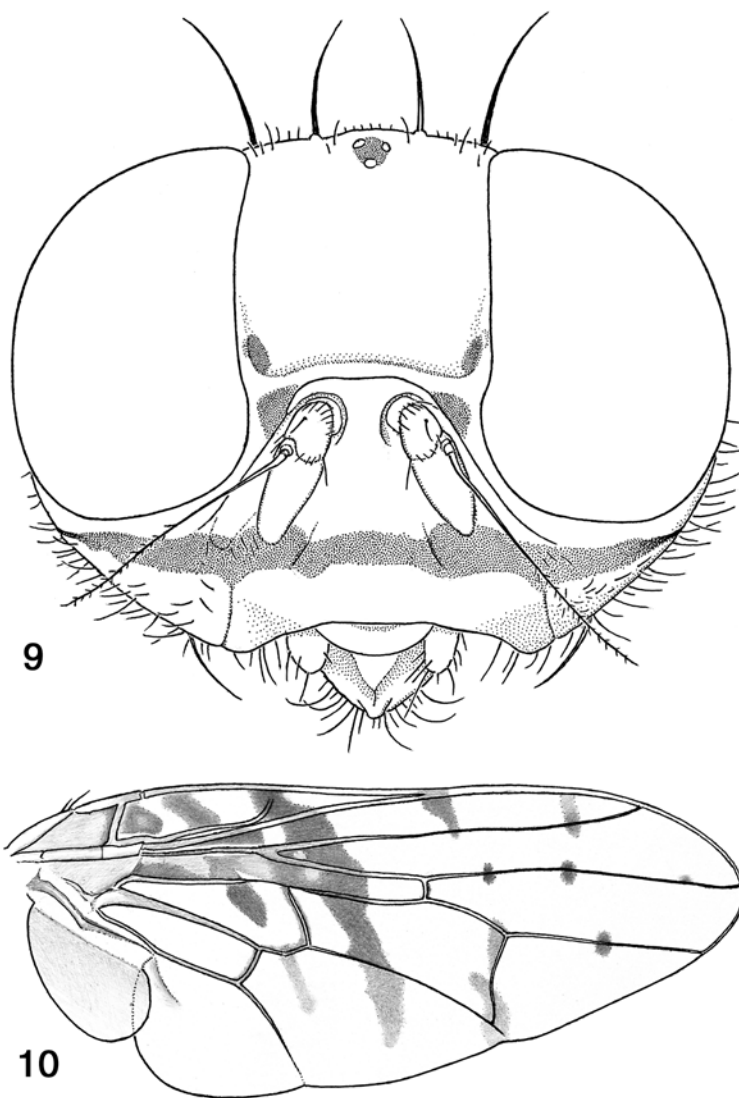
Notes

Naupoda is a diverse and widely distributed genus, and has perhaps not been adequately defined as a monophyletic taxon. The subgenus *Gonga* McAlpine, 2001, which contains exclusively the known Australasian species, is distinguished as given by McAlpine (2001: table 3), except that the fronto-orbital bristle is not always distinct.

The following key to species is preliminary, as it is based on the limited material at present on hand. *Naupoda* “sp. 1” is an apparently undescribed species from the East Sepik and Central Provinces of Papua New Guinea (AM).

Key to Australasian species of *Naupoda*

- 1 Arista (or antennal segment 6) bare, except for pubescence near base; anteroventral quarter of mesopleuron covered with dense white pubescence; length of discal cell less than 0.8 of length of second basal cell, both measured along vein 4; Lord Howe Island *nudiseta* (Bezzi)
- Arista with many short hairs or pubescence on distal half or more; anteroventral quarter of mesopleuron almost bare, shining black; discal cell c. as long as second basal cell or slightly longer 2
- 2 Anterior margin of postfrons with yellow transverse rounded ridge extending from eye to eye; facial region with horizontal black stripe extending from cheek to cheek; central region of mesoscutum very broadly tawny-orange; New Caledonia *burwelli* n.sp.
- Anterior margin of postfrons without transverse ridge; facial region without horizontal dark stripe; mesoscutum black on central part 3
- 3 Humeral callus without obvious yellow mark; anal cell with substantial bare zone, hyaline except at basal and distal extremities; New Guinea sp. 1
- Humeral callus with large pale yellow mark; anal cell entirely microtrichose, either extensively suffused with brown, or with brown spot near or just beyond mid-length 4
- 4 Mesopleuron almost entirely blackish; humeral callus with additional small yellow mark on upper margin; second basal and anal cells partly hyaline on basal halves; New Guinea and eastern Australia *regina* Hendel
- Mesopleuron with horizontal yellow stripe; humeral callus with lower yellow mark only; second basal and anal cells brown on at least basal halves; Solomon Archipelago *ventralis* Curran



Figs 9, 10. *Naupoda burwelli*. (9) Head. (10) Wing.

***Naupoda (Gonga) burwelli* n.sp.**

Figs 9, 10

Type. HOLOTYPE ♀ (unique), New Caledonia: Pic du Pin site 1, rainforest, 280 m, 22°15'S 166°49'E, 25.xi.2004–23.xii.2004, C.J.B., S.G.W. (PM).

Description. Female (male unknown).

Coloration. Head predominantly tawny to tawny-yellow; postfrons with four small darker marks, blackish ocellar spot, and pale yellow anterior margin; parafacial with grey-brown spot near upper extremity; blackish horizontal stripe crossing face at about lower third and extending on to central cheek region; occiput with broad blackish zone on upper part. Antenna orange-tawny; arista largely brown. Prelabrum and palpus tawny-yellow. Mesoscutum and scutellum predominantly tawny-orange, with brown to blackish markings; humeral callus yellow, with large

dark brown central zone; thoracic pleura brown-black, with two pale yellow marks on mesopleuron and smaller tawny marks on pteropleuron and hypopleuron. Legs predominantly tawny-yellow; all coxae partly brown; mid and hind femora with some longitudinal brown streaks; hind tibia with small anterior and posterior brown marks at c. basal third, and with larger blackish anterior and posterior subapical marks; tarsi pale yellow. Wing hyaline, with brown markings as in Fig. 10; subapical part of subcostal cell opaque yellow; alula faintly browned; axillary lobe and squama grey. Halter creamy-white. Abdominal tergite 1+2 tawny-orange to brownish; tergite 3 shining blackish with some tawny suffusion; pleural membrane of segments 1 to 3 grey-brown, that of segments 4 to 6 (judging from position of sternites) creamy-white, the two zones quite sharply contrasted; a narrow transverse blackish stripe within pale zone behind tergite 3 apparently covering the minute tergite 4, and, between this and segment 7, a pair of black dorsal spots (doubtfully associated with vestiges of tergite 5 or 6); ovipositor sheath and aculeus tawny.

Head c. 1.4× as wide as high; width of postfrons near mid-length 0.35× width of head; height of cheek 0.31 of height of eye; anterior margin of postfrons forming a somewhat prominent rounded ridge extending from eye to eye; face with pair of relatively deep antennal grooves, separated by a prominent, rounded median carina more complete than in other species of *Gonga*; the following cephalic bristles well developed: inner and outer vertical, postgenal; fronto-orbital bristle indistinctly differentiated from adjacent setulae. Antenna slightly longer than half height of face; segment 5 asymmetrical, very short, but longer than segment 4; segment 6 with very short hairs, mainly on distal half and basal extremity. Prelabrum moderately small, not attenuated medially.

Thorax. Length of mesoscutum 0.78 of its width; length of scutellum 0.42 of length of mesoscutum; the following bristles present: rather small humeral, 1+1 notopleurals, postalar, rather large posterior intra-alar, quite small dorsocentral, prescutellar acrostichal, two pairs of scutellars, mesopleural, very small but distinguishable sternopleural. Legs: fore femur with numerous short posteroventral bristles; mid tibia with one rather large apical ventral spur. Wing: distal quarter of basal section of vein 4 abruptly attenuated, only slightly curved; second section of vein 5 longer than anal crossvein, bent near mid-length; anal crossvein only slightly oblique, slightly curved; length of discal cell 1.3× that of second basal cell, both measured along vein 4; cell-4 index = 0.63; both second basal and anal cells with extensive bare zones.

Abdomen. Tergite 2 with posterior margin produced into slight median prominence; tergite 3 large and quadrate; tergite 4 apparently represented by minute sclerite within black band; sternites 1 to 3 well developed but progressively smaller in that sequence; sternites 4 to 6 distinct but much smaller.

Dimensions. Total length 4.8 mm; length of thorax 2.7 mm; length of wing 5.5 mm.

Distribution New Caledonia: southern part of Grande Terre.

Notes

Though close to other species of subgenus *Gonga*, *N. burwelli* is quite distinct in both morphology and colour pattern. It is the only species with a transverse ridge on the anterior margin of the postfrons, and an associated feature is the less strongly and narrowly arched ptilinal fissure immediately below this ridge. The discal cell is longer in proportion to the second basal cell than in any other species, and the extensive bare zones (i.e. without microtrichia on either surface) in the second basal and anal cells differentiate it from most species. The most readily appreciated features of colour pattern are the horizontal blackish stripe across the facial region and the extensively tawny-orange thoracic dorsum.

The specific epithet refers to Christopher J. Burwell who collected much interesting material for this project.

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References

- De Meijere, J.C.H., 1911. Studien über südostasiatische Dipteren. VI. *Tijdschrift voor Entomologie* 54: 258–432.
- Hendel, F., 1914a. Diptera, Fam. Muscaridae, Subfam. Platystominae. *Genera Insectorum* 157: 179 pp., 15 pls.
- Hendel, F., 1914b. Die Arten der Platystominae. *Abhandlungen der K.K. Zool. Botan. Gesellschaft in Wien* 8(1): 410 pp., 4 pls.
- McAlpine, D.K., 1973. The Australian Platystomatidae (Diptera, Schizophora) with a revision of five genera. *The Australian Museum Memoir* 15, 256 pp.
- McAlpine, D.K., 1975. Combat between males of *Pogonortalis doclea* (Diptera, Platystomatidae) and its relation to structural modification. *Australian Entomological Magazine* 2: 104–107.
- McAlpine, D.K., 2000. Australian signal flies of the genus *Rhytidortalis* (Diptera: Platystomatidae). *Proceedings of the Linnean Society of New South Wales* 121: 147–174.
- McAlpine, D.K., 2001. Review of the Australasian genera of signal flies (Diptera: Platystomatidae). *Records of the Australian Museum* 53(2): 113–199.
http://www.australianmuseum.net.au/pdf/publications/1327_complete.pdf
- McAlpine, D.K., 2007. The surge flies (Diptera, Canacidae, Zaleinae) of Australasia and notes on tethinid-canacid morphology and relationships. *Records of the Australian Museum* 59(1): 27–64 [this volume].
http://www.australianmuseum.net.au/pdf/publications/1468_complete.pdf
- Osten Sacken, C.R., 1881. [Untitled]. *Société Entomologique de France Bulletin des Séances, 9ème année* (198)15: 134–135.
- Steyskal, G.C., 1961. The genera of Platystomatidae and Otitidae known to occur in America north of Mexico (Diptera, Acalyptratae). *Annals of the Entomological Society of America* 54: 401–410.

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A Revision of the Australian Jumping Spider Genus *Prostheclina* Keyserling, 1892 (Araneae: Salticidae)

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ABSTRACT. The genus *Prostheclina* is commonly found in collections made in the wetter parts of eastern Australia from South Australia to northern Queensland. The type species *P. pallida* and six new species, *P. amplior* n.sp., *P. basilonesae* n.sp., *P. boreoaita* n.sp., *P. boreoxantha* n.sp., *P. eungella* n.sp. and *P. bulburin* n.sp. are described. Both sexes are described for all species except *P. boreoaita* (male only). Remarks on the biology and known and predicted distribution of each species are given.

RICHARDSON, BARRY J., & MAREK ZABKA, 2007. A revision of the Australian jumping spider genus *Prostheclina* Keyserling, 1892 (Araneae: Salticidae). *Records of the Australian Museum* 59(1): 79–96.

The genus *Prostheclina* and a single included species, *P. pallida*, were described by Keyserling in 1882. A further two Australian and twelve American species have been described since. All of the latter were removed to other genera by Simon (1901) and Bryant (1950). The genus (including the three Australian species) was synonymized with *Saitis* by Simon (1901), a proposal rejected by Davies & Zabka (1989) for *P. pallida* but not for *S. signatus* (Keyserling, 1883) and *S. insectus* (Hogg, 1896). The genus *Saitis*, as used for Australian material, includes a number of ill defined species, none of which belong to *Saitis sensu stricto*. The type material for neither *S. signatus* nor *S. insectus* could be found. The description of *S. insectus* is poor and revision of the generic placement of the species could not be made. Neither the collection location (central Australia) nor the patterning of the abdomen shown in the figure match that of any of the species considered here. The figure of the female

genitalia of *S. signatus* in the original description shows the species does not have a pair of adjoining fossae or the other characteristics of *Prostheclina* given below.

Prostheclina is clearly identifiable by the presence of a single combined conductor and embolus in the male and pear-shaped spermathecae, partly posterior to the pair of adjoining fossae, in the females (Davies & Zabka, 1989). Though often found in collections made in southeastern Australia, no species, other than *P. pallida*, have been described. Variation in size and secondary sexual characters, however, are conspicuous in males and the observed patterns are discontinuously distributed. Similar situations are found in other jumping spiders, for example, in the American genus *Habronattus* (Griswold, 1987). As well as re-describing *P. pallida*, six new species, namely: *P. amplior* n.sp., *P. basilonesae* n.sp., *P. boreoaita* n.sp., *P. boreoxantha* n.sp., *P. eungella* n.sp. and *P. bulburin* n.sp. are described in this work.

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Material and methods

Material from the collections of AM (Australian Museum, Sydney), ANIC (Australian National Insect Collection, CSIRO, Canberra), NMV (Museum Victoria, Melbourne), QM (Queensland Museum, Brisbane) and SAM (South Australian Museum, Adelaide), as well as the types from ZMH (Zoologisches Museum Hamburg), and BMNH (Natural History Museum London), was used in the study.

Meristic characteristics were noted for specimens of each form. As well, a series of measurements were taken, as shown in Fig. 1. The following abbreviations are used: *AEW*, anterior eye width; *AL*, abdomen length; *AMEW*, anterior median eye width; *AW*, abdomen width; *CH*, cephalothorax height; *ChL*, cheliceral length; *CL*, cephalothorax length; *CIH*, clypeal height; *CLWP*, cephalothorax length to the widest point; *CW*, cephalothorax width; *EFL*, eye field length; *F1*, femur 1; *M1*, metatarsus 1; *PEW*, posterior eye width; *P1*, patella 1; *L1–4*, legs 1–4; *StL*, sternum length; *StW*, sternum width; *P1+T1*, tibia plus patella length; *Ts1*, tarsus 1; *T1*, tibia 1. The values for the types (and the means and standard errors for sets of specimens of each species and sex) are given. Where ever possible only one specimen (of

each sex) was measured from a locality. The data for each character were examined separately and the combined data set was analysed (excluding *AL* and *AW*, sexes separate) using Principal Component Analysis.

Female copulatory organs were dissected, cleared using 50% lactic acid, and drawn.

The predicted distributions of each species and the genus were calculated using BIOCLIM (Nix, 1986) as compiled in BIOLINK. Twelve environmental variables were used in the analysis, namely: annual mean temperature (°C), hottest month mean maximum temperature (°C), coldest month mean minimum temperature (°C), annual temperature range (°C), wettest quarter mean temperature (°C), driest quarter mean temperature (°C), annual mean precipitation (mm), wettest month mean precipitation (mm), driest month mean precipitation (mm), annual precipitation range (mm), wettest quarter mean precipitation (mm), driest quarter mean precipitation (mm). These variables provide estimates of total energy and water inputs, seasonal extremes and a measure of conditions prevailing during potential active and dormant seasons (Richardson *et al.*, 2006). Conservation status was determined according to IUCN Red Listing Criteria (IUCN, 2001).

Table 1. Means, standard errors and sample sizes for measurements for each sex and species. Significance of Wilcoxon Signed Rank Tests for each sex are also given.

species	character (mean±S.E.)							n
	CL (mm)	AEW/CL	AMEW/CL	CW/CL	PEW/CL	EFL/CL	CWP/CL	
<i>pallida</i> ♂	2.10±0.04	0.72±0.01	0.45±0.01	0.77±0.01	0.69±0.01	0.51±0.01	0.62±0.01	13
<i>pallida</i> ♀	2.01±0.03	0.77±0.01	0.47±0.01	0.83±0.01	0.74±0.01	0.51±0.01	0.60±0.01	11
<i>amplior</i> ♂	2.33±0.04	0.72±0.01	0.44±0.01	0.81±0.01	0.70±0.01	0.51±0.01	0.59±0.01	27
<i>amplior</i> ♀	2.42±0.03	0.72±0.01	0.44±0.03	0.81±0.01	0.70±0.01	0.48±0.01	0.61±0.01	24
<i>basilonesa</i> ♂	1.90±0.05	0.70±0.02	0.43±0.01	0.81±0.04	0.75±0.08	0.51±0.04	0.62±0.00	2
<i>basilonesa</i> ♀	2.04	0.70	0.42	0.82	0.73	0.52	0.61	1
<i>boreoaitha</i> ♂	1.72	0.82	0.50	0.80	0.79	0.57	0.68	1
<i>boreoxantha</i> ♂	1.67	0.85	0.56	0.85	0.82	0.56	0.59	1
<i>boreoxantha</i> ♀	1.91	0.77	0.48	0.84	0.74	0.53	0.57	1
<i>eungella</i> ♂	1.85±0.00	0.86±0.01	0.53±0.01	0.88±0.01	0.83±0.00	0.60±0.00	0.70±0.10	2
<i>eungella</i> ♀	2.22±0.06	0.76±0.01	0.47±0.02	0.79±0.02	0.74±0.01	0.50±0.01	0.59±0.04	2
<i>bulburin</i> ♂	2.43±0.04	0.70±0.02	0.43±0.00	0.76±0.01	0.69±0.02	0.50±0.02	0.59±0.03	3
<i>bulburin</i> ♀	2.18±0.00	0.75±0.01	0.47±0.01	0.81±0.01	0.74±0.00	0.51±0.01	0.61±0.02	3
<i>sign</i> ♂	0.0003**	0.047*	0.058 ns	0.049*	0.096 ns	ns	ns	
<i>sign</i> ♀	<0.0001**	0.01**	0.02*	ns	0.02*	0.08 ns	ns	

species	character (mean±S.E.)							n
	AL/CL	AW/CL	CH/CL	CIH/CL	ChH/CL	StL/CL	StW/CL	(P1+T1)/CL
<i>pallida</i> ♂	0.96±0.03	0.67±0.03	0.59±0.01	0.06±0.01	0.36±0.01	0.40±0.01	0.30±0.01	0.88±0.01
<i>pallida</i> ♀	1.18±0.05	0.97±0.05	0.60±0.01	0.06±0.01	0.37±0.01	0.40±0.01	0.31±0.01	0.67±0.01
<i>amplior</i> ♂	1.00±0.02	0.69±0.01	0.59±0.01	0.07±0.00	0.38±0.01	0.41±0.01	0.31±0.00	1.04±0.02
<i>amplior</i> ♀	1.25±0.05	1.01±0.04	0.58±0.01	0.06±0.00	0.38±0.01	0.40±0.01	0.31±0.00	0.69±0.01
<i>basilonesa</i> ♂	1.09±0.04	0.72±0.02	0.66±0.04	0.09±0.01	0.29±0.04	0.43±0.01	0.33±0.01	0.93±0.04
<i>basilonesa</i> ♀	1.70	1.36	0.64	0.06	0.39	0.42	0.30	0.67
<i>boreoaitha</i> ♂	1.00	0.61	0.64	0.04	0.32	0.41	0.29	0.93
<i>boreoxantha</i> ♂	1.00	0.74	0.59	0.06	0.41	0.48	0.37	0.96
<i>boreoxantha</i> ♀	1.29	1.10	0.61	0.05	0.45	0.39	0.32	0.68
<i>eungella</i> ♂	1.05±0.02	0.62±0.12	0.68±0.02	0.07±0.00	0.38±0.02	0.45±0.02	0.34±0.01	1.00±0.00
<i>eungella</i> ♀	1.33±0.07	1.01±0.07	0.54±0.03	0.04±0.02	0.38±0.02	0.39±0.01	0.29±0.22	0.64±0.02
<i>bulburin</i> ♂	0.93±0.02	0.68±0.01	0.58±0.01	0.06±0.02	0.42±0.01	0.39±0.01	0.30±0.01	0.95±0.02
<i>bulburin</i> ♀	1.39±0.17	1.08±0.08	0.60±0.00	0.06±0.00	0.42±0.01	0.40±0.02	0.30±0.01	0.63±0.02
<i>sign</i> ♂	ns	ns	ns	ns	0.064 ns	0.094 ns	0.049*	<0.0001*
<i>sign</i> ♀	ns	ns	0.09 ns	ns	ns	ns	ns	ns

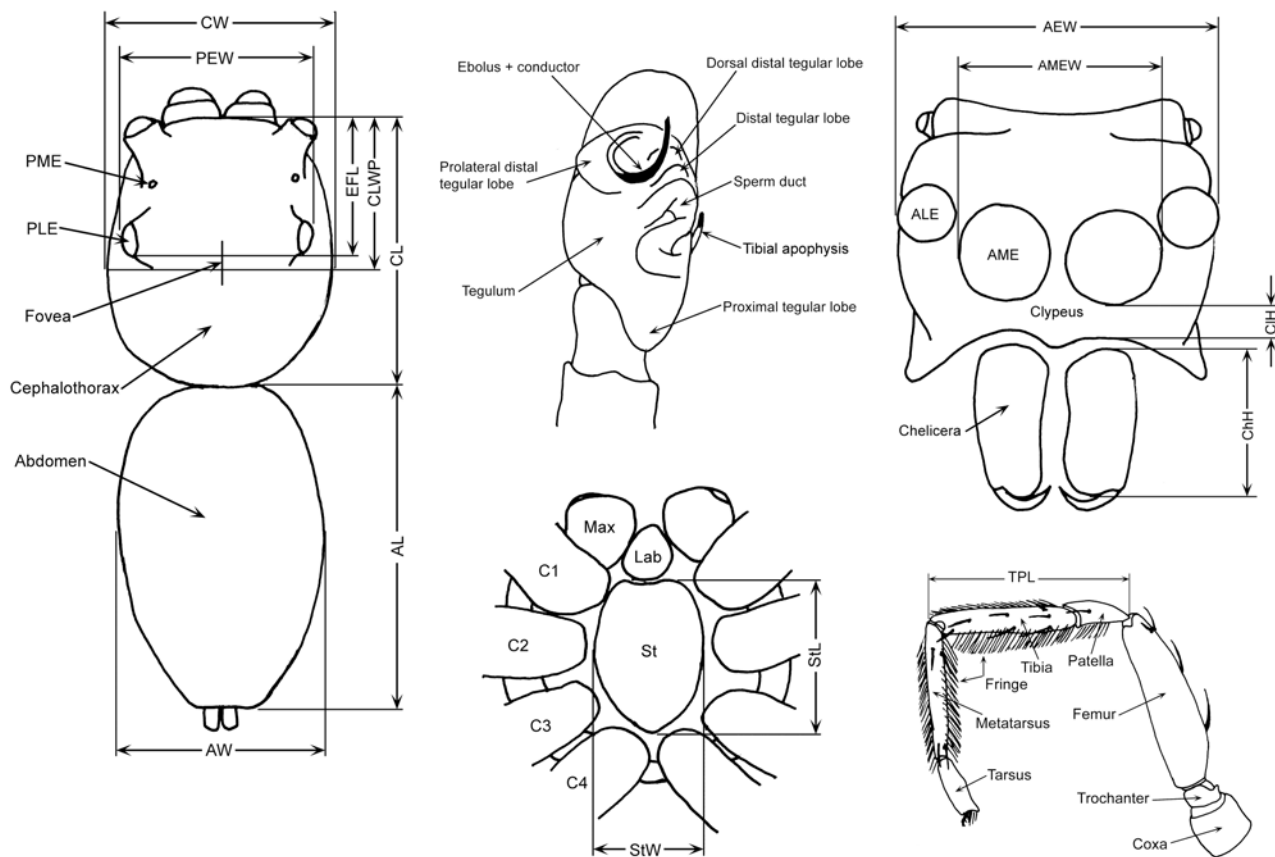


Fig. 1. Characters and measurements taken from specimens. See Methods for abbreviations.

Morphological and meristic results

The analysis of the morphological data set showed that, though variation in size could be corrected for in some characters by dividing by CL (see Fig. 2A), this was not always the case (see Fig. 2B). The size of the eye-field in particular did not vary linearly with overall size; it covered proportionately more of the cephalothorax in small species (e.g., PEW/CL versus CL in Fig. 2B). Sexual dimorphism was present in the length of L1 (i.e., $(P1+T1)/CL$, Fig. 2A). As well, $(P1+T1)/CL$ is proportionally shorter in male *P. pallida* and relatively longer in *P. amplior* than in the other

species (Table 1). There were also differences in overall size between species and in some cases (e.g., *P. bulburin*) between the sexes (Table 1). The first dimension of the PCA reflected the size related differences between specimens and species. No patterns were discernable in the other dimensions that might differentiate between species.

Variation in the males in meristic patterns related to the face and cephalothorax plus colour variation in the face, palps, chelicerae and first legs (Fig. 3) are related to variations in size and geographical distribution, allowing seven different species to be identified. Differences in female copulatory organs were detected between these species (see below).

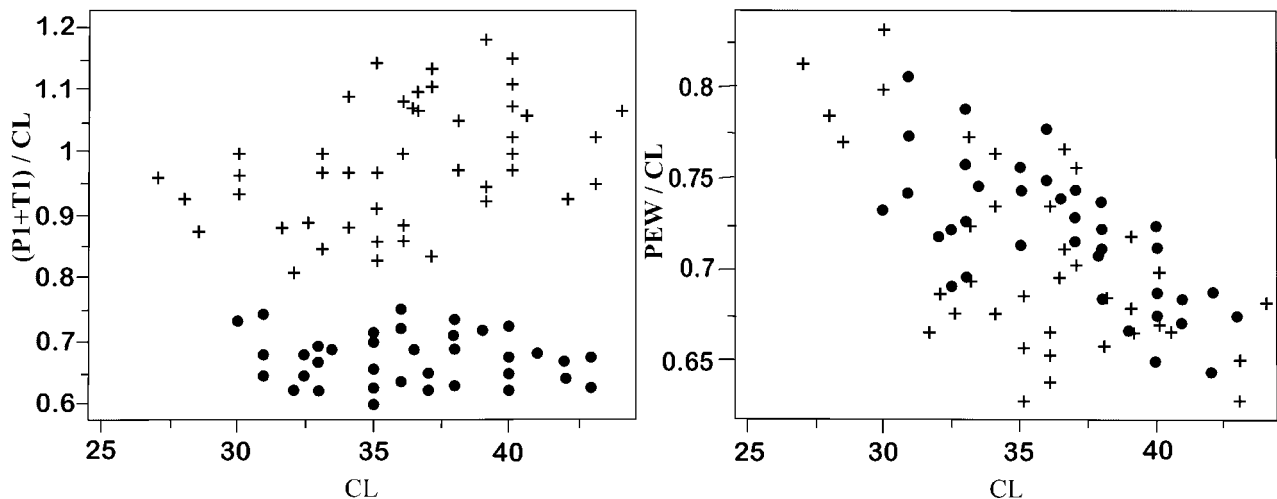


Fig. 2. Allometric effects of size, and sex on the proportional size of: (A) $(P1+T1)$ and (B) PEW/CL . + males; • females.

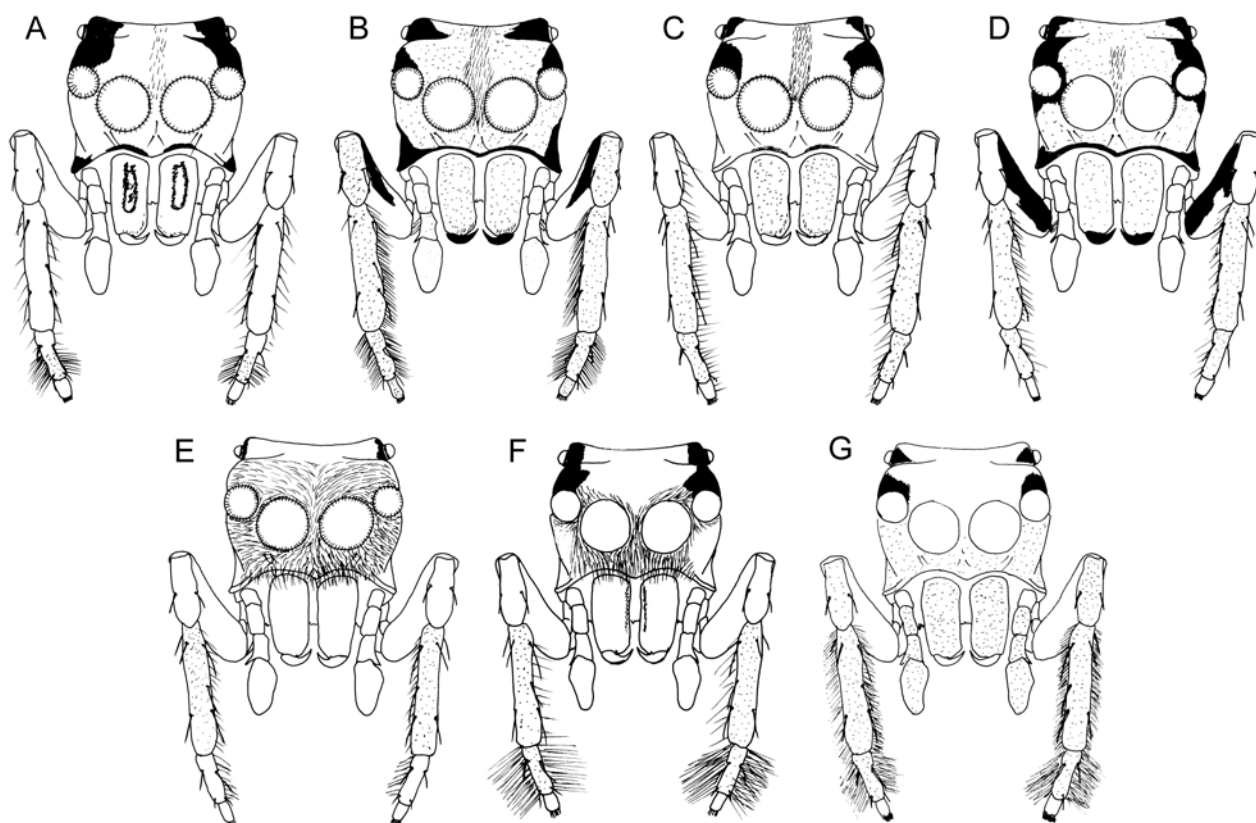


Fig. 3. Male face patterns (semi-diagrammatic). (A) *Prostheclina basilonesae*; (B) *P. amplior*; (C) *P. eungella*; (D) *P. boreoaitha*; (E) *P. pallida*; (F) *P. bulburin*; (G) *P. boreoxantha*. Stippled areas are orange/mid-brown in colour, plain areas are yellow, black areas are black or very dark brown, median dorsal strip of hair is white, mat of hair on clupeus and surrounding areas is normally mid-orange but may be paler (to off-white) in occasional animals.

Taxonomic survey

Prostheclina Keyserling, 1882

Prostheclina Keyserling, 1882: 1368.

Saitis Simon (part), 1901: 558.

Prostheclina Davies & Zabka, 1989: 238.

Type species. *Prostheclina pallida* Keyserling 1882, by monotypy.

Diagnosis. Unidentate spiders with the left embolus curved anticlockwise through 270° and combined with the conductor, leg 4 longer than leg 3, sparse to thick fringing on at least the metatarsus of leg 1 of the male, distinct ventral lip anterior to spinnerets in male (Fig. 6F), female fossae clearly separated with pear-shaped spermathecae at least partially below the fossae. It can be separated from *Saitis sensu stricto*, which is not found in Australia, by the absence of colored fringing on leg 3 of the male.

Description. Medium sized spiders, adult body length (3–7 mm). Colour varying from vanilla to dark brown, males usually darker than females, variously sized and shaped, carapace high steeply sloped from behind PLE to posterior margin, fovea short and just behind PLE, ALE set at an angle to AME, PME relatively small and about halfway between ALE and PLE, ALEW equal to PLEW, EFL 50% of CL, chelicerae medium size and vertical with single, retromarginal

tooth and either two closely aligned or a fissident promarginal tooth, labium subtriangular, sternum oval in shape, width 70% of length, abdomen ovoid, spinnerets subequal in length, legs of medium length, leg 4 longer than leg 3, in the **male**, the left embolus curved anticlockwise through 270° and combined with the conductor, proximal tegular lobe, leg 1 more strongly developed than in the female, sparse to thick fringing on at least the metatarsus of leg 1, distinct ventral lip anterior to spinnerets (Fig. 6F), in the **female**, the fossae clearly separated with pear-shaped spermathecae at least partially below the fossae.

Biology. Animals are found on foliage in tropical and temperate rainforests and in wet eucalypt forest as well as in drier and grassier areas. They are frequently collected on ferns and in disturbed or artificial habitats (e.g., amenity plantings of shrubs). The distinctive colouring, markings and fringing on L1 and face, combined with limited differences in the copulatory organs, leads to the conclusion that visual cues are important in species recognition.

Distribution. The genus is restricted to Australia and is found, or predicted to be found, in the wetter parts of Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia and Tasmania. Though Keyserling reports specimens from Cape York, the furthest north specimen in collections is from the Windsor Tableland. The inland edge of distributions roughly follows the 600 mm rainfall line.

Key to *Prostheclina* species

Males

- 1 Chelicera and clypeus mid- to dark brown coloured 2
 - Chelicera and clypeus yellow or orange, occasionally with dark markings 3
- 2 M1 and T1 fringed, F1 with brown and yellow patches, occasionally almost entirely brown, legs, F2–4 yellow/orange patches, CL >2.2 *amplior*
 - M1 and T1 not fringed, F1–4 dark brown and yellow patches, CL <1.9 mm *boreoaitha*
- 3 Clypeus with orange or white fringe (see Fig. 3A–D) 4
 - Clypeus without orange or white fringe (see Fig. 3E–G) 5
- 4 F1 orange with strong double fringe on M1, body length >4.5 mm, central Queensland (see Fig. 3G) *bulburin*
 - F1 yellow with single, usually sparse, fringe varying from almost absent to medium, body length 3.5–5 mm, southern Queensland to South Australia (see Fig. 3E) *pallida*
- 5 T1 with thick double fringe (see Fig. 3G) *boreoxantha*
 - T1 with sparse or no fringe 6
- 6 M1 with double fringe, T1 orange, from King Island and SW Victoria *basilonesa*
 - M1 with sparse or no fringe, T1 yellow, from central Queensland *eungella*

Females*

- 1 Insemination duct entrance anterior to spermatheca and insemination duct forms a median loop beside the spermatheca *basilonesa*
 - Insemination duct entrance beside spermatheca, and insemination duct with no median loop beside the spermatheca 2
- 2 Left insemination duct (in ventral view) makes a full clockwise spiral coil prior to joining spermatheca (e.g., Fig. 6E) 3
 - Left seminal duct joins directly to spermatheca without following a spiral path (e.g., Fig. 4E) 4
- 3 Spermatheca round with the spiral in the seminal duct visible anterior to the spermatheca (in ventral view) (see Fig. 13E) *eungella*
 - Spermatheca pear shaped with spiral in the seminal duct hidden under the spermatheca (in ventral view) (see Fig. 6E) *amplior*
- 4 Cephalothorax length >2.1 mm, seminal duct relatively long and forming “S” bends before joining spermatheca (see Fig. 12E) *bulburin*
 - Cephalothorax length <2.1 mm, seminal duct relative short and directly (no “S” bends) joining spermatheca (e.g., Fig. 4E) 5
- 5 Found southwards from southern Queensland to South Australia *pallida*
 - Found in northern Queensland *boreoxantha*

* *Prostheclina boreoaitha* is not included in the female key as no female specimens were found. It will be found in northern Queensland and probably be separable from *P. boreoxantha* by the presence of a spiral coil in the insemination duct.

***Prostheclina pallida* Keyserling, 1882**

Figs 2, 4, 5; Table 1

Prostheclina pallida Keyserling, 1882: 1368
Saitis pallidus.—Simon, 1901: 558

Material examined. LECTOTYPE female, Sydney, NSW, Daemel, ZMH (ex Museum Godeffroy 8646). A lectotype is here designated to stabilize nomenclature. The larger of the ZMH syntypes from Sydney has been used. The original description reports further syntype(s) from Peak Downs in central Queensland (not found) and specimens from there would belong to a different species to the Sydney specimens. PARALECTOTYPES The other ZMH specimen, a female also from Sydney, two females in NMV, K9712–K9713, also labelled “Museum Godeffroy 8646”, plus one female labelled “Sidney” in BMNH (1891.8.1.797) become paralectotypes.

Other material. New South Wales: 1 female, Batemans Bay, 35°44'S 150°15'E, D. Hirst, SAM NN19594; 1 male, Beecroft Peninsula, northern headland of Jervis Bay, 35°03'S 150°47'E, L. Gibson, 6 Jun 1999, AM KS63497; 4 males 14 females, Beecroft Reserve, 33°45'S 151°04'E, J. Noble, 15 Feb 1997, AM KS58514; 22 Jan 1994, AM KS56527; 25 Mar 2001, AM KS71717; 15 Nov 1999, AM KS66267; 15 Oct 1997, AM KS51246, AM KS51445, AM KS51243; 26 Oct 1997, AM KS51238, AM KS51247; 25 May 1997, AM KS51998; 11 Sep 1997, AM KS51441; 28 Jan 1994, AM KS56534; 20 Aug 1995, AM KS56526; 10 Oct 1997, AM KS51443, AM KS51444, AM KS51442; 28 Oct 1997, AM KS51446; 20 May 2001, AM KS72873; 1 male, Bellangary State Forest Wilson River Flora Reserve; 31°18'S 152°29'E, M.R. Gray, 6 Mar 1981, AM KS045775; 1 male, Berowra Valley Regional Park, 33°42'S 151°06'E, G. Milledge, H. Smith, 29 Dec 2000, AM KS70053; 1 male, Brooklana East of Dorrig, 30°16'S 152°51'E, W. Herron, 30 Dec, 1899, AM KS19186; 1 female, Bulga State Forest, Pole Bridge Rd 0.5km E of Knodingbul Rd, 31°37'S 152°10'E, M.R. Gray, G. Cassis, 4 Feb 1993, AM KS042941; 1 male 2 females 4 immatures, Bulledehlah State Forest, O'Sullivan's Gap rest area, 32°19'S 152°16'E, D. Hirst, 14 May 1988, SAM NN19591-3; 1 female, Carrai State Forest, Hogsback Track, “Heydonville”, 31°04'S 152°20'E, M.R. Gray, 26 Jan 1981, AM KS49103; 1 female, Carrow Brook, 32°18'S 151°19'E, J. Noble, 2 Sep 1998, AM KS54055; 1 male, Cathedral of Ferns, Mount Wilson, 33°28'S 150°23'E, J. Stanisic, G. Ingram, 15 Aug 1992, S60227; 1 male, Cheltenham, 33°45'S 151°05'E, J. Noble, 20 Dec 1999, AM KS65708; 1 male, Cundletown, 31°54'S 152°32'E, J. Noble, 26 Mar 1995, AM KS51454; 1 male 1 female, Epping Station, 33°47'S 151°05'E, J. Noble, 10 Mar 1995, AM KS56533; 4 Feb 1995, AM KS56531; 1 female, Ewingar State Forest, Nogrigar Rd, 29°07'S 152°27'E, M.R. Gray, G. Cassis, 4 Feb 1993, AM KS042393; 1 male 1 female, Foxground, near Gerringong, 34°43'S 150°46'E, M. Zabka, M.R. Gray, 29 Oct 2002, AM KS81356; G. Wishart, 12 Apr 1999, AM KS56353; 2 males 1 female, Gordon; 33°45'S 151°10'E, AM, KS12436; M. Horseman, D. Jones, 8 Dec 1982, AM KS10481; AM KS13489; AM KS9549; M. Horseman, M. McEvoy, 17 Feb 1989, AM KS20226; 1 male, Gumbayngirr Nature Res [League Scrub]; 30°36'S 152°32'E, D.D. Bickel, 11 Jan 2001,

AM KS70888; 1 male, Hornesby, Calnack Gully, 33°42'S 151°06'E, M.R. Gray, 19 Feb 1973, AM KS51672; 2 males, Hornesby, Waitara Creek, 33°42'S 151°06'E, G. Milledge, 8 Oct 2000, AM KS68316; 1 male, Jamberoo Mountain, 34°40'S 150°43'E, J. Noble, 25 Apr 2001, AM KS76934; 1 male 4 females, Jamberoo Mountain, 34°40'S 150°43'E, J. Noble, 20 Apr 1995, AM KS51657; 24 Dec 1994, AM KS54044; 11 Apr 1994, AM KS54046; 14 Apr 1998, AM KS56454; 24 Apr 1998, AM KS56427; 1 male 6 females, Jamieson Pk Narrabeen; 33°43'S 151°18'E, M.R. Gray, 10 Nov 2002, AM KS81983; M.R. Gray, H.M. Smith, 5 Mar 1996, AM KS49764; 2 males, Kuringai Chase National Park, Grovenor Track, 33°38'S 151°12'E, M.R. Gray, 8 Oct 1987, AM KS19188; 3 males, Kuringai Chase National Park, 33°41'S 151°14'E, D. Bickel, 23 Sep 2001, AM KS75560; E. M. Zabka, M.R. Gray, AM KS81944; 1 male, 4 females, Lane Cove River National Park, North Ryde, 33°48'S 151°10'E, D. Hirst, 17 Apr 1990, SAM NN19587; 22 Apr 1990, SAM NN19588; 11 Apr 1990, SAM NN19589-90; 1 male, Lindfield, 33°47'S 151°10'E, D. Doolan, 16 Oct 1966, AM KS18980; 1 male 1 female, Macquarie Pass National Park, 34°34'S 150°39'E, M. Zabka, 12 Sep 1988, AM KS64648; 1 male, Mount Keira, 34°25'S 150°51'E, D. Bickel, 21 Dec 1986, AM KS32212; 1 male 3 females, Mulligans Hut, Gibraltar Range, 29°36'S 152°11'E, R. Raven, 10 Nov 1980, S61014, S61014; 1 male, Munmorah National Park, 33°13'S 151°34'E, M.R. Gray, 12 Nov 2002, AM KS81975; 1 male, Nadgee Nature Reserve, Table Creek, 29°29'S 152°38'E, D. Bickel, 15 Feb 1986, AM KS32174; 1 male, Royal National Park, E of Waterfall, 34°08'S 151°03'E, D. Bickel, 8 Mar 1991, AM KS27960; 3 males 2 females 1 immature, Royal National Park, 34°08'S 151°04'E, M. Zabka, 24 Mar 1988, AM KS64514; 25 Aug 1988, AM KS64512; R. Mascord, 15 Dec 1966, AM KS18280; 1 female, Royal National Park, Reids Flat, 34°08'S 151°04'E, M. Zabka, 20 Apr 1988, AM KS64513; 1 male, Seven Mile Beach National Park, 34°48'S 150°46'E, M.R. Gray, 28 Oct 2002, AM KS81906; 1 male, Seven Mile Beach, 34°49'S 150°46'E, M. Zabka, AM KS64509; 1 female, Wahroonga, Frazer Res., 33°43'S 151°07'E, J. Noble, 10 Dec 1994, AM KS56506; 1 male, Waitara Creek, Hornesby, 33°43'S 151°05'E, G. Milledge, 22 Sep 2002, AM KS79676; 1 male, Washpool State Forest, 29°18'S 152°21'E, AM KS9327; 1 male, Washpool State Forest, Moogen Rd past Coombadjah TO, 29°18'S 152°21'E, AM KS9344; 1 male, Waterfall; 34°08'S 151°00'E, M.R. Gray, 14 Jan 1969, AM KS18935; 1 male, Werrikimbe National Park, Cobcroft Creek; 31°12'S 152°10'E, D. Bickel, 18 Nov 1998, AM KS56331; 1 male 1 female 3 immatures, Willowvale, “Scalloway”, near Gerringong, 34°44'S 150°48'E, M.R. Gray, AM KS18470; AM KS81894; 4 males 1 female, Wilson River Flora Reserve, 31°19'S 152°51'E, AM KS9598; AM KS9674; D. Bickel, 21 Jul 1986, AM KS32171. **Queensland:** 1 male, Conondale National Park, Booloumba Creek Rd, 26°41'S 152°37'E, G. Milledge, AM KS56465; 1 male 2 females, Gold Creek Reservoir, Brookfield, 27°28'S 152°53'E, V. Davies, R. Raven, 15 Oct 1980, S61008; 14 Nov 1980, S61010; 1 male 1 female, Kenilworth State Forest, Booloumba Creek Rd, 4 km W of Cambroon, 26°38'S 152°39'E, G. Milledge, 5 May 1998, AM KS52192; 1 female, Kenilworth State Forest, Sunday Creek Rd; 26°41'S 152°33'E, G. Milledge, 6 May 1998, AM KS52184; 1 male 1 immature, Lamington National Park, Binna Burra, Tullawallal Circuit, 28°12'S 153°11'E, D.

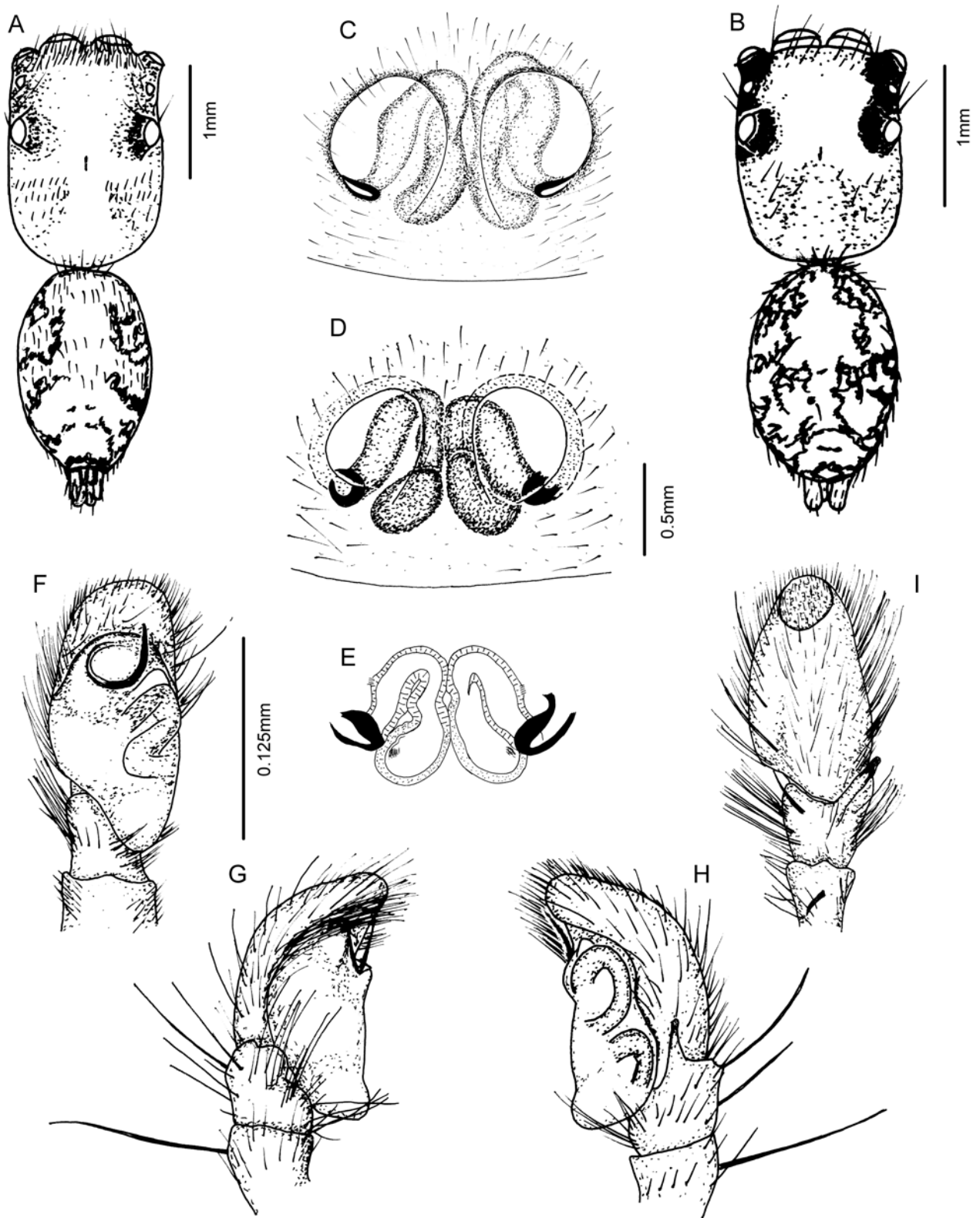


Fig. 4. Morphology of *Prostheclina pallida*. (A) male, dorsal view; (B) female, dorsal view; (C) female copulatory organs, external view of lectotype; (D) female copulatory organs, external view; (E) female copulatory organs, internal anatomy of the same specimen; (F) male left palp, ventral view; (G) male left palp, right side; (H) male left palp, right side; (I) Male left palp, dorsal view.

Hirst, SAM NN19586; 1 male, The Head, near Wilsons Peak, 28°09'S 152°17'E, I. Naumann, J. Cardale, 13 Oct 1984, ANIC 42-000002; 2 males 5 immatures, Upper Brookfield, 27°29'S 152°52'E, V. Davies, R. Raven, 11 Nov 1981, S61016; 11 Dec 1980, S61007. **South Australia:** 1 female 1 immature, Cleland Conservation Park, 34°57'S 138°41'E, G. Crook, P. Christie, 7 Oct 1975, SAM NN19596; 1 female, Mark Oliphant Conservation Park, 35°02'S 138°42'E, L. Nicolson, 27 Mar 1990, SAM NN19597. **Victoria:** 1 female, Rubicon State Forest, 37°15'S 145°45'E, M.R. Gray, 7 Apr 1978, AM KS045342.

Diagnosis. Clypeal mat of hairs in the males extending over the front of the cephalothorax (separating it from all but *P. bulburin*), relatively faint markings on the dorsal abdomen, sparse fringing on M1 (separates it from *P. bulburin*), male copulatory organs without prolateral distal tegular lobe or dorsal distal tegular lobe, female copulatory organs with proximal seminal ducts long and uncoiled anterior to spermatheca (separating it from *P. basilonesae* and *P. amplior*).

Description

Male. Medium sized species, cephalothorax yellow with orange marks and striae on the thorax, eye field brown, clypeus orange with orange mat of hairs, chelicera yellow with small, blunt retromarginal tooth and one small fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, abdomen dorsal vanilla with black pattern, ventral yellow and squared posterior lip, L1 relatively smaller and weaker than in other species, T1 orange, F1, P1, M1 and Ts1 yellow, T1 and M1 sparsely fringed, (P1+T1) relatively short,

L2–4 yellow, palps yellow, male copulatory organs with only distal and proximal tegular lobes. Dimensions: (AM KS64514) 2.2 mm CL, 0.71 AEW/CL, 0.46 AMEW/CL, 0.77 CW/CL, 0.66 PEW/CL, 0.46 EFL/CL, 0.63 CWP/CL, 0.91 AL/CL, 0.63 AW/CL, 0.57 CH/CL, 0.057 CIH/CL, 0.37 ChH/CL, 0.43 StL/CL, 0.31 StW/CL, 0.83 (P1+T1/CL).

Female. Medium sized species, cephalothorax yellow with faint orange marks on the thorax, eye field black, AME fringe sparse, sparse hairs covering cephalothorax, clypeus yellow, chelicera yellow with medium, blunt retromarginal tooth and a medium fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, dorsal abdomen vanilla with black pattern, ventral abdomen yellow, L2–4 yellow, palps yellow, female copulatory organs with proximal seminal ducts straight and anterior to spermatheca, accessory glands in insemination ducts weakly developed. Dimensions: lectotype 2.1 mm CL, 0.70 AEW/CL, 0.44 AMEW/CL, 0.77 CW/CL, 0.70 PEW/CL, 0.49 EFL/CL, 0.56 CWP/CL, 1.17 AL/CL, 0.94 AW/CL, 0.56 CH/CL, 0.067 CIH/CL, 0.33 ChH/CL, 0.43 StL/CL, 0.33 StW/CL.

Distribution. Southern Queensland, New South Wales, inland Victoria and South Australia (Fig. 5). At lower altitudes on the eastern and western side of the Great Dividing Range.

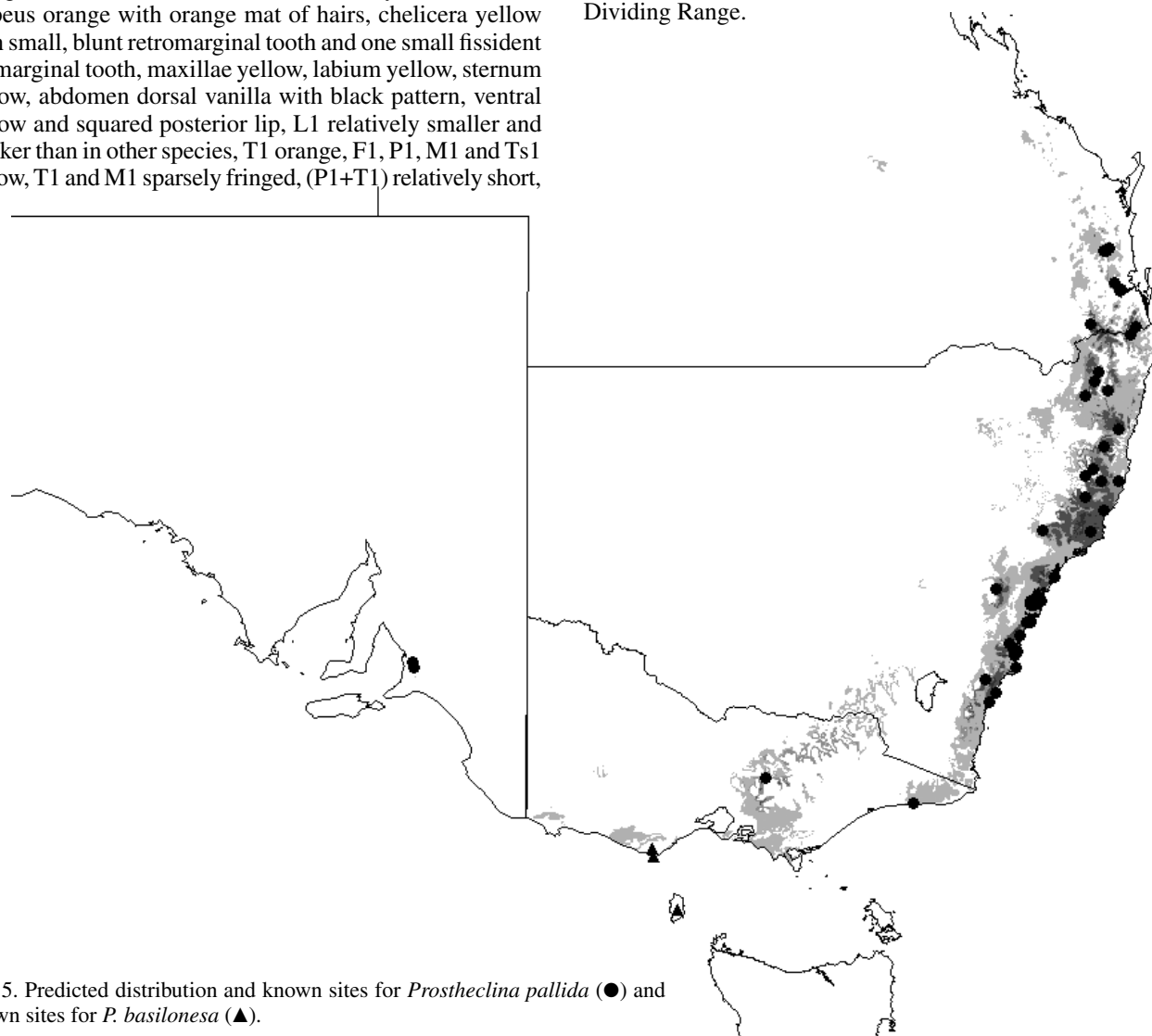


Fig. 5. Predicted distribution and known sites for *Prostheclina pallida* (●) and known sites for *P. basilonesae* (▲).

***Prostheclina amplior* n.sp.**

Figs 2, 6, 7; Table 1

Material examined. HOLOTYPE male, Kanagra-Boyd National Park, Filly Creek near Jenolan Caves, NSW, (33°49'S 150°02'E), M. M.R. Gray, G.S. Hunt, J. McDougall, 27 March 1976, AM KS29984. PARATYPES 3 males, 2 females, 4 juveniles, details as for holotype.

Other material. ACT: 1 female, Tidbinbilla Nature Reserve; 35°28'S 148°52'E, AM KS13841; **New South Wales:** 3 females, Carrow Brook, 32°18'S 151°19'E, J. Noble, 21 Apr 1999, AM KS56413, KS56412, 10 Feb 1999, AM KS56391; 1 female, Dorrig National Park, Dome Rd, 1km W of Never Never Picnic Area, 30°21'S 152°47'E, M.R. Gray, G. Cassis, 4 Feb 1993, AM KS037601; 1 female, Marengo State Forest, 2km NE along Chimney Rd from Chaelundi Rd, 30°07'S 152°26'E, M.R. Gray, G. Cassis, 4 Feb 1993, AM KS037587; 1 female, Marengo State Forest, Opossum Creek, 30°07'S 152°26'E, M.R. Gray, G. Cassis, 18 Feb 1993, AM KS64614; 2 males, Mt Dromedary Summit, 36°18'S 150°04'E, D. Bickel, 9 Nov 1985, AM KS23689; 4 males 6 females, 2 immatures, Kanagra-Boyd National Park, Filly Creek near Jenolan Caves, 33°49'S 150°02'E, M.R. Gray, G. Hunt, J. McDougall, 27 Mar 1976, AM KS30018; AM KS29984; 1 female, Bondi State Forest, 37°09'S 149°12'E, M. Zabka, 6 Apr 1988, AM KS64510; 1 male 2 females, Jamberoo Mountain, 34°40'S 150°43'E, J. Noble, 12 Jan 2001, AM KS70904; 12 Apr 1994, AM KS54048; 26 Apr 2001, AM KS72898; 1 female, Jenolan, 33°49'S 150°02'E, AM KS22277; 1 male, Barren Grounds Nat Res, 14km NW Jamberoo, Illawarra Escarp, 34°40'S 150°42'E, Robinson, 12 Mar 2000, AM KS65025; 1 male, Boyd River Crossing, 34°03'S 150°05'E, M.R. & G. Gray, 3 Mar 1973, AM KS19187; 1 male, Washpool State Forest Moongem Rd before Coobadjah, 29°16'S 152°22'E, C. Horseman, 2 Oct 1982, AM KS9229; 1 female, Guthega, 36°21'S 148°25'E, J. Noble, 17 Jan 1992, AM KS045454; 1 male, Tubrabucca, 31°53'S 151°25'E, R. Prescott and A. Burns, 18 Jan 1948, NMV; 1 female, 1 immature, Point Lookout, New England N.P., 30°29'S 152°25'E, I. Naumann, 12 Nov 1984, ANIC 42-000013; 1 male, 1 female, Monga Forest, 35°28'S 149°54'E, R. Moran, 4 Mar 1984, ANIC 42-000005; 1 male 2 females, 12 immatures, Cobark Forest Park, Barrington Tops, 31°54'S 151°36'E, I. Naumann, 11 Feb 1984, ANIC 42-000003; 11 Nov 1984, ANIC 42-000001. **Queensland:** 1 male, Mount Superbus, 28°13'S 152°26'E, QM S16607. **Tasmania:** 1 female, 8 immatures, SW Tasmania, V.V. Hickman, 2 Feb 1976, AM KS27035; 2 males, Farmhouse Creek, Picton Rd, 43°15'S 146°38'E, D. Bickel, 22 Jan 1989, AM KS56414; 1 male, Tarraleah; 42°18'S 146°24'E, V.V. Hickman, 1 May 1952, AM KS31050; 1 male, 2 females, Mount Field National Park, Russell Falls; 42°45'S 146°50'E, D. Bickel, 25 Jan 1989, AM KS56352; 1 female, Bathurst Harbour, eastern entrance, Old River; 43°21'S 146°10'E, J. Waterhouse, 14 Feb 1987, AM KS17513; 2 males, 1 female, Western Creek; 41°39'S 146°30'E, 31 Jan 1930, AM KS30969; 1 male, 1 female, 1 immature, Lenah Valley; 42°52'S 147°17'E, V.V. Hickman, 4 Jan 1934, AM KS30961; 1 male, Tarraleah; 42°18'S 146°24'E, V.V. Hickman, 27 Dec 1954, AM KS31049; 1 female, 7 immatures, Mount Nelson; 42°56'S 147°20'E, J.L. Hickman, 5 Apr 1987, AM

KS31577; 1 male, Hellyer River, south of Wynyard; 41°14'S 145°31'E, D. Bickel, 29 Jan 1989, AM KS56369; 1 female, SW Tasmania, L. Hill, 4 Feb 1978, AM KS27080; 1 female, SW Tasmania; C.L. Howard, 19 Jan 1978, AM KS27126; 1 male, Gordon River Rd and Little Florentine Rd; D. Bickel, 5 Feb 1983, AM KS53426; 4 females, Ferntree; 42°55'S 147°15'E, V.V. Hickman, 4 Mar 1964, AM KS31073; 1 female, south of Tayene; 41°20'S 147°26'E, D. Bickel, 1 Nov 1989, AM KS56347; 1 immature, Andrew River Caves area; 42°20'S 145°47'E, M.R. Gray, Eberhard, 22 Mar 1988, AM KS20899; 1 female, Melaleuca; 43°26'S 146°07'E, M.L. Potts, Feb 2000, SAM NN19595; 1 male, Tunnel Hill; 42°51'S 147°24'E, K.C. Collins, 16 Jan 1974, AM, KS19233; 1 female, Flowery Gully; 41°16'S 146°49'E, G. Hunt, 25 Oct 1988, AM KS56328; 1 male, Mount Field National Park, Lyrebird Walk; 42°45'S 146°50'E, D. Bickel, 25 Jan 1989, AM KS56348; 1 male, Liffey Falls; 41°30'S 147°02'E, V.V. Hickman, 14 May 1953, AM KS31078; 1 male, Lake Pedder; 42°50'S 145°59'E, A. Neboiss, 1 Feb 1965, NMV; 1 male, Birthday Bay and Hibbs Lagoon; 42°27'S 145°15'E, ANZSS Expedition, Jan 1983, S61011; 30 males and females 4 immatures, Pelion Hut, 3km S Mt Oakleigh; 41°50'S 146°03'E, I. Naumann, 5 Feb 1990, ANIC 42-000015; Mar 1991, ANIC 42-000004; 3 males, 1 female, Weldborough; 41°50'S 146°03'E, I. Naumann, J. Cardale, 13 Jan 1983, ANIC 42-000014; 1 female, Melaleuca; 43°26'S 146°07'E, E. Nielsen, E. Edwards, 3 Dec 1990, ANIC 42-000007; 1 female, Mount Rufus; 42°07'S 146°07'E, J. Lawrence, T. Weir, 26 Jan 1980, ANIC 42-000006; 2 males 1 female Lake St Clair, 42°04'S 146°10'E, 25 Jan 1980, ANIC 42-000008. **Victoria:** 1 female, Otway Ranges, 9.5 km SSE Beech Forest, 38°43'S 143°37'E, LaTrobe University Otway Survey, 19 May 1975, AM KS50829; 3 males, Blanket Bay, Otway National Park, 38°50'S 143°35'E, D. Bickel, 4 Dec 1994, AM KS045180; 3 males 6 females, Otway Ranges, Young Creek Rd, 38°40'S 143°29'E, G. Milledge, 15 Nov 1994, NMV; 1 male, 2 females, Tarra-Bulga National Park, Strzelecki Ranges, Tarra Valley Picnic Area, 38°27'S 146°32'E, G. Milledge, 14 Nov 1995, NMV; 10 Jan 1996, NMV; 3 females, The Big Culvert, 2.5 km ENE of Mt Observation, 37°34'S 145°52'E, G. Milledge, 19 Feb 1996 NMV; 4 males, Phillips Track, 0.5km N of Triplet Falls, 38°40'S 143°29'E, G. Milledge, 31 Jan 1995, NMV; 2 males, Aire Crossing Track, 0.5km N of Aire River Crossing, 38°42'S 143°29'E, G. Milledge, 31 Jan 1995, NMV; 2 females 1 immature, Young Creek Road, 0.4km NW of Triplet Falls, 38°40'S 143°29'E, G. Milledge, 31 Jan 1995, NMV; P. Lillywhite, 31 Jan 1995, NMV; 1 male 1 immature, Myrtle Gully Reserve, 3.4 WSW of Mount Donna Buang, 37°43'S 145°38'E, G. Milledge, 29 Nov 1994, NMV; 21 Jan 1995, NMV; 2 males, 2 females 1 immature, Croydon, 37°48'S 145°17'E, S.W. Fulton, 11 Jan 1909, NMV; 28 Feb 1909, NMV; 2 females, Young Creek Road, 0.2 km NE of Ciancio Creek Crossing, 38°40'S 143°29'E, P. Lillywhite, 31 Jan 1995, NMV; 1 female, Phillips Track, Youngs Creek Crossing, 0.6 km N Triplet Falls, 38°40'S 143°29'E, P. Lillywhite, G. Milledge, 30 Oct 1991, NMV; 3 males, Gunyah-Toora Road, 2km SSW of Gunyah Gunyah, 38°32'S 146°19'E, G. Milledge, 5 May 1996, NMV; 1 immature, 0.7km N of Acheron Gap, 7 km NE of Mount Donna Buang, 37°40'S 145°44'E, G. Milledge, 29 Aug 1996, NMV; 1 male, Sassafras, 37°52'S 145°21'E, Jan 1922, NMV; 2 males, 1 female, Maits Rest, 10km W of Apollo Bay; 38°45'S 143°34'E, K. Walker, 18

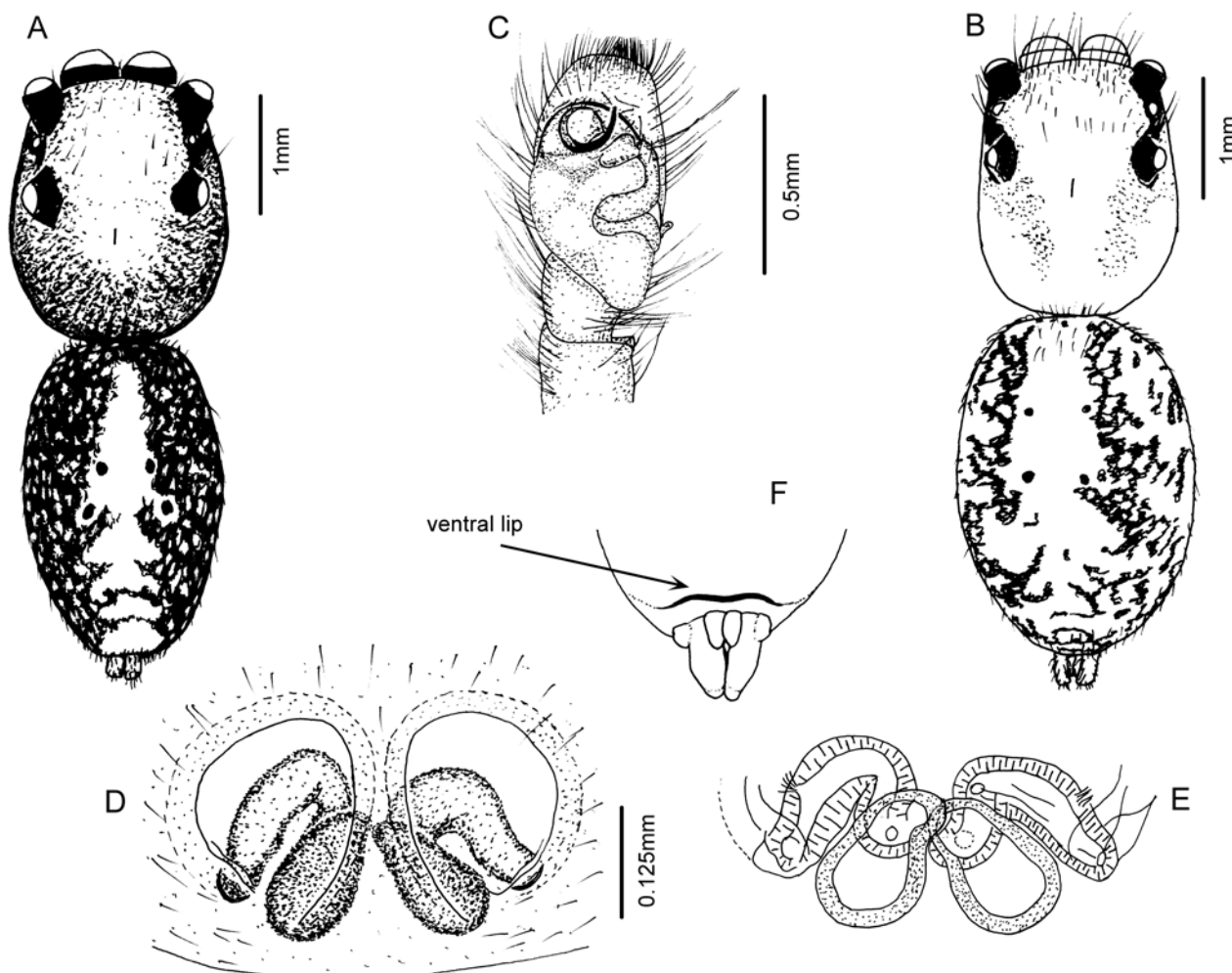


Fig. 6. Morphology of *Prostheclina amplior*. (A) male, dorsal view; (B) female, dorsal view; (C) male left palp, ventral view; (D) female copulatory organs, external view; (E) female copulatory organs, internal anatomy of the same specimen; (F) posterior section of male abdomen showing ventral lip, ventral view.

Feb 1992, NMV; 2 females, 3.5 km SW of Beauchamp Falls, 38°40'S 143°35'E, G. Milledge, 16 Mar 1992, NMV; 1 male, Jeeralang West Road, 0.1km N of Binns Hill Junction, 38°27'S 146°29'E, G. Milledge, 14 Nov 1995, NMV; 1 male, Jeeralang West Rd, 0.1km N of Binns Hill Junction, 38°27'S 146°29'E, G. Milledge, 10 Jan 1996, NMV; 4 females, 1 immature, Beauchamp Falls, 33.6km ESE of Beech Forest, 38°39'S 143°36'E, K. Walker, 18 Feb 1992, NMV; 1 female, Mount Buffalo, 36°43'S 146°46'E, A. Neboiss, 24 Feb 1955, NMV; 1 male, 1 immature, Dart-Mitta Road Junction, 36°32'S 147°31'E, 4 Mar 1973, NMV; 1 male, The Big Culvert, 2.5km ENE of Mount Observation, 37°34'S 145°52'E, G. Milledge, 28 Dec 1995, NMV; 1 male, Mount Baw Baw, 37°50'S 146°17'E, M. Baehr? 5 Jan 1973, QM S61201.

Diagnosis. White scales on cephalothorax and around eyes, no clypeal mat of hairs (separating it from *P. pallida*), square brown end to abdomen, male copulatory organs without well-developed prolateral distal tegular lobe (separating it from *P. basilonesae*), female copulatory organs with proximal seminal ducts coiled anterior to spermatheca (separating it from *P. basilonesae* and *P. pallida*).

Description

Male. Relatively large species, cephalothorax orange with clear dark brown marks and striae on the thorax, faint median white strip of hairs, eye field brown, AME fringe sparse, white scales on cephalothorax and around eyes, clypeus dark brown with no mat of hairs, chelicera dark brown with large, pointed retromarginal tooth and one large fissident promarginal tooth, maxillae brown, labium brown, sternum brown, abdomen dorsal orange with black pattern, ventral with brown markings and squared posterior lip, L1 larger and stronger than in other species, F1 with brown and yellow patches, P1, T1, M1 and Ts1 orange, T1 and M1 strongly fringed, (P1+T1) relatively long, L2–4 yellow, palps yellow, male copulatory organs with distal and proximal tegular lobes. Dimensions: holotype 2.3 mm CL, 0.77 AEW/CL, 0.51 AMEW/CL, 0.92 CW/CL, 0.76 PEW/CL, 0.54 EFL/CL, 0.64 CWP/CL, 1.22 AL/CL, 0.81 AW/CL, 0.57 CH/CL, 0.081 CIH/CL, 0.43 ChH/CL, 0.46 StL/CL, 0.34 StW/CL, 1.12 (P1+T1/CL).

Female. Relatively large species, cephalothorax orange with dark orange/brown marks on the thorax, eye field black, AME fringe sparse, sparse hairs covering cephalothorax, clypeus yellow, chelicera yellow with large, pointed

retromarginal tooth and a large fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, dorsal abdomen vanilla with black pattern, ventral abdomen yellow, L2–4 yellow, palps yellow, female copulatory organs with proximal seminal ducts coiled anterior to spermatheca, the spermathecae, accessory glands in insemination ducts well developed. Dimensions: paratype 2.3 CL, 0.71 AEW/CL, 0.42 AMEW/CL, 0.82 CW/CL, 0.71 PEW/CL, 0.47 EFL/CL, 0.61 CWP/CL, 1.24 AL/CL, 0.97 AW/CL, 0.61 CH/CL, 0.053 CIH/CL, 0.40 ChH/CL, 0.37 StL/CL, 0.32 StW/CL, 0.63 (P1+T1/CL).

Distribution. Tasmania, to southern Queensland in higher, cooler and wetter regions (Fig. 7).

Etymology. From ἀμπλιος = large.

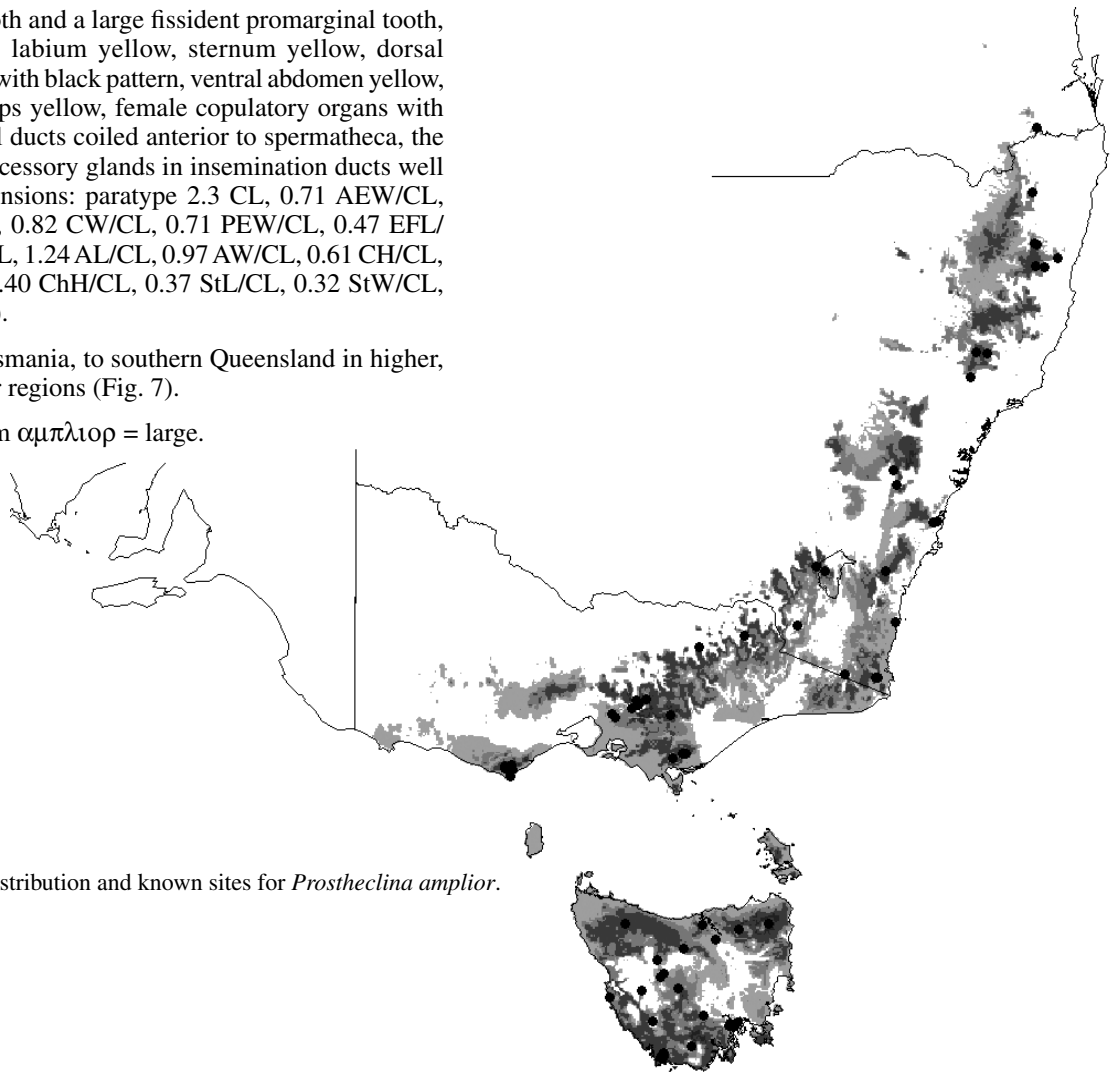


Fig. 7. Predicted distribution and known sites for *Prostheclina amplior*.

Prostheclina basilones n.sp.

Figs 2, 5, 8; Table 1

Material examined. HOLOTYPE Tasmania: 1 male, King Island, 39°55'S 144°00'E, J.A. Kershaw, Dec 1906, NMV K9709. PARATYPES 2 females, details as above, NMV K9710–K9711.

Other material. Victoria: 1 male, Cape Otway, Lighthouse, 39°55'S 144°00'E, D. Bickel, 4 Dec 1994, AM KS045959; 1 male Phillips Track, 0.5km N of Triplet Falls, 38°40'S 143°29'E, G. Milledge, 20 Feb 1992, NMV; 1 male, Young Creek Road, 0.4km NW of Triplet Falls, 38°40'S 143°29'E, G. Milledge, 31 Jan 1995, NMV

Diagnosis. Median white stripe on the cephalothorax, white scales on cephalothorax and around eyes, square brown end to abdomen, male copulatory organs with well-developed prolateral distal tegular lobe, female copulatory organs with seminal ducts folded down between the spermathecae.

Description

Male. Medium sized species, cephalothorax yellow with clear orange marks on the thorax, median white strip of hairs, eye field brown, AME fringe sparse, white scales on

cephalothorax and around eyes, clypeus yellow with no mat of hairs, chelicera yellow with large, pointed retromarginal tooth and one fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, abdomen dorsal yellow with black pattern, ventral yellow/orange with squared posterior lip, L1–4 yellow, T1 sparsely fringed and M1 fringed, (P1+T1) medium length, palps yellow, male copulatory organs with broad tegulum compared to other species, a distinctive prolateral distal tegular lobe, as well as distal and proximal tegular lobes. Dimensions: holotype 1.9 mm CL, 0.72 AEW/CL, 0.43 AMEW/CL, 0.85 CW/CL, 0.83 PEW/CL, 0.55 EFL/CL, 0.62 CWP/CL, 1.13 AL/CL, 0.73 AW/CL, 0.70 CH/CL, 0.10 CIH/CL, 0.333 ChH/CL, 0.43 StL/CL, 0.33 StW/CL, 0.97 (P1+T1/CL).

Female. Medium sized species, cephalothorax yellow with orange marks on the thorax, eye field brown, AME fringe sparse, sparse hairs covering cephalothorax, clypeus yellow, chelicera yellow with large, pointed medium retromarginal tooth and two closely placed promarginal teeth, maxillae yellow, labium yellow, sternum yellow, dorsal abdomen vanilla with black pattern, ventral abdomen yellow, legs yellow, palps yellow, female copulatory organs with proximal seminal ducts folded down between the spermathecae, accessory glands in insemination ducts not well developed.

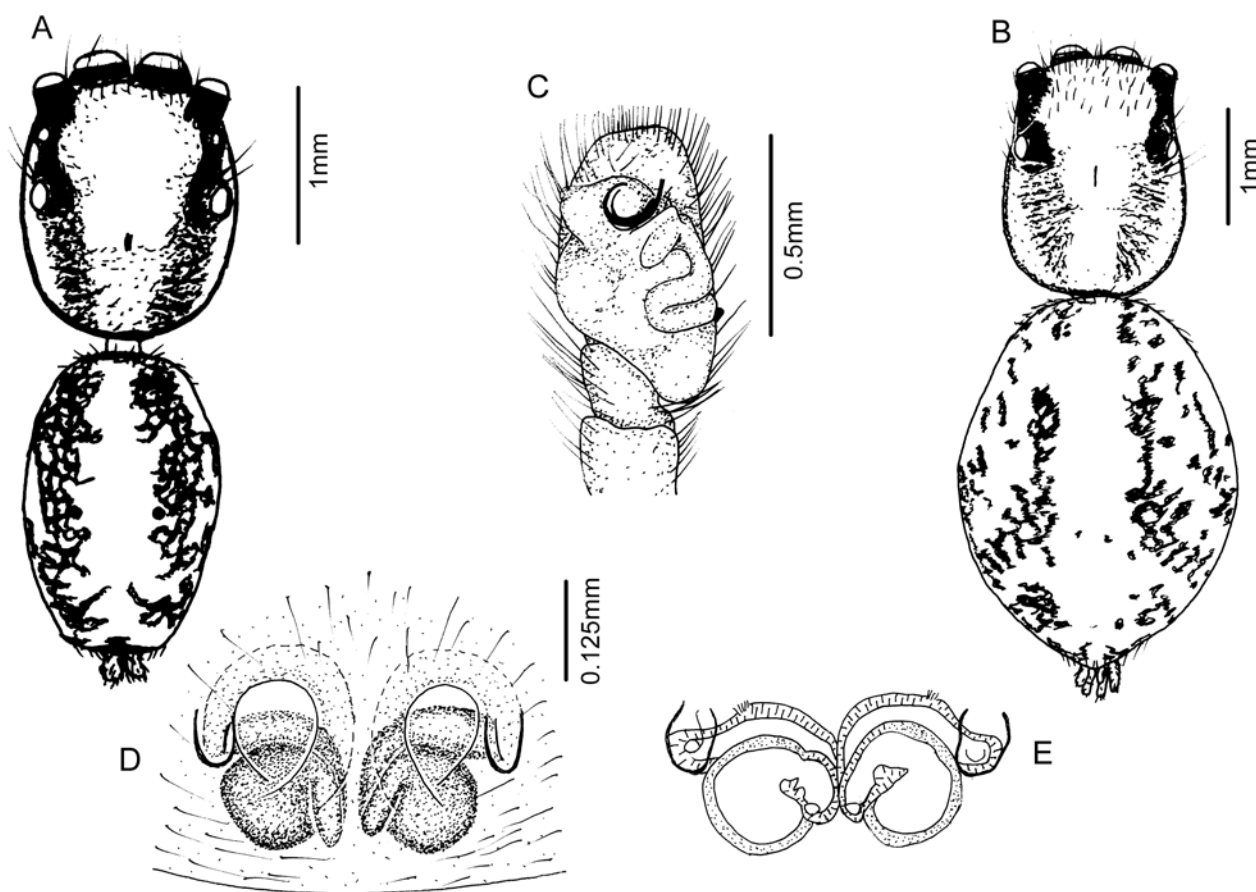


Fig. 8. Morphology of *Prostheclina basilonesae*. (A) male, dorsal view; (B) female, dorsal view; (C) male left palp, ventral view; (D) female genitalia, external view; (E) female genitalia, internal anatomy of the same specimen.

Dimensions: paratype 2.0 mm CL, 0.70 AEW/CL, 0.42 AMEW/CL, 0.82 CW/CL, 0.73 PEW/CL, 0.52 EFL/CL, 0.61 CWP/CL, 1.70 AL/CL, 1.36 AW/CL, 0.64 CH/CL, 0.061 CIH/CL, 0.39 ChH/CL, 0.42 StL/CL, 0.30 StW/CL, 0.68 (P1+T1/CL).

Distribution. King Island and the Otway area of Victoria (Fig. 5).

Etymology. From Greek βασιλῆς = king and νῆσος = island, to be treated as a female noun in apposition.

***Prostheclina boreoaitha* n.sp.**

Figs 2, 9, 10; Table 1

Material Examined. HOLOTYPE Queensland: Male, Windsor Tableland, (approx. 16°13'S 145°00'E), J. Thompson, M. Moulds, F. McKillop, 17 April 1994, AM KS45747.

Diagnosis. Relatively small species, F1–4 covered with black and vanilla coloured patches, T1 and M1 orange with sparse fringing, P1 and Ts1 yellow, palps vanilla colour. Can be separated from *P. boreoxantha* by colour, the presence of white median strip of hair, and the presence of dorsal distal tegular lobe as well as a distal tegular lobe in *P. boreoxantha*, and from *P. amplior*, the only other species with black leg markings, by smaller size (75%) and the presence of black leg markings on F1–4 rather than just F1.

Description

Male. Relatively small species, cephalothorax orange with tan margin and striae, eye field black, median white strip of hair present but sparse, AME fringe sparse, clypeus tan with no moustache, chelicera tan with large and pointed retromarginal tooth and one fissident promarginal tooth maxillae yellow, labium tan with yellow margin, sternum yellow, abdomen dorsal yellow with black pattern, ventral yellow/orange with squared posterior lip, T1 and M1 orange with sparse fringing, P1 and Ts1 yellow, F1–4 covered with black and vanilla patches remainder of L2–4 yellow, (P1+T1) medium length, palps yellow, male copulatory organs with dorsal distal tegular lobe as well as distal and proximal tegular lobes. Dimensions: holotype CL 1.7 mm, AEW/CL 0.82, AMEW/CL 0.50, CW/CL 0.80, PEW/CL 0.79, EFL/CL 0.57, CWP/CL 0.68, AL/CL 1.0, AW/CL 0.61, CH/CL 0.64, CIH/CL 0.04, ChH/CL 0.32, StL/CL 0.41, StW/CL 0.29, (P1+T1/CL) 0.93.

Distribution. Known only from the type locality (Fig. 10).

Etymology. From Greek βορρεας = northern and αιθος = reddish-brown, to be treated as a female noun in apposition.

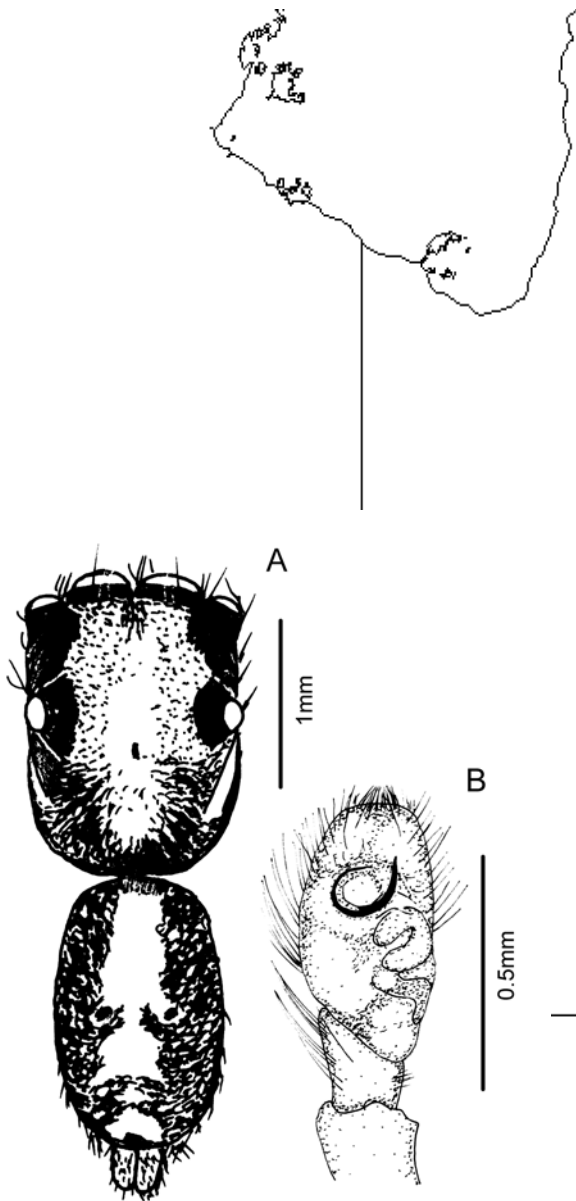


Fig. 9. Morphology of *Prostheclina boreoaitha*. (A) male, dorsal view; (B) male left palp, ventral view.

***Prostheclina boreoxantha* n.sp.**

Figs 2, 10, 11; Table 1

Material Examined. HOLOTYPE Queensland: 1 male, Mt Spurgeon area, 16°26'S 145°12'E, J. Thompson, M. Moulds, F. McKillop, 9 Apr 1994, AM KS64638. PARATYPE Queensland: 1 female, Mt Spurgeon area, 16°26'S 145°12'E, J. Thompson, M. Moulds, F. McKillop, 19 Apr 1994, (copulatory organs missing) AM KS64610.

Diagnosis. F1–4 yellow, P1, T1 and M1 orange, Ts1 yellow, lush fringes on M1 and T1, palps vanilla colour. Neither dorsal median white strip of hair nor red clypeal moustache, Male copulatory organs with dorsal distal tegular lobe as well as distal and proximal tegular lobes. Female copulatory organs with proximal seminal duct short and straight. Can be separated from *P. boreoaitha* by the absence of dark

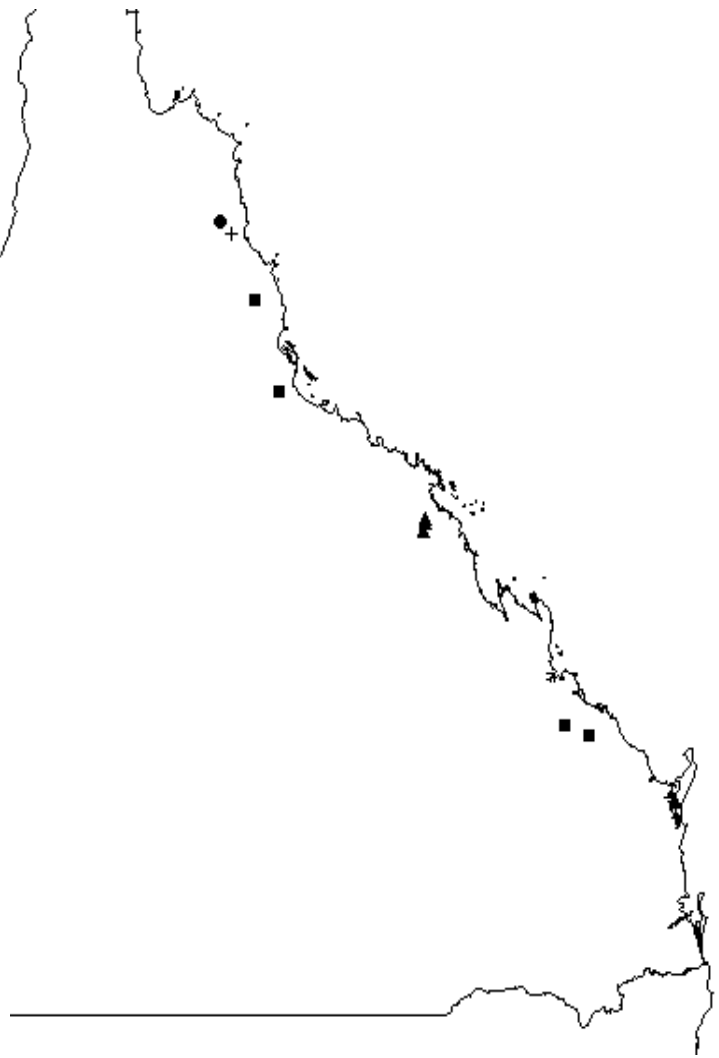


Fig. 10. Distribution of location data for *Prostheclina boreoaitha* (●), *P. eungella* (▲), *P. boreoxantha* (+) and *P. bulburin* (■).

colour patches on F1–F4 and the presence of a dorsal, distal tegular lobe, and from *P. bulburin*, by smaller size (75%), the presence of a dorsal, distal tegular lobe and the absence of the red mat of hairs covering the clypeus and around AME found in *P. bulburin*.

Description

Male. Relatively small species, cephalothorax yellow with faint orange marks on the thorax, sparse hairs covering cephalothorax, no median white strip of hairs, eye field brown, AME fringe sparse, clypeus orange with no moustache, chelicera orange with small, pointed retromarginal tooth and one fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, abdomen dorsal yellow with black pattern, ventral yellow/orange with squared posterior lip, P1, T1 and M1 orange, T1 and M1 fringed, Ts1 yellow, (P1+T1) medium length, F1–4 yellow, palps yellow, male copulatory organs with dorsal distal tegular lobe as well as distal and proximal tegular lobes. Dimensions: holotype 1.7 mm CL, 0.85 AEW/CL, 0.56 AMEW/CL, 0.85 CW/CL, 0.82 PEW/CL, 0.56 EFL/CL, 0.59 CWP/CL, 1.00 AL/CL, 0.74 AW/CL, 0.59 CH/CL, 0.056 CIH/CL, 0.41 ChH/CL, 0.48 StL/CL, 0.37 StW/CL, 0.96 (P1+T1/CL).

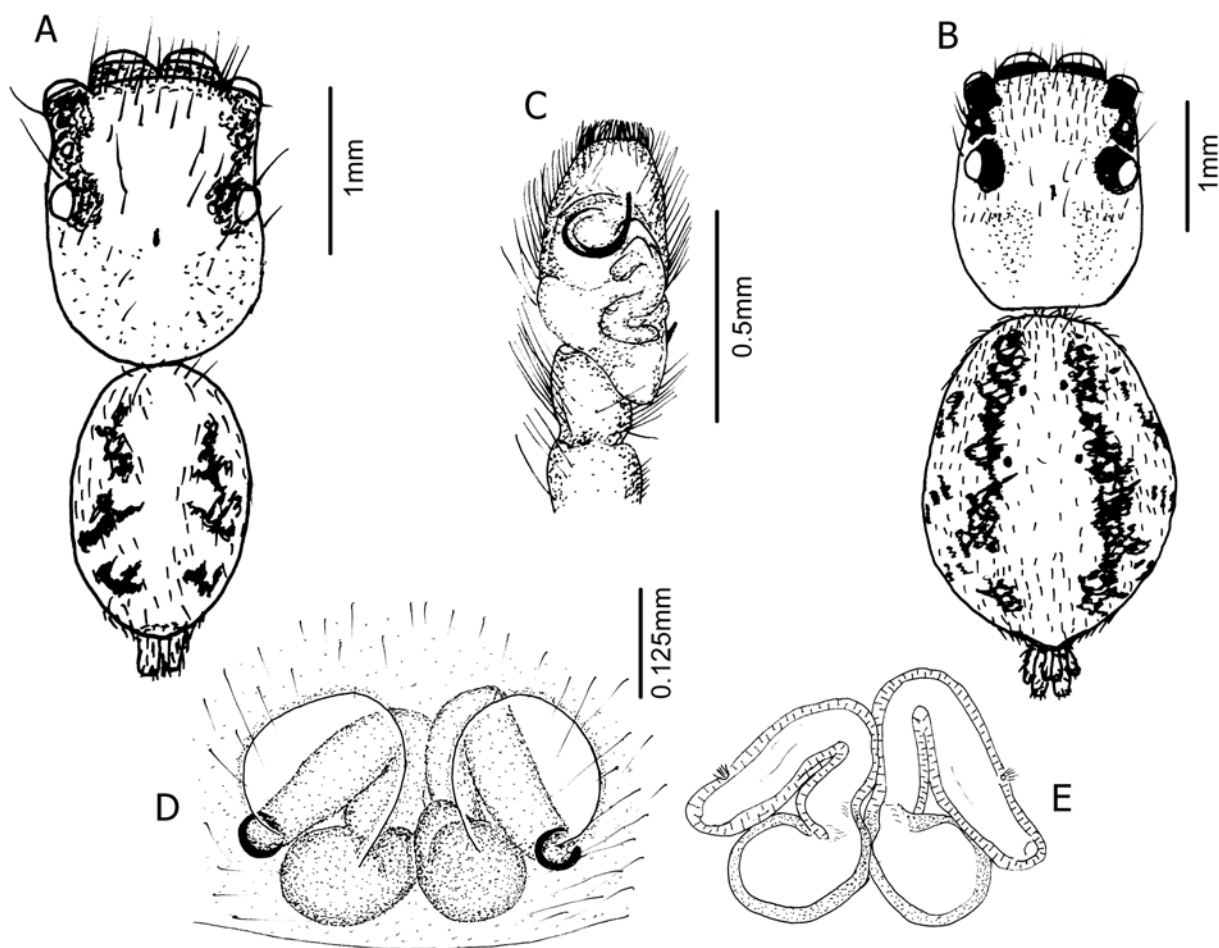


Fig. 11. Morphology of *Prostheclina boreoxantha*. (A) male, dorsal view; (B) female, dorsal view; (C) male left palp, ventral view; (D) female genitalia, external view; (E) female genitalia, internal anatomy of the same specimen.

Female. Relatively small species, cephalothorax yellow with faint orange marks on the thorax, eye field black, AME fringe sparse, sparse hairs covering cephalothorax, clypeus orange with no moustache, chelicera yellow with large, blunt retromarginal tooth and two promarginal teeth, maxillae yellow, labium yellow, sternum yellow, dorsal abdomen vanilla with black pattern, ventral abdomen yellow, legs yellow, palps yellow, female copulatory organs with proximal seminal duct short and straight, accessory glands in insemination ducts not well developed. Dimensions: paratype 1.9 mm CL, 0.77 AEW/CL, 0.48 AMEW/CL, 0.84 CW/CL, 0.74 PEW/CL, 0.53 EFL/CL, 0.57 CWP/CL, 1.29 AL/CL, 1.10 AW/CL, 0.61 CH/CL, 0.048 CIH/CL, 0.45 ChH/CL, 0.39 StL/CL, 0.32 StW/CL, 0.68 (P1+T1/CL).

Distribution. The species has only been collected at two sites on Mt Spurgeon in northern Queensland (Fig. 10).

Etymology. From Greek βορεας = northern and χανθος = yellowish-brown, to be treated as a female noun in apposition.

Prostheclina bulburin n.sp.

Figs 2, 10, 12; Table 1

Prostheclina pallida Davies & Zabka, 1989: 238

Material Examined. HOLOTYPE Queensland: 1 male, Bulburin Forestry Nursery NW of Bundaberg, 24°31'S 151°29'E, M.R. Gray & C. Horseman, 1 Mar 1975, AM KS0101. PARATYPES Queensland: 2 males 3 females 11 immatures, data as for holotype.

Other material. Queensland: 1 male 1 female, Kroombit Tops, 18°59'S 146°02'E, R. Raven, 25 Nov 1987, S 35066, (illustrated in Davies & Zabka, 1989 as *P. pallida*); 1 female, Paluma Dam Road, 18°59'S 146°02'E, Monteith, Seymor, 8 Dec 1990, QM S60379; 3 immatures, Kroombit Tops, Beauty Spot 98, 45 km SSW Calliope, 24°22'S 151°03'E, E.V. Davies, Gallon, 9 Dec 1983, QM S61015; Kroombit Tops, Dawes Range, 45km SSW Calliope, 24°22'S 151°03'E, E. Davies, Gallon, 9 Dec 1983, QM S61013; Kroombit Tops, upper TA47 Creek, 45km SSW Calliope, 24°22'S 151°03'E, E. Davies, Gallon, 9 Dec 1983, QM S61012, Millaa Millaa, 17 30'S 145 37'E, Richardson, 3 Aug 2003, ANIC 42 000142.

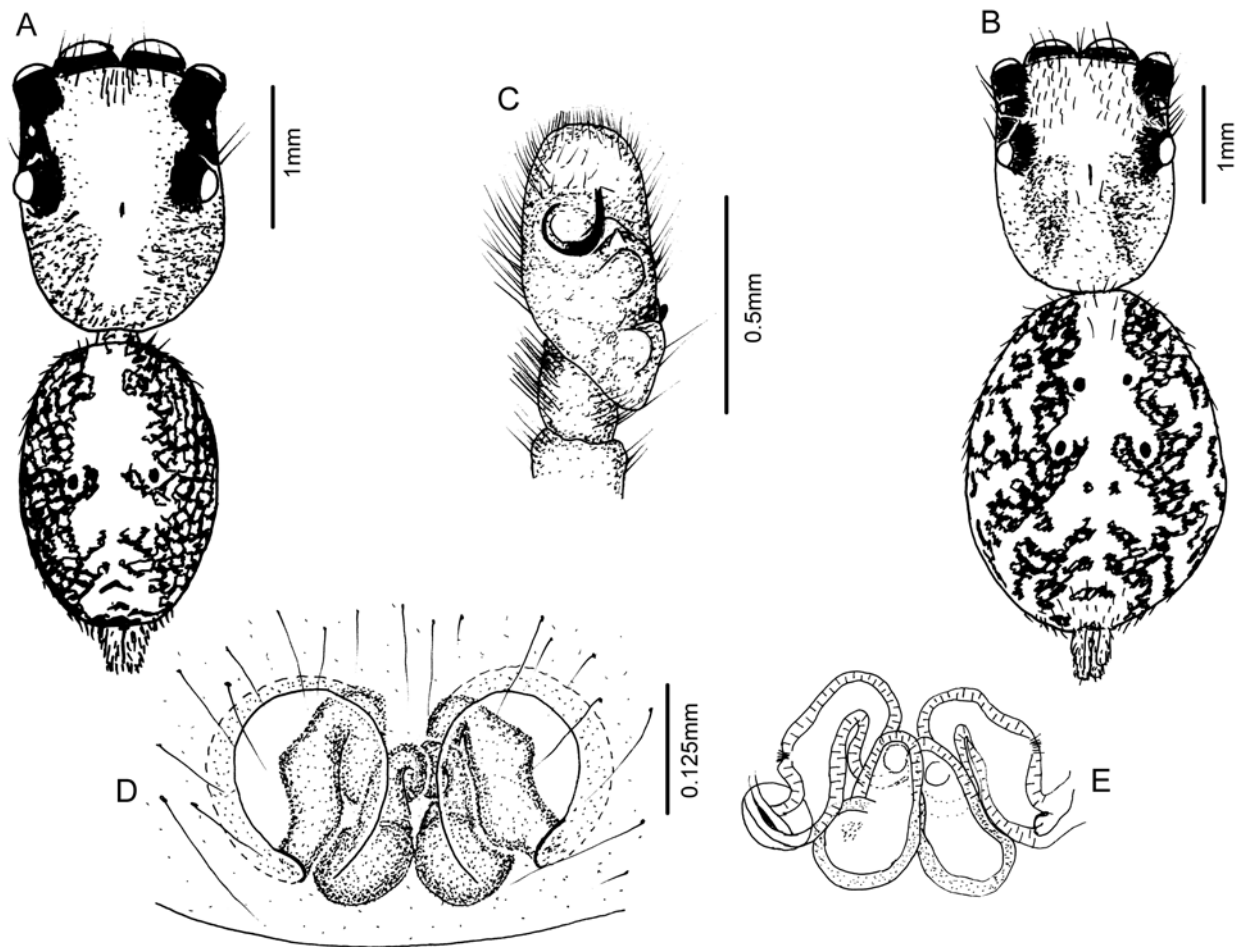


Fig. 12. Morphology of *Prostheclina eungella*. (A) male, dorsal view; (B) female, dorsal view; (C) male left palp, ventral view; (D) female genitalia, external view; (E) female genitalia, internal anatomy of the same specimen.

Diagnosis. *Male*, large size, F1–4 yellow, P1, T1 and M1 orange, M1 and Ts1 orange, lush fringes on M1 and T1, palps vanilla colour. dorsal median white strip of hair on cephalothorax, white to red mat of hairs covering the clypeus and around AME, copulatory organs with dorsal distal tegular lobe as well as distal and proximal tegular lobes. Males can be separated from *P. eungella*, by the presence of only a sparse fringe on M1 and long thick fringe on T1, absence of a dorsal, distal tegular lobe on the male palp and the presence of white to red mat of hairs covering the clypeus and around AME. *Female* large size, copulatory organs with coiled proximal seminal ducts, unlike *P. bulburin*.

Description

Male. Medium size, cephalothorax orange with faint strong orange marks on the thorax, sparse hairs on front of cephalothorax, eye field black, AME fringe thick, clypeus orange, mat of white to orange hair covering clypeus and front of cephalothorax, chelicera yellow with large, pointed retromarginal tooth and one fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, abdomen dorsal yellow with black pattern, ventral yellow/orange with brown squared posterior lip, T1 and M1 orange, T1 sparse fringe and M1 with long lush fringe, (P1+T1) medium length, F1, P1 and Ts1 yellow, L2–4 yellow, palps yellow, male

copulatory organs with distal and proximal tegular lobes plus a weak prolateral distal tegular lobe. Dimensions: holotype, 2.4 mm CL, 0.72 AEW/CL, 0.44 AMEW/CL, 0.77 CW/CL, 0.72 PEW/CL, 0.51 EFL/CL, 0.64 CWP/CL, 0.90 AL/CL, 0.69 AW/CL, 0.59 CH/CL, 0.077 CIH/CL, 0.41 ChH/CL, 0.39 StL/CL, 0.28 StW/CL, 0.92 (P1+T1/CL).

Female. Relatively large size, cephalothorax yellow with faint orange marks on the thorax, eye field black, AME fringe sparse, sparse hairs covering cephalothorax, clypeus yellow, chelicera yellow with large, narrow and pointed retromarginal tooth and two very close promarginal teeth, maxillae yellow, labium yellow, sternum yellow, dorsal abdomen vanilla with black pattern, ventral abdomen vanilla with faint dark markings, legs yellow, palps yellow, female copulatory organs with proximal seminal ducts long and uncoiled, accessory gland in spermatheca large. Dimensions: paratype, 2.3 mm CL, 0.77 AEW/CL, 0.49 AMEW/CL, 0.80 CW/CL, 0.74 PEW/CL, 0.51 EFL/CL, 0.63 CWP/CL, 1.06 AL/CL, 0.91 AW/CL, 0.60 CH/CL, 0.057 CIH/CL, 0.40 ChH/CL, 0.43 StL/CL, 0.31 StW/CL, 0.66 (P1+T1/CL).

Distribution. Central eastern Queensland (Fig. 10).

Etymology. A combination of letters, to be treated as a female noun in apposition.

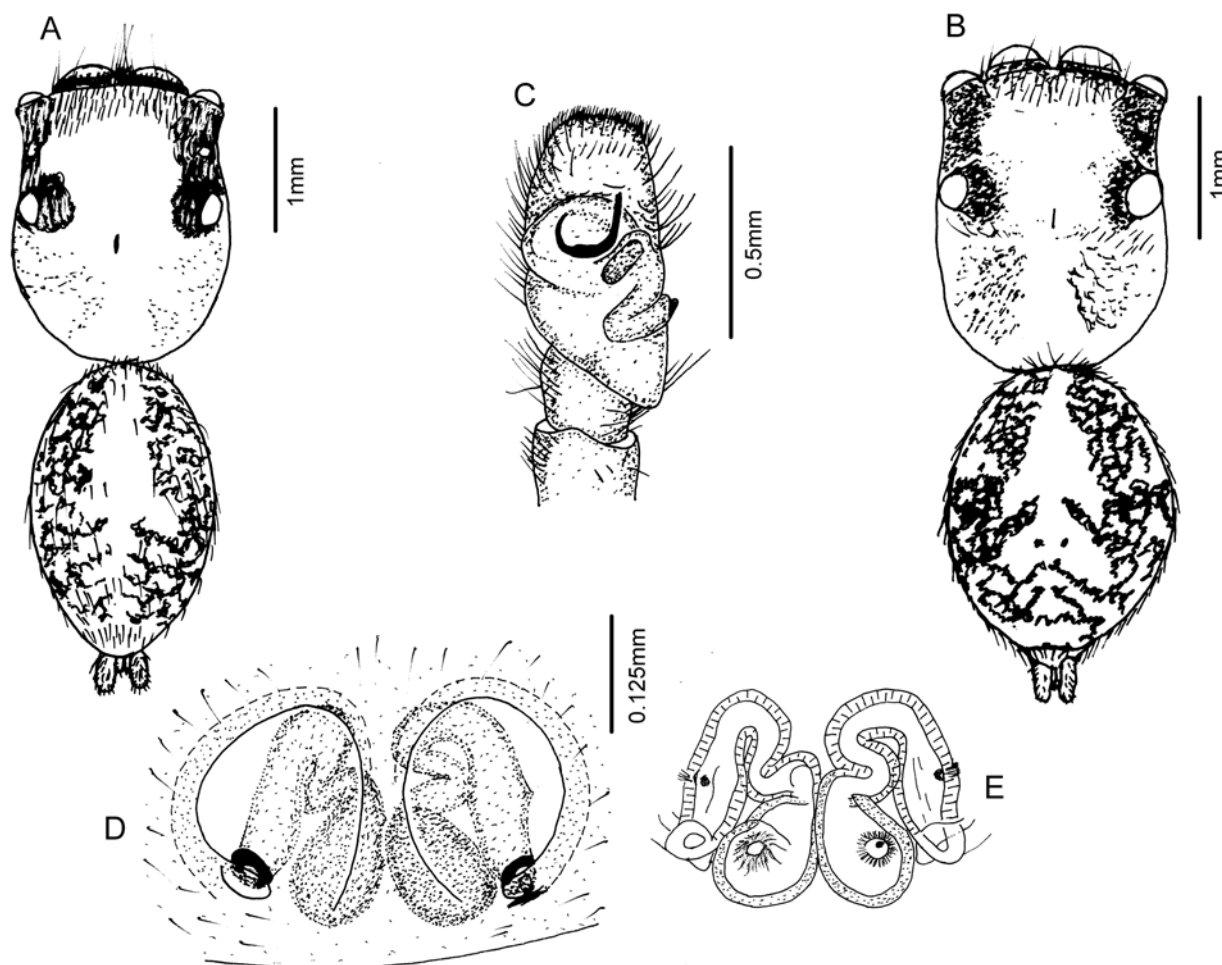


Fig. 13. Morphology of *Prostheclina bulburin*. (A) male, dorsal view; (B) female, dorsal view; (C) male left palp, ventral view; (D) female genitalia, external view; (E) female genitalia, internal anatomy of the same specimen.

Prostheclina eungella n.sp.

Figs 2, 10, 13; Table 1

Material Examined. HOLOTYPE Queensland: 1 male, Mount William, Dalrymple Heights, near Eungella, Qld, 21°01'S 148°36'E, M.R. Gray, C. Horseman, Apr 1975, KS0372. PARATYPES Queensland: 2 males, 1 female, 22 immatures (as for holotype).

Other material. Queensland: 1 male, 3 immatures, Crediton, Campsite, 21°13'S 148°33'E, 14 Apr 1975, QM S4694; 1 male, 2 females, 3 immature, Dalrymple Heights near Eungella, 21°04'S 148°35'E, M.R. Gray, C. Horseman, Mar 1975, AM KS0293; 1 male, Fraser Island, 25°33'S 152°59'E, Australian National University, 1 Jan 1971, AM KS19249.

Diagnosis. Male, medium size, F1–4 yellow, P1, T1 and M1 orange, M1 and Ts1 orange, very sparse fringes on M1 and T1, (P1+T1) relatively long, palps vanilla colour. dorsal median white strip of hair on cephalothorax, no red clypeal moustache, copulatory organs with dorsal distal tegular lobe as well as distal and proximal tegular lobes. Males can be separated from *P. bulburin*, by the presence of only a sparse

fringe on M1 and T1, of a dorsal, distal tegular lobe on the male palp and the presence of a white median stripe on the cephalothorax and absence of the white to red mat of hairs covering the clypeus and around AME found in *P. bulburin*. **Female** large size, copulatory organs with coiled proximal seminal duct, unlike *P. bulburin*.

Description

Male. Medium size, cephalothorax orange with faint strong orange marks on the thorax, sparse hairs on front of cephalothorax, median white strip of hairs, eye field black, AME fringe thick, clypeus orange with no mat of hairs, chelicera orange with large, pointed retromarginal tooth and one fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, abdomen dorsal yellow with black pattern, ventral yellow/orange with brown squared posterior lip, P1, T1 and M1 orange, T1 and M1 very sparse fringe, Ts1 yellow, F1 yellow, L2–4 yellow, palps orange, male copulatory organs with dorsal distal tegular lobe as well as distal and proximal tegular lobes. Dimensions: holotype, 1.9 mm CL, 0.87 AEW/CL, 0.53 AMEW/CL, 0.88 CW/CL, 0.83 PEW/CL, 0.60 EFL/CL, 0.60 CWP/CL, 1.07 AL/CL, 0.50 AW/CL, 0.67 CH/CL, 0.067 CIH/CL, 0.40 ChH/CL, 0.43 StL/CL, 0.33 StW/CL, 1.00 (P1+T1/CL).

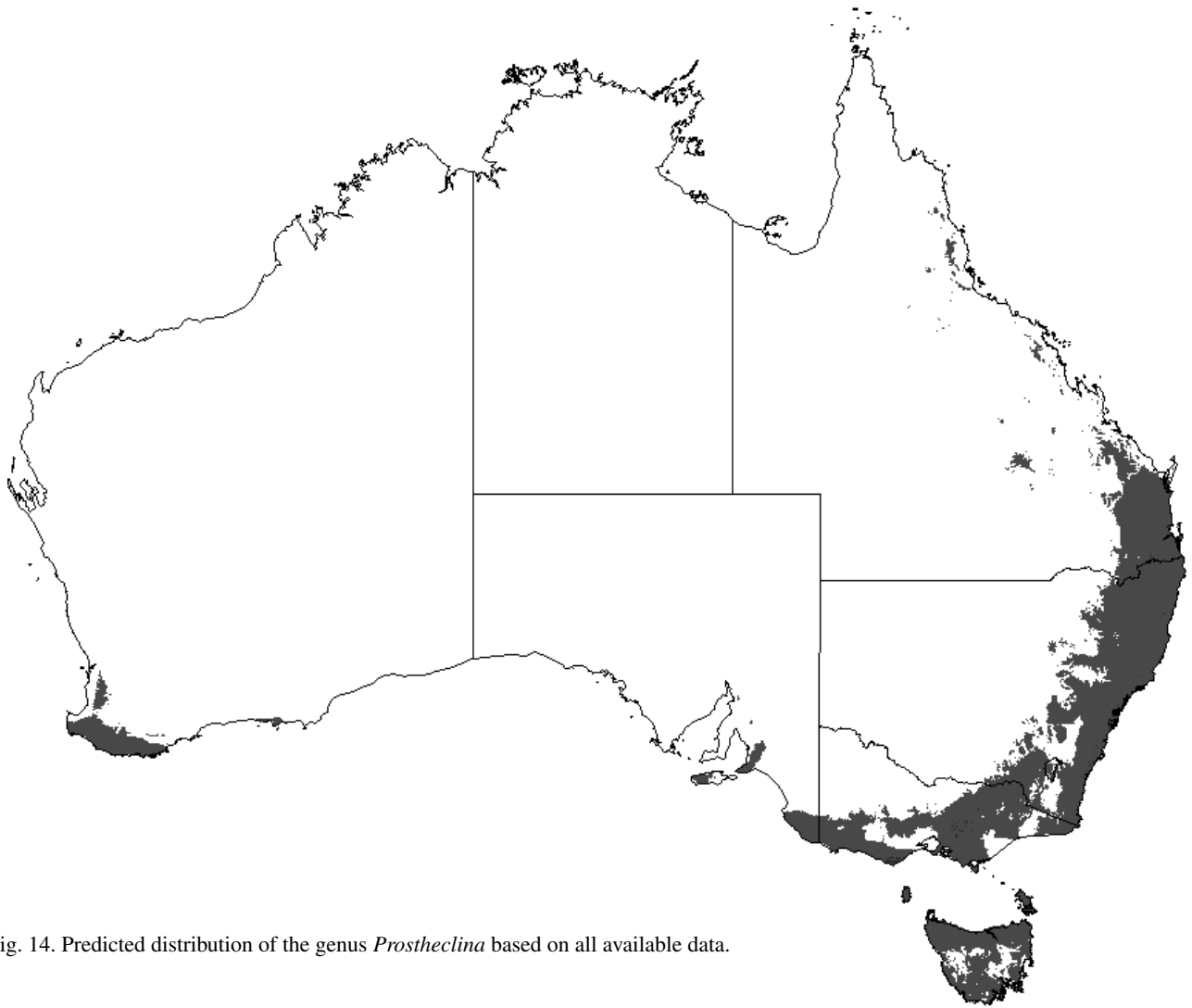


Fig. 14. Predicted distribution of the genus *Prostheclina* based on all available data.

Female. Relatively large, cephalothorax yellow/orange with orange marks on the thorax, eye field black, AME fringe sparse, sparse hairs covering cephalothorax, clypeus yellow, chelicera yellow with large, blunt retromarginal tooth and fissident promarginal tooth, maxillae yellow, labium yellow, sternum yellow, dorsal abdomen vanilla with black pattern, ventral abdomen yellow with faint dark markings, legs yellow, palps yellow, female copulatory organs with proximal seminal ducts long and coiled, accessory glands in insemination ducts clear. Dimensions: paratype, 2.3 CL, 0.76 AEW/CL, 0.46 AMEW/CL, 0.76 CW/CL, 0.73 PEW/CL, 0.49 EFL/CL, 0.54 CWP/CL, 1.41 AL/CL, 1.08 AW/CL, 0.57 CH/CL, 0.027 CIH/CL, 0.35 ChH/CL, 0.38 StL/CL, 0.27 StW/CL, 0.62 (P1+T1/CL).

Distribution. Eastern central Queensland (Fig. 10).

Etymology. A combination of letters, to be treated as a female noun in apposition (pronounced “young-gella”).

General considerations

The predicted distribution of the genus based on all available records is shown in Fig. 14. The only large additions to the combined predicted distributions of the species are the prediction that areas in SW WA are suitable for the genus and an increased coverage in SW Vic and SE SA. The genus has not been found in WA (J. Waldock, pers. comm.). The increased ranges predicted for the genus in SA and western Vic are probably due to the limited numbers of specimens available from these areas. It is likely that *P. pallida* and, perhaps, *P. basilones* will be found more widely in the region.

The conservation status of *P. pallida*, *P. amplior*, *P. bulburin* and *P. eungella* is LC as they are widely distributed, including in national parks. The two northern species *P. boreoxantha* and *P. boreoaitha* are only known from their type localities but in each case they are in protected areas; consequently they also may be graded LC. The environment of King Island however has been greatly altered since 1906 and the status of *P. basilones* should be checked; it should be considered NT B2b(iii) until then.

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References

- Bryant, E.B., 1950. The salticid spiders of Jamaica. *Bulletin of the Museum of Comparative Zoology* 103: 163–209.
- Davies, V.T., M. Zabka, 1989. Illustrated keys to the genera of jumping spiders (Araneae: Salticidae) in Australia. *Memoirs of the Queensland Museum* 27: 189–268.
- Griswold, C.E., 1987. A revision of the jumping spider genus *Habronattus* F.O.P.-Cambridge (Araneae; Salticidae) with phonetic and cladsitic analyses. *University of California Publications, Entomology*, vol. 107, 344 pp.
- IUCN, 2001. *IUCN Red List Categories and Criteria. Version 3.1*. IUCN: Gland
- Keyserling, E., 1882. *Die Arachniden Australiens, nach der Natur beschrieben und abgebildet*. Nürnberg: Bauer & Raspe, vol. 1 pp. 1325–1420.
- Nix, H., 1986. A biogeographical analysis of Australian elapid snakes. In *Atlas of Elapid Snakes of Australia*, ed. R. Longmore, pp. 4–15. Canberra: AGPS.
- Richardson, B.J., M. Zabka, M.R. Gray & G. Milledge, 2006. Distributional Patterns of Jumping spiders (Araneae: Salticidae) in Australia. *Journal of Biogeography* 33: 707–719.
- Simon, E., 1901. *Histoire naturelle des Araignées*. Paris: Encyclopédie Rorét, vol. 2(3), 2nd edn, pp. 381–668.

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