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A new genus of lauxaniid fly from South Africa (Diptera: Acalypttratae: Lauxaniidae), associated with proteas (Proteaceae)

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ABSTRACT

Proteaphila gen. n. (Diptera: Acalypttratae: Lauxaniidae) is described. It is distinguishable on the basis of the shape of the head, and wing patterning and venation. Male and female terminalia are similar across species (e.g. structure of male hypandrium, aedeagus and surstylus) and the new genus is notable for the large body size (body length *ca* 5.5–6 mm), robust habitus, pointed head-shape, ornate body patterning, stump vein on M₁₊₂, massive aedeagus, and large surstyli. In terms of prevailing suprageneric lauxaniid taxonomy, *Proteaphila* is placed in the subfamily Lauxaniinae because it has a sapromyziform costa, 1 mesotibial spur and lacks a profemoral ctenidium. The elongated frons of *Proteaphila* is similar to morphological modifications of the head in *Trigonometopus* Macquart and related genera of Trigonometopini, but without formal analysis, it must be assumed that this resemblance could have arisen convergently, with *Proteaphila* not being phylogenetically close to these genera. The bulk of specimens have been collected from *Protea* trees (Proteaceae), and the genus obviously has some as yet unelucidated biological relationship with proteas. *Proteaphila* is endemic to South Africa, being restricted to *Protea*-rich montane grassland in the Drakensberg Mountains of KwaZulu-Natal and fynbos (macchia) of the Western Cape. Three new species are described in the genus: *Proteaphila maculosa* Davies & Miller, sp. n., *P. pajori* Davies, Miller & Muller, sp. n. and *P. stuckenbergorum* Davies & Miller, sp. n. A key to the identification of species is presented.

KEY WORDS: Diptera, Lauxaniidae, *Proteaphila*, Afrotropical, Drakensberg, Proteaceae, *Protea*, fynbos, identification key, new genus.

INTRODUCTION

Lauxaniid flies (Diptera: Acalypttratae: Lauxaniidae) are renowned for their morphological diversity relative to other acalypttrate fly families. In his important generic review, Brian Stuckenberg (1971: 500) commented on their ‘extraordinary morphological plasticity’ and Frank McAlpine (1989: 1445) expressed the same sentiments. This morphological diversity has led to a relatively high genus to species ratio in the family, i.e. there are, in general, many genera with rather few species in each genus.

Head-shapes among lauxaniids have become especially modified, for example note the diversity of head-shapes in the Nearctic fauna, illustrated by Shewell (1987, figs 2–10). One notable modification of the lauxaniid head has been the elongation of the frons in genera such as *Trigonometopus* Macquart, 1835, giving the head an overall triangular or sub-triangular appearance. The evolutionary and functional reasons for this elongation remain speculative and disputed amongst specialists. Stuckenberg (1971: 516) suggested that it was connected with the development of an elongate body-form in grassy habitats such that the fly would orientate itself longitudinally (and cryptically) on a grass stem, but Shewell (1977: 182) queried this explanation, observing that there was ‘some evidence that *Trigonometopus* is associated with *Pinus* [pine trees], and in

both northern Europe and Canada'. Conversely, in Britain, Collin (1948: 227) stated that *Trigonometopus frontalis* is not uncommon where reeds (*Phragmites*) flourish, and Chandler and Ismay (1978: 106) reported that *Trigonometopus* was 'often present' in *Carex* reed tussocks. The functional explanation(s) for this head-shape remains an open question.

The flies that form the subject of this paper also have an elongated frons, being approximately $\frac{1}{3}$ the length of the eye, but the remainder of the body is robust and compact. They appear to be associated with *Protea* trees and bushes, not grass (see Discussion below).

In the early 1990s, R.M.M. noticed in the drawers of unsorted dipteran material in the Natal Museum, some large, robust, richly-coloured, ornately-patterned lauxaniids. They did not resemble any other genus known from Africa, and running these flies through Stuckenberg's (1971) generic key did not reveal any 'clear' matches. Consequently, it is the purpose of this paper to describe these new flies, and also to emphasise some of the interesting morphological modifications displayed as well as their apparent association with *Protea* trees. One difficulty in erecting new genera in the Lauxaniidae is that some genera (e.g. *Sapromyza* Fallén, 1810) have become a depository for 'problematic' species that could not be accommodated elsewhere. The erection of a new lauxaniid genus, especially from such a poorly documented fauna as that in the Afrotropics, requires careful substantiation. Fortunately, the new genus described here is distinctive and its creation appears fully warranted.

MATERIAL AND METHODS

Material examined originates from the KwaZulu-Natal Museum, Pietermaritzburg, South Africa (NMSA) and Stellenbosch University Entomological Museum, Stellenbosch, South Africa (SUNC). A total of 60 specimens of the new genus were examined for this study, together with representative examples of superficially similar genera and species (e.g. *Trigonometopus frontalis* (Meigen, 1830) [usually one stump (appendicular) vein] and *Dyticomys oraria* Stuckenberg, 1971 [with two stump veins]).

The standard terminology (McAlpine 1981) is followed, with older terminology in brackets: frons (postfrons), face (prefrons), parafacial (paraprefrontal area), facial ridge (prefrontal ridge), frontogenal suture (prefrontal-genal suture), postocellar bristles (postvertical bristles), anepisternum (mesopleuron), katopisternum (sternopleuron), postpronotal lobe (humeral callus), posthumeral bristle (presutural bristle), R_1 (Vein 1), R_{2+3} (Vein 2), R_{4+5} (Vein 3), M_{1+2} (Vein 4), CuA+1A (Vein 6), r-m (anterior crossvein), dm-cu (posterior crossvein). The following abbreviations are used: T – tergite (e.g. T3 – tergite 3), S – sternite (e.g. S3 – sternite 3).

The number and deployment of dorsocentral bristles in lauxaniids is described in a particular format, e.g. 1+3. This shorthand indicates that there is one dorsocentral bristle anterior to the transverse suture on the mesoscutum and three dorsocentral bristles behind the suture.

Head length was measured from the anterior edge of the frons to the posterior edge of the eye. Thorax length was measured from the anterior edge of the mesoscutum to the posterior edge of the scutellum. Abdomen length was measured from the anterior edge of syntergite 1+2 to the posteriormost visible extremity of the abdomen. All measurements are in millimetres.

Terminalia were extracted by relaxing the specimen in a phenol chamber, excising the softened abdomen tip with a small blade, and then depositing it in cold 10% potassium hydroxide (KOH) overnight. Once removed from KOH, the terminalia were washed in acetic acid and then placed in tap water or glycerol for examination under a microscope. Habitus photographs were captured using an Automontage camera attached to a Leica MZ16 stereomicroscope.

TAXONOMY

Genus **Proteaphila** Davies & Miller, gen. n.

Etymology: From *Protea*, a large genus of >100 species of bushes and small trees characterized by their dramatic inflorescences, and Latin *phila* (loving). Gender: feminine. Proteas are highly diversified in the Cape Floristic Region, Western Cape Province, and are also common in the temperate Afromontane grasslands along the Great Escarpment in KwaZulu-Natal and Mpumalanga, South Africa. The generic name reflects the apparent preference these flies have for *Protea*.

Type species: *Proteaphila stuckenbergorum* sp. n.

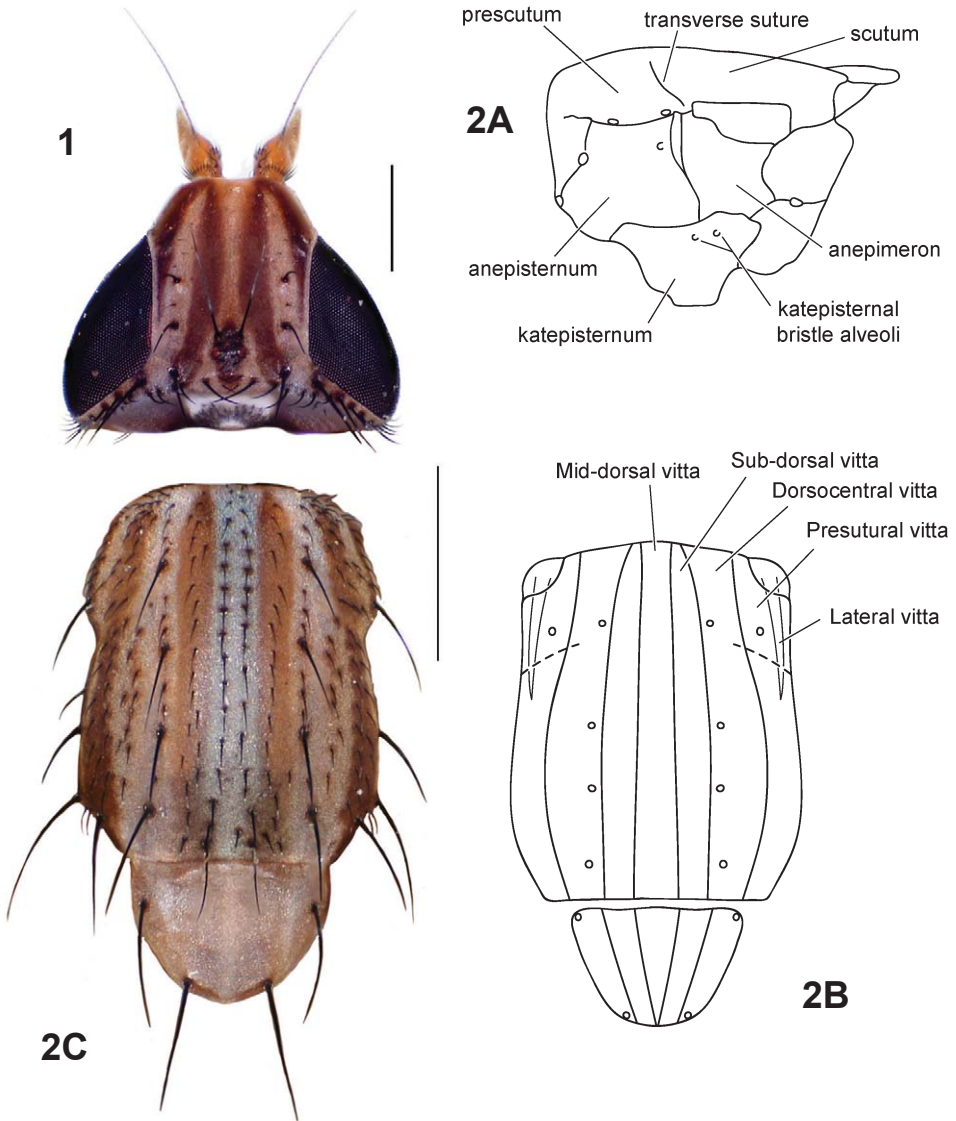
Diagnosis: Noteworthy features of *Proteaphila* are: (1) large body (body length *ca* 5.5–6 mm); (2) habitus robust and compact; (3) frons elongated, slightly sloping (the extension being *ca* 30% of the length of the eye); (4) two reclinate fronto-orbital bristles located on the posterior half of the frons; (5) arista micropubescent (appears almost devoid of setulae when viewed at low magnification); (6) ocellar bristles strong, proclinate, subparallel to slightly divergent; (7) face recessed, not visible laterally; (8) scape recessed; (9) pruinescent surface to most of the head, thorax and legs and parts of the abdomen, giving the flies a grey sheen; (10) posthumeral (= presutural) bristle present; (11) intra-alar bristle absent; (12) 1 presutural dorsocentral bristle and 3 post-sutural dorsocentral bristles (1+3 *dc*); (13) quadriseriate acrostichal setae; (14) two katapisternal bristles; (15) no profemoral ctenidium; (16) 1 mesotibial spur; (17) costa setulae sapromyziform; (18) 1 stump vein on M_{1+2} ; (19) large aedeagus with recurved apex; and (20) large, rounded surstyli articulating with epandrium.

Description:

Coloration: Ground-colour orange-brown to dark grey. All species heavily overlaid with fine, silvery-white pruinescence. Frons with three vittae: (1) brown vitta running from inner vertical seta to anterior margin of frons, (2) brown vitta extending from anterodorsal margin of eye to anterior margin of frons, (3) short black vitta running from inner margin of eye to base of antenna. Maxillary palpus orange to yellowish. On thorax, pruinescence restricted to longitudinal rows (see *Thorax*). Haltere yellow to orangish.

Head (Figs 1, 6B): Frons moderately sloping, longer than wide, projecting noticeably beyond anterior margin of eye. Boundary between frons and occiput sharp. Ocellar triangle about two ocellus diameters from boundary between occiput and frons. Two pairs of reclinate fronto-orbital bristles, anterior bristle slightly shorter than posterior bristle, and placed closer to posterior bristle than to anterior edge of frons. Postocellar bristles decussate, intersection high. Inner vertical seta longer than outer vertical seta. Ocellar bristles proclinate, strong, parallel to slightly divergent. Setulae on ocellar triangle extending posteriorly underneath postocellar bristles. Postocular setae biseriate, primary row stronger than secondary row, primary row disclinate (out-curved), secondary

row inclinate (in-curved). Lunule hidden beneath facial extension. Antennal bases widely spaced (1–2 antennal socket widths). Scape short, cylindrical, setulae along anterior margin. Pedicel simple, short, expanded apically with row of setulae along anterior margin, setulae becoming progressively longer ventrally, 1 dorsal, erect setula. Postpedicel short, rounded to weakly pointed apically. Arista black, micropubescent. Face narrow, receding, not visible laterally. Eye red-brown (discolored to black), 1.2× longer than high. Gena fairly broad (approx. half the height of eye), fairly weak setulae



Figs 1, 2. (1) *Proteaphila stuckenbergorum* sp. n., dorsal aspect of head, showing deployment of alveoli and postfrontal vittae, scale bar = 0.5 mm; (2A) schematic illustration of thorax (lateral view); (2B) schematic illustration of thoracic vittae; (2C) dorsal view of thorax, scale bar = 1 mm.

along frontogenal suture; gena directly below eye asetulose but heavily overlaid with silvery-white pruinescence. Gena behind eye, postgena and lower occiput setulose; paired postgenal setae present. Clypeus (prelabrum) fairly robust. Maxillary palpus clavate.

Thorax (Figs 2A–C): Scutum moderately arched, with six longitudinal vittae (here informally termed *mid-dorsal vitta*, *sub-dorsal vitta*, *dorsocentral vitta*, *presutural vitta*, *lateral vitta* and *notopleural vitta*), alternating between pruinulent (silver) and non-pruinulent (brown or orange) vittae. Chaetotaxy comprising five distinct longitudinal rows or groupings of setulae/setae: (1) primary acrostichal row, (2) secondary acrostichal row, (3) dorsocentral row, (4) sublateral band, and (5) lateral row; 1+3 *dc*; 1 postpronotal bristle (+ a few setulae anterior to bristle); 2 notopleural bristles; 1 presutural and 1 postsutural supra-alar bristle (+ 1 setula or seta anteriorly); 2 postalar bristles (lower bristle longer). No intra-alar bristle. Two pairs of scutellar bristles, posterior pair not decussate. Prosternum with 1 or 2 inconspicuous setulae on each half of sclerite. Propleural bristle strong and erect, reaching to base of postpronotal lobe. Katepisternum with medial clump of *ca* 10 setae ventrally, irregular line of setulae extending dorsally towards anterior katepisternal bristle. Two dorsoposterior katepisternal bristles, anterior bristle *ca* 0.7× length of posterior bristle.

Legs: Profemur without anteroventral ctenidium; posteriorly with strong *posterodorsal*, weak *posteromedian* and strong *posteroventral setal* rows. Mesofemur with *apico-anterior setal* row of *ca* 6 strong setae. Preapical tibial bristle strongest on mesotibia; 1 ventral mesotibial bristle accompanied by 4–6 stout setulae on either side. Pro- and metatibiae with small, apicoventral comb. Distal tarsomeres in some species darkened.

Wings (Fig. 5): Intricately patterned or largely infuscated. Costa sapromyziform, marginal setulae terminating slightly less than half-way between apices of R_{2+3} and R_{4+5} . Costa terminates on M_{1+2} apex. Stump vein on M_{1+2} projects into cell M_1 (Fig. 5D).

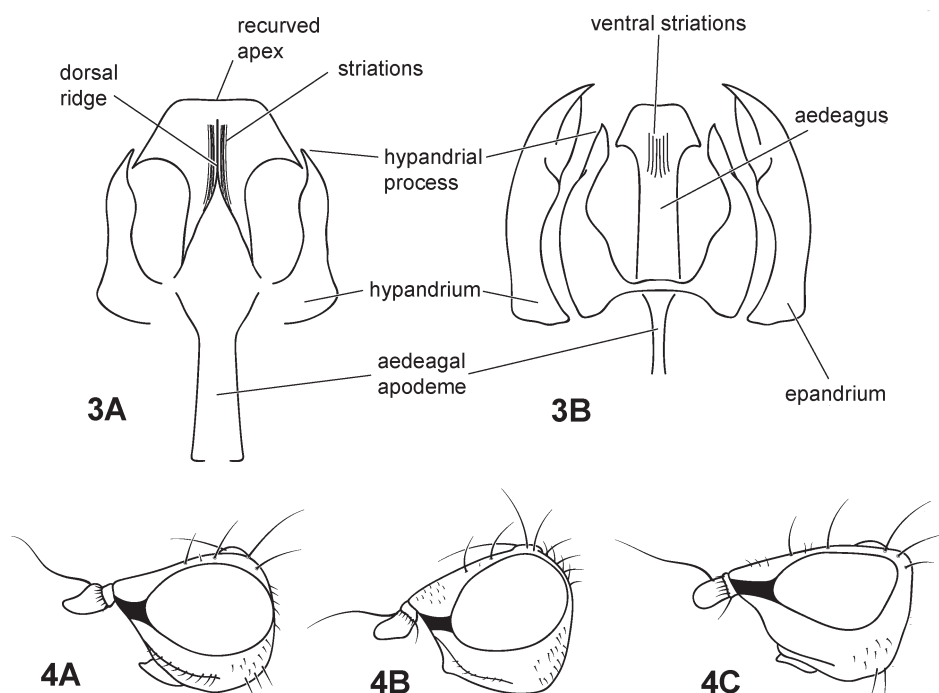
Abdomen: Suboval, tapering gently posteriorly.

Male terminalia (Figs 3, 9–11): Protandrium saddle-shaped, broad dorsally, narrowing laterally, incomplete ventrally. Protandrium not fused to epandrium dorsomedially. Epandrium narrow dorsally, expanding laterally and projecting posteriorly as rounded lobes. Surstyli large and rounded or weakly truncate, articulating with epandrium. Cerci small, somewhat flattened, setulose. Aedeagus very large, apically recurved and fimbriated or lobed, subapical flanges may be present, remainder of aedeagus flattened with transparent dorsal ridge and ventral striations. Hypandrium extending posteriorly as acuminate processes (arms). Aedeagal apodeme short, rod-like.

Female terminalia (Figs 12–14): Three exposed tergites (syntergite 1+2, T3 and T4), remaining tergites (T5 onwards) narrowed and telescoped. Segment 7 forming syntergosternite (with spiracle in sclerite). Cerci quite long, flattened, setulose. Epi- and hypoproct simple, setulose. 2+1 spermathecae.

Comments: *Proteaphila* has a stump vein on M_{1+2} , a characteristic otherwise seen only in *Trigonometopus frontalis* (Meigen), *Dyticomyia* Stuckenberg, 1971 and *Shatalkinella* Papp, 2007. In *T. frontalis*, there is usually only one stump vein, and in *Dyticomyia oraria*, there are two stump veins (e.g. Stuckenberg 1971, fig. 49), whereas in *Shatalkinella*, some species may have a single stump vein (e.g. Papp 2007, figs 69, 71), like *Proteaphila*.

In the middle of the scutum, *Proteaphila* has a medial pair of acrostichal setae (here informally termed the *primary acrostichal* row). The setae comprising the *primary*



Figs 3, 4. (3) Schematic illustration of inner ♂ genitalia: (3A) *Proteaphila maculosa* sp. n., dorsal view; (3B) *P. stuckenbergorum* sp. n., ventral view; (4) lateral view of the different head shapes: (4A) *P. stuckenbergorum* sp. n., (4B) *P. pajori* sp. n., (4C) *P. maculosa* sp. n.

acrostichal row are setulae, except for the posteriormost pair or penultimate pair, which are longer and more robust than the other acrostichals and morphologically qualify as setae. Each pair of alveoli comprising the *primary acrostichal rows* are not exactly aligned but, rather, displaced relative to the other, such that the setulae are deployed in a slightly zigzag conformation. Adjoining the *primary acrostichal rows* on either side is a further longitudinal row of setulae (here informally termed the *secondary acrostichal row*). We were uncertain as to whether to call these setulae acrostichals or not, because there appears to be no strict definition in the literature. We have tentatively labelled them as acrostichals, and thus *Proteaphila* has quadriseriate acrostichals (i.e. four longitudinal rows). The *secondary acrostichal rows* only comprise setulae and they are irregularly arrayed in a disorderly longitudinal arrangement between the primary acrostichal row and dorsocentral axis.

The dorsocentrals are made up of setulae and four stout, progressively longer, posterior bristles. As a generic characteristic, there is one presutural dorsocentral bristle and three post-sutural dorsocentral bristles. The posteriormost and sometimes the penultimate dorsocentral bristle are displaced laterally from the main dorsocentral axis. Between the dorsocentral row and the presutural supra-alar bristle is an irregular, longitudinal swathe of setulae running from the anterior part of the scutum posteriorly, to fade out near the upper postalar bristle; these setulae are informally termed the *sublateral band*.

They are clumped in the presutural area. In the postsutural area, the setulae are arranged in approximately three haphazard rows. Lastly, along the lateral sides of the scutum is the *lateral row* or axis, comprising the posthumeral (= presutural), supra-alar and postalar bristles.

The massive aedeagus of *Proteaphila* species is immediately noticeable on dissection, and it is as long as two or three tergites. The recurved apex of the aedeagus is distinctly fimbriated or lobed and the ventral surface is characteristically striated. The hypandrial ring bears posteriorly-projecting acuminate arms (processes) that resemble gonopods (or parameres) in other lauxaniids. We do not have any firm opinion on the homology of these processes and here tentatively refer to them as hypandrial arms; they may be gonopods (or parameres) that have become fused basally to the hypandrium. The inner genitalia represent a fairly simple system, comprising the aedeagus + hypandrium + hypandrial arms/gonopods. The surstyli are large, rounded, conspicuous, and articulate with the epandrium; they are reminiscent of the large surstyli seen in *Minettia* Robineau-Desvoidy, 1830 species.

Key to *Proteaphila* species

- 1 Wing fumose (Fig. 5A). [KwaZulu-Natal]..... **stuckenbergorum** sp. n.
- Wing intricately patterned with brown reticulations.....2
- 2 Cell r_1 partially infuscated with several small, paired, diffuse brown markings, cell r_{4+5} and discal-medial cell with brown reticulate (not longitudinal) patterning (Fig. 5B). [KwaZulu-Natal] **pajori** sp. n.
- Cell r_1 completely infuscated, cell r_{4+5} and discal-medial cell with irregular longitudinal (not reticulate) brown markings (Fig. 5C). [Western Cape] **maculosa** sp. n.

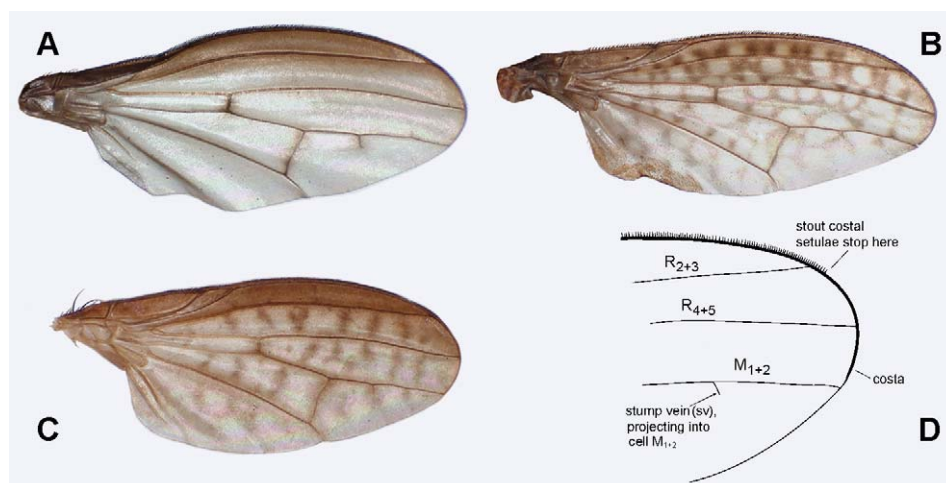


Fig. 5. Wings of *Proteaphila*: (A) fumose wing of *P. stuckenbergorum* sp. n.; (B) reticulate, patterned wing of *P. pajori* sp. n.; (C) longitudinally marked wing of *P. maculosa* sp. n.; (D) *P. pajori* sp. n., apex of right wing showing sapromyziform costa, i.e. stout costal setulae terminating well before apex of R_{4+5} (fine costal setulae not shown).

Proteaphila maculosa Davies & Miller sp. n.

Figs 3A, 4C, 5C, 6, 9, 12

Etymology: From Latin *maculosa* (dappled, spotted), in reference to patterned wings.

Diagnosis: A grey-orange fly with brown stripes and intricately patterned wings. Although the other species resemble each other in general facies, the male terminalia of *maculosa* look more like those of *stuckenbergerorum*. Acrostichal bristles are large and robust (they all qualify as setae, not setulae). The aedeagus looks vaguely like the head of a flatworm or arrowhead.

Description:

Measurements: head length: ♀ (n=4) = 1.3 (1.2–1.3), ♂ (n=2) = 1.3; thorax length: ♀ = 2.4 (2.3–2.6), ♂ = 2.4 (2.3–2.5); abdomen length: ♀ = 2.0 (1.7–2.3), ♂ = 2.0 (1.9–2.1); wing length: ♀ (n=3) = 5.3 (5.1–5.5), ♂ = 5.2 (5.1–5.3).

Head (Figs 4C, 6B, 6D): Frons straight, oriented at slight angle relative to scutum. Frons with 3 pairs of vittae, first vitta brown, beginning at inner vertical seta, extending to anterior edge of frons. Another brown vitta runs from inner anterior edge of eye to anterior edge of frons. Anterior edge of frons very slightly emarginate. Short, black vitta extends from anterior edge of eye to base of antenna. Two reclinate fronto-orbital bristles, anterior bristle *ca* 0.7× length of posterior bristle; 1–3 setulae between fronto-orbital bristles, posterior fronto-orbital bristle *ca* 0.7× length of inner vertical seta. Other setal features of head as per genus (e.g. strong ocellar bristles, decussate postocellars, cluster of setulae on anterior of frons and two rows of postocular setae). Postcranium blackish grey, heavily overlaid with silver pruinescence. Scape, pedicel and postpedicel orange; scape recessed under frons (not visible in lateral view). Arista micropubescent. Face covered heavily by cream-silver pruinescence, 2 blackish dots on lower lateral face. Gena with silver-cream pruinescence. Maxillary palpus orange.

Thorax (Fig. 6C): Thorax weakly arched. Ground-colour brown, overlaid with grey-silver, pruinose longitudinal vittae. Mesoscutum with 5 vittae: grey-silver medial vitta, brown submedial vittae and grey-silver dorsocentral vittae. Chaetotaxy: Setae of medial acrostichal rows large and robust (= setae), outer rows smaller (setulae); 1+3 *dc*; 1 postpronotal bristle, 1 presutural and 1 postsutural supra-alar bristle (+ setula), 2 notopleural bristles, 2 postalar bristles. Scutellum with thin, grey medial vitta, 2 broad, brown sublateral vittae, 2 lateral, grey-silver pruinose vittae. Pleura brownish, heavily overlaid by silver-grey pruinescence, except for brownish edges to pleural sclerites and 2 brown spots on anepisternum; 1 anepisternal bristle, patch of setulae anterior and ventral to bristle, setular alveoli encircled by brown spots; 2 katepisternal bristles, anterior bristle weaker.

Legs: Procoxa pale yellow, profemur orange-brown with silver-grey pruinescence posteriorly. Protibia yellow, with black apical band. Protarsomere 1 yellow, other tarsomeres dark brown-orange. Mesocoxa yellow. Mesofemur yellow, with brown patch apicoventrally and light silver pruinescence. Mesotibia yellow, with brown ventral patch proximally and dark band apically. Mesotarsomeres yellow, except for distal 2, which are orange-brown. Metacoxa to metatarsomeres yellow, except for brown patch apicoventrally on metafemur, brown patch proximally and brown band apically on metatibia, and brown distal 2 tarsomeres.

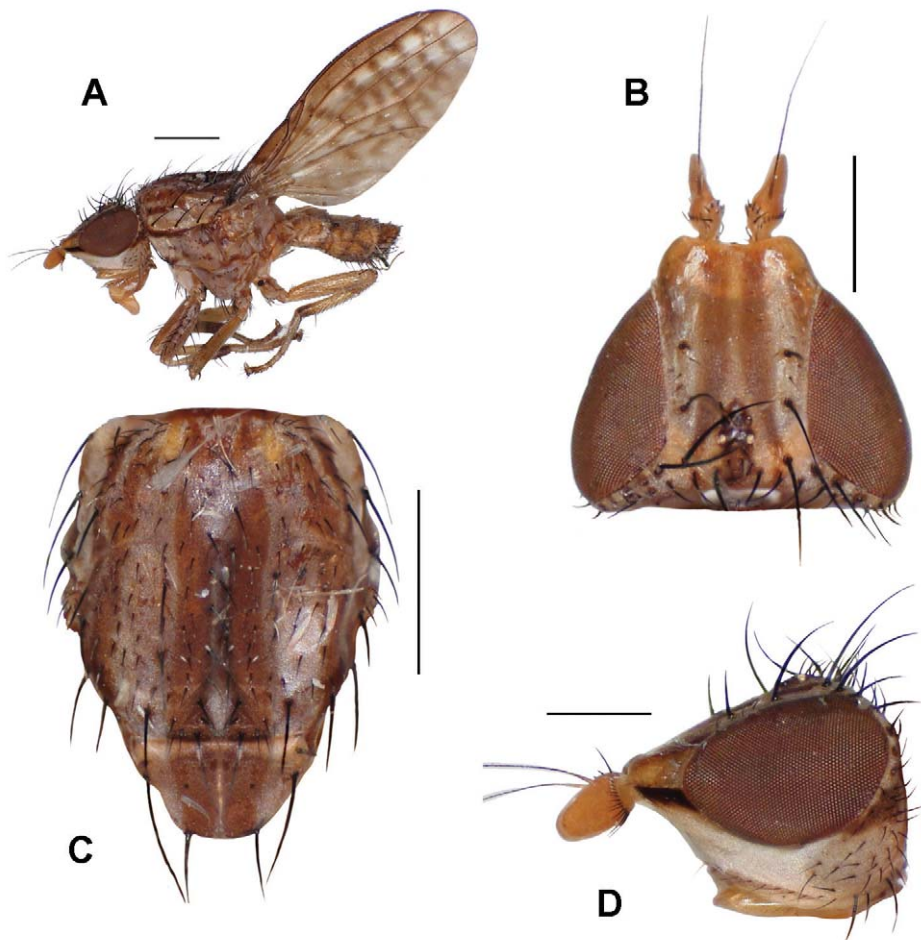


Fig. 6. *Proteaphila maculosa* sp. n., ♂: (A) habitus image showing intricately patterned wings with longitudinal brown markings, scale bar = 1 mm; (B) head, dorsal view, scale bar = 0.5 mm; (C) thorax, dorsal view, scale bar = 1 mm; (D) head, lateral view, scale bar = 0.5 mm.

Wings (Fig. 5C): Basal costa, pterostigma and radial cells shaded brown. Brown longitudinal bars in cells R_{1+2} and R_{3+4} , with apex shaded brown. 1st posterior, discal and 3rd posterior cells with brown barring. M_{1+2} and M_3 and crossveins $r-m$ and $m-m$ shaded brown. Stump vein on M_{1+2} shaded brown. Axillary vein (2a) extending beyond $CuA+1A$.

Abdomen: Tergites and sternites yellow, but often discolored to black. Setal alveoli surrounded by brown spots.

Male terminalia (Figs 3A, 9): Protandrium not sufficiently investigated (sclerite damaged during dissections or badly contorted as a result thereof), but essentially saddle-shaped. Epandrium large, broader (longer) laterally than dorsally. Surstyli large, with narrow digitated processes extending mesad. Surstyli clearly differentiated from epandrium. Cerci simple, setulose. Aedeagus large, conspicuous, extrusive, flat, with

recurved apex and sharp, subapical flanges. Aedeagus with striations ventrally, with sharp, narrow, prominent ridge dorsally that bifurcates basally. Hypandrium prominent, transverse sclerite with lobes projecting apically (posteriorly). Hypandrial lobes narrow, setulose basally and apically acuminate, resemble gonopods (which have become fused to the hypandrium). Aedeagal apodeme small and inconspicuous.

Female terminalia (Fig. 12): Tergites narrowed from T5 onwards. Segment 7 is a syntergosternite. Cerci fairly long, flattened, setulose. S8 with truncate apex.

Holotype: ♂ SOUTH AFRICA: *Western Cape*: Cape Peninsula, Skoorsteenkop [34°02'S 18°23'E], 2.ii.1951, P. Brinck & G. Rudebeck (NMSA, Type no. 2285).

Paratypes: SOUTH AFRICA: *Western Cape*: 1♂ 1♀ Cape Peninsula, Hout Bay, Skoorsteenkop [34°02'S 18°23'E], 15.xii.1950, P. Brinck & G. Rudebeck (NMSA); 2♂ 1♀ same data but 26.xii.1950 (NMSA); 2♀ same data but xii.1950 (NMSA); 2♀ same data but 22.i.1951 (NMSA); 2♂ same data but 2.ii.1951 (NMSA); 1♂ Stellenbosch, Jonkershoek [33°53'S 18°52'E], 5.xii.1980, G.A. Giliomee (SUNC); 1♂ same locality, 2.ii.1981, L.M. du Preez (SUNC); 1♂ 2♀ same locality, 4.ii.1981, L.M. du Preez (SUNC); 1♂ same locality, 16.i.1982, G.A. Giliomee (SUNC); 1♀ same locality, 11.ii.1985, J.H. Coetzee (SUNC); 1♂ same locality, 6.iii.1985, J.H. Coetzee (SUNC); 1♀ Riviersonderend [34°10'S 19°50'E], 12.iii.1985, J.H. Coetzee (SUNC); 1♀ same locality, 7.i.1985, J.H. Coetzee (SUNC); 1♀ Du Toit's Kloof [33°43'S 19°10'E], 13.iii.1987, M. Wright (SUNC); 1♀ Protea Heights [33°53'10"S 18°41'50"E], 5.iii.1985, J.H. Coetzee (SUNC); 2♂ 1♀ 1♀ same locality, 11.xi.1985, J.H. Coetzee (SUNC); 3♂ 1♀ same locality, 2.xii.1985, L.M. Latsky (SUNC); 1♂ Tygerhoek [34°08'55"S 19°54'10"E], 13.xi.1985, J.H. Coetzee (SUNC); 1♂ 35 km N of Mossel Bay, Robinson Pass [33°45'S 22°03'E], 12.i.1983, R.M. Miller & P. Stabbins (NMSA); 1♂ Tsitsikamma area, Coldstream [33°55'S 23°03'E], 25–26.x.1964, B. & P. Stuckenberg (NMSA).

Distribution: Restricted to fynbos of the Western Cape Province, South Africa.

Ecological notes: *Proteaphila maculosa* has been collected from *Protea repens* (L.) L. and *Protea neriifolia* R.Br.

***Proteaphila pajori* Davies, Miller & Muller, sp. n.**

Figs 4B, 5B, 5D, 7, 10, 13

Etymology: Patronym for Istvan Pajor, who, as a postgraduate student of the University of KwaZulu-Natal researching the insect fauna associated with *Protea* species, collected the holotype of this species, along with many other specimens of *Proteaphila*.

Diagnosis: *Proteaphila pajori* is a grey fly with many brown spots (especially on the thorax) and intricately patterned wings. There is a complex pattern of vittae on the scutum, which gives a striped appearance. There are 1+3 *dc*, but presutural dorsocentral bristle is weak, short and not particularly bristle-like, although it is clearly differentiated from the setulae preceding and following it.

Description:

Measurements: head length: ♀ (n = 1) = 1.1, ♂ (n = 3) = 1.1 (1.1–1.2); thorax length: ♀ = 2.5, ♂ = 2.3 (2.2–2.4); abdomen length: ♀ = 2.5, ♂ (n=1) = 1.9; wing length: ♀ = 5.5, ♂ = 5.3 (5.0–5.5).

Head (Figs 4B, 7B, 7D): Frons nearly horizontal, slightly angled relative to scutum. Frons longer than wide (1.2:1). Fronto-orbital bristles reclinate, rather short (posterior fronto-orbital bristle *ca* 0.6× length of inner vertical seta), of similar length and fairly widely spaced (distance between bristles equal to distance between posterior dorsocentral bristle and inner vertical seta); setula between the fronto-orbital bristles. Cluster of tiny setulae (*ca* 20) distad of anterior fronto-orbital bristle. Ocellar bristle strong, slightly disclinate, extending to ¾ length of frons. Outer vertical seta disclinate, only slightly

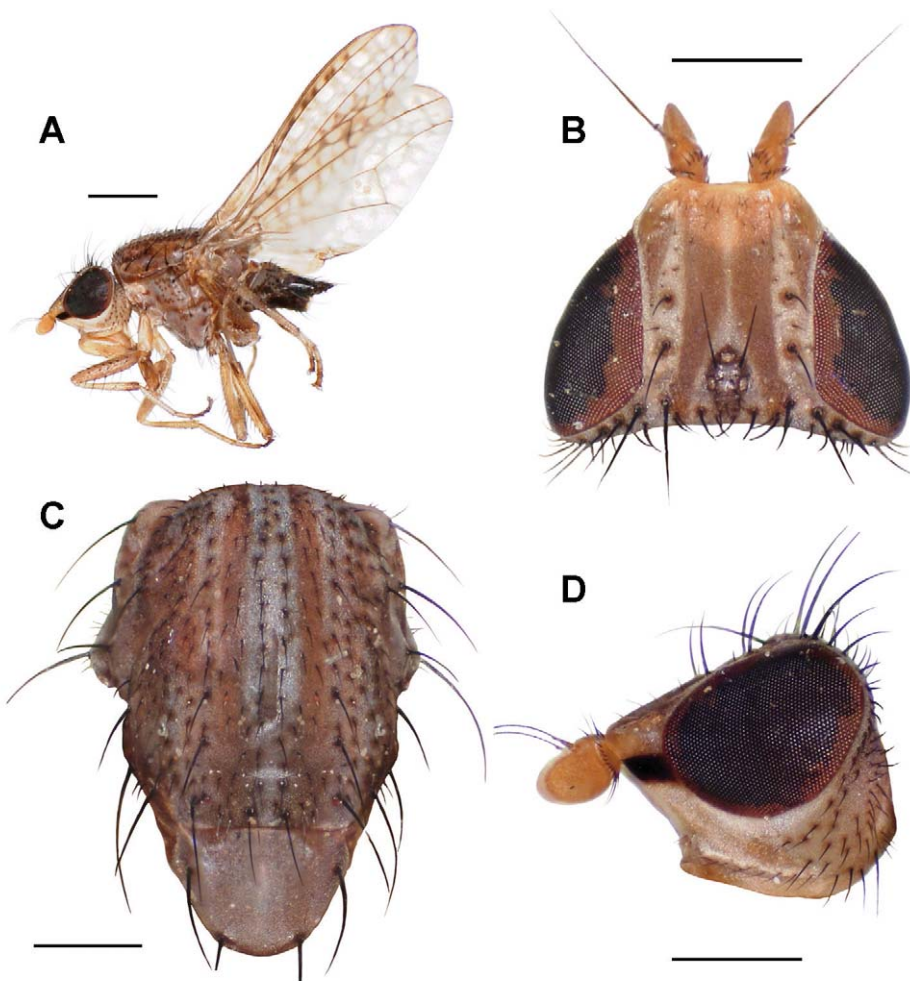


Fig. 7. *Proteaphila pajori* sp. n., ♂: (A) habitus image showing intricately patterned wings with reticulated brown markings, scale bar = 1 mm; (B) head, dorsal view, scale bar = 0.5 mm; (C) thorax, dorsal view, scale bar = 0.5 mm; (D) head, lateral view, scale bar = 0.5 mm.

shorter than inner vertical seta. Two postocular rows of setulae. Setulae under decussate postocellar bristles. Two brownish vittae on frons, first vitta beginning at inner vertical seta and fading out towards anterior margin of frons, second diffuse brown vitta extending from anterior edge of eye, fading out on anterior edge of frons; both vittae becoming orange-tinged anteriorly. Anterior edge of frons truncate. Ocellar triangle black-brown, coloration extending posteriorly under postocellar bristles, sides slightly longer than base. Dense cluster of setulae on ocellar triangle, extending posteriorly under postocellar bristles. The latter decussate, intersection high. Short, black vitta runs from medial edge of eye to base of antenna. Scape hidden in lateral view, pedicel simple, saucer-like, postpedicel somewhat bulbous. Scape to postpedicel orange. Arista micropubescent (appears almost devoid of setulae when viewed at low magnification). Eye longer than

high (longitudinally elongate). In lateral view, frons projecting beyond anterior edge of eye (postfrontal projection). Face recessed, heavily covered in fine silver pruinescence, diffuse, paired, blackish spots on lower face. Gena covered in silver pruinescence. Gena and lower occiput with many setulae. Maxillary palpus orange-yellow.

Thorax (Fig. 7C): Colour of sclerites brown, overlaid with grey-silver pruinescence. Scutum with light grey pruinose medial vitta, brown non-pruinose submedial vitta, grey pruinose dorsocentral vitta (with irregular brown blotches), brown presutural vitta and grey lateral notopleural vitta. Alveoli of grey medial stripe encircled by brown dots. Chaetotaxy: Acrostichal setulae quadriseriate, inner row with alveoli slightly jagged, outer row of setulae irregular; 1+3 *dc*, first bristle anterior to transverse suture weak, short and inconspicuous (only 0.3× length of posteriormost dorsocentral bristle); sublateral band of irregularly deployed setulae; 1 postpronotal bristle, 2 notopleural bristles, 1 presutural and 1 postsutural supra-alar bristle (+1 setula), 2 postalar bristles (lower bristle longer). Scutellum with thin grey medial vitta, brown submedial vitta and grey lateral vitta, posterior marginal bristles not decussate. Pleura brown, covered in silver-grey pruinosity, except edges of anepisternum; 1 anepisternal bristle, surrounded by setulae; brown spots encircling alveoli; 2 katepisternal bristles.

Legs: Procoxa pale yellow, with light silver pruinescence. Profemur yellow-brown anteriorly, with silver pruinosity; brown posteriorly, with silver pruinescence. Protibia yellow, with apical dark brown band. Protarsomere 1 yellow, remaining tarsomeres progressively darker. Mesocoxa yellow-brown, with some silver pruinescence. Mesofemur yellow, darker distally. Remainder of midleg yellow-brown. Metacoxa brownish, covered in silver pruinosity. Metafemur yellow, with purple-silver sheen. Metatibia yellow, darkened proximally and apically.

Wings (Figs 5B, 5D): Wing pattern complex, with basal costal, pterostigma and most radial cells infuscated anteriorly. Remainder of wing with very light infuscation pockmarked by white spots.

Abdomen: Tergites predominantly yellow, but each darkened apically. Laterally, with dark silver pruinescence and setal alveoli encircled by brown dots.

Male terminalia (Fig. 10): Protandrium broader (longer) laterally than dorsally, not entire (ventral portion absent). Epandrium broader laterally. Surstylus fairly large, with apex truncated, somewhat elongated posteroventrally and then inwards as short, inconspicuous finger. Aedeagus very large and protruding, with strongly recurved apex pointing almost anteriorly.

Female terminalia (Fig. 13): Abdominal segments narrowing from T5 onwards. Segment 7 is a syntergosternite. Cerci fairly long, flattened, setulose. S8 with a truncated apex, appearing very much similar to that of *maculosa* in structure.

Holotype: ♂ SOUTH AFRICA: *KwaZulu-Natal*: Cathedral Peak, Mike's Pass [28°58'S 29°14'E], 1710 m, 30.viii.1988, I. Pajor (NMSA, Type no. 2286).

Paratypes: SOUTH AFRICA: *KwaZulu-Natal*: 1 ♂ Royal Natal National Park [28°41'38"S 28°55'40"E], 11.ix.1963, 1580 m, B. & P. Stuckenberg (NMSA); 1 ♂ Royal Natal National Park, Vemvaan River Valley, 28°43'S 28°56'E, 1.ix.1992, 1800 m, D. Barraclough & A. Whittington (NMSA); 1 ♀ Cathedral Peak, Mike's Pass, 9.viii.1988, 1710 m, I. Pajor (NMSA); 1 ♀ Cathedral Peak, Tarn Hill [28°58'S 29°13'E], 11.ix.1988, I. Pajor (NMSA).

Distribution: Restricted to the Drakensberg Mountains above 1500 m.

Ecological notes: Three specimens have been collected from *Protea roupelliae* Meisn., although a male from the Royal Natal National Park, KwaZulu-Natal, was taken 'from

montane forest'. Specimens have only been collected in August and September, although this is probably a sampling artifact as only five specimens are known.

***Proteaphila stuckenbergorum* Davies & Miller, sp. n.**

Figs 1, 2, 3B, 4A, 5A, 8, 11, 14

Etymology: Named in honour of two of South Africa's foremost dipterists: Brian Roy Stuckenberg and Pamela Stuckenberg (née Usher).

Diagnosis: *Proteaphila stuckenbergorum* is a cream-grey fly with striped head and thorax, elongated frons, smoky fumose wings and having distal tarsomeres on all legs darkened.

Description:

Measurements: head length: ♀ (n=4) = 1.3 (1.2–1.3), ♂ (n=2) = 1.1 (1.0–1.1); thorax length: ♀ = 2.5 (2.4–2.5), ♂ = 2.2 (2.0–2.4); abdomen length: ♀ = 2.1 (1.9–2.5), ♂ = 1.8 (1.7–1.9); wing length: ♀ = 5.3, ♂ = 5.1 (4.6–5.6).

Head (Fig. 1, 4A, 8B): Frons flat, inclined at slight angle relative to plane of mesoscutum, elongated, protruding beyond anterior margin of eye (postfrontal extension *ca* 0.3× length of eye), truncate anteriorly. Frons cream-yellow with 2 brown vittae, first vitta beginning just mesad of inner vertical seta, vitta broadening beyond ocellar triangle. Second brown vitta extending from inner margin of eye to anterior edge of frons. Short, black vitta runs from lower anterior edge of eye to base of antenna. Fronto-orbital bristles reclinate, fairly short, anterior fronto-orbital bristle slightly shorter than posterior fronto-orbital bristle, the latter bristle *ca* 0.5× length of inner vertical seta. Fronto-orbital bristles far from anterior edge of frons, widely spaced, distance between bristles equal to distance between posterior fronto-orbital bristle and inner vertical seta. One minute, disclinate setula half-way between fronto-orbital bristles. Inconspicuous setulae (orientations variable) distad of anterior fronto-orbital bristle. Ocellar triangle dark brown, sides slightly longer than base (1.4:1.1), dark brown coloration extending posteriorly beyond triangle. Ocellar bristle strong, slightly disclinate, and semi-erect, extending through $\frac{3}{4}$ of distance of frons. Several setulae behind ocellar bristles and under postvertical bristles. The latter decussate, intersection high. Outer vertical seta disclinate, strong, *ca* 0.8× length of inner vertical seta. Primary row of postocular setae robust, disclinate,

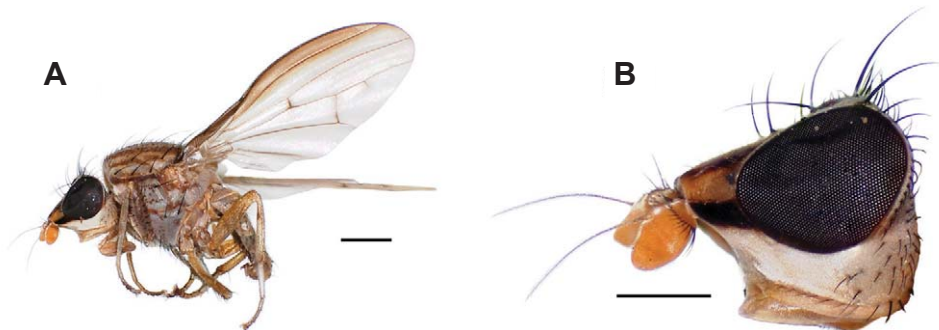


Fig. 8. *Proteaphila stuckenbergorum* sp. n., ♂: (A) habitus image showing fumose wings; (B) head, lateral view. Scale bars = 0.5 mm.

becoming progressively shorter away from outer vertical seta. Secondary row of post-ocular setulae inclinate, weaker and shorter than primary row. Scape not visible in lateral view, recessed underneath facial extension. Pedicel orange; postpedicel orange, simple (only slightly elongated); arista black, micropubescent. Face narrow, covered in silvery pruinescence, pair of blackish dots on lower, lateral parts. In lateral view, face not easily visible (obscured by secondary parafacial ridge) and abruptly receding. Pre- and postfrontal angle acute. Setulae adjacent to frontogenal suture uniform, small and terminate along lower third of face. Eye orange-red (discolored to black), ovoid, longitudinally elongated, longer than high (1.2:1), broader posteriorly than anteriorly. Postcranium blackish, overlaid with silver pruinescence. Gena cream-white, fairly dense cover of setulae in posterior part of gena and lower occiput, including 3 robust setae ventro-posteriorly. Maxillary palpus orange-yellow, no long apical seta.

Thorax (Fig. 2): Scutum moderately arched, colour pattern consisting of alternate grey (pruinescent) and brown (non-pruinescent) vittae. Medial vitta pruinescent, grey-silver (covering central pair of acrostichal setal rows). Submedial vitta brown. Dorsocentral vitta broad, pruinescent, grey-silver (covering dorsocentral bristle rows). Presutural vitta brown, bisected by thin, diffuse grey vitta. Lateral vitta pruinescent, grey. Notopleural vitta brown. Postpronotal lobe black-grey, covered in silver pruinescence. Scutellum grey with 2 dark brown vittae. All pleura overlaid by grey-silver pruinosity. Anepisternum with brown spots encircling setal alveoli. Subscutellum black-grey. Chaetotaxy: Acrostichal setae quadriseriate, inner row of acrostichals aligned in longitudinal axis but each pair of alveolar bases jagged (not aligned), prescutellar pair of acrostichals strong, $ca\ 0.6\times$ length of posterior dorsocentral bristle, penultimate pair of acrostichals fairly robust; 1+3 dc ; 1 postpronotal bristle, 2 notopleural bristles, 1 presutural and 1 postsutural supra-alar bristle (+1 setula, $<0.2\times$ length of bristle), 2 postalar bristles (ventral bristle is longer; 2 setulae in-between bristles). Posterior marginal scutellar bristles not decussate. 1 strong anepisternal bristle, surrounded by patch of $ca\ 5$ setulae. Two katepisternal bristles, anterior bristle strong, $ca\ 0.8\times$ length of posterior bristle; 1 or 2 fine, longish setulae between bristles; line of setulae running down to ventral katepisternal setal patch. Other thoracic pleura devoid of setation (aside from fine silvery pruinescence).

Wings (Fig. 5A): Anterior half of wing strongly infuscated: basal costal cell, pterostigma, cell R_1 and anterior half of cell R_{2+3} fumose. Crossveins $r-m$ and $dm-cu$, M_{1+2} , its stump vein and M_3 also infuscated. Crossvein $dm-cu$ slightly sinuate towards M_{1+2} . Axillary vein longer than $CuA + 1A$, approaching wing margin.

Legs: Procoxa cream-orange. Profemur dark brown, covered with abundant silvery pruinosity. Protibia orange-yellow, dark brown apically. Protarsomeres 1–2 yellow, protarsomeres 3–5 black. Midleg mostly yellow-orange (including mesofemur), last 2 tarsomeres black. Metacoxa orange with silver pruinescence. Metafemur orange-yellow with 2 faint, greyish stripes (sometimes indistinct) anteriorly. Metatibia yellow, with subproximal brown patch ventrally and darkened apically. Metatarsomeres yellow, last 2 tarsomeres black.

Abdomen: T1–T4 yellow-brown, laterally covered with grey pruinosity. Alveoli on lateral sides encircled by brown dots. T1–T4 with medial, black, truncated vittae. T5 onwards dark grey.

Male terminalia (Figs 3B, 11): Protandrium saddle-shaped (broad dorsally in longitudinal plane, narrowing abruptly laterally), with complete ventral segment. Epandrium

elongated laterally in longitudinal plane, narrower dorsally. Surstylus large, prominent and almost as broad (in vertical plane) as lateral sides of epandrium. Surstylus with tiny digitated process on inner edge. Aedeagus large, apically bifurcate, subapically flanged.

Female terminalia (Fig. 14): Abdominal segments from segment 5 onwards abruptly narrowed, T5 only approximately half the width of T4 (in transverse plane). T5–T8 narrow, segments tubular and elongated. Segment 7 is a syntergosternite. S8 with recurved, setulose apex.

Holotype: ♂ SOUTH AFRICA: *KwaZulu-Natal*: Cathedral Peak [28°57'S 29°12'E], 14–18.ix.1982, D. & C. Barraclough (NMSA, Type no. 2284).

Paratypes: SOUTH AFRICA: *KwaZulu-Natal*: 1♀ Giant's Castle Game Reserve [29°15'S 29°30'E], 18–23.ix.1961, B. & P. Stuckenberg (NMSA); 1♂ Giant's Castle Game Reserve, Bannerman's Hut [29°15'S 29°25'E], 2300 m, 24.x.1981, R.M. Miller (NMSA); 2♀ Royal Natal National Park [28°41'38"S 28°55'40"E], 12–13.ix.1963, 1500 m, B. & P. Stuckenberg (NMSA); 1♂ Cathedral Peak [28°57'S 29°12'E], 26–27.xii.1977, R.M. Miller (NMSA); 1♂ 1♀ same locality, 14–18.ix.1982, D. & C. Barraclough (NMSA); 1♂ Cathedral Peak, Tarn Hill [28°58'S 29°13'E], 26.ix.1987, 1550 m, I. Pajor (NMSA); 1♂ same locality, 1.ix.1988, 1800 m, I. Pajor (NMSA); 2♀ same locality, 8.x.1988, 1810 m, I. Pajor (NMSA); 2♀ same locality, 24.ix.1989, 1735 m, I. Pajor (NMSA); 1♂ same locality, 26.ix.1989, 1550 m, I. Pajor (NMSA); 1♂ Cathedral Peak, Mike's Pass [28°58'S 29°14'E], 19.viii.1988, I. Pajor (NMSA); 1♀ same locality, 30.viii.1988, I. Pajor (NMSA); 1♂ 1♀ same locality, 10.ix.1988, 1710 m, I. Pajor (NMSA); 1♀ same locality, 9.x.1988, 1640 m, I. Pajor (NMSA).

Ecological notes: *Proteaphila stuckenbergerorum* has been captured on *Protea roupelliae* Meisn. and *Protea caffra* Meisn. Specimens were collected in the austral Spring and Summer from August to December, with a peak in September (Table 1).

Distribution: Restricted to the Drakensberg Mountains above 1500 m in montane grassland dotted with *Protea* trees.

DISCUSSION

The first matter to be dealt with is whether the flies do represent a new genus or are ascribable to another, described genus hitherto unrecorded from the Afrotropics, e.g. one of the many Indo-Malayan genera. The starting point for all modern investigations into Afrotropical (and Old World) lauxaniid genera is Brian Stuckenberg's generic key (Stuckenberg 1971) – 'a watershed study for lauxaniid specialists and other dipterists' (Barraclough & Whittington 1994: 452).

In Stuckenberg's (1971) key, the new genus runs eventually and with some difficulty to *Protrigonometopus* Hendel, 1938, at couplet 66. *Protrigonometopus* is an East and Southeast Asian genus found in China, Japan, Korea and Vietnam (Papp 2007: 146–149). However, *Protrigonometopus* differs from the new genus in being smaller (<4 mm long), having the scape exposed, a densely pubescent arista, 0+3 dorsocentral bristles, and lacking surstyli. Papp (2007: 146, figs 21, 27) also described and illustrated a spatulate 'supragenital (subepandrium) sclerite' in *Protrigonometopus*; we have not seen a similar sclerite in *Proteaphila*. *Protrigonometopus* also lacks the intricate wing-patterning and stump vein on M_{1+2} , as seen in *Proteaphila* and *Dyticomyia*.

In a recent, important paper, Papp (2007) reviewed the Old World trigonometopine genera, which he arranged in the tribe Trigonometopini. Papp believed this tribe to be a monophylum and gave a tribal 'characterisation' (Papp 2007: 130–131). Some of the characteristics that Papp (2007: 130–131) listed for Trigonometopini are not exhibited by *Proteaphila*. For example, the thorax in *Proteaphila* is not 'more or less elongated',

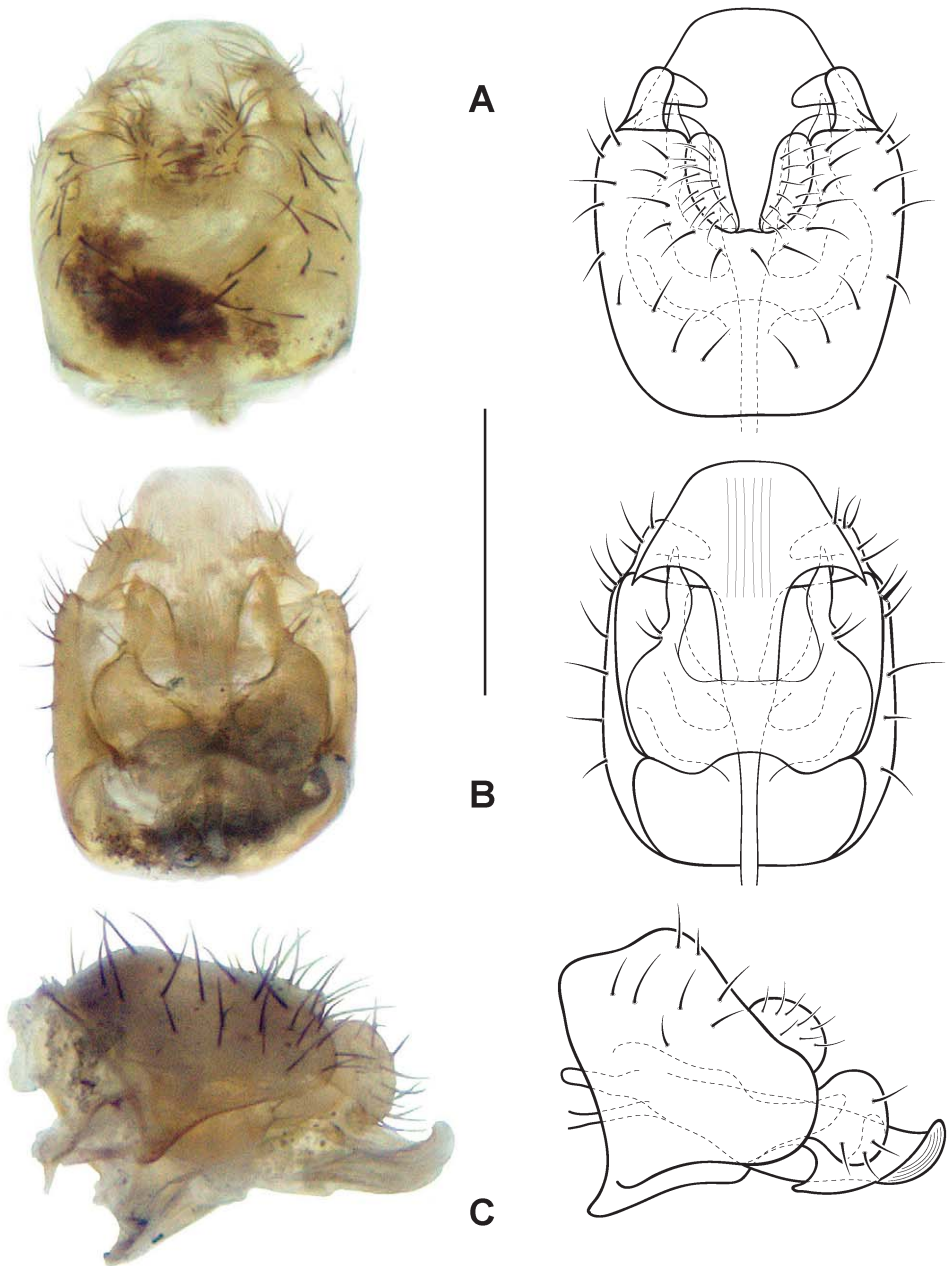


Fig. 9. *Proteaphila maculosa* sp. n., ♂ terminalia: (A) dorsal view; (B) ventral view; (C) lateral view. Scale bar = 0.5 mm.

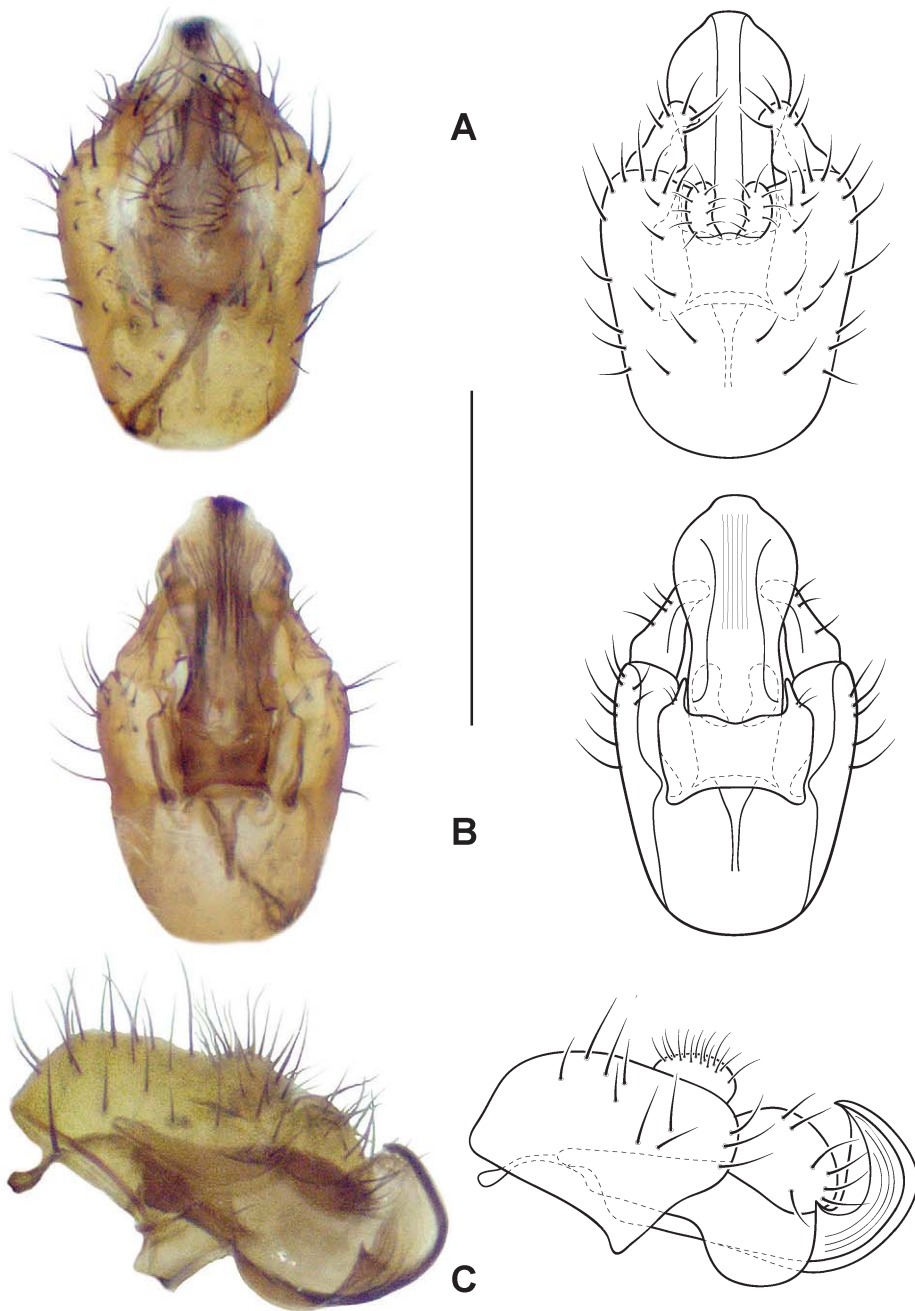


Fig. 10. *Proteaphila pajori* sp. n., ♂ terminalia: (A) dorsal view; (B) ventral view; (C) lateral view (note the extremely large, apically recurved aedeagus and bulbous surstyli). Scale bar = 0.5 mm.

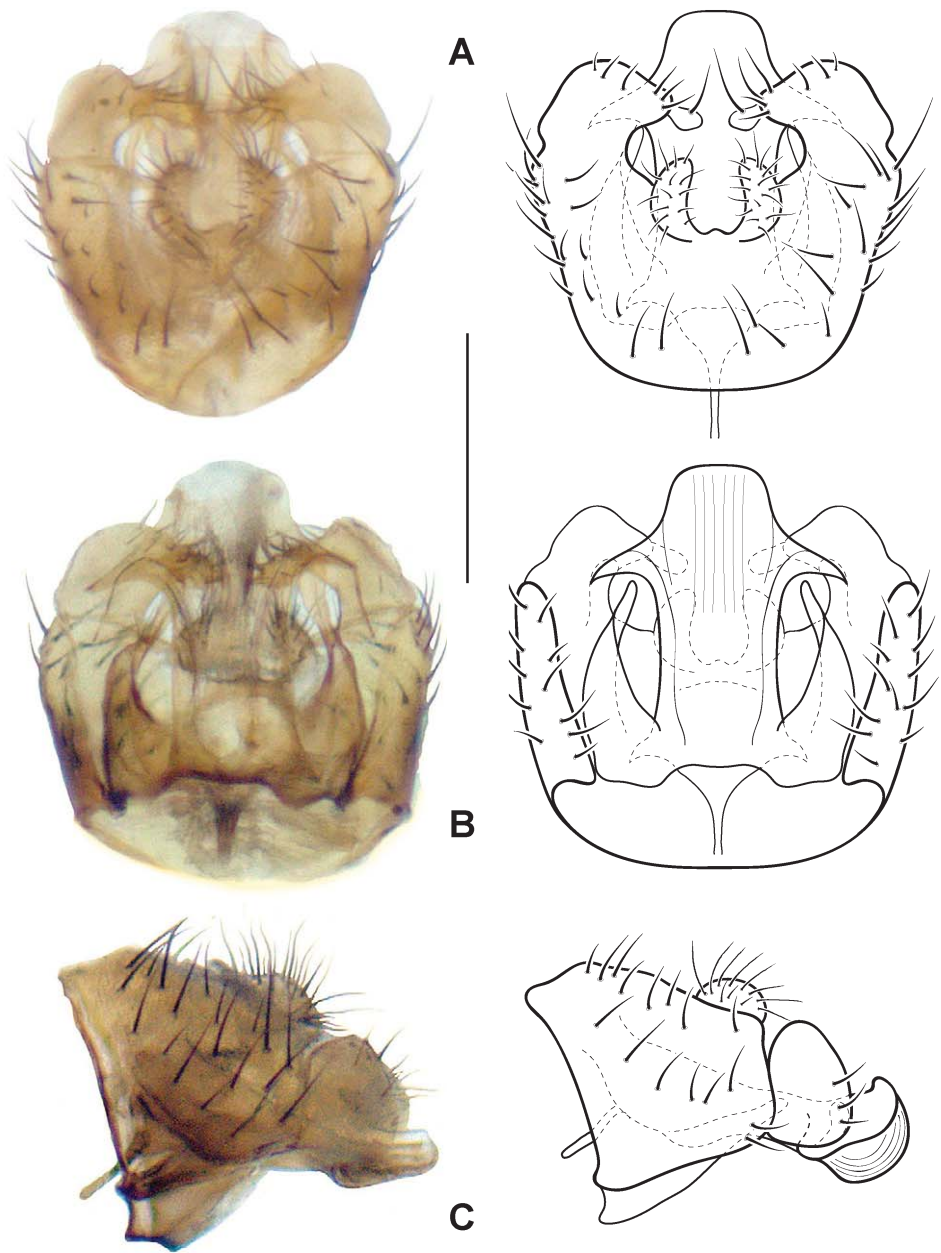


Fig. 11. *Proteaphila stuckenbergorum* sp. n., ♂ terminalia: (A) dorsal view; (B) ventral view; (C) lateral view. Scale bar = 0.5 mm.

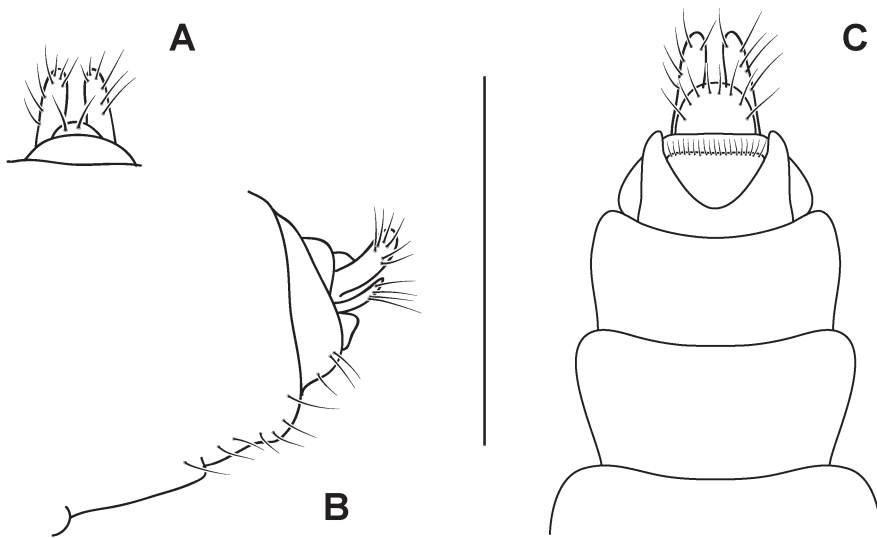


Fig. 12. *Proteaphila maculosa* sp. n., ♀ terminalia: (A) dorsal view; (B) lateral view. Scale bar = 1 mm.

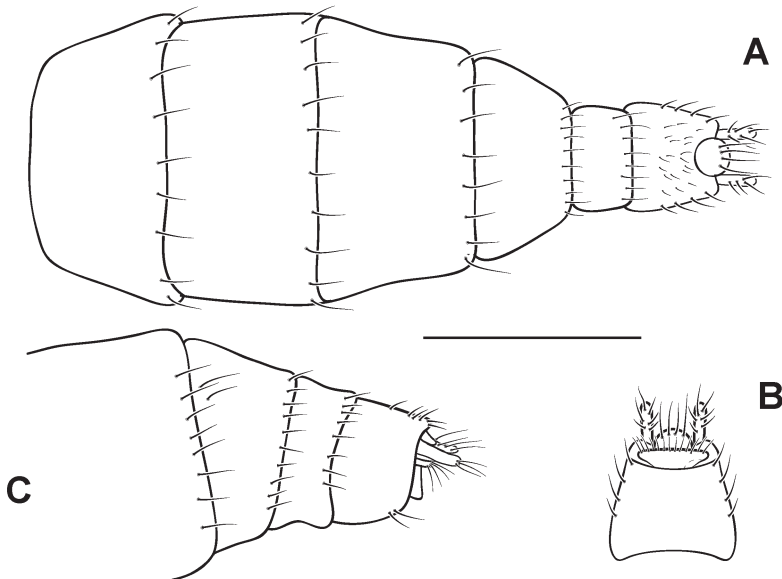


Fig. 13. *Proteaphila pajori* sp. n., ♀ terminalia: (A) dorsal view; (B) ventral view; (C) lateral view. Scale bar = 1 mm.

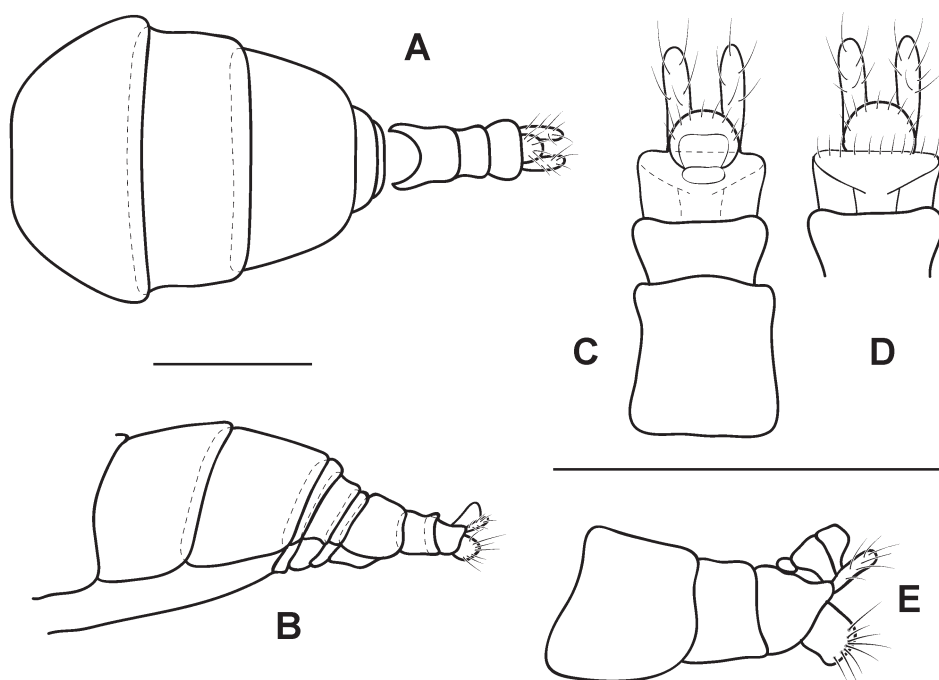


Fig. 14. *Proteaphila stuckenbergorum* sp. n., ♀ terminalia: (A) dorsal view; (B) lateral view; (C–E) abdominal tip, dorsal (C), ventral (D), and lateral (E) views. Scale bars = 1 mm.

the ocellar bristles are not ‘absent or minute’ (although Papp indicated that some of his included genera have strong ocellar bristles, e.g. *Neotrigonometopus* Malloch, 1928), and there is a distinct surstylus in *Proteaphila* (‘no surstylus or distinct surstylar lobe on epandrium’ in Trigonometopini). Papp stated that ‘broad, setose fronto-orbital plates’ were ‘a strong synapomorphy of the tribe’; we are not entirely sure of his meaning here, but *Proteaphila* does not have conspicuously broad or setulose fronto-orbital plates. Papp also indicated that ‘tergite 7 (“protandrium”) fused to epandrium, at least centrally, is one of the most important synapomorphies of the tribe’; T7 is not fused to the epandrium in *Proteaphila*. Consequently, if we accept Trigonometopini as a monophylum, *Proteaphila* does not appear to be phylogenetically close to the included genera, and the evolution of a pointed, sub-triangular head with elongated frons is a convergence.

Using Papp’s (2007: 131–132) generic key, *Proteaphila* moves with extreme difficulty through the couplets, for example stalling at the first couplet where the genus displays one half of the characters listed for each option: posthumeral (= presutural) bristle present and male epandrium with caudal appendages. Following either route from couplet 1 results in further problems at both options, i.e. couplets 2 and 7, where the presence of 1+3 *dc* in *Proteaphila* contravenes both couplets. The trouble experienced in keying *Proteaphila* through these couplets corroborates the view that (1) *Proteaphila* is a new genus, and (2) it is not attributable to Trigonometopini.

It is also important that the existence of two undescribed genera in Australia be mentioned. R.M.M. became aware of them via an unpublished key prepared by D.K.

TABLE 1
Phenology of *Proteaphila* species.

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
<i>P. stuckenbergorum</i>	-	-	•	•	•	•	•	-	-	-	-	-
<i>P. pajori</i>	-	-	•	•	-	-	-	-	-	-	-	-
<i>P. maculosa</i>	-	-	-	-	•	•	•	•	•	•	-	-

McAlpine in the mid-1960s, which has been subsequently updated (McAlpine pers. comm. 2011). Of similar importance is another undescribed southern African group (ca 5 species), possibly related to *Proteaphila*, but differing in having clear wings, no stump vein and a slightly elongated frons, but with the same general head and body patterning. Only one of these species has been collected from the proteas in the Drakensberg Mountains, whereas none of the other species has any recorded biological association.

Zoogeographical and biological notes

Proteaphila is endemic to South Africa, the northernmost records being from the KwaZulu-Natal Drakensberg. The genus displays a well-known distributional pattern exhibited by Afrotropical taxa (both invertebrates and vertebrates), whereby the taxon is restricted to high altitude (>1000 m) temperate grasslands and forests along the Great Escarpment in eastern South Africa but occurs at lower altitudes (<1000 m) in the Cape Floristic Region (Fynbos Biome) of the Western Cape. Bearing these familiar distributional ranges in mind, and that of the *Protea* genus, it is a reasonable inductive inference that *Proteaphila* will be found in the Drakensberg Mountains of Mpumalanga Province, South Africa, and possibly also in the montane grasslands of the eastern highlands of Zimbabwe and beyond; *Protea* trees are also found in these regions.

The insects that visit *Protea* inflorescences have been fairly well studied over the years (e.g. Coetzee & Giliomee 1985; Roets *et al.* 2006). To date, few Diptera have been reported from proteas. *Proteaphila maculosa*, *P. pajori*, and *P. stuckenbergorum* have all been collected on *Protea* trees and appear to have some biological association with proteas. Speculatively, *Proteaphila* may be visiting *Protea* inflorescences to feed on fungi (cf. Broadhead 1984), although we did not have a chance to examine the mouthparts of *Proteaphila* to check for the characteristic fungivorous modifications of the labellum described by Broadhead. *Protea* flowers appear to be host to a variety of fungi (e.g. Lee *et al.* 2005) and, aside from merely feeding on fungi, lauxaniids have also been implicated in dispersing pathogenic fungal spores (e.g. Lemon 1992). The ecological relationship between lauxaniids and fungi is a vast, unexplored area awaiting attention.

Phenology of *Proteaphila* species is shown in Table 1. It is notable that the Western Cape species (*P. maculosa*) is active much later in the summer months than the KwaZulu-Natal species (*Proteaphila pajori* and *P. stuckenbergorum*).

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