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A new Australian genus and five new species of Rogadinae (Hymenoptera: Braconidae), one reared as a gregarious endoparasitoid of an unidentified limacodid (Lepidoptera)

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Abstract

Teresirogas Quicke & Shaw gen. nov. (type species *T. australicolorus* Quicke & Shaw sp. nov.) is described and illustrated, based on a series recently reared gregariously from a cocooned mummy of an unidentified species of Limacodidae collected under loose *Eucalyptus* bark in New South Wales, Australia. Older reared and unreared congeneric specimens represent four additional species, *T. billbrysoni* Quicke & van Achterberg sp. nov., *T. nolandii* Quicke & Butcher sp. nov., *T. prestonae* Quicke & van Achterberg sp. nov., and *T. williamsi* Quicke & van Achterberg sp. nov., which are also described and illustrated. Three of these additional species have also been reared from Limacodidae cocoons on *Eucalyptus*, with one, perhaps erroneous, record suggesting a saturniid host. Molecular analysis confirms the placement of the new type species of *Teresirogas* in the tribe Rogadini, as inferred initially from the claws with pointed basal lobe and host relationships of some of the species, but one species has the claw character poorly developed which had made its affinities uncertain before the more recently reared and sequenceable material became available.

Key words: Hymenoptera, Braconidae, new genus, new species

Introduction

The first and third authors (DQ & CvA) have been aware for some time of an undescribed Australian genus probably belonging to the Rogadinae mostly from old specimens in the Natural History Museum, London, the Australian Museum, Sydney and the Australian National Insect Collection, Canberra. However, its relationships were not easily discerned. Its lack of a prepectal carina, the entirely smooth and undifferentiated mid-basal area on the 2nd metasomal tergite, and the greatly reduced occipital carina (broadly absent dorsally and ventrally) would allow it to key to the Opiinae in several identification works (e.g. van Achterberg 1993, Wharton *et al.* 1997). If it was a member of the Rogadinae, as its general Gestalt suggested, variation in an important morphological character, the presence/absence of a pointed basal lobe on the claws, and also of the sometimes greatly swollen male maxillary palp segments, again made assessment of its affinities difficult. Fortunately, the fourth author (KPB) recently collected a mummified limacodid prepupa in its cocoon under loose *Eucalyptus* bark which, in addition to revealing the host group, both unequivocally showed that the new genus (or at least its type species) was gregarious and provided fresh material for molecular analysis. Mummification of lepidopteran host caterpillars or prepupae is a characteristic of the Rogadinae, some of which are known to be gregarious, whereas opiines are exclusively parasitoids of Diptera and—as far as is known—inevitably solitary. Preliminary BLAST searches with the DNA sequence data (28S rDNA and the barcoding region of cytochrome oxidase 1) obtained from *T. australicolorus* sp. nov., confirm that it is indeed a member of the Rogadinae, and molecular analyses presented here show that it belongs to the tribe Rogadini with 100% Bayesian support.

The recognition here of a new and quite widespread Australian genus of rogadine wasp with several brightly coloured species, all undescribed, and recently another new genus from Papua New Guinea (Quicke et al. 2012), serves to highlight the need for more work on the Australian, and more broadly the Australasian braconid wasp fauna. To date members of only six genera of Rogadinae are definitely confirmed from Australia, viz. *Aleiodes*, *Anachyra*, *Batotheca*, *Heterogamus*, *Spinaria*, and *Yelicones* (Quicke 1995, Quicke et al. 1998, van Achterberg 2007, Yu et al. 2014). Of these, the only one for which the Australian fauna has been revised is *Yelicones* (Quicke et al. 1998). Species placed under the name *Rogas* from older literature most probably belong either to *Aleiodes*, or possibly to *Triraphis*. DQ has seen one additional undescribed new genus from Australia based on a specimen in the NHM, but its condition is very poor indeed and description of this genus will need to await the discovery of fresh specimens.

Institutions housing type material are abbreviated as follows: AMS (Australian Museum, Sydney; Australian National Insect Collection, Canberra (ANIC); National Museums of Scotland, Edinburgh (NMS); Natural History Museum, London (BMNH); Naturalis Biodiversity Center, Leiden (RMNH).

Material and methods

Descriptive taxonomy. Wing vein terminology follows Sharkey & Wharton (1997); other terminology follows van Achterberg (1988). Images of *T. australicolorus* sp. nov. were made using a Leica MZ16 microscope and phototube with an Olympus C-5060 camera, with multiple images stacked using ZereneStacker. Illustrations of *T. nolani* sp. nov. were made using an Olympus SXZ16 microscope with automated multiple image capture at preset focal levels using an Olympus DP72 camera, and image combination using the Cell^{^A}D image processing system.

Since the species recognised here differ very little in characters other than those mentioned in the identification key, and since each is illustrated with a more or less comparable portfolio of photographs, we have adopted a minimalist verbal description style for each.

Molecular methods. Phylogenetic analyses to assess the relationships of the new genus were carried out on cytochrome oxidase 1 and 28S rDNA sequence data for representative cyclostome braconids, and in particular, members of the Rogadinae. Details of taxa included are given in Appendix 1. Taxon selection was based on representing a taxonomically broad set of Rogadinae genera and putatively closely related subfamilies, with individual species selection governed largely by those species for which sequence data were available for both gene fragments. Trees were rooted with *Rhyssalus clavator* Haliday (Rhyssalinae) since this subfamily has emerged from numerous studies as the most basal of the true cyclostome braconids (Quicke 2014).

DNA protocols. Genomic DNA was extracted from legs of mounted specimens using the DNeasyTM Tissue Kit (Qiagen, Valencia, CA, U.S.A.) following the manufacturer's instructions. Two genes were targeted: 28S rDNA using 28SD1shortF (5'-GUG GUA AAC UCC AUC UAA G-3') and 28SD2shortR (5'-ACA TGT TAG ACT CCT TGG TC-3') (Sharanowski et al. 2011); and Cytochrome Oxidase I (COI) using universal primers LCO1490 (5'-GGT CAA CAA ATC ATA AAG ATA TTG G-3') and HCO2198 (5'-TAA ACT TCA GGG TGA CCA AAA AAT CA-3') (Folmer et al. 1994). All polymerase chain reactions (PCRs) were performed on a Bio-Rad MyCyclerTM thermal cycler, using approximately 1 µg DNA extract, 1X Standard *Taq* Buffer (10 mM Tris-HCl, 50 mM KCl, 1.5 mM MgCl₂, pH 8.3, New England Biolabs, Ipswich, Massachusetts, U.S.A.), 200 µM dNTP (Invitrogen, Carlsbad, California, U.S.A.), 4 mM MgSO₄, 400 nM of each primer, 1 unit of *Taq* DNA polymerase (New England Biolabs) and purified water to a final volume of 25 µl. Amplicons of 28S rDNA were generated using an initial denaturation of 4 min at 95°C, followed by 35 cycles of 95°C for 30 s, 55°C for 30 s and 72°C for 30 s, and a final elongation for 7 min at 72°C. Amplicons of COI were generated with an initial denaturation of 1 min at 95°C, followed by 35 cycles of 95°C for 15 s, 49°C for 15 s and 72°C for 45 s, and a final elongation period of 4 min at 72°C. Sequencing and product purification was carried out at the University of Kentucky Advanced Genetic Technologies Center (Lexington, Kentucky, USA). Product purification was performed using ExoSAP-IT (Affymetrix, Santa Clara, California, U.S.A.) and sequencing was done on an Applied Biosystems 3730xl DNA Analyzer. Contigs were assembled and edited using Geneious version 5.4.6. (Biomatters, 2011). Sequences were deposited in GenBank and their accession numbers are given in Table 1, and additionally includes 44 newly released sequences.

Alignment. Bases in the length variable 28S rDNA gene fragment were partitioned for analysis as pairing or non-pairing, and regions of ambiguous alignment excluded. Secondary structure interpretation followed the model

of Gillespie *et al.* (2005), though with this more taxonomically restricted subset of taxa it was possible to identify a few additional pairing bases than in other recent studies on larger groupings (e.g. Zaldivar-Riverón *et al.* 2008, 2009, 2013).

Cytochrome oxidase 1 sequences were manually aligned as they were not length variable, with the exception of a three base pair deletion present in all three of the included *Yelicones* species, and its location was ascertained by reference to the amino acid sequence.

Molecular data analyses. Bayesian MCMC analyses of a concatenated dataset of 28S and COI of 101 taxa were performed using Mr.Bayes version 3.2 (Ronquist *et al.* 2012) with two independent searches and four chains. All three datasets were run with and without partitions, with the COI data treated as three separate partitions based on codon positions, while the 28S were divided into two partitions based on secondary structures.

The final concatenated dataset with partitions was run for 30,000,000 generations, using the general time-reversible model, with a parameter for invariant sites and rate heterogeneity modelled under a gamma distribution (GTR+I+G) with a 10% burn-in value (i.e. 3,000,000 generations) discarded.

Results

Bayesian analyses

The Bayesian tree obtained from analysis of the partitioned data set is shown in Figure 1. While most tribes within the subfamily Rogadinae were recovered as monophyletic in the concatenated dataset with 5 partitions, the subfamily itself was not, *Tetratermus* sp. 2 and *Mesocentrus* sp., belonging to subfamilies Lysiterminae and Betylobraconinae respectively, rendering it apparently polyphyletic with this limited taxon sampling. The non-partitioned dataset did not differ greatly either in clade support or topology. A notable difference in the non-partitioned dataset is the monophyly of Yeliconini as the sister group to Aleiodini, while Aleiodini was recovered within Yeliconini in the partitioned dataset.

Despite the subfamily anomaly mentioned above, *Teresirogas* gen. nov. is recovered within the tribe Rogadini in all analyses, although the lack of resolution within this clade prevents further insights into the phylogenetic relationships of *Teresirogas* with other members of the tribe.

Systematic treatment

Teresirogas Quicke and Shaw gen. nov.

Antenna quite long, approximately 1.3 times fore wing length, with 46–60 flagellomeres. Terminal fagellomere strongly acuminate apically. Clypeus rectangularly protruding in lateral view and sculptured. Malar suture present. Eyes glabrous, weakly emarginated opposite antennal sockets. Maxillary palp with 6 segments, that of female with segments 3 and 4 flattened and weakly expanded, that of male with segments 3, 4 and 5 strongly expanded and rather globular. Occipital carina very weak and extending only from approximately the mid-height of the eye and not connecting to hypostomal carina ventrally. Propleuron with postero-dorsal flange. Mesosoma virtually entirely smooth, unsculptured but with widely spaced minute setiferous punctures with long setae. Notauli short and deep, smooth or finely crenulate posteriorly; mesonotum otherwise completely smooth and shining but the somewhat raised scutellum superficially granulate or coriaceous. Middle lobe of mesoscutum more or less protruding anteriorly over pronotum. Scutellar sulcus wide with single strong midlongitudinal carina. Prepectal carina absent. Mesopleuron smooth with mostly widely spaced minute setiferous punctures; precoxal sulcus absent or at most represented by slight dent. Median area of metanotum without midlongitudinal carina. Propodeum largely smooth but with narrow medial longitudinal carina on anterior 0.5 to 0.6; with strong, complete lateral carina. Fore wing second submarginal cell not especially elongate; vein 1-CU1a slightly postfurcal, interstitial or slightly antefurcal (in which case it should be referred to as M+Cub); 1st subdiscal cell distinctly (Figs 4B, 6A) to strongly (Figs 8D, 10A) expanded distally. Hind wing veins M+CU and 1-M approximately equal length; vein m-cu absent. Legs shining, with sparse long setae. Hind tibial comb present. Hind spurs distinctly though weakly curved but not especially long, and largely setose. Claws with or without pointed basal lobe (in the type species this character is present). Metasoma strongly shining without any trace of carinae or rugosity, just the minute, rather evenly and

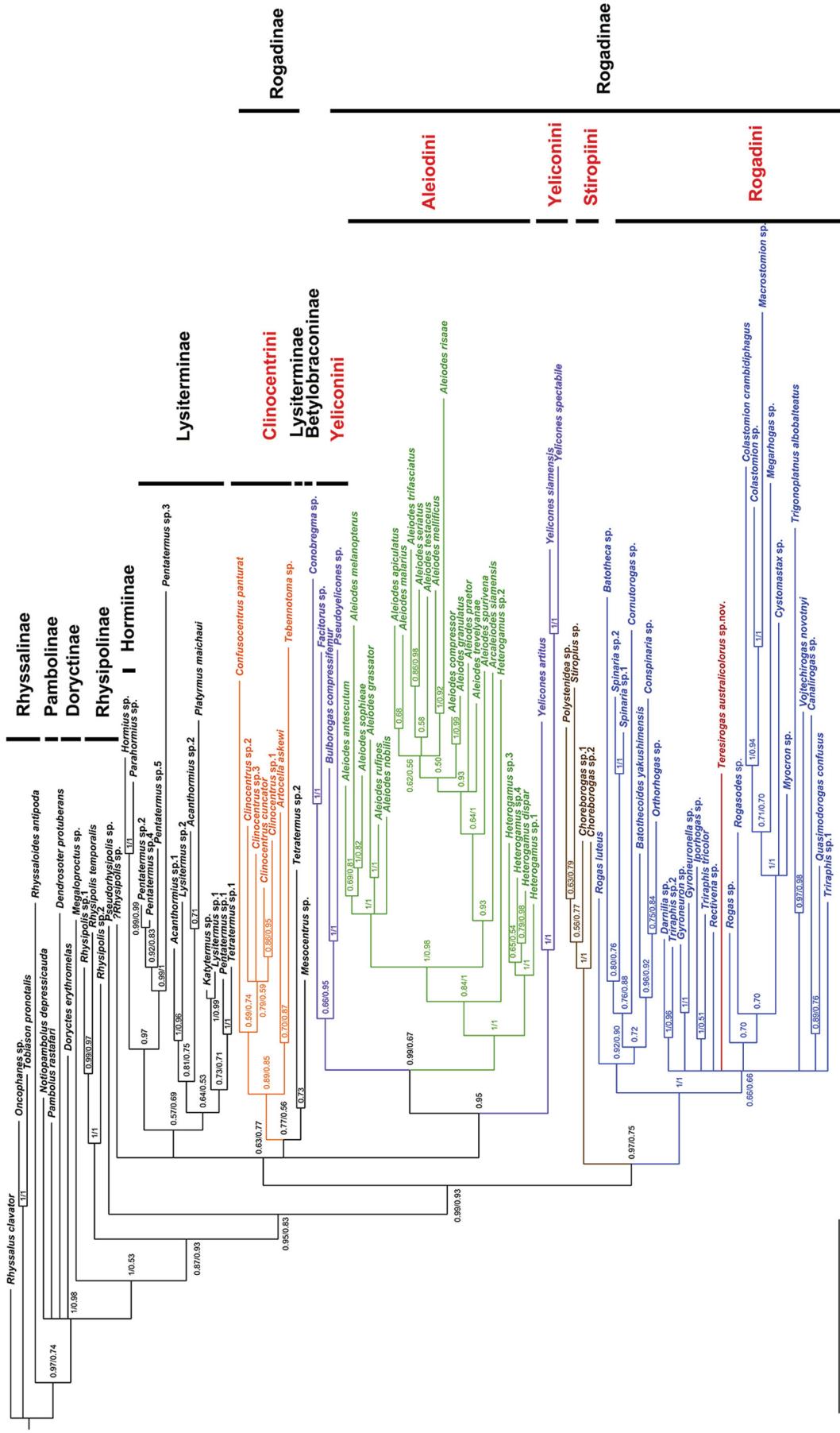


FIGURE 1. Bayesian phylogenetic tree for two genes combined (28S + COI) based on a combined 30 million postburn-in generation using the GTR+I+G model of evolution. The Bayesian posterior probability of clade support is shown as non-partitioned/partitioned. In the cases of discrepancy, only the partitioned probability is shown.

quite widely spaced punctures at bases of setae. All tergites entirely smooth and shining except for rather sparse setiferous puncturation. 1st metasomal tergite not significantly widened in front of sub-basal constriction; with dorsal carinae uniting to form weak midlongitudinal ridge but this not extending the full length of the tergum; with dorsolateral and lateral carinae well-developed and posteriorly running more or less parallel the whole length of segment. 2nd metasomal tergite without midlongitudinal carina, and without basal triangular area; the only sculpture separating it from the first tergite being the carinate posterior margin of the latter. Hypopygium short, apically transverse. Ovipositor normal, hardly to weakly exserted, straight.

Diagnosis. On a global basis the new genus is somewhat difficult to diagnose simply, since some Afrotropical and Neotropical members of *Aleiodes* have completely smooth and shiny metasomas, though they all have a well developed median carina and basal triangular area on the second tergite. However, all specimens of the new genus have the upper part of the clypeus strongly and squarely protruding in profile, and the middle lobe of the mesoscutum more or less protruding over the pronotum. We place it in the Rogadini on the basis at least some members having claws with a pointed basal lobe and interpret the variation as being due to reductions. No members of the Aleiodini have pointed basal lobes though many members of the Rogadini do.

Notes. The new genus will falter at couplet 13 the key to genera of Rogadinae from China by Chen & He (1997) since it has curved hind tibial spurs but these are completely setose. If this curvature is ignored it will founder at couplet 15 because of its lobed claws and smooth rather than longitudinally striate tergites.

Etymology. From Latin ‘*teres*’ meaning smooth, shiny or polished, and the generic name *Rogas*.

Type species. *Teresirogas australicolorus* Quicke & Shaw sp. nov.

Additional species. *T. billbrysoni* Quicke & van Achterberg sp. nov., *T. nolani* Quicke & Butcher sp. nov., *T. prestonae* Quicke & van Achterberg sp. nov. and *T. williamsi* Quicke & van Achterberg sp. nov.

Key to the species of *Teresirogas* gen. nov.

1. Tarsal claws with large pointed and black basal lobe (Figs 4A, 6C, 11B); head usually darker or paler than mesoscutum (Figs 3B, 5A, 6B, 11A) 2
- Tarsal claws with rounded or only weakly angular basal lobes (Figs 7E,F); head and mesoscutum similarly brownish yellow (Figs 7A, 9A) 4
2. Pterostigma largely yellow and contrasting with dark brown basal fifth (Fig. 12A); hind tarsus brownish yellow (Fig. 11B); ocelli (females) larger, shortest distance between posterior ocellus and eye 0.6–0.7 times transverse diameter of posterior ocellus (Fig. 11E); [head brown or brownish yellow; mesoscutum brownish yellow] *Teresirogas williamsi* sp. nov.
- Pterostigma evenly infuscate or dark brown (Figs 4B, 6A); hind tarsus dark brown or blackish (Figs 4A, 6C); ocelli (females) smaller, shortest distance between posterior ocellus and eye about equal to transverse diameter of posterior ocellus (Figs 3A, 5D); [head usually paler than black mesoscutum (Figs 3B, 5A), but sometimes similarly coloured because of brownish yellow mesoscutum] 3
3. Face generally more extensively finely rugose (Fig. 2C) *Teresirogas australicolorus* sp. nov.
Face shiny, generally with distinct setiferous punctures (Fig. 5B,C), those near the slightly raised middle part becoming more confluent along a vertical axis *Teresirogas billbrysoni* sp. nov.
4. Ocelli (females) very large, shortest distance between posterior ocellus and eye 0.3–0.5 times transverse diameter of posterior ocellus (Fig. 9B); hind tarsus brownish yellow (Fig. 12B); scapus largely dark brown or brown (Fig. 9B) *Teresirogas prestonae* sp. nov.
- Ocelli (females) smaller, shortest distance between posterior ocellus and eye about equal to transverse diameter of posterior ocellus (Figs 7D); hind tarsus dark brown or blackish (Figs 7A); scapus brownish yellow (Figs 7B); [mesoscutum variably produced over pronotum (Figs 7C)] *Teresirogas nolani* sp. nov.

Teresirogas australicolorus Quicke & Shaw sp. nov.

(Figs 2–4)

Holotype ♀, “AUSTRALIA, N[ew] S[outh] W[ales] Murrumbateman 35°08’S 149°02’E 22.ix.2013 K.P. Bland.”; “Brood of 9 (6 ♀, 2 ♂ sexable) ex indet. limacodid mummy in cocoon coll. under loose Eucalyptus bark, em. end xii.2013” (ANIC).

Paratypes: AUSTRALIA: 4 ♀, 2 ♂, same data as holotype (NMS); 1 ♀, Australia, New South Wales, Tahmoor, nr. Picton, 22.i.1966, M. I. Nikitin (BMNH).

Female. Body length 7.2 mm, fore wing length 6.7 mm.

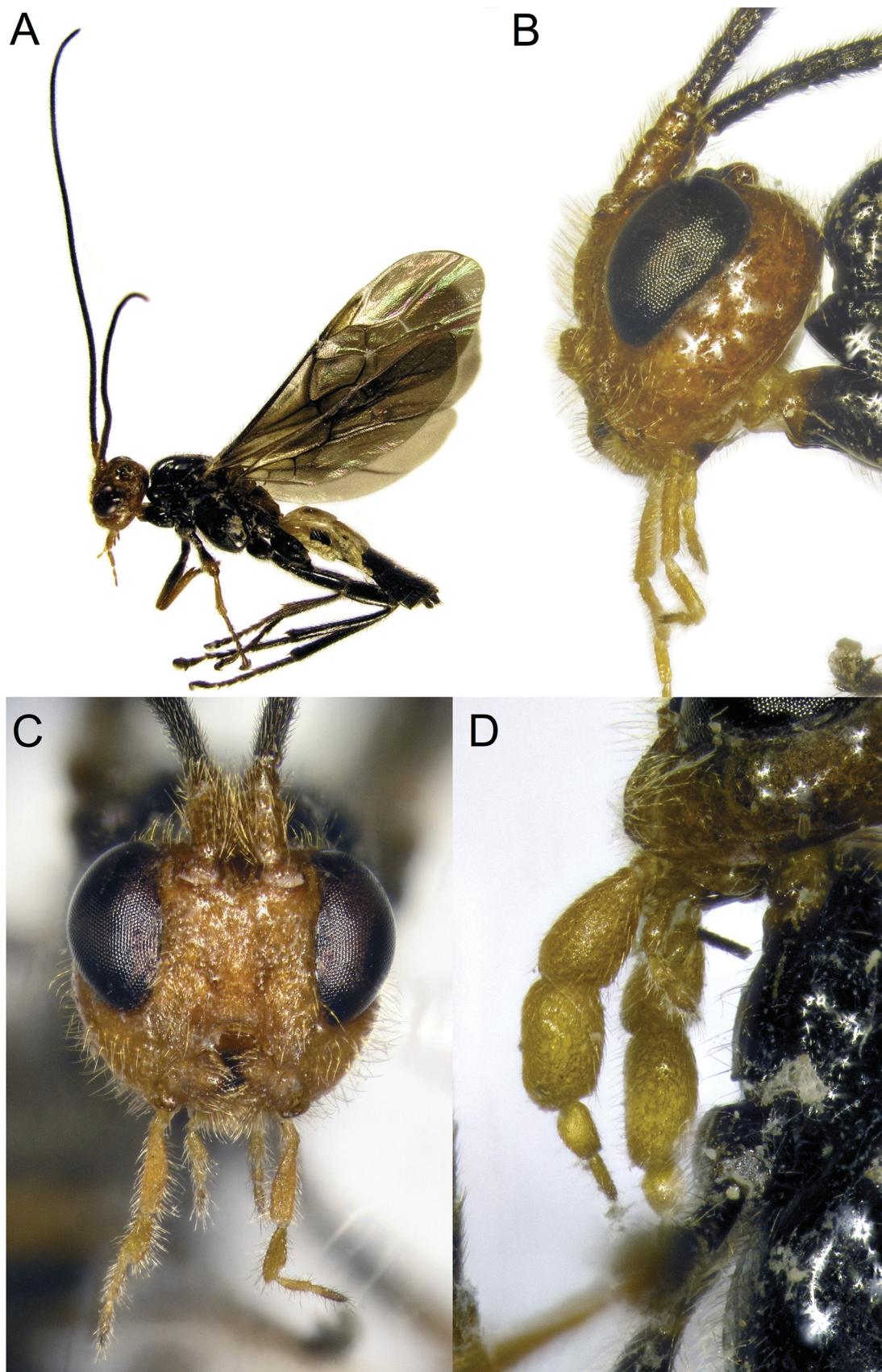


FIGURE 2. *Teresiogas australicolorus* gen. et sp. nov. A, habitus, lateral view; B, head (female), lateral view showing protruding clypeus and normal palps; C, head, front view; D, head (male), lateral view showing greatly expanded maxillary palp segments.

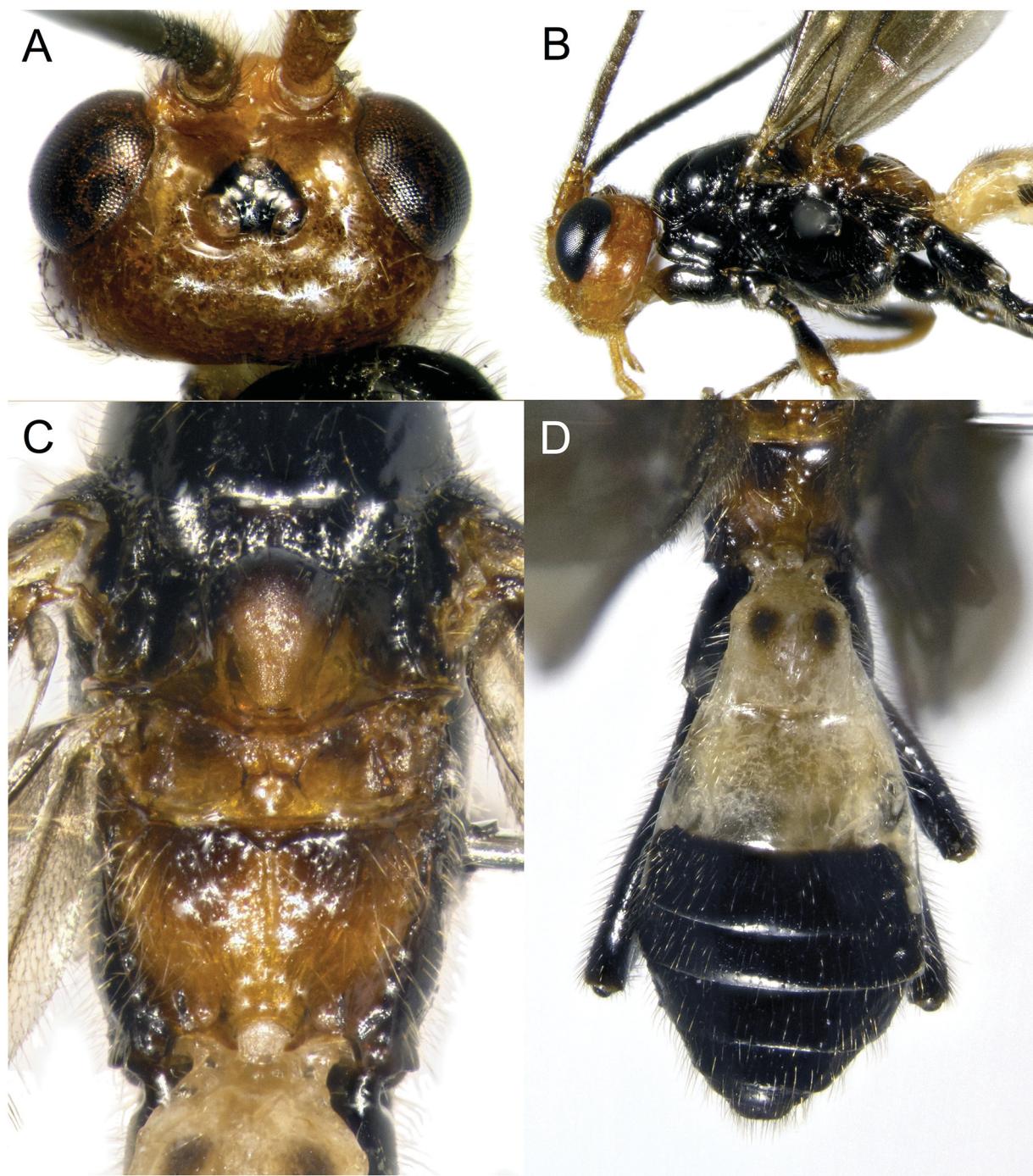


FIGURE 3. *Teresiogas australicolorus* gen. et sp. nov. A, head dorsal view; B, head and mesosoma, lateral view; C, mesosoma, except anterior part, dorsal view; D, metasoma, dorsal view.

Antenna with 57, 58, 58 (♀) and 52 (♂) flagellomeres. Head 2.2–2.4 x wider than face. Face largely coriaceous, with dense, deep setiferous puncturation laterally, the punctures coalescing to form sub-striate-rugulose sculpture rather obscuring malar suture. Mesosoma 1.6 x longer than maximally high. Notauli almost entirely smooth, without punctures or crenulae.

Coloration. Flagellum black; head, scapus and pedicellus orange except stemmaticum black; mesosoma black except scutellum (partly), metanotum and propodeum (largely orange) and legs black except fore tarsus, tibia and apical half of its femur orange; wings brown with dark brown venation but pterostigma largely yellowish; metasomal tergites 1 and 2 mostly white but with a pair of diffuse blackish spots near anterior of 1st tergite in holotype series, tergite 3 onwards black; metasomal sternites membranous with black spots.

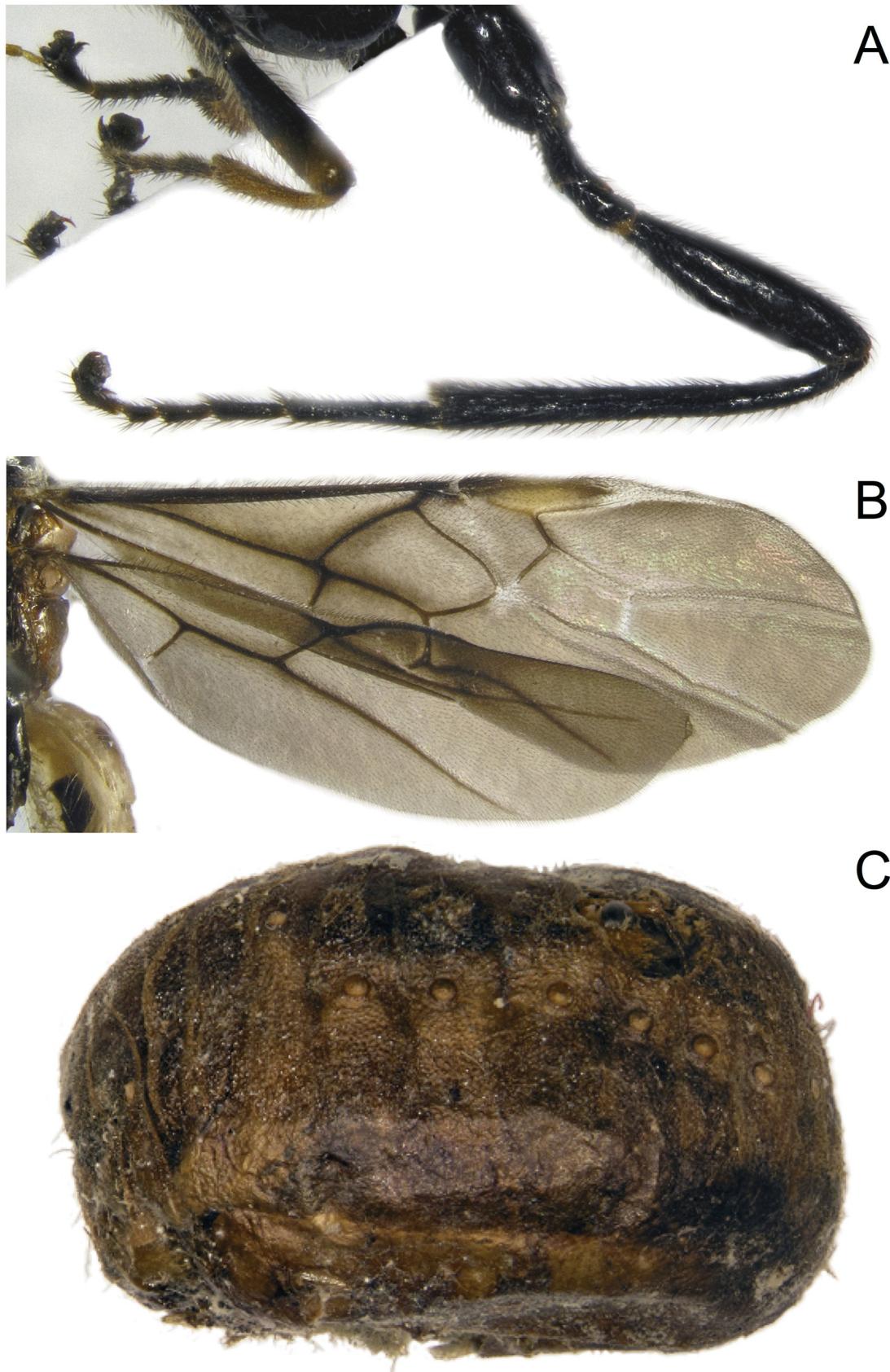


FIGURE 4. *Teresiogas australicolorus* gen. et. sp. nov. A, hind leg and middle and hind claws showing pointed basal lobes; B, wings; C, mummified prepupal host remains, note incompletely emerged wasp, upper right.

Male like female, but maxillary palp with segments 3–5 greatly cylindrically swollen (Fig. 2D).

Etymology. The name alludes to the colour pattern being typical of many of the larger Australian braconids belonging to several subfamilies, and indeed to various other insects of Australia and adjacent areas.

Biology. The squat mummy of the holotype series contained nine distinct adpressed cells aligned to the host's longitudinal axis. Emergence was, or would have been, towards the anterior end of the host in all but one case (1♀, died partly uneclosed, visible in Fig. 4C). In fact only 3♀ and 1♂ had eclosed successfully; a further 2♀ and 1♂ were extracted from the mummy as fully formed dead adults, though in variable condition. Another ♀, a pharate adult (i.e. still in its pupal cuticle, with wings unexpanded) in largely mouldy condition, was sexed from its maxillary palpi, and a further individual was represented by a completely mouldy pupa which could not be sexed; neither of these two is included as paratype.

Teresirogas billbrysoni Quicke & van Achterberg sp. nov.

(Figs 5–6)

Holotype ♀, Australia, "Canberra, ACT, 7 Mar. 1988, L. Barton-Browne, ex *Doratifera* pupa" (ANIC).

Paratypes: AUSTRALIA: 3♀, 4♂, with same label data as holotype (2♀, 3♂, ANIC; 1♀, 1♂ RMNH); 22♀, 6♂, "Ludlow, WA, 6 Jan. 1987, G. Tribe, ex cocoon under bark of *Eucalyptus*. *rudis*" (16♀, 4♂, ANIC; 6♀, 2♂, RMNH); 1♀, "NE section of Yarratt State Forest, NE. [of] Wingham, 23 Feb. 1982, G. & T. Williams, at U/V light", "in dry sclerophyll forest" (AMS); 1♀, CSIRO Exp. Fm, Witton, NSW, 4:1:1969, V.J. Robinson" (AMS); 11♀, 3♂, "Canberra, ACT, 16 Feb. 1960, E.F. Riek" (8♀, 2♂, ANIC; 3♀, 1♂, RMNH); 1♀, Como West, NSW, near Sydney, 21 Feb. 1972, L.S. Willan, MV light" (ANIC).

Female. Body length 6.9 mm, fore wing length 6.6 mm.

Antennae with 46–57 flagellomeres (even among females from the same series as the holotype, flagellar segment numbers were broadly spread across this range). Palpi of male vesiculate, of female somewhat widened. Median carina of propodeum distinct. Fore wing vein 1cu-a postfurcal, vein 2-CU1 less curved than in *T. prestonae*. Tarsal claws with large, pointed, black basal lobes.

Etymology. Named after the William Bryson, author of "Down Under" about a trip through Australia as well as many other entertaining works.

Biology. The two series of reared specimens and their data would seem to suggest that they are gregarious parasitoids, though there were no associated host remains with them.

Teresirogas nolani Quicke & Butcher sp. nov.

(Figs 7–8)

Holotype ♀, Australia, "Lakemba, New South Wales, 4:1:1949", "Ex cocoon *Doratifera velnerans* Lew", "COM. INST. ENT. COLL. NO. 11346", "Pres by Com Inst Ent B.M. 1950-58" (BMNH).

Paratypes: AUSTRALIA: 1♀, same data as holotype (BMNH); 7♀, "Berala, 6-2-[19]68, G. Daniels" (5♀ AMS; 2♀ RMNH); 1♀, but 11-2-[19]68 (AMS); 1♀, 29-2-[19]68 (AMS); 1♀, "Bred from cup moth [= Limacodidae] pupae, 29 Mch 1934" (AMS); 2♀, "Coma West, nr Sydney, NSW, 13.v.1972, L. Willan" (1♀ AMS; 1♀ RMNH); 1♀, "Kw.ring.gai Chase Nat. Park, NSW, 27.i.1971, A. & G. Daniels" (AMS); 2♀, Sydney, NSW, Oct. 1966, P. Robertson", "cup moth parasite" (ANIC); 1♀, "New South Wales, 4.1.[19]60. Ex Emperor moth, C.I.E. A 1313" (BMNH), "Pres by Com Inst Ent B.M. 1966-3" (BMNH); 1♀, "Brisbane: H. Hacker 20/11/[19]11" (QM).

Female. Body length 6.9 mm, fore wing length 6.0 mm.

Antennae with 46–60 flagellomeres (the specimen from Kw ring. Gai Chase Nat. Park, NSW having the smallest number, and those from Berala the largest numbers, the holotype has incomplete antennae). Head 2.4 x wider than face. Face largely smooth and shiny except for punctures associated with setae. Mesosoma 1.55 x longer than maximally high. Notauli completely smooth. Fore wing vein 3RSb 2.45 x 3RSA. Vein 3RSA 1.3 x 2RS. Vein 1cu-a interstitial.

Coloration. Flagellum black; head, scapus and pedicellus orange except stemmaticum black; mesosoma

orange; legs dark brown [fore legs missing but coxa orange]; wings brown with darker brown venation; metasomal tergites 1 and 2 largely cream coloured but with small brownish marks at base of 1st tergite and postero-laterally on 2nd, remaining tergites black; metasomal sternites membranous with black spots.

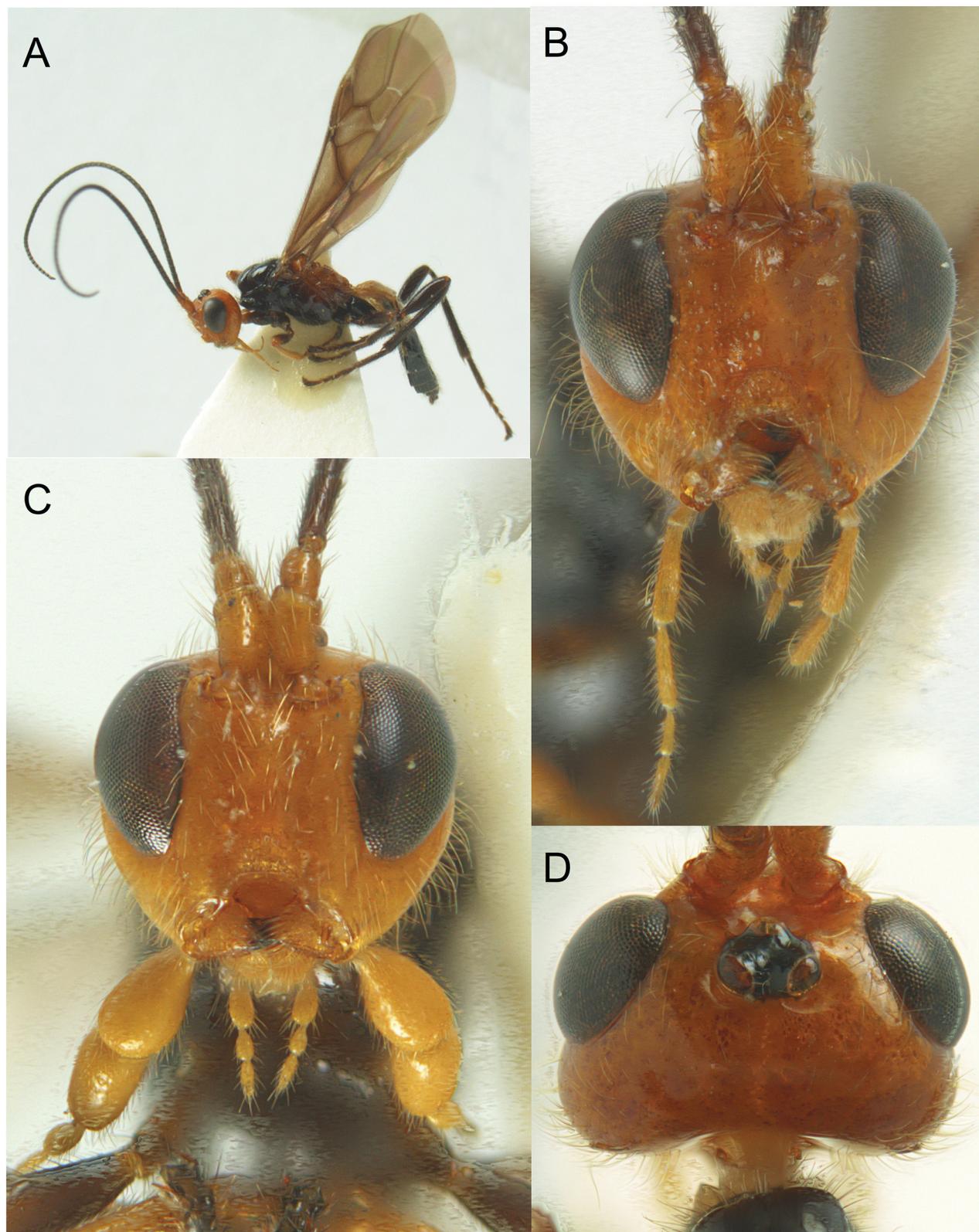


FIGURE 5. *Teresiogas billbrysoni* gen. et sp. nov. A, habitus; B, head (female), front view; C, head (male), front view; D, head (female), dorsal view.

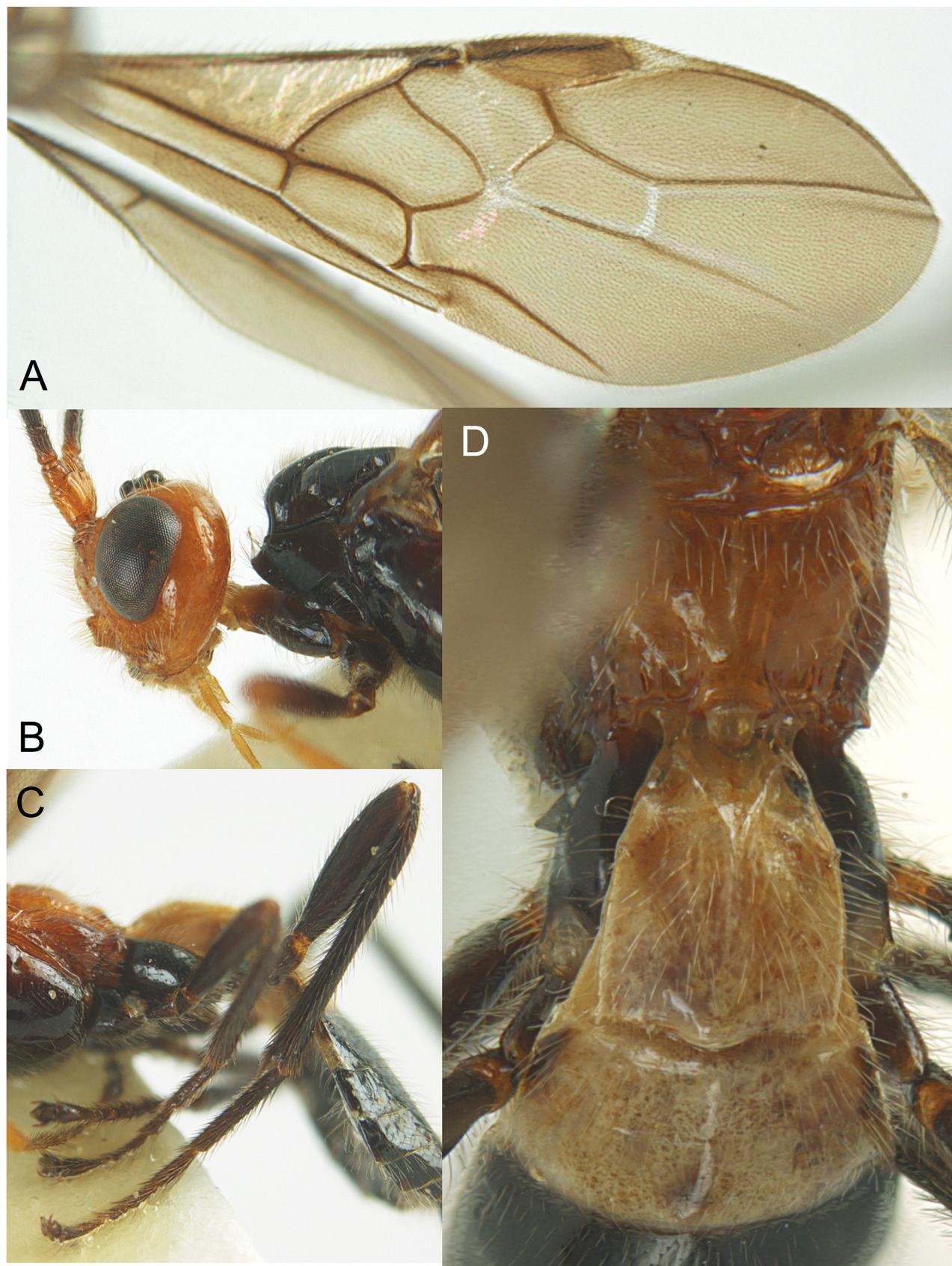


FIGURE 6. *Teresirogas billbrysoni* gen. et sp. nov. A, fore wing; B, head and anterior of mesosoma, lateral view; C, propodeum, metasoma, mid- and hind legs, lateral view; D, propodeum and metasomal tergites 1 and 2, dorsal view.

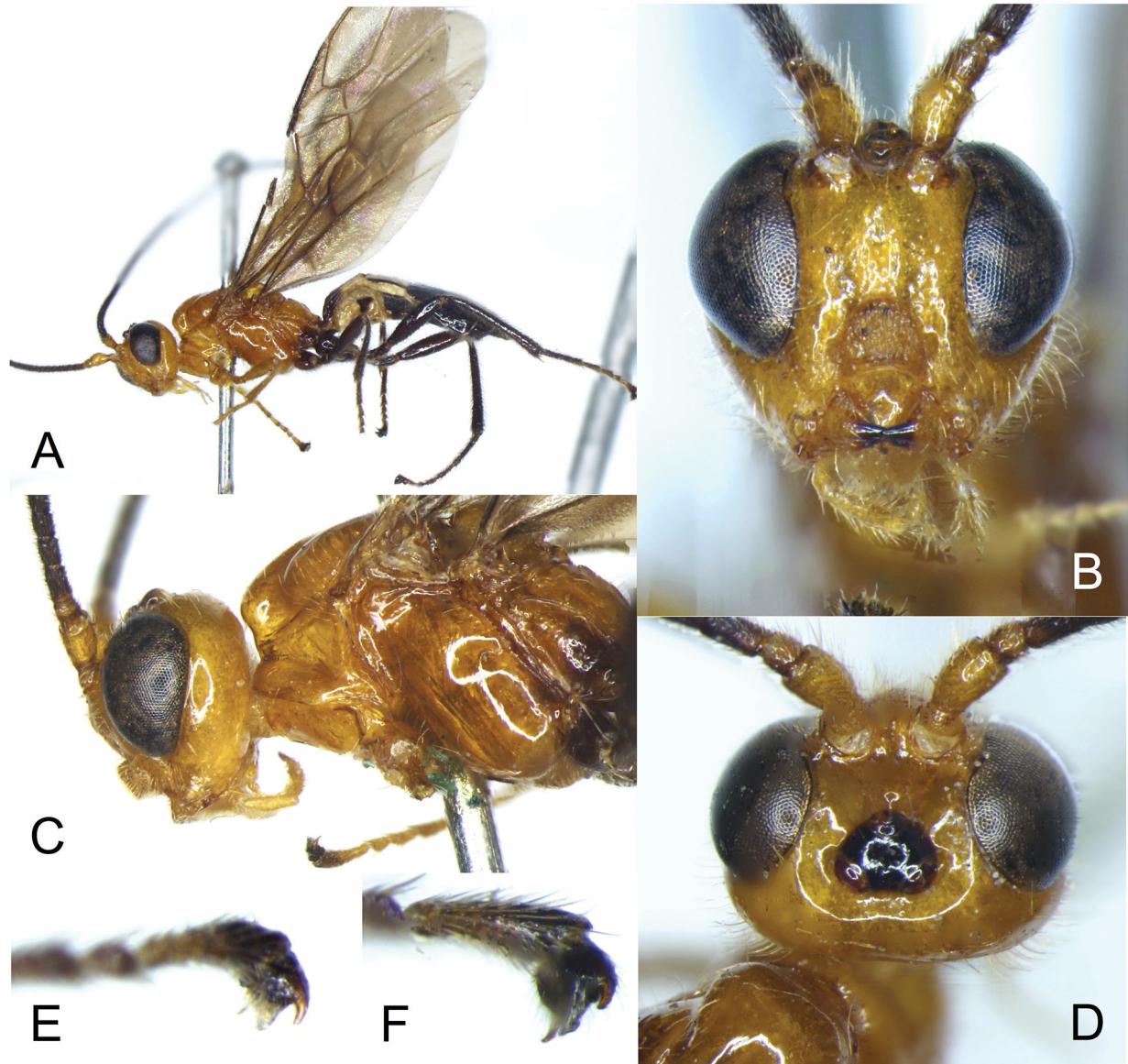


FIGURE 7. *Teresiogas nolani* gen. et. sp. nov. A, habitus; B, head, front view; C, head and mesosoma, lateral view; D, head dorsal view; E, F, views of hind telotarsus and claw showing reduced basal lobe.

Etymology. Named after the famed Australian artist, Sidney Robert Nolan (1917–1972) well known for his Ned Kelly series of paintings.

Biology. The host recorded on the data label of the holotype is a limacodid. Although the mummy is not present the paratype with the same data suggests that the species is gregarious. The host of the other paratype is indicated to be an “emperor moth” which would indicate a member of the Saturniidae, however, all other records are from Limacodidae, especially cup moths of the genus *Doratifera* on *Eucalyptus*, and although there are *Eucalyptus*-feeding saturniids, it may be that the host was misidentified. There is nothing in this case to suggest solitary or gregarious development.

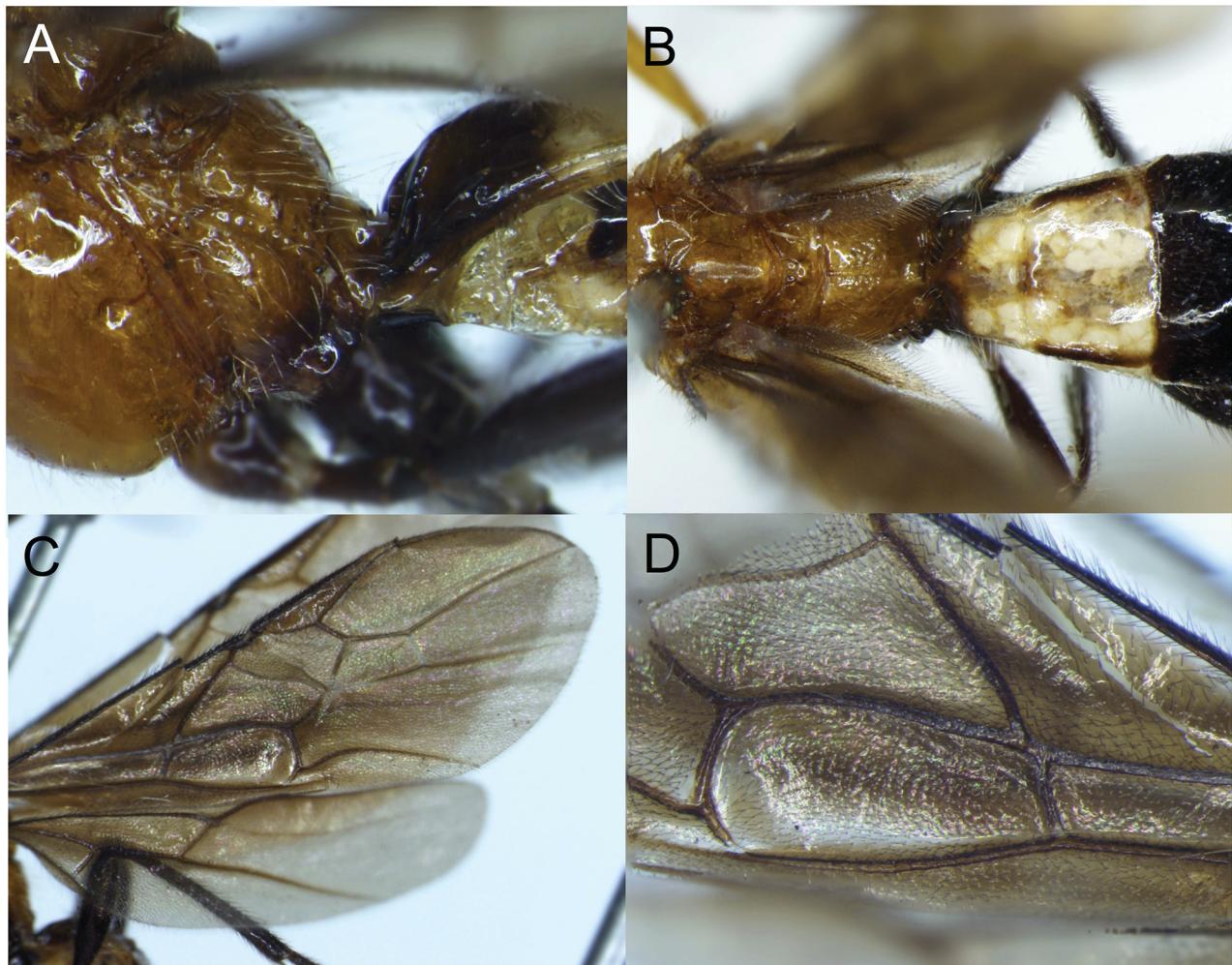


FIGURE 8. *Teresiogas nolani* gen. et sp. nov. A, posterior of mesosoma and metasomal tergite 1, lateral view; B, scutellum, propodeum, tergite 1, dorsal view; C, wings; D, wings, detail of subdiscal cell.

***Teresiogas prestonae* Quicke & van Achterberg sp. nov.**
(Figs 9–10)

Holotype ♀ (ANIC) “4 mi. W. of Coolibah HS, N.T., 15.34S 130.54E, 21 June 1968, M. Mendum”.

Paratypes: 1♀, “W.A., Homestead, Beverley Springs, 16.35S 125.29E, 31.v.1993, E.D. Edwards” (ANIC); 1♀, “Qld., 7 km E Laura, 15.35S 144.30E, 27.v.1993, at light, P. Zborowski & A. Roach” (ANIC); 1♀, “18 km NE by E Heathlands, Q., 11.40S 142.43E, 19.iii.1992, E.D. Edwards” (RMNH).

Female. Body length 7.6 mm, fore wing length 6.8 mm.

Median carina of propodeum reduced. Fore wing vein 1cu-a distinctly antefurcal to subinterstitial. Vein 2-CU1 distinctly curved. Basal lobes of claws reduced.

Coloration. Head (except stemmaticum) and mesosoma orange, coloration otherwise rather variable; metasomal tergite 1 entirely pale (ivory), only basal half dark brown, or up to basal two-thirds dark brown; tergite 2 entirely pale or laterally partly darkened.

Etymology. Named after the influential Australian modernist artist, Margaret Preston (1875–1973), well known for her highly colourful paintings.

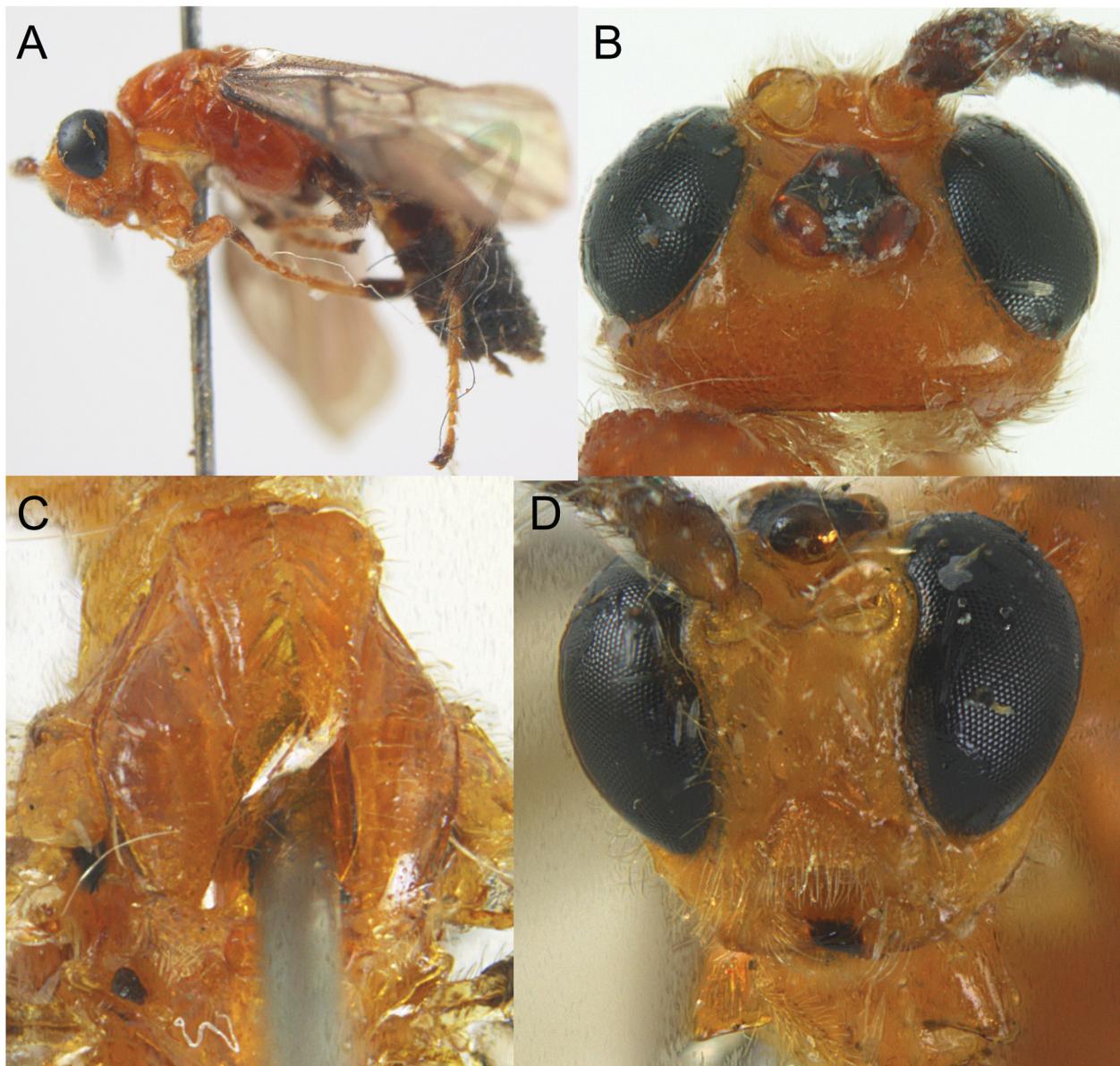


FIGURE 9. *Teresiogas prestonae* gen. et sp. nov. A, habitus; B, head, dorsal view; C, mesoscutum, dorsal view; D, head, front view.

***Teresiogas williamsi* Quicke & van Achterberg sp. nov.**
(Figs 11–12)

Holotype 1♀, “Solar Village, Humpty Doo, 12.35S 131.07E, N.T., 9 April 1991, M.S. Upton” (ANIC).

Paratype: 1♀, “Near airport, Iron Range, Qld, 20 Dec. 1971, MV light, D.K. McAlpine, G.A. Holloway, D.P. Sand” (AMS).

Female. Body length 7.4 mm, fore wing length 6.0 mm.

Antenna with 51 flagellomeres. Claws with large black pointed lobes (Fig. 11B).

Coloration similar to pale *T. billbrysoni* except pterostigma largely yellow (Fig. 12A) and brownish yellow hind basitarsus.

Etymology. Named after the Australian painter Fred Williams (1927–1982), well known for his evocative paintings of the Australian landscape.

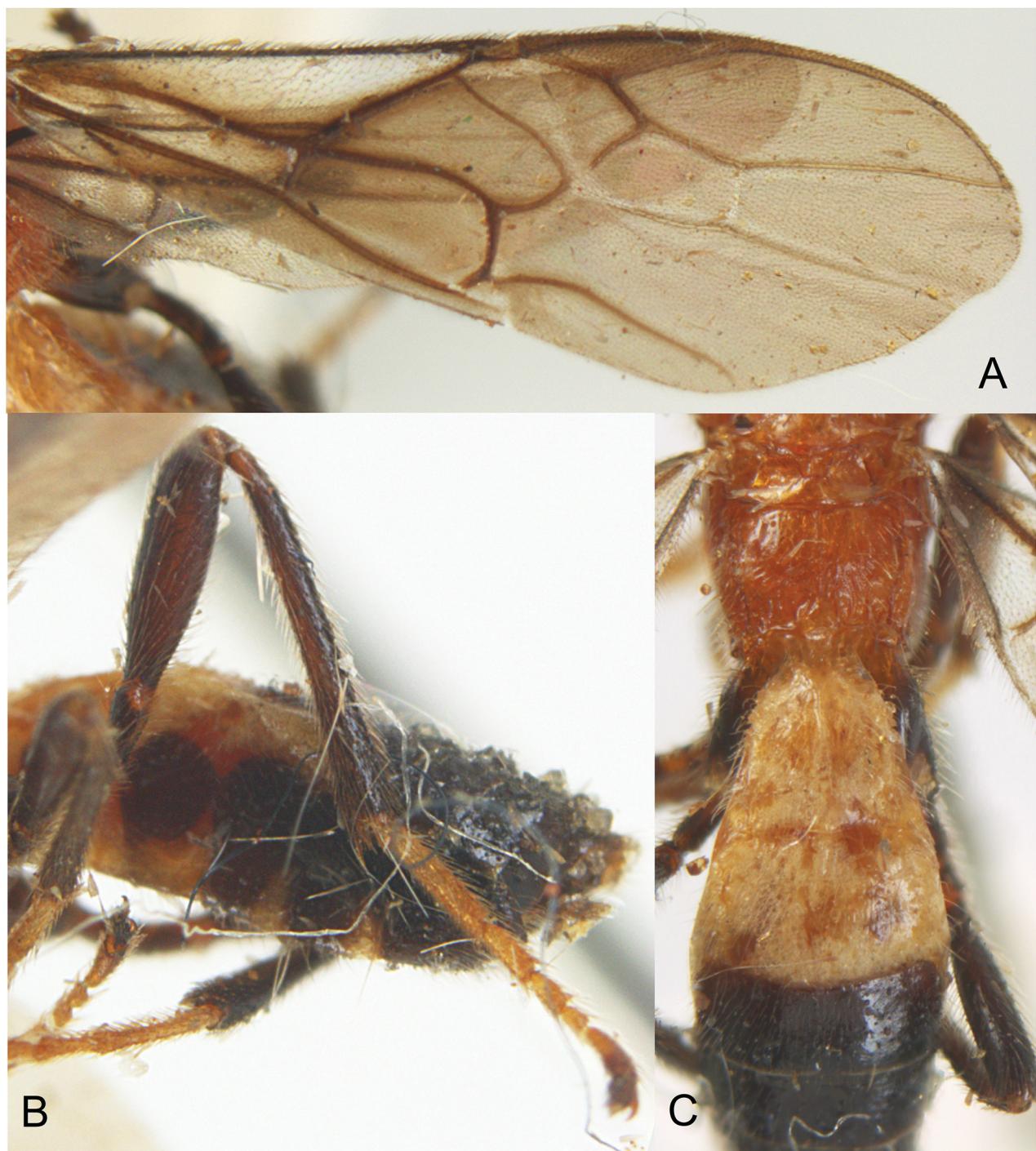


FIGURE 10. *Teresiogas prestonae* gen. et. sp. nov. A, fore wing; B, hind leg and mesosoma, lateral view; C, propodeum and metasomal tergites 1–4, dorsal view.

Discussion

It is very surprising that no members of the new genus appear to have been described; perhaps earlier workers assumed that it had, as has happened before for several rather large Australian braconids. Yet neither DQ nor CvA, despite their extensive knowledge of braconid wasps and study of major collections, have ever seen a described species of this taxon. Indeed, the Rogadinae have been a rather taxonomically neglected group until a relatively recent surge in activity (e.g. van Achterberg 1991, Chen & He 1997), especially in the tropics though much work still needs to be done on the temperate fauna also.

The Rogadini (including the Spinariini) are a morphologically heterogeneous group, dominated in terms of number of species by '*Triraphis*' though unpublished molecular analyses strongly suggest that the New World representatives of that genus are not monophyletic with the Old World ones (Quicke *et al.* in prep.). At genus level it is most diverse in the Old World tropics, and two new genera have recently come to light from the S. E. Asian to Indo-Australian region (Quicke & Areekul Butcher 2011, Quicke *et al.* 2012).

Rogadines are normally quite extensively sculptured, but in common with many groups of normally sculptured Ichneumonoidea from Australia, the new taxon has evolved a very smooth cuticle. Only one other genus of Rogadinae lacks a prepectal (=epicnemial) carina, and that is *Orthorhogas* which is currently only known from Madagascar. However, the latter genus is almost certainly not closely related to *Teresirogas* since it is strongly sculptured, has an elongate metasoma, large and ventrally curved hypopygium and strongly curved and exserted ovipositor. Further, in the Bayesian molecular analysis (Fig. 1) *Orthorhogas* is nested with quite strong support within a clade largely comprising genera of Spinariina.

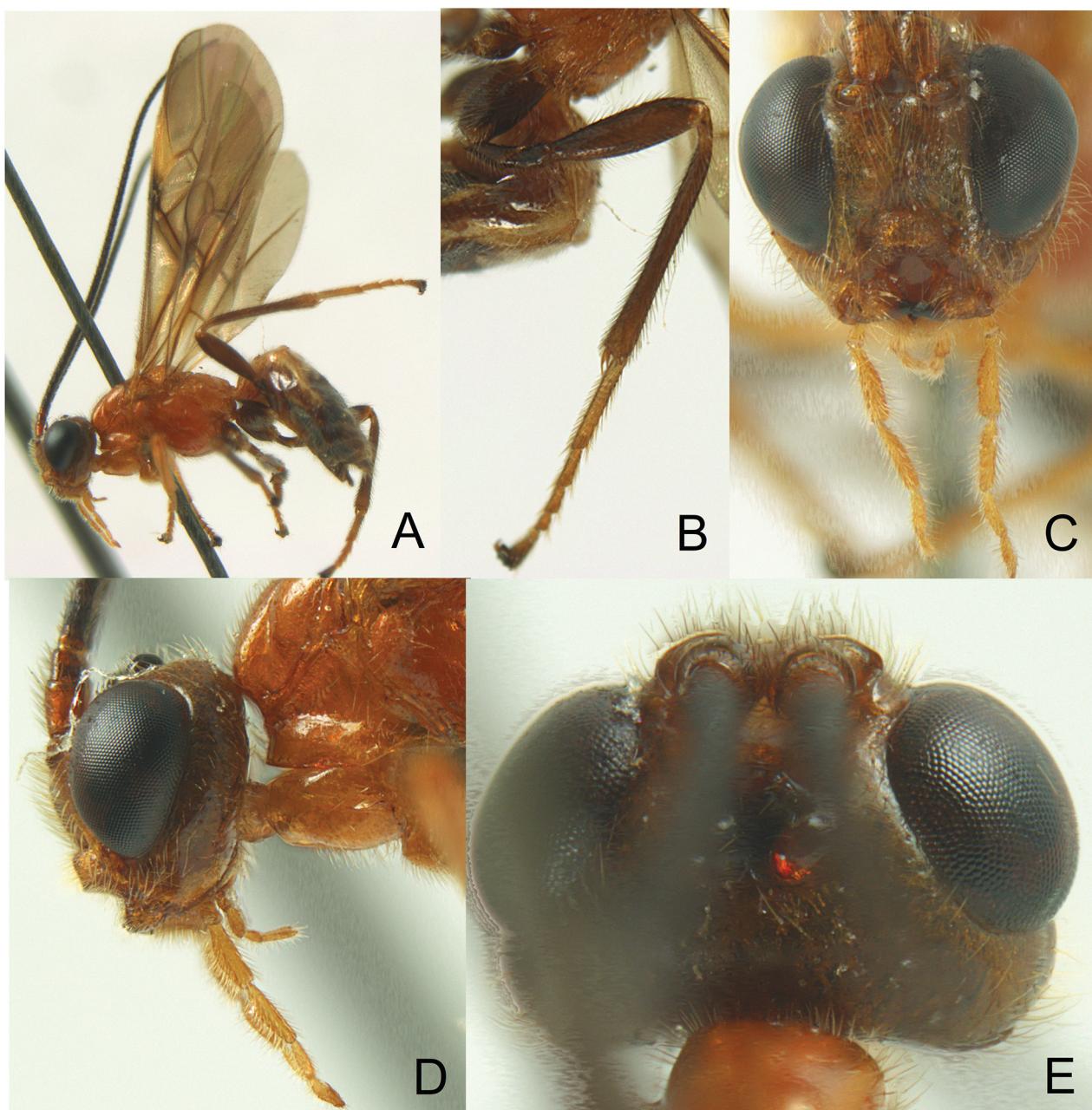


FIGURE 11. *Teresirogas williamsi* gen. et sp. nov. A, habitus; B, hind leg; C, head, front view; D, head, lateral view; E, head, dorsal view.



FIGURE 12. *Teresiogas williamsi* gen. et sp. nov. A, fore wing; B, posterior of mesosoma and anterior of metasoma, dorsal view; C, metasomal tergites 2 and following, dorsal view.

Within *Teresiogas* gen. nov. two groups of species are apparent. *T. australicolorus* sp. nov., *T. williamsi* sp. nov. and *T. billbrysoni* sp. nov. having the least expanded 1st subdiscal cell of the fore wing and the tarsal claws with a large acute basal lobe. The other species have the 1st subdiscal cell of the fore wing more expanded and the tarsal claws lack an acute basal lobe. The modification of the 1st subdiscal cell is in keeping with that in that oval cells (either the 1st subdiscal or apical part of the subbasal cell) is largely restricted to nocturnal taxa, though its function is yet to be determined (Quicke & Shaw 2005, Quicke in press). The basic colour pattern of the body of all

species is typically tricoloured: head and more or less mesosoma orange or brownish yellow, basal half of metasoma ivory or white and its apical half black. The colour of the mesosoma is variable, even within species (e.g. *T. billbrysoni* sp. nov.).

Acknowledgements

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APPENDIX 1. Material included in molecular analyses. Genbank accessions numbers starting with KM are newly generated for this study.

Subfamily/tribe	Species	Provenance	Genbank accession number	
			28S	COI
Betylobraconinae	<i>Mesocentrus</i> sp.	Australia	KM067175	JF963534
Doryctinae	<i>Dendrosoter protuberans</i>		EF645736	EF645775
	<i>Doryctes erythromelas</i>	USA	GQ374709	GQ374627
	<i>Megaloprocetus</i> sp.	Colombia	AY935466	AY935393
Hormiinae	<i>Hormius</i> sp.	Madagascar	AY935455	AY935385
	<i>Parahormius</i> sp.	Cameroun	AY935456	AY935386
Lysiterminae	<i>Acanthormius</i> sp. 1	Madagascar	AJ302883	AY935381
	<i>Acanthormius</i> sp. 2	Thailand	-	KM067236
	<i>Katytermus</i> sp.	Japan	EU854406	EU979624
	<i>Lysitermus</i> sp. 1	Uganda	EU854405	KM067238
	<i>Lysitermus</i> sp. 2	Nigeria	KM067177	JF963503
	<i>Pentatermus</i> sp. 1	Madagascar	KM067178	FN662435
	<i>Pentatermus</i> sp. 2	Madagascar	KM078032	JF963713
	<i>Pentatermus</i> sp. 3	Thailand	KM067179	KM067254
	<i>Pentatermus</i> sp. 4	Nigeria	KM067212	JF963501
	<i>Pentatermus</i> sp. 5	Benin	AY935453	AY935383
	<i>Platyrmus maichau</i>		EU854407	-
	<i>Tetratermus</i> sp. 1	Uganda	AY935452	AY935382
	<i>Tetratermus</i> sp. 2	Nigeria	KM067180	? JF963501
Pambolinae	<i>Notiopambolus depressicauda</i>	Australia	AY935459	AY935389
	<i>Pambolus rastafari</i>		-	JQ268750
Rhysipolinae	<i>Pseudorhysipolis</i> sp.	Costa Rica	AY935450	AY935377
	<i>Rhysipolis temporalis</i>	Russia	AY935449	AY935376
	<i>Rhysipolis</i> sp. 1	-	GQ374708	GQ374626
	<i>Rhysipolis</i> sp. 2	Thailand	-	KM067237
	? <i>Rhysipolis</i>	Chile	KM078031	KM078033
Rhyssalinae	<i>Oncophanes</i> sp.	UK	AY935481	AY935407

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APPENDIX 1. (Continued)

Subfamily/tribe	Species	Provenance	Genbank accession number	
			28S	COI
	<i>Rhyssaloides antipoda</i>		JN710479	JN710487
	<i>Rhyssalus clavator</i>	Poland	AY935482	AY935409
	<i>Tobiason pronotalis</i>	Vietnam	AY935480	AY935408
Rogadinae: Aleiodini				
	<i>Aleiodes antescutum</i>	Thailand	KM067183	JF962536
	<i>Aleiodes apiculatus*</i>	UK	EF115440	EF115455
	<i>Aleiodes compressor</i>	UK	EU854328	EF115458
	<i>Aleiodes melanopterus</i>	Brazil	KM067213	KM067239
	<i>Aleiodes granulatus</i>	Canada	KM067214	JF962657
	<i>Aleiodes grassator</i>	Hungary	EU854332	EU979584
	<i>Aleiodes malarious</i>	Thailand	KM078029	JQ388336
	<i>Aleiodes mellificus</i>	Thailand	KM078030	JF962707
	<i>Aleiodes nobilis</i>	UK	KM067184	JF962562
	<i>Aleiodes praetor</i>	UK	EU854334	KM067256
	<i>Aleiodes risaee</i>	Thailand	KM067215	JQ388401
	<i>Aleiodes rufipes</i>	Sweden	KM067186	KM067257
	<i>Aleiodes seriatus</i>	UK	KM067216	KM067240
	<i>Aleiodes sophieae</i>	Thailand	KM067217	JQ388368
	<i>Aleiodes spurivena</i>	Vietnam	-	JF903066
	<i>Aleiodes testaceus</i>	UK	EF115493	EF115454
	<i>Aleiodes trevelyanae</i>	Uganda	EF115433	EF115448
	<i>Aleiodes trifasciatus</i>	Malawi	EU854354	EU979604
	<i>Arcaleiodes siamensis</i>	Thailand	KM067187	JQ388379
	<i>Heterogamus dispar</i>	UK	KM067190	JF963404
	<i>Heterogamus</i> sp. 1	Colombia	KM067218	KM067241
	<i>Heterogamus</i> sp. 2	Costa Rica	KM067219	JF963395
	<i>Heterogamus</i> sp. 3	Papua New Guinea	KM067221	KM067242
	<i>Heterogamus</i> sp. 4	Thailand	KM067220	JF962667
Rogadinae: Clinocentrini				
	<i>Artocella askewi</i>	Spain	AY93335451	AY935379
	<i>Clinocentrus cuncator</i>	UK	AJ784962	AY935378
	<i>Clinocentrus</i> sp. 1	Madagascar	KM067194	KM078033
	<i>Clinocentrus</i> sp. 2	Papua New Guinea	KM067233	KM067251
	<i>Clinocentrus</i> sp. 3	Papua New Guinea	KM067234	KM067252
	<i>Confusocentrus panturat</i>	Thailand	-	KM067258
	<i>Tebennotoma</i> sp.	Madagascar	KM067235	JF963885
Rogadinae: Rogadini				
	<i>Batotheca</i> sp.	Papua New Guinea	KM067226	JF415904
	<i>Batothecoides yakushimensis</i>	Taiwan	JF962970	EU854360
	<i>Canalirogas</i> sp.	Thailand	KM067198	JF963044
	<i>Colastomion crambidiphagus</i>	Papua New Guinea	KM067228	JF963127

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APPENDIX 1. (Continued)

Subfamily/tribe	Species	Provenance	Genbank accession number	
			28S	COI
	<i>Colastomion</i> sp.	Papua New Guinea	KM067229	KM067247
	<i>Conspinaria</i> sp.	Taiwan	AJ509014	EU480586
	<i>Cornutorogas</i> sp.	Thailand	KM067201	KM067262
	<i>Cystomastax</i> sp.	Venezuela	AY935445	AY935369
	<i>Darnilia</i> sp.	Thailand	KM067199	KM067263
	<i>Gyroneuron</i> sp.	Thailand	KM067202	JF963364
	<i>Gyroneuron testaceator</i>	China	EU854372	EU979614
	<i>Iporhogas</i> sp.	Thailand	KM067222	KM067243
	<i>Macrostomion</i> sp.	Thailand	KM067230	HM435179
	<i>Megarhogas ?maculipennis</i>	Thailand	EU854379	JF963804
	<i>Myocron</i> sp.	Tanzania	EU854380	EU979616
	<i>Orthorhogas</i> sp.	Madagascar	-	JN278324
	<i>Quasimodorogas confusus</i>	Thailand	-	KM067250
	<i>Rectivena</i> sp.	Benin	EU854384	EU979618
	<i>Rogas luteus</i>	France	KM067204	KM067264
	<i>Rogas</i> sp	Tanzania	AJ784931	AY935364
	<i>Rogasodes</i> sp.	Thailand	KM067224	KM067245
	<i>Spinaria</i> sp. 1	Papua New Guinea	KM067227	JF271524
	<i>Spinaria</i> sp. 2	Thailand	KM067205	FN662444
	<i>Teresirogas australicolorus</i> gen. et sp. nov.	Australia	KM067223	KM067244
	<i>Trigonoplatnus albopalteatus</i>	Papua New Guinea	KM067225	JF415905
	<i>Triraphis</i> sp. 1	Belize	KM067232	KM067249
	<i>Triraphis</i> sp. 2	Papua New Guinea	KM067231	KM067248
	<i>Triraphis tricolor</i>	Netherlands	KM067206	KM067265
	<i>Troporhogas</i> sp.	Sri Lanka	KM067246	KM067246
	<i>Vojtechirogas novotnyi</i>	Papua New Guinea	-	JF271566
Rogadinae: Stiropiini				
	<i>Choreborogas</i> sp. 1	Costa Rica	KM067207	JF963107
	<i>Choreborogas</i> sp. 2	Colombia	KM067208	AY935374
	<i>Polystenidea</i> sp.	USA	-	JF963791
	<i>Stiropius</i> sp.	Costa Rica	AJ784961	AY935373
Rogadinae: Yeliconini				
	<i>Bulborogas compressifemur</i>	Belize	KM067209	KM067266
	<i>Facitorus</i> sp.	Vietnam	EU450765	EU450766
	<i>Pseudoyelicones</i> sp.	Costa Rica	KM067210	KM067267
	<i>Yelicones artitus</i>	Costa Rica	KM067211	JF963958
	<i>Yelicones siamensis</i> *	Thailand	AJ784323	JN278234
	<i>Yelicones spectabile</i>	Madagascar	AJ784319	AJ784319

* sequences combined from two different individuals.