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Opiine parasitoids (Hymenoptera: Braconidae) of tropical fruit flies (Diptera: Tephritidae) of the Australian and South Pacific region

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Abstract

Opiine wasps are parasitoids of dacine fruit flies, the primary horticultural pests of Australia and the South Pacific. A taxonomic synopsis and distribution and host records (44% of which are new) for each of the 15 species of dacine-parasitizing opiine braconids found in the South Pacific is presented. Species dealt with are *Diachasmimorpha hageni* (Fullaway), *D. kraussii* (Fullaway), *D. longicaudata* (Ashmead), *D. tryoni* (Cameron), *Fopius arisanus* (Sonan), *F. deeralensis* (Fullaway), *F. ferrari* Carmichael & Wharton **sp. n.**, *F. illusorius* (Fischer) **comb. n.**, *F. schlingeri* Wharton, *Opius froggatti* Fullaway, *Psyttalia fijiensis* (Fullaway), *P. muesebecki* (Fischer), *P. novaguineensis* (Szépligeti) and *Utetes perkinsi* (Fullaway). A potentially undescribed species, which may be a colour morph of *F. vandenboschi* (Fullaway), is diagnosed but not formally described. *Fopius vandenboschi* sensu stricto, *Diachasmimorpha fullawayi* Silvestri, *Psyttalia concolor* Szépligeti and *P. incisi* Silvestri have been liberated into the region but are not considered to have established: a brief diagnosis of each is included. *Biosteres illusorius* Fischer is formally transferred to the genus *Fopius*. A single opiine specimen reared from a species of *Bactrocera* (*Bulladacus*) appears to be *Utetes albimanus* (Szépligeti), but damage to this specimen and to the holotype (the only previously known specimen) means that this species remains unconfirmed as a fruit fly parasite: a diagnosis of *U.* cf. *albimanus* is provided. *Psyttalia novaguineensis* could not be adequately separated from *P. fijiensis* using previously published characterizations and further work to resolve this complex is recommended. A key is provided to all taxa.

Keywords: *Bactrocera*, biological control, natural enemies, Australia, Papua New Guinea

Introduction

Fruit flies (Diptera: Tephritidae) are among the most economically important pests of edible fruits worldwide (White & Elson-Harris, 1992). Interest in the biological control of fruit flies, utilizing parasitic Hymenoptera, dates back to the early 1900s (Silvestri, 1913, 1914; Lever, 1938) and has been a focus of fruit fly research ever since (Knipling, 1992; Waterhouse, 1993). Among the most commonly used biological control agents against fruit flies are members of the Opiinae (Hymenoptera: Braconidae). Opiines are koinobiont endoparasites of the egg or larval stages of Diptera and have been introduced and released as classical biological control agents of fruit flies in many regions (Wharton &

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Gilstrap, 1983; Waterhouse, 1993; Ovruski *et al*., 2000). More recently, opiines have been used in manipulative and inundative release programmes against fruit flies (Messing *et al*., 1993; Purcell *et al*., 1998; Ramadan, 2004), with foreign exploration continuing (Wharton *et al*., 2000).

Despite their importance in applied entomology, the identification of opiine fruit fly parasitoids remains difficult. A previously published key to opiine parasitoids of dacine tephritid pests (Wharton & Gilstrap, 1983) is now taxonomically dated and restricted in the taxa covered. Because the Opiinae is a large group with over 1500 described species, using primary taxonomic literature to identify these wasps is a time-consuming and difficult task, especially if no host records are available. For fruit fly workers of the South Pacific region, problems of parasitoid identification are exacerbated due to the fact that regional faunas are now mixed as a result of biological control liberations, the geographic area covered is large and much of the primary regional literature is in difficult-to-access foreign language journals (e.g. Fischer, 1963a, 1967a, 1978, 1988).

Fruit fly parasitoids are best collected through the rearing of fruit flies from their host fruit, rather than as collections of individual adults. Such host rearing work led, for example, to the first comprehensive survey of opiine fruit fly parasitoids from Thailand and Malaysia (Chinajariyawong *et al*., 2000). From the mid-1990s, a series of fruit fly projects in the South Pacific region resulted in substantial, new parasitoid collections being generated as the indirect result of host fruit studies. These projects included the *Bactrocera papayae* Drew & Hancock eradication programme in far north Queensland (Cantrell *et al*., 2001), the [Pacific] Regional Fruit Fly Project (Ferrar, 1997) and the Papua New Guinea Fruit Fly Project (see Acknowledgements). These new parasitoid collections provided an opportunity hitherto unavailable to examine the taxonomy, distribution and host associations of the regional fruit fly parasitoid fauna.

Based on an examination of nearly 4000 specimens, the greater percentage collected in the last decade, a synopsis of the South Pacific tephritid-infesting opiine fauna is presented. Information provided includes a key to taxa and synopses of each species (including illustrations, distributions and host records). The document is targeted at fruit fly workers and inclusion of taxa is based on the parasitoids having been reared from a dacine tephritid, as evidenced by label or previously published data. Opiines reared from other dipterans (e.g. Belokobylskij *et al*., 2004) are not included in this review.

Materials and methods

Geographic scope

This paper covers the countries and territories of the South Pacific, including Polynesia, Melanesia and Australia. It does not extend north of the equator, therefore excludes Hawaii, the Federated States of Micronesia and the Marshall Islands.

Material examined

Material examined came from: the Australian National Insect Collection, Canberra, Australia (ANIC); the Agricultural Scientific Collections Unit, NSW Department of Primary Industries, Orange, Australia (ASCU); the Bernice P. Bishop Museum, Honolulu, Hawaii (BPBM); the Griffith University Fruit Fly Research Group, Nathan, Australia (GU); the Queensland Department of Primary Industries and Fisheries Insect Collection, Indooroopilly, Australia (QDPIF); the Secretariat of the Pacific Community, Suva, Fiji (SPC); Texas A&M University Insect Collection (TAMU). Holotype specimens from international collections were examined by R.A.W. Collections were strongly biased towards Australian and Papua New Guinea material, with the number of specimens examined by country as follows: American Samoa 1, Australia 1297, Cook Islands (NZ) 123, Fiji 713, Papua New Guinea 1296, Samoa 36, Solomon Islands 5, Tonga 373, Vanuatu 27. The holotype of the newly described species is housed at the Queensland Museum, Brisbane, Australia (QM).

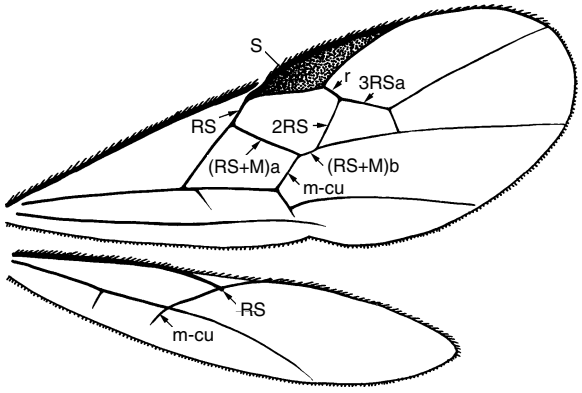

Fig. 1. Opiine wing venation and terminology (following Sharkey & Wharton, 1997). Forewing: m-cu, cross vein between the media and cubitus veins, also known as the recurrent vein; r, small cross vein which connects RS and the stigma; RS, first branch of the radial vein; (RS+M), RS and M (media) fuse to form a composite vein RS+M and when the anterior end of m-cu is basad 2RS, RS+M is subdivided into (RS+M)a and (RS+M)b; 2RS, the second branch of the radial vein; 3Rsa, the third branch of the radial vein; S, stigma. Hindwing: RS, radial sector; m-cu, cross vein between the media and cubitus veins, also known as the postnervellus.

Terminology

The morphological terminology follows that of Sharkey & Wharton (1997) and is illustrated in figs 1 and 2. The mesosoma is the thorax plus propodeum and the metasoma is the petiole plus the gaster.

Distribution and host records

The distribution and host fly associations have been gathered from the literature or from specimen label data. For each host association record, the source of the record is given, in brackets, after the fly species using the following code: 1 (label data); 2 (Wharton & Gilstrap, 1983); 3 (Waterhouse, 1993); 4 (Quimio & Walter, 2001); 5 (Wharton, 1999); 6 (Fullaway, 1952); 7 (Fischer, 1963a). One important caveat has been placed on the host association data to minimize error. When host fruit-rearing is being carried out, multiple fly species may be reared from the one fruit sample. If parasitoids also emerge from such samples, then ambiguity exists over the fly species with which the parasitoid

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was associated (Clausen *et al*., 1965). Where label data for an individual specimen showed that the parasitoid was associated with two or more host fruit flies, then that label data has not been reported in this paper. Host data is given individually for each species and as a comparative summary table (table 1).

A number of the parasitoids dealt with in this paper are known to parasitize fruit fly species which do not occur in the South Pacific region. These records are not included here so as to avoid possible confusion over the geographical distribution of those flies.

Key to the Opiinae parasitizing Tephritidae of the South Pacific region

1. Hind tibia dorso-posteriorly without basal carina 3
– Hind tibia dorso-posteriorly with distinct basal carina (fig. 17) 2

2. Body uniformly dark brown to black, tarsi white .... *Utetes* cf. *albimanus*
– Head and at least apical metasomal terga dark brown to black, mesosoma yellow/orange, hind tarsi dark .... *Utetes perkinsi* (Fullaway)

3. Notauli smooth (fig. 4d) to absent or nearly so (fig. 14d) 4
– Notauli crenulate (fig. 7d) 13

4. Labrum exposed, not concealed by clypeus (fig. 14a) 5
– Labrum concealed by clypeus (fig. 6a) 9

5. Midpit of mesoscutum absent (fig. 14d) 6
– Midpit of mesoscutum deep and circular (fig. 13b) .... *Opius froggatti* Fullaway

6. Propodeal carina present (fig. 14e) 7
– Propodeal carina absent .... *Psyttalia muesebecki* (Fischer)

7. Forewing vein (RS+M)b present (fig. 1); vein 2RS narrow throughout, not thickened medially 8
– Forewing vein (RS+M)b absent; junction of 2RS and m-cu expanded into a large, irregular thickening; 2RS also thickened medially in most specimens .... *Psyttalia fijiensis/novaguineensis*

8. Forewing vein 2RS about twice the length of r .... *Psyttalia concolor* (Szépligeti)*
– Forewing vein 2RS about equal in length to r .... *Psyttalia incisi* (Silvestri)*

9. Ventral margin of clypeus sinuate or evenly convex (fig. 5a) 10
– Clypeus with two small teeth along midline at apex of clypeus ..... *Diachasmimorpha fullawayi* (Silvestri)*

10. Metasomal tergum 2 smooth and polished (fig. 6f) (or occasionally with weak striae at extreme base) 11
– Metasomal tergum 2 extensively longitudinally striate ..... *Diachasmimorpha longicaudata* (Ashmead)

11. Metasoma at least partly black 12
– Metasoma entirely yellow/orange .... *Diachasmimorpha kraussii* (Fullaway)

12. Occipital carina well developed, extending dorsally to level of mid-eye .... *Diachasmimorpha hageni* (Fullaway)
– Occipital carina nearly absent, or present ventrally only near base of mandible .... *Diachasmimorpha tryoni* (Cameron)

13. Tergum 2 densely striate (fig. 7f) 14
– Tergum 2 either without striae (fig. 10f) or with only a few weak striae basal-medially 17

14. Frons and vertex rugose-punctate 16
– Frons densely punctate, vertex more sparsely punctate, neither frons nor vertex rugose-punctate 15

15. Metasomal terga 1–5 yellow to orange .... *Fopius deeralensis* (Fullaway)
– At least metasomal terga 2+3 black .... *Fopius* cf. *vandenboschi*

16. Metasoma dark brown to black. Apex of ovipositor lacking dorsal ridges, distinctly constricted subapically ..... *Fopius arisanus* (Sonan)
– Petiole dark brown, remainder of metasoma usually yellow/orange, at least in female. Apex of ovipositor with weak dorsal ridge and without subapical constriction ..... *Fopius vandenboschi* (Fullaway)*

17. Metasomal terga 1–4 entirely yellow/orange (apical metasomal terga sometimes black in males) 18
– Metasomal terga entirely dark brown to black 19

18. Clypeus with ventral margin very obtusely angulate (fig. 8a) ..... *Fopius deeralensis* (Fullaway)
– Clypeus with rounded ventral margin (fig. 11a) .... *Fopius schlingeri* Wharton

19. Clypeus with ventral margin very obtusely angulate, body densely setose (fig. 9a) ..... *Fopius ferrari* **sp. n.**
– Clypeus with rounded ventral margin (fig. 10a) .... *Fopius illusorius* (Fischer)

* Indicates species which have been released but not yet recovered.

Diachasmimorpha hageni (Fullaway)

(fig. 3)

Opius hageni Fullaway, 1952: 412.
Opius (Biosteres) hageni: Fischer, 1963b: 231.
Biosteres hageni: Fischer, 1971a: 25.
Biosteres (Chilotrichia) hageni: Fischer, 1978: 386.
Diachasmimorpha hageni: Wharton, 1987: 62; Waterhouse, 1993: 38.

Description. Frons and vertex sparsely setose and punctate. Frons polished and weakly punctate, the punctures anteriad ocellar field sparse and shallow; ocellar triangle arranged to form an obtuse triangle with a slight depression anteriad the median ocellus. Occipital carina well developed; clypeus in profile slightly bulged medially; ventral margin of clypeus slightly thickened and sufficiently convex to completely conceal labrum when mandibles closed. Notauli deep, broad, unsculptured; propodeum rugose laterally, with a median longitudinal carina stemming a pentagonal areola, the base of which coincides with the posterior margin. Sternaulus broad, deep, crenulate. Wings strongly infumate. Forewing r vein arising slightly basad midpoint of stigma, 2RS slightly longer than 3RSa, (RS+M)a weakly sinuate; (RS+M)b absent, m-cu arising distad 2RS. Hindwing RS absent; m-cu well developed and pigmented to wing margin. Petiole with dorsal lateral carinae strongly elevated over basal half, weaker posteriorly, but extending to posterior margin. Metasomal tergum 2 smooth and polished. Ovipositor sheath about equal in length to body including head. Ovipositor subapically sinuate. Head,

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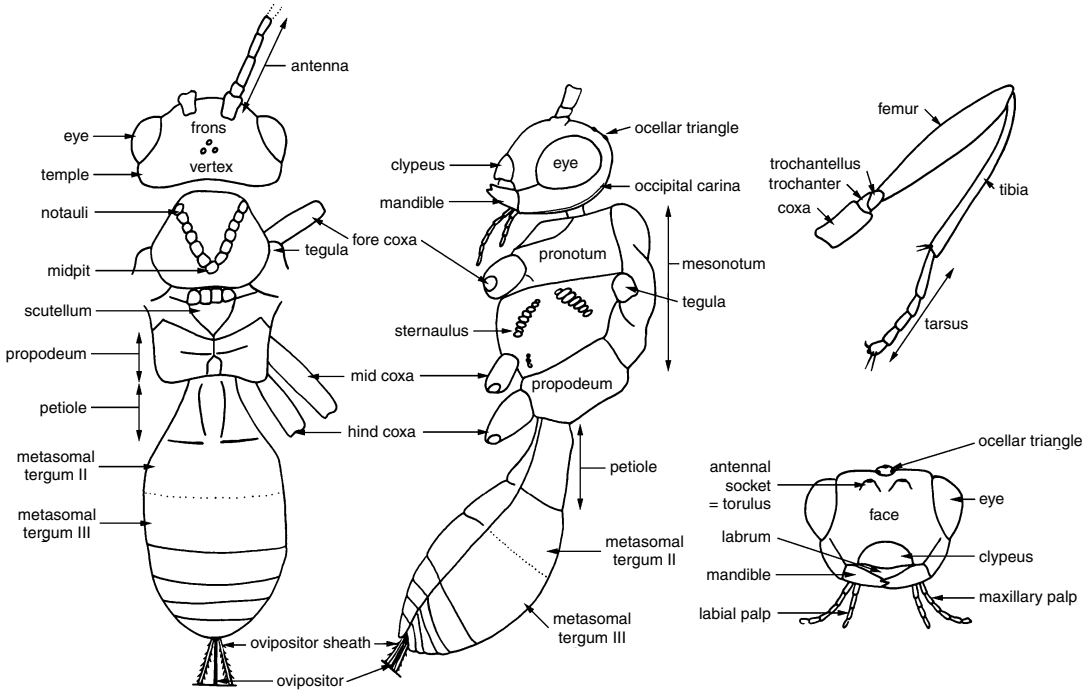

Fig. 2. Opiine body morphology and terminology (following Sharkey & Wharton, 1997).

mesosoma and petiole yellow/orange, remainder of metasoma dark brown; legs yellow/orange.

Distribution. Fiji, Viti Levu.

Type locality. Ndeumba, Viti Levu, Fiji.

Material examined. ANIC: 5♂, 4♀, 1 sex undetermined.

Host associations. Bactrocera passiflorae (Froggatt) (2, 3, 6).

Comments. Morphologically similar to *D. tryoni* and *D. kraussii*. Distinguished from *D. tryoni* by paler coloration and *D. kraussii* by dark metasoma. This species is native to Fiji (Wharton & Gilstrap, 1983; Waterhouse, 1993) and was described from specimens collected by N.L.H. Krauss in May 1951.

Diachasmimorpha kraussii (Fullaway)

(fig. 4)

Opius kraussii Fullaway, 1951: 249.
Opius (Biosteres) kraussii: Fischer, 1963b: 233.
Biosteres kraussi: Fischer, 1971a: 26.
Biosteres (Chilotrichia) kraussi: Fischer, 1978: 386.
Diachasmimorpha kraussii: Wharton, 1987: 62; Waterhouse, 1993: 40.

Description. Frons and vertex punctate and setose. Ocellar triangle arranged to form an obtuse triangle with a slight depression anteriad the median ocellus. Occipital carina well developed; clypeus semicircular, ventral margin completely concealing labrum when mandibles closed. Notauli deep, broad, unsculptured; propodeum rugose laterally, with a median longitudinal carina stemming a pentagonal areola, the base of which coincides with the posterior margin. Wings hyaline. Forewing r arising from midpoint of stigma, 2RS slightly longer than 3RSa, (RS+M)a weakly sinuate; (RS+M)b absent, m-cu arising distad 2RS. Hindwing RS absent; m-cu well developed and pigmented to wing margin. Petiole weakly longitudinally striate, dorsal carinae strongly elevated and weakly convergent to posterior margin. Metasomal tergum 2 smooth. Ovipositor sheath about equal in length to body, including head. Ovipositor apically sinuate. Entire body yellow orange.

Distribution. Australia: collected from Biogu Island, Darnley Island, Dauan Island, Sabai Island and mainland Australia, from Cape Tribulation in the north to Sydney in the south. Papua New Guinea: collected from both high and low altitude regions of the main island of New Guinea and the Gazelle Peninsular of East New Britain. Solomon Islands: Visale. Vanuatu: Efate.

Type locality. Deeral, Australia.

Material examined. ANIC: 20♂, 32♀, 2 sex undetermined; ASCU: 4♂, 6♀, 1 sex undetermined; GU: 89♂, 107♀, 7 sex undetermined; QDPIF: 176♂, 159♀, 3 sex undetermined.

Host associations. Bactrocera barringtoniae (Tryon) (2), *B. bidentata* (May) (1), *B. cacuminata* (Hering) (2, 3), *B. cucurbitae* (Coquillett) (1), *B. dissidens* Drew (1), *B. frauenfeldi* (Schiner) (1), *B. jarvisi* (Tryon) (1, 2, 3), *B. kraussi* (Hardy) (1, 2, 3), *B. murrayi* (Perkins) (2), *B. neohumeralis* (Hardy) (1, 3), *B. pallida* (Perkins

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Table 1. For each host association record, the source of the record is given in the table using the following code: 1 (label data); 2 (Wharton & Gilstrap, 1983); 3 (Waterhouse, 1993); 4 (Quimio & Walter, 2001); 5 (Wharton, 1999); 6 (Fullaway, 1952); 7 (Fischer, 1963a).

	D. hageni (Fullaway)	*D. kraussii* (Fullaway)	*D. longicaudata* (Ashmead)	*D. tryoni* (Cameron)	*F. arisanus* (Sonan)	*F. deeralensis* (Fullaway)	*F. ferrari* Carmichael & Wharton	*F. illusorius* (Fischer)	*F. schlingeri* Wharton	*F.* cf. *vandenboshci*	*O. froggatti* (Fullaway)	*P. fijiensis* (Fullaway)	*P. muesebecki* (Fischer)	*P. novaguineensis* (Szépligeti)	*U.* cf. *albimanus*	*U. perkinsi* (Fullaway)
B. aberrans (Hardy)					1											
B. aglaiae (Hardy)						1						1		1		
B. bancrofti (Tryon)												1				
B. barringtoniae (Tryon)		2			1, 4	1, 2						2		1		
B. bidentata (May)		1														
B. cacuminata (Hering)		2, 3			1, 2, 4											2
B. calophylli (Perkins & May)														1		
B. caryeae Kapoor			2													
B. cucurbitae (Coquillett)		1	1, 2													
B. curvipennis (Froggatt)			2, 3									2				
B. dissidens Drew		1														
B. distincta (Malloch)					1											
B. dorsalis Hendel			2, 3	2	2, 3, 4											
B. endiandrae (Perkins & May)					1	1, 2						1		1		
B. facialis (Coquillett)					1							1				
B. fagraea (Tryon)						2						2		1		
B. frauenfeldi (Schiner)		1	1, 2			1, 2, 3	1	1	1	1		2, 3		1		
B. halfordiae (Tryon)				1					1, 5							
B. jarvisi (Tryon)		1, 2, 3			1, 4	2						1, 2				2
B. kirki (Froggatt)					1							1				
B. kraussi (Hardy)		1, 2, 3			1, 4	2			1		2	1, 2		1		1, 2
B. laticaudus (Hardy)						2					2	2				2
B. latifrons Hendel			2		2, 4											
B. manskii (Perkins & May)					1											
B. melanotus (Coquillett)					1											
B. murrayi (Perkins)		2														
B. musae (Tryon)						2, 3	1	1	1			2, 3		1		
B. neohumeralis (Hardy)		1, 3			1, 4				1, 5					1		1
B. pallida (Perkins & May)		2				1, 2						1, 2				
B. passiflorae (Froggatt)	2, 3, 6		1	2	1, 2, 4							1, 2, 3				
B. pedestris (Bezzi)			2													
B. penefurva Drew		1							1					1		
B. peninsularis (Drew & Hardy)									5							
B. psidii (Froggatt)			2								2, 3	2	7			
B. redunca (Drew)							1									
B. rufofuscula (Drew & Hancock)									5							
B. tinomiscii Drew									1					1		
B. trivialis (Drew)							1									
B. tryoni (Froggatt)		1	2	1, 2, 3, 7	1	1, 2, 3			5			1, 2, 3				2, 3
B. umbrosa (Fabricius)		1	1													
B. visenda (Hardy)												1		1		
B. vulgaris (Drew)							1									
B. xanthodes (Broun)			1	2	1							1, 2, 3				
B. zonata (Saunders)			2													
D. ciliatus Loew			2													
B (Bulladacus) sp.									1					1	1	
B.(Gymnodacus) sp.														1		
C. capitata Wiedemann			2	2, 7	2											

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Fig. 3. *Diachasmimorpha hageni*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

& May) (2), *B. penefurva* Drew (1), *B. tryoni* (Froggatt) (1), and *B. umbrosa* (Fabricius) (1).

Comments. Morphologically similar to *D. longicaudata* and *D. hageni*, but can be readily distinguished from these species by its pale coloration and smooth metasomal tergum 2. *Diachasmimorpha kraussii* is considered native to Australia (Wharton & Gilstrap, 1983; Waterhouse, 1993) and Solomon Islands (Waterhouse, 1993); Papua New Guinea is also likely to be part of its native range.

Diachasmimorpha longicaudata (Ashmead)

(fig. 5)

Biosteres longicaudatus Ashmead, 1905: 970.
Diachasmimorpha comperei Viereck, 1913: 641; syn. by Wharton & Gilstrap, 1983: 733.
Biosteres compensans Silvestri, 1916: 168; Fischer, 1963b: 234 as subsp.; Wharton & Gilstrap, 1983: 733 as syn.
Biosteres formosanus Fullaway, 1926: 283; syn. by Fischer, 1963b: 234.

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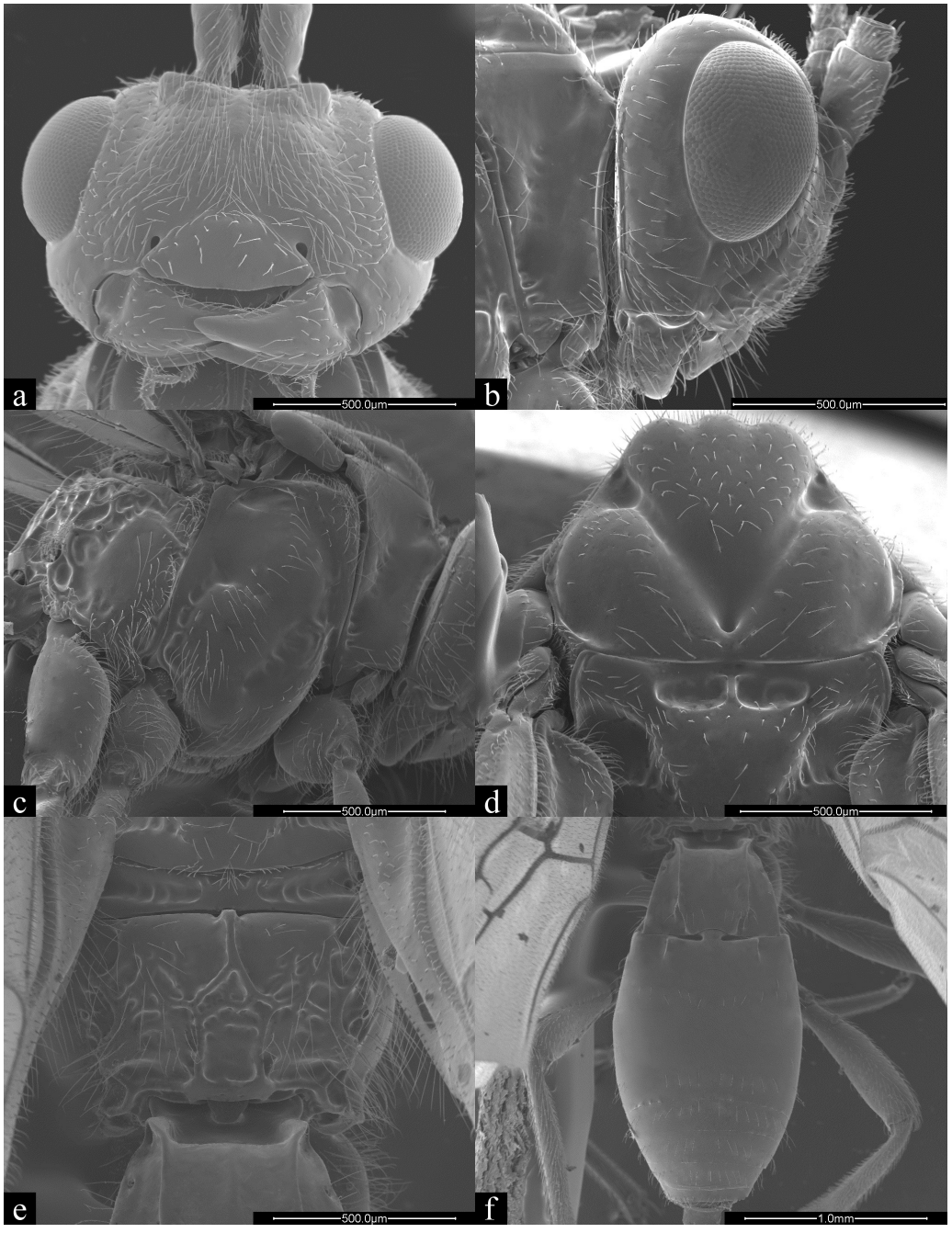

Fig. 4. *Diachasmimorpha kraussii*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

Opius longicaudatus: Fullaway, 1951: 243.
Opius longicaudatus var. *chocki* Fullaway, 1953: 310.
Opius longicaudatus var. *novocaledonicus* Fullaway, 1953: 311.
Opius longicaudatus var. *malaiaensis* Fullaway, 1953: 312.
Opius longicaudatus var. *taiensis* Fullaway, 1953: 313.
Opius (Biosteres) longicaudatus taiensis: Fischer, 1963b: 234.
Opius (Biosteres) longicaudatus longicaudatus: Fischer, 1963b: 234.
Biosteres longicaudatus: Fischer, 1971a: 27.
Biosteres (Chilotrichia) longicaudatus: Fischer, 1978: 386.
Diachasmimorpha longicaudata: Wharton, 1987: 62.

Description. Frons and vertex sparsely punctate and setose. Ocellar triangle arranged to form an obtuse triangle with a slight depression anteriad the median ocellus. Occipital carina well developed; ventral margin of clypeus completely concealing labrum when mandibles closed. Notauli deep, broad, unsculptured; propodeum irregularly areolate with a median longitudinal carina extending from anterior margin

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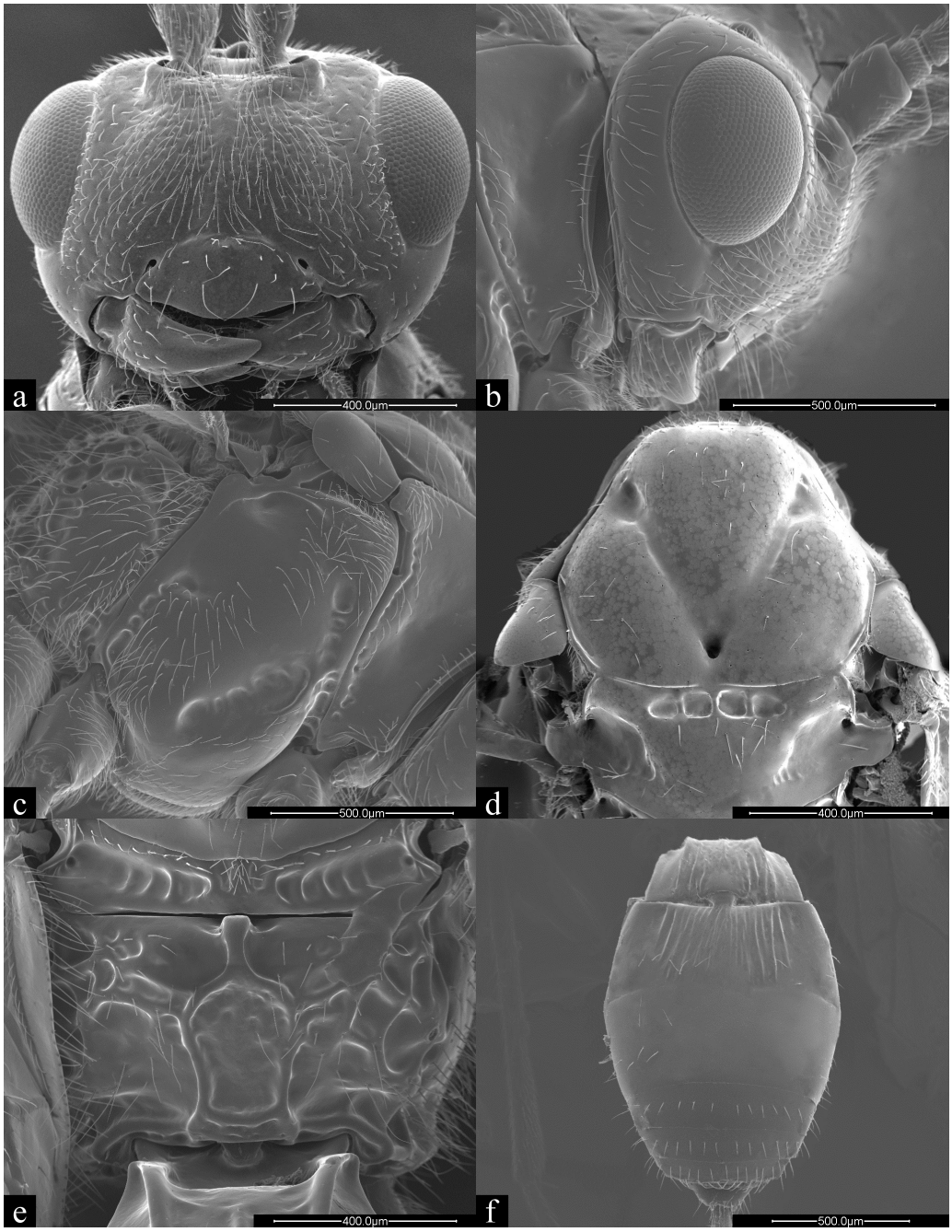

Fig. 5. *Diachasmimorpha longicaudata*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

to areola. Wings hyaline. Forewing r arising slightly basad midpoint of stigma, 2RS slightly longer than 3RSa, (RS+M)a weakly sinuate; (RS+M)b absent, m-cu arising distad 2RS. Hindwing RS absent; m-cu well developed and pigmented to wing margin. Petiole longitudinally striate, with dorsal lateral carinae strongly elevated and slightly divergent to posterior margin. Metasomal tergum 2 longitudinally striate. Ovipositor sheath about equal in length to body, including head. Body entirely yellow orange, or with black transverse stripe(s) subapically on metasomal terga.

Distribution. Australia: collected from the Bloomfield River, far North Queensland and Lord Howe Island. Fiji: collected from many sites on Viti Levu and Vanua Levu, also collected on islands of the Lau and Yasawa groups. Papua New Guinea: Lae and Sonoma. Vanuatu: Efate.

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Type locality. Manila, Philippines.

Material examined. ASCU: 1♂, 2♀; GU: 8♂, 16♀, 1 sex undetermined; QDPIF: 70♂, 86♀; SPC: 1♂, 3♀.

Host associations. Bactrocera caryeae Kapoor (2), *B. cucurbitae* (1, 2), *B. curvipennis* (Froggatt) (2, 3), *B. dorsalis* (Hendel) (2, 3), *B. frauenfeldi* (1, 2), *B. latifrons* (Hendel) (2), *B. passiflorae* (1), *B. pedestris* (Bezzi) (2), *B. psidii* (Froggatt) (2), *B. tryoni* (2), *B. umbrosa* (1), *B. xanthodes* (Broun) (1), *B. zonata* (Saunders) (2), *Dacus ciliatus* Loew (2), and *Ceratitis capitata* (Wiedemann) (2).

Comments. Morphologically similar to *D. kraussii* and *D. hageni*. Distinguished by pale coloration and having striae on metasomal tergum 2. *Diachasmimorpha longicaudata* is not considered native to the South Pacific region, but was introduced to Australia and elsewhere around the Pacific from Hawaii for the biological control of pest *Bactrocera* species during the 1950s. Multiple releases were made under a number of different varietal names, the biological status of which was, and is still, unclear (O'Connor, 1960; Wharton & Gilstrap, 1983; Waterhouse, 1993). There are a range of colour variants of *D. longicaudata* on several of the Pacific islands and since this species, and those related to it, have traditionally been separated only by colour and the presence or absence of striae on tergum 2, this creates a taxonomic problem. All of the variations have been listed here as *D. longicaudata*, however, further study is required to accurately differentiate these populations and determine their true biological status.

Diachasmimorpha tryoni (Cameron)

(fig. 6)

Opius tryoni Cameron, 1911: 343.
Diachasma tryoni: Silvestri, 1913: 116.
Opius (Biosteres) tryoni: Fischer, 1959: 29.
Biosteres (Parasteres) acidusae Fischer, 1967b: 3; syn. by Wharton & Marsh, 1978: 157.
Biosteres tryoni: Fischer, 1971a: 31.
Parasteres tryoni: Fischer, 1978: 394.
Diachasmimorpha tryoni: Wharton, 1987: 62.

Description. Frons and vertex setose and punctate. Frons polished and weakly punctate, the punctures anteriad the ocellar field sparse and shallow; ocellar triangle arranged to form an obtuse triangle with a slight depression anteriad the median ocellus. Occipital carina weakly developed to almost absent; clypeus in profile slightly bulged medially; ventral margin of clypeus sinuate, ventral margin sufficiently convex to completely conceal labrum when mandibles closed. Notauli deep, unsculptured; propodeum weakly rugose laterally, with a median longitudinal carina stemming from a weakly developed pentagonal areola, the base of which coincides with the posterior margin. Sternaulus broad, shallow, crenulate. Wings strongly infumate. Forewing r arising slightly basad midpoint of stigma, 2RS about equal in length to 3RSa, (RS + M)a weakly sinuate; (RS + M)b absent, m-cu arising distad 2RS. Hindwing RS absent; m-cu well developed and pigmented to wing margin. Petiole with dorsal lateral carinae strongly elevated over basal half, weaker posteriorly but reaching the posterior margin. Metasomal tergum 2 smooth and polished. Ovipositor sheath about equal in length to body including head. Ovipositor subapically sinuate. Head and mesosoma yellow/orange, petiole and tergum 2 black medially, pale to almost white laterally, remainder of metasoma black dorsally; fore and mid legs yellow/orange except tarsal segments 4–5 brown, hind leg basal half of coxa yellow orange, remainder of leg dark brown.

Distribution. Australia: collected along the eastern coast of Australia, from Mossman in the north to Sydney in the south.

Type locality. Narara, Australia.

Material examined. ANIC: 20♂, 23♀, 1 sex undetermined; ASCU: 15♂, 3♀; QDPIF: 5♂, 11♀.

Host associations. Bactrocera dorsalis (2), *B. halfordiae* (Tryon) (1), *B. passiflorae* (2), *B. tryoni* (1, 2, 3, 7), *B. xanthodes* (2), and *C. capitata* (2, 7).

Comments. Morphologically similar to *D. hageni*, *D. kraussi* and *D. longicaudata* in having an apically sinuate ovipositor and notauli deep and unsculptured to midpit. Distinguished by dark metasomal coloration, metasomal tergum 2 smooth and polished and having a weakly developed occipital carina. *Diachasmimorpha tryoni* is native to eastern Australia (Silvestri, 1914; Wharton & Gilstrap, 1983) and was released, but did not become established, in Fiji, French Polynesia and Western Australia (Waterhouse, 1993).

Fopius arisanus (Sonan)

(fig. 7)

Opius arisanus Sonan, 1932: 67–68.
Opius oophilus Fullaway, 1951: 248; syn. by Wharton & Gilstrap, 1983: 730.
Diachasma arisanum: Fischer, 1967a: 68; Fischer, 1988: 250.
Biosteres arisanus: Wharton & Gilstrap, 1983: 730.
Fopius arisanus: Waterhouse, 1993: 41.

Description. Frons and vertex densely setose and rugose-punctate. Occipital carina well developed; clypeus in profile not bulging medially, ventral margin almost completely concealing labrum when mandibles closed. Notauli deep and foveolate/crenulate to midpit; propodeum rugose, the sculpture largely without obvious pattern. Sternaulus rugose. Wings weakly infumate. Forewing r arising distad midpoint of stigma, 2RS longer than 3RSa, (RS + M)a weakly sinuate; (RS + M)b sinuate, m-cu arising basad or directly in line with 2RS. Hindwing RS virtually absent, m-cu well developed and at least weakly pigmented to wing margin. Petiole longitudinally striate, dorsal carinae elevated over basal half and reaching posterior margin. Metasomal tergum 2 longitudinally striate. Ovipositor sheath equal to or greater than length of metasoma. Ovipositor narrowed apically, with distinct subapical constriction. Head almost entirely orange-brown, antennae dark; mesosoma varying from orange brown anteriorly, darker brown posteriorly to entirely brown (males often darker than females); metasoma dark brown to black. Legs pale yellow, except tarsi brown.

Distribution. Australia: collected along the eastern coast of Australia, from Cape Tribulation in the north to Sydney in the south, and Lord Howe Island. Cook Islands (New

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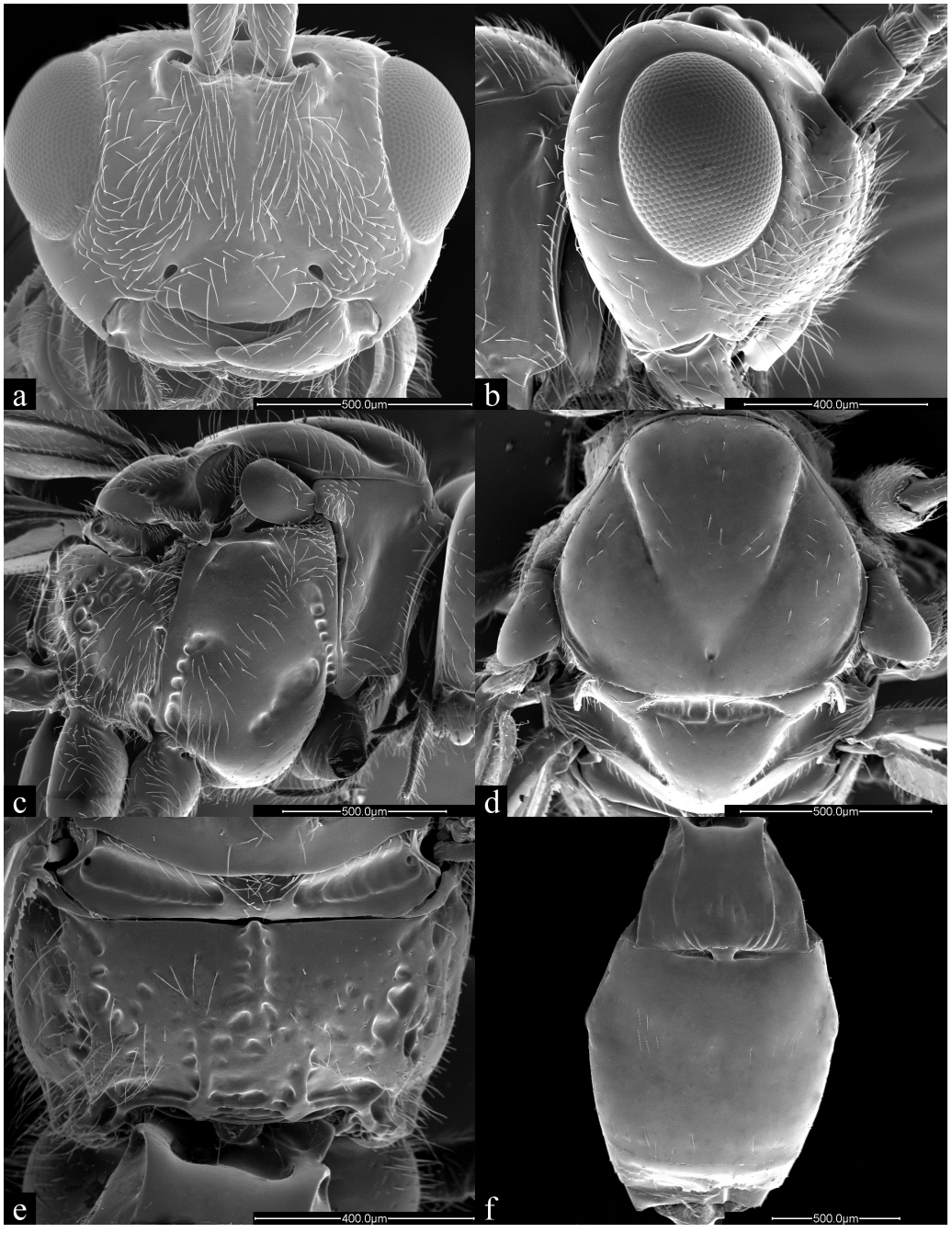

Fig. 6. *Diachasmimorpha tryoni*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

Zealand): Rarotonga. Fiji: collected from many sites on Viti Levu and Vanua Levu, also collected on Mana Island and the islands of the Lau and Yasawa groups. Tonga: Havelotu and Tongatapu. Western Samoa: Savoli and Upolu.

Type locality. Funkiko, Arisan, 1400 m, Formosa (Taiwan).

Material examined. ANIC: 86♂, 105♀, 18 sex undetermined; ASCU: 3♂, 4♀; QDPIF: 416♂, 711♀, 34 sex undetermined; SPC: 2♂, 3♀.

Host associations. Bactrocera aberrans (Hardy) (1), *B. barringtoniae* (1, 4), *B. cacuminata* (1, 2, 4), *B. distincta* (Malloch) (1), *B. dorsalis* (2, 3, 4), *B. endiandrae* (Perkins & May) (1), *B. facialis* (Coquillett) (1), *B. jarvisi* (1, 4), *B. kirki* (Froggatt) (1), *B. kraussi* (1, 4), *B. latifrons* (2, 4), *B. manskii* (Perkins & May) (1), *B. melanotus* (Coquillett) (1), *B. neohumeralis* (1, 4), *B. passiflorae* (1, 2, 4), *B. tryoni* (1), *B. xanthodes* (1), and *C. capitata* (2).

Comments. Morphologically similar to *F. illusorius* in its dark coloration and sculpture of the notauli, however, it can be

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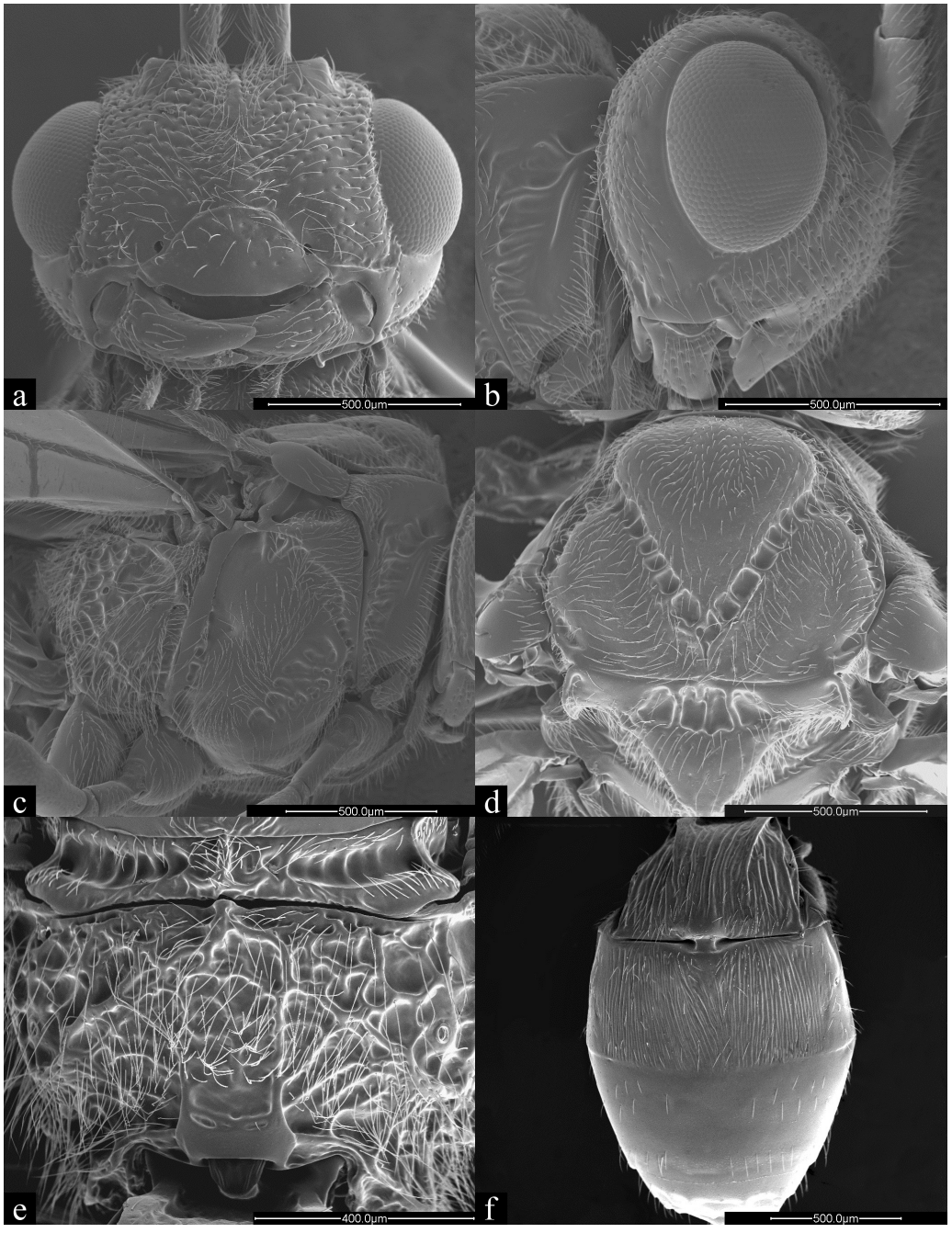

Fig. 7. *Fopius arisanus*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

readily distinguished in having dense longitudinal striations on tergum 2. *Fopius arisanus* (as *Opius oophilus*) was introduced to Australia from Hawaii, for the control of *B. tryoni*, in 1956–57 and again in 1958–59, with the first liberation not thought to have established (Waterhouse, 1993). *Fopius arisanus* has also been introduced to Fiji (1951 and 1954). Although there is no record of its introduction there, *F. arisanus* has been recovered on the Cook Islands (Waterhouse, 1993).

Fopius deeralensis (Fullaway)

(fig. 8)

Opius deeralensis Fullaway, 1950: 65.
Opius (Biosteres) deeralensis: Fischer, 1963b: 230.
Biosteres deeralensis: Fischer, 1971a: 23.
Biosteres (Chilotrichia) deeralensis: Fischer, 1978: 386.
Fopius deeralensis: Waterhouse, 1993: 41.

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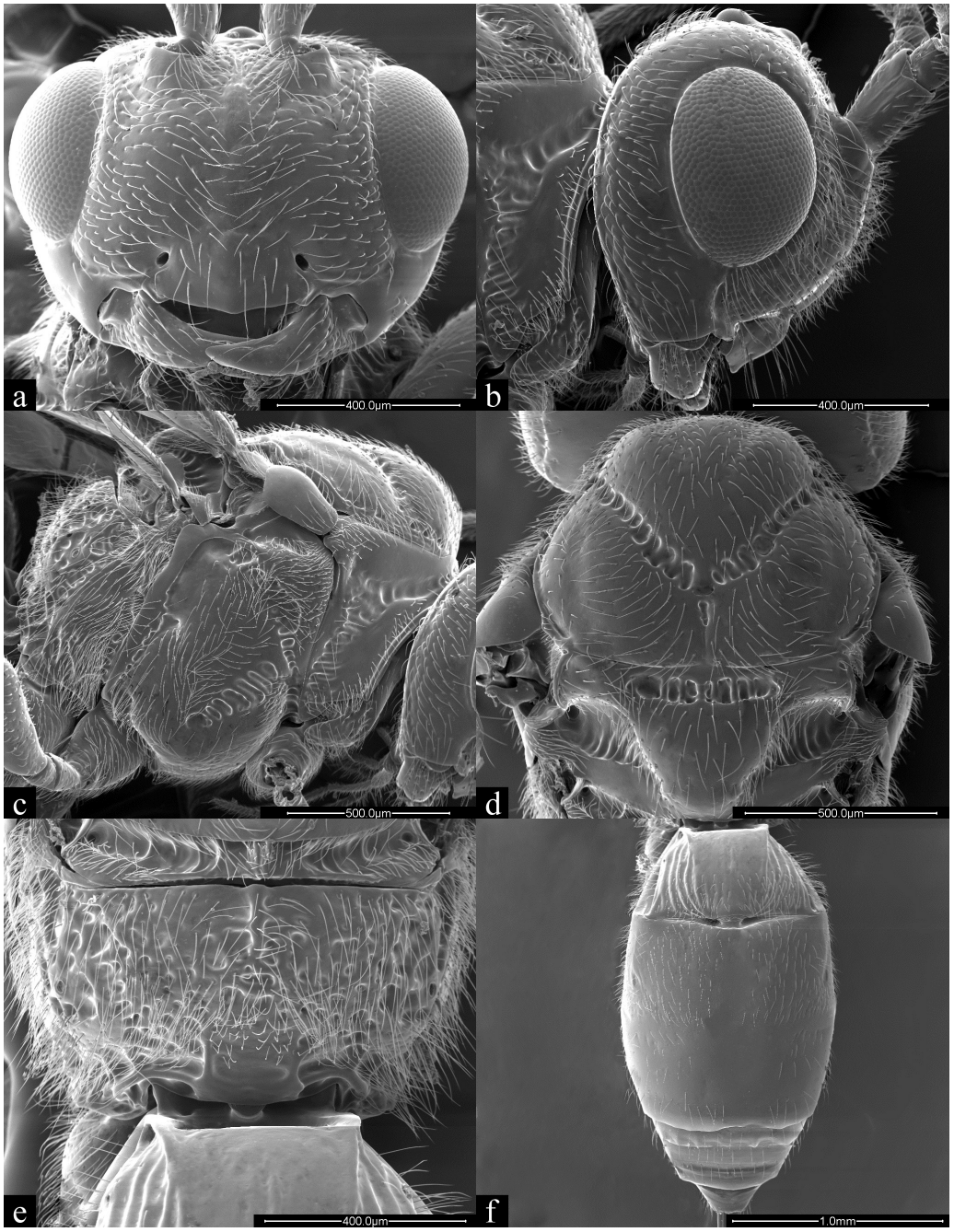

Fig. 8. *Fopius deeralensis*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

Description. Frons and vertex densely setose; frons densely punctate, vertex more sparsely and weakly punctate. Frons with polished, weakly elevated projection extending from the median ocellus at least half the distance to torulus. Ocellar triangle arranged to form an obtuse triangle with a slight depression anteriad the median ocellus. Occipital carina well developed; clypeus with anterior margin very obtusely angulate, forming an indistinct median tooth. Notauli foveolate/crenulate to midpit; propodeum irregularly areolate with coarse rugose sculpture; median carina distinct on basal 0.3–0.4. Sternaulus broad, deep, crenulate. Wings infumate. Forewing r arising from or slightly distad midpoint of stigma, 2RS longer than 3RSa, (RS + M)a weakly sinuate; (RS + M)b varying from short to absent, m-cu arising basad or directly in line with 2RS. Hindwing RS absent; m-cu well developed and pigmented to wing margin. Petiole longitudinally striate, dorsal lateral carinae strongly elevated over basal two-thirds, converging posteriorly and extending to posterior margin.

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Metasomal tergum 2 sometimes smooth and laterally setose, frequently with weak longitudinal striae especially anteromedially. Ovipositor sheath equal to or longer than length of body including head. Whole body yellow/orange except hind tibiae and tarsi dark brown.

Distribution. Australia: collected in north eastern Australia, from Stephen Island in the north to Brisbane in the south. Papua New Guinea: New Britain (but see Comments).

Type locality. Deeral, Australia.

Material examined. ANIC: 17♂, 13♀, 3 sex undetermined; ASCU: 1♂, 1♀; QDPIF: 30♂, 60♀.

Host associations. Bactrocera aglaiae (Hardy) (1), *B. barringtoniae* (1, 2), *B. endiandrae* (1, 2), *B. fagraea* (Tryon) (2), *B. frauenfeldi* (1, 2, 3), *B. jarvisi* (2), *B. kraussi* (2), *B. laticaudus* (Hardy) (2), *B. musae* (Tryon) (2, 3), *B. pallida* (1, 2), and *B. tryoni* (1, 2, 3).

Comments. Morphologically similar to *F. schlingeri* in coloration and notauli sculpture, however, *F. deeralensis* has a distinctly angulate clypeus and frequently has weak striae on metasomal tergum 2. *Fopius deeralensis* was recorded from Australia (Queensland) and Papua New Guinea (New Britain Island) by Wharton & Gilstrap (1983), however, this publication predates the description of *F. schlingeri* by Wharton (1999). No Papua New Guinea material examined by us fit the description of *F. deeralensis* and its presence in that country must now be reassessed.

Fopius ferrari Carmichael & Wharton, sp. n.

(fig. 9)

Diagnosis. This species is similar to the Philippines species *F. skinneri* (Fullaway) in coloration, but differs from *F. skinneri* and darker specimens of *F. arisanus* by the absence of striae on metasomal tergum 2. The pattern of metasomal colour and sculpture thus closely resembles that of *F. illusorius*. The clypeus, however, differs from that of *F. illusorius* and is similar to that of *F. deeralensis*. *Fopius deeralensis* is variable in T2 sculpture but is readily differentiated from the new species because of its yellow to orange coloration.

Description. Frons and vertex densely covered with white, decumbent setae; densely but finely punctate. Frons with polished, elevated projection extending from median ocellus almost to torulus; ocellar triangle otherwise margined by an impressed line. Occipital carina well developed, in lateral view extending dorsally nearly level with top of eye. Clypeus smooth, polished, very sparsely covered with long, erect setae, ventral margin obtusely angulate, forming a distinct median tooth; clypeus bulging along midline in profile. Notauli deep and foveolate-crenulate to midpit; midpit extending narrowly to posterior margin of scutum; propodeum exceptionally densely setose and rugose, the sculpture largely without obvious pattern except for median carina on basal 0.3; postpectral carina present. Sternaulus broad, crenulate/rugose throughout. Wings hyaline to weakly infumate. Forewing r arising slightly distad midpoint of stigma, 2RS longer than 3RSa, (RS + M)a weakly sinuate; (RS + M)b absent, m-cu arising directly in line with 2RS. Hindwing RS absent; m-cu developed and pigmented, but not reaching wing margin. Petiole weakly bicarinate longitudinally, otherwise polished, setose and weakly striate. Metasomal tergum 2 smooth (occasionally weakly striate) and densely setose; tergum 3 densely setose at least laterally. Ovipositor sheath almost twice length of metasoma; ovipositor not narrowed apically. Entire body dark brown to black. Fore and mid legs brown, hind legs dark brown to black.

Distribution. Papua New Guinea: collected from low altitude regions of the main island of New Guinea.

Material examined. Holotype ♀; 3 labels, Label 1: Morobe Province, Lae: Bundun Conf Centre, 1.vi.2000, Label 2: Bred from: *Persea americana* Lauraceae N1516, Label 3: In association with *[Bactrocera] frauenfeldi* (QM). Paratypes: 1♀ (ANIC): 3 labels, Label 1: PNG Morobe Province, Lae, Wampit village area, 16.ii.2000, Label 2: Bred from *Musa* ?, Musaceae, N 1263, Label 3: In association with [*Bactrocera*] *musae*. 1♀ (ANIC): Label 1: PNG Morobe Province Lae, Bukawa Tikeling 2 forest 27.v.1999 Label 2: Bred from ? N557 Label 3: In association with [*Bactrocera*] *redunca*; 3♂(ANIC): 3 labels, Label 1: PNG Morobe Province, Lae, Wampit village area, 16.ii.2000, Label 2: Bred from *Musa* ?, Musaceae, N 1263, Label 3: In association with [*Bactrocera*] *musae*. 2♀, 2♂ (QM): 3 labels, Label 1: PNG Morobe Province, Lae: FRI forest botanical garden, 16.v.2000, Label 2: Bred from: ? N 1462, Label 3: In association with [*Bactrocera*] *frauenfeldi* and [*Bactrocera*] *trivialis*. 3♀ (QM): 3 labels, Label 1: PNG Morobe Province, Lae, Gabensis Village, 6.iv.2000, Label 2: Bred from: *Psidium guajava*, Myrtaceae, N1384, Label 3: In association with [*Bactrocera*] *frauenfeldi*. 2♀, 1♂ (QM), 1♀ (ANIC): 3 labels, Label 1: PNG Morobe Province, Lae, Omsis forest, 11.vii.2000, Label 2: Bred from: ?, N1562, Label 3 In association with [*Bactrocera*] *vulagaris* [sic]. 1♀ (QM): 2 labels, Label 1: PNG Central Province, Bereina Station, Joe Aisa residence, 17.v.1999, Label 2: Bred from *Averrhoa carambola* Oxalidaceae, L 2552.

Other material examined. Papua New Guinea: Madang Province, Baitabag, 16.viii.2000, ex *Neisosperma oppositifolia*, M 220, 10 sex undetermined (specimens damaged); Morobe Province, Lae: Bukawa, Tikeling 2 forest, 27.v.1999, in association with *Bactrocera redunca*, N 557, 1; Morobe Province, Lae: Omsis forest, 1.vi.2000, in association with *Bactrocera trivialis?*, N 1513(A), 1♂; Morobe Province, Lae, Gabensis Village, 6.iv.2000, ex *Psidium guajava*, Myrtaceae, in association with [*Bactrocera*] *frauenfeldi* N1384, 1♂, 1 sex undetermined (specimen damaged).

Etymology. Named after Dr Paul Ferrar, recently retired as Crop Sciences II Programme Manager at the Australian Centre for International Agricultural Research. Paul's long-term support for regional fruit fly research lead directly to several projects which helped generate the parasitoid collections upon which this paper is based.

Comments. Although this species appears at first glance to be just a somewhat darker, more densely setose variety of *F. illusorius*, the ovipositor and clypeus are sufficiently different to warrant description as a separate species. The tip of the ovipositor is not narrowed as it is in *F. illusorius* and *F. arisanus*.

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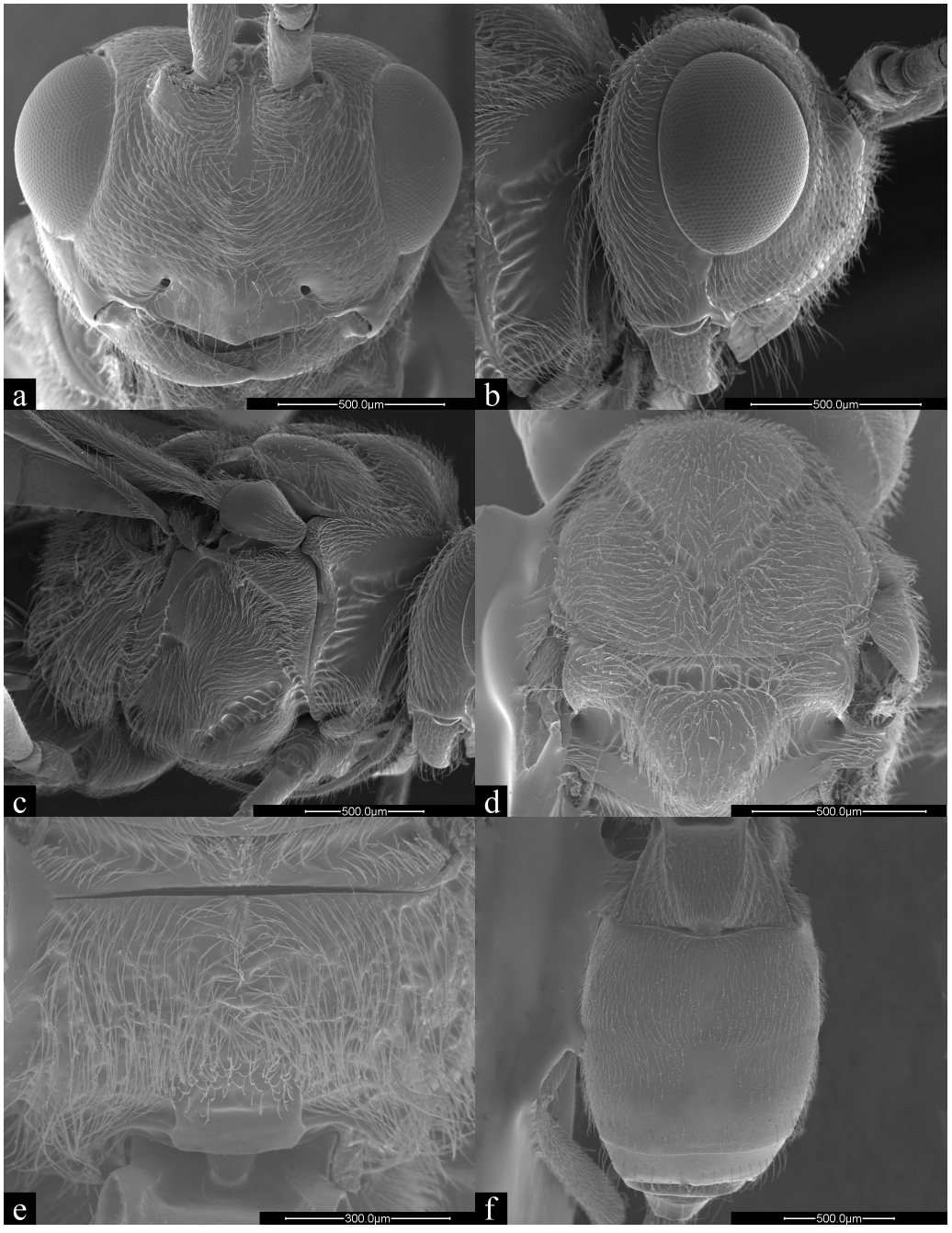

Fig. 9. *Fopius ferrari*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

Fopius illusorius (Fischer) comb. n.

(fig. 10)

Biosteres illusorius Fischer, 1971b: 487.
Biosteres (Chilotrichia) illusorius: Fischer, 1978: 386.

Description. Frons and vertex densely setose; frons rugose-punctate, vertex densely punctate. Ocellar triangle arranged to form an obtuse triangle with a slight depression anteriad the median ocellus. Occipital carina well developed; clypeus in profile bulging very slightly dorsomedially, ventral margin slightly thickened medially, without distinct medial projection. Notauli deep, foveolate/crenulate to midpit; propodeum rugose, the sculpture largely without obvious pattern except for median carina on basal 0.3; postpectral carina present. Sternaulus deep, broad, crenulate. Wings infumate. Forewing

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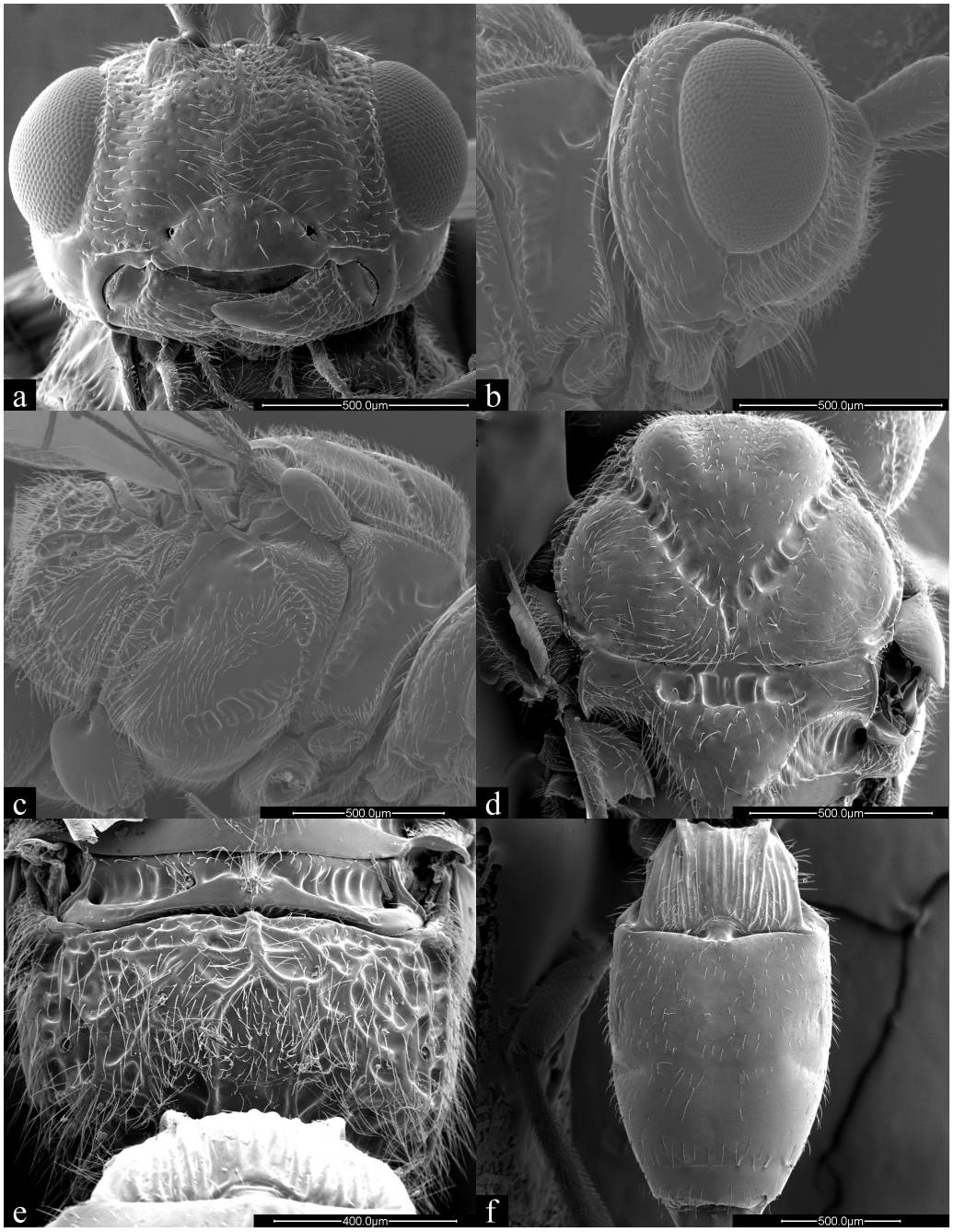

Fig. 10. *Fopius illusorius*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

r arising slightly distad midpoint of stigma, 2RS longer than 3RSa, (RS+M)a weakly sinuate; (RS+M)b usually present, m-cu arising distad or directly in line with 2RS. Hindwing RS virtually absent basally, represented only by a faint crease near the wing margin; m-cu well developed and at least weakly pigmented to wing margin. Petiole longitudinally striate, dorsal lateral carinae elevated over basal half and extending to posterior margin. Metasomal tergum 2 usually smooth, polished, and setose; occasionally with a few weak striae antero-medially. Ovipositor sheath equal in length to mesosoma plus metasoma; ovipositor tip narrower apically, with weak subapical constriction. Head orange-brown; mesosoma orange brown, with propodeum and usually metathorax dark brown to black; metasoma dark brown to black. Fore and mid legs yellow, except mid coxa dark brown dorsally; hind legs dark brown to black with apical tarsomeres lighter brown. Females tend to be slightly darker than males.

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Distribution. Australia: Nambour. Papua New Guinea: collected from low altitude regions of the main island of New Guinea, the Gazelle Peninsular of East New Britain and Duke of York Island. Solomon Islands Visale/Guadalcanal and Ysabel.

Type locality. Original reference: Waris, Hollandia, Papua New Guinea. [Hollandia is actually a province of Indonesia, now officially known as 'Irian Jaya' or 'West Papua'.]

Material examined. BPBM: 1♂; GU: 227♂, 504♀, 65 sex undetermined; QDPIF: 3♂, 2♀; TAMU: 15♂, 20♀.

Host associations. Bactrocera frauenfeldi (1) and *B. musae* (1).

Comments. This species is here transferred to the genus *Fopius* Wharton on the basis of mandibular morphology, wing venation and sculpture of the mesosoma. Additionally it has the long ovipositor typical of most *Fopius* species. This species is distinct from nearly all *Biosteres* species due to the absence of a strong basal tooth or lobe, a feature characteristic of all other *Biosteres* species except *B. blandus* (Wharton, 1997). Unlike the type species of *Chilotrichia*, the hindwing RS is absent basally and only represented by a faint crease near the apex of the wing. The propleuron has the strongly developed oblique ridge typical of *Fopius* and the postpectal carina is also well developed. As noted above, *F. illusorius* is similar in coloration to *F. arisanus*, but the second metasomal tergum is smooth or nearly so. *Fopius illusorius* was previously known only from the original description (Fischer, 1971b) based on two males. The previously undescribed female has an ovipositor that is morphologically similar to that of *F. arisanus* and thus *F. illusorius* may oviposit in the eggs of its host as does *F. arisanus*. The hosts of *F. illusorius* were previously unknown as the males from the type series were collected with a sweep net.

Fopius schlingeri Wharton

(fig. 11)

Fopius schlingeri Wharton, 1999: 58.

Description. Frons and vertex densely setose; frons densely punctate, vertex more sparsely and weakly punctate. Frons with polished, weakly elevated projection extending from median ocellus at least half the distance to torulus. Ocellar triangle arranged to form an obtuse triangle with a slight depression anteriad the median ocellus. Occipital carina well developed; clypeus with rounded ventral margin. Notauli foveolate/crenulate to midpit; propodeum densely rugose, the sculpture without obvious pattern except for median carina basally. Sternaulus broad, deep, crenulate. Wings weakly infumate. Forewing r arising slightly distad midpoint of stigma, 2RS slightly longer than 3RSa, (RS+M)a sinuate; (RS+M)b present, m-cu arising basad 2RS. Hindwing RS virtually absent, represented only by a faint crease near wing margin; m-cu well developed and pigmented to wing margin. Petiole longitudinally, somewhat irregularly striate, dorsal lateral carinae well developed over basal two-thirds, weaker posteriorly. Metasomal tergum 2 smooth and setose laterally. Ovipositor sheath equal to or longer than length of body including head. Ovipositor tip strongly narrowed subapically. Whole body yellow/orange except hind tarsi dark brown.

Distribution. Australia: collected along the eastern coast of Australia, from Cape Tribulation in the north, to Sydney in the south. Papua New Guinea: collected from low altitude regions of the main island of New Guinea and the Gazelle Peninsula of East New Britain.

Type locality. Mount Glorious, Australia.

Material examined. ANIC: 6♂, 10♀; ASCU: 2♀; GU: 20♂, 65♀; QDPIF: 13♂, 34♀.

Host associations. Bactrocera frauenfeldi (1), *B. halfordiae* (1, 5), *B. kraussi* (1), *B. musae* (1), *B. neohumeralis* (1, 5), *B. penefurva* (1), *B. peninsularis* (Drew & Hardy) (5), *B. rufofuscula* (Drew & Hancock) (5), *B. tinomiscii* Drew (1), *B. tryoni* (5), and *B.* (*Bulladacus*) sp. (1).

Comments. Morphologically similar to *F. deeralensis* in coloration and in sculpture of the frons, vertex, and notauli. However, *F. schlingeri* has a rounded clypeus, without a distinct medial projection. Originally described as occurring along the eastern coast of Australia (Wharton, 1999), the native range is now extended to include Papua New Guinea.

Fopius cf. *vandenboschi*

(fig. 12)

Description. Frons and vertex densely setose and punctate. Frons with polished, weakly depressed, laterally carinate projection extending from median ocellus at least half the distance to torulus; frons otherwise weakly punctate, the punctures anteriorad ocellar field dense, with spacing between punctures slightly less than diameter of punctures; ocellar triangle margined by an impressed line. Occipital carina well developed. Clypeus in profile bulging dorsomedially; ventral margin of clypeus slightly thickened medially, and sufficiently convex to completely conceal labrum when mandibles closed. Notauli deep and foveolate/crenulate to midpit; propodeum rugose, the sculpture largely without obvious pattern. Sternaulus broad, deep, crenulate/rugose throughout. Wings weakly infumate. Forewing r arising slightly distad midpoint of stigma, second submarginal cell short, 2RS slightly longer than 3RSa, (RS+M)a sinuate; (RS+M)b short to absent, m-cu arising basad or directly in line with 2RS. Hind wing RS virtually absent; m-cu well developed and at least weakly pigmented to wing margin. Petiole longitudinally striate, dorsal lateral carina weakly developed to posterior margin. Metasomal tergum 2 striate. Ovipositor sheath about equal in length to body including head. Apex of ovipositor parallel sided with very weak dorsal node. Head and mesosoma yellow/orange, metasoma yellow orange with terga 2+3 and often 4 black, sternites pale yellow/brown to almost white; petiole varying from orange to dark brown.

Distribution. Papua New Guinea: Kerevat.

Material examined. GU: 10♂, 25♀; TAMU: 1♀.

Host associations. Bactrocera frauenfeldi (1).

Comments. Fopius vandenboschi (Fullaway) appears to consist of a number of colour morphs and potentially cryptic species in

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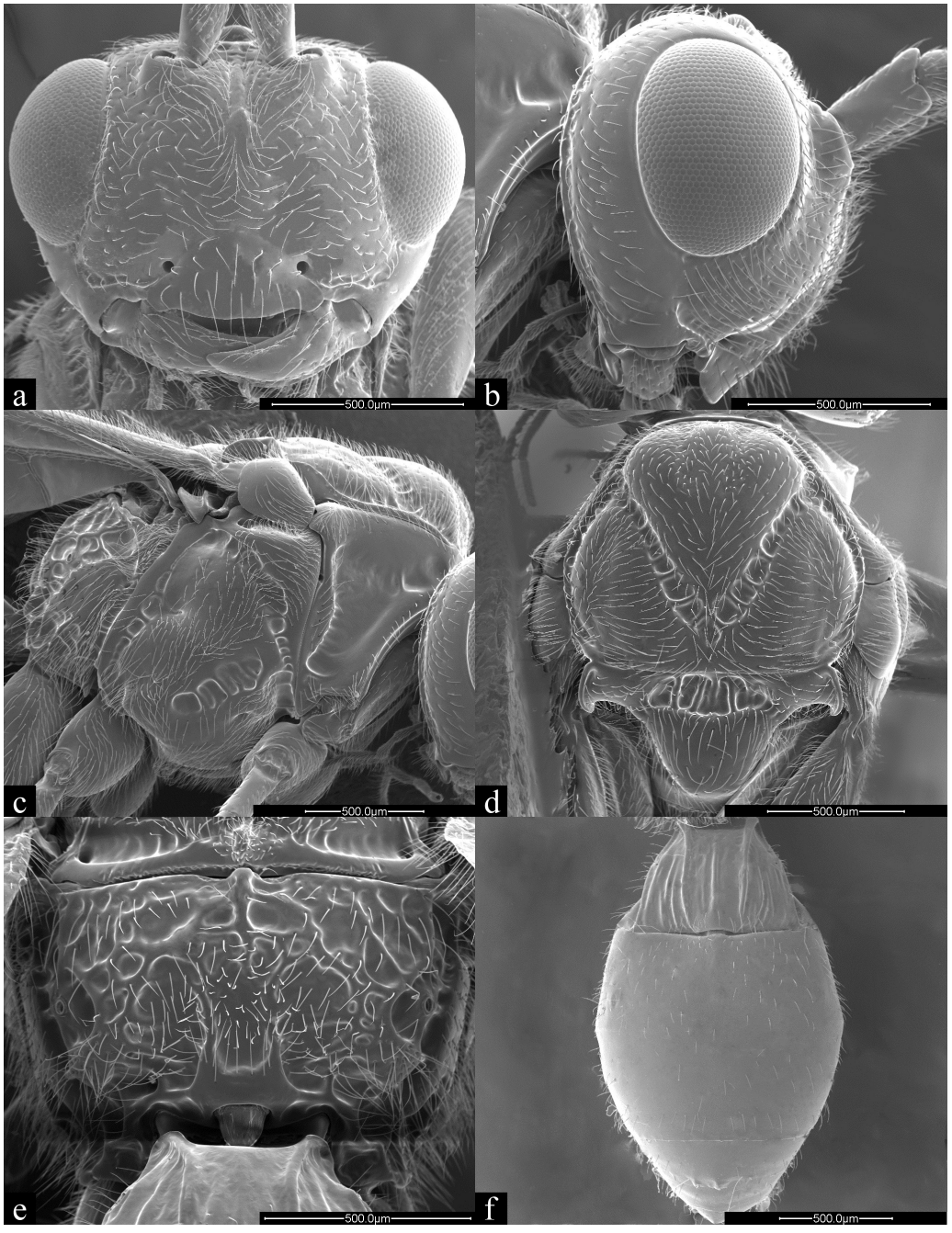

Fig. 11. *Fopius schlingeri* Carmichael & Wharton, new species. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

the Indo-Pacific region. This colour form is potentially distinct from the true *F. vandenboschi*, having developed in isolation on the island of New Britain. Slight differences in clypeal morphology and punctation of the vertex and frons provide support for considering this distinctive colour morph as a separate species, but further studies are needed. The second metasomal tergum is more extensively striate than shown in fig. 12f both in typical *F. vandenboschi* and in the New Britain material.

Opius froggatti (Fullaway)

(fig. 13)

Opius froggatti Fullaway, 1950: 67.
Opius (Opius) froggatti: Fischer, 1963b: 203.
Opius (Utetes) froggatti: Fischer, 1987: 186.
Opius froggatti: Wharton, 1997: 29.

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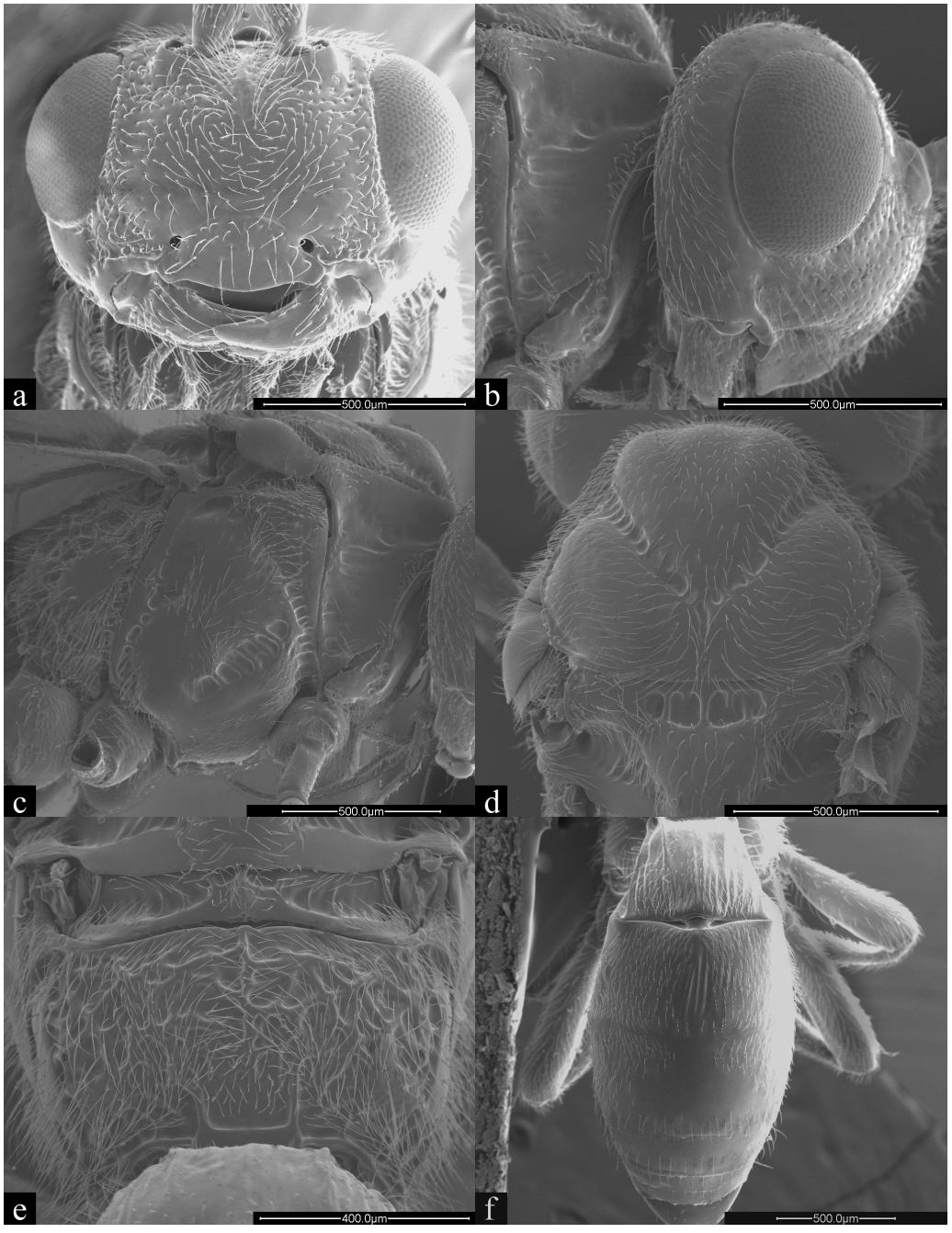

Fig. 12. *Fopius* cf. *vandenboschi*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

Description. Frons and vertex polished and sparsely setose. Ocelli arranged in an equilateral triangle margined by a depression. Occipital carina well developed. Clypeus in profile bulging dorsomedially; labrum visible in frontal view; gap between mandible and ventral margin of clypeus large and distinct. Notauli beginning as deep grooves, converging and becoming shallower posteriorly, meeting in a deep circular midpit. Propodeum reasonably smooth, usually with a complete medial longitudinal carina. Sternaulus shallow, minutely crenulate throughout. Wings weakly infumate. Forewing r arising slightly basad midpoint of stigma, 2RS notably shorter than 3RSa, (RS+M)a weakly sinuate; (RS+M)b absent, m-cu arising distinctly distad 2RS. Hind wing RS and m-cu absent. Petiole with dorsal lateral carinae elevated, diverging posteriorly, but extending to posterior margin. Metasomal tergum 2 smooth and polished. Ovipositor sheath about two-thirds length of metasoma. Whole body yellow orange in coloration.

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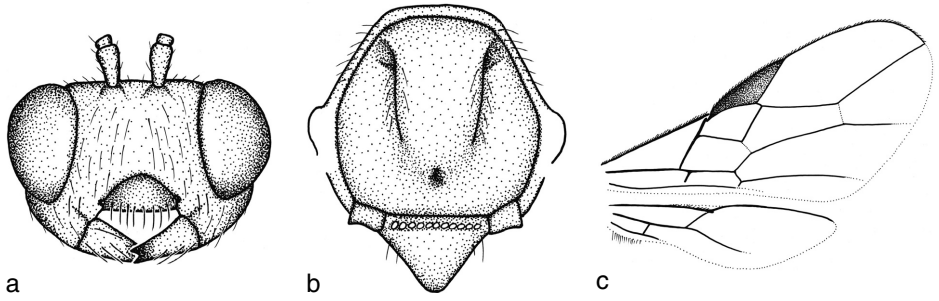

Fig. 13. *Opius froggatti*. a, head, anterior view; b, mesonotum, dorsal view; c, wing.

Distribution. Australia: Deeral.

Type locality. Deeral, Australia.

Material examined. ASCU: 1♂, 1♀, 2 sex undetermined.

Host associations. Bactrocera kraussi (2), *B. laticaudus* (2), and *B. psidii* (2, 3).

Comments. Opius froggatti is morphologically similar to species in the genus *Utetes* (venation, readily visible labrum, distinct median pit on mesoscutum), but can be easily distinguished by the absence of a basal carina on the hind tibia. *Opius froggatti* is similar to *Utetes perkinsi* in having weakly developed notauli, but in addition to the presence of a tibial carina, the latter has a dark head.

Psyttalia fijiensis (Fullaway)

Opius fijiensis Fullaway, 1936: 179.
Austroopius fijiensis: Fischer, 1963a: 177.
Psyttalia (*Austroopius*) *fijiensis*: Wharton, 1987: 64.
Psyttalia fijiensis: Waterhouse, 1993: 42.

Description. See *P. novaguineensis*

Distribution. Australia: collected in north eastern Australia, from Yam Island in the north, south to Brisbane; Fiji: Suva and surrounding area, Viti Levu. Solomon Islands: Bougainville Island. Tonga: Tongatapu and 'Eua Islands'.

Type locality. Noainee, Fiji Islands.

Material examined. ANIC: 24♂, 20♀, 5 sex undetermined; ASCU: 4♂, 7♀; QDPIF: 77♂, 81♀.

Host associations. Bactrocera aglaiae (1), *B. bancrofti* (Tryon) (1), *B. barringtoniae* (2), *B. curvipennis* (2), *B. endiandrae* (1), *B. facialis* (1), *B. fagraea* (2), *B. frauenfeldi* (2, 3), *B. jarvisi* (1, 2), *B. kirki* (1), *B. kraussi* (1, 2), *B. laticaudus* (2), *B. musae* (2, 3), *B. pallida* (1, 2), *B. passiflorae* (1, 2, 3), *B. psidii* (2), *B. tryoni* (1, 2, 3), *B. visenda* (Hardy) (1), and *B. xanthodes* (1, 2, 3).

Comments. According to Fischer (1963a), *P. fijiensis* should be readily separated from *P. novaguineensis* on the basis of a broad, infuscated stripe running medially across the forewing. However, in almost all specimens examined from Australia (including some of those previously determined as *P. fijiensis* by Fischer) this stripe was not readily apparent. In the specimens examined, the forewing pattern varied from distinctly infumate on the basal half to completely hyaline. The variation appeared to be continuous rather than representing two or more discrete patterns. In the absence of this distinctive wing pattern, we were unable to separate *P. fijiensis* from *P. novaguineensis*. The distribution and host records listed above are based solely on museum specimens of *P. fijiensis* previously determined as that species. All previously undetermined material is listed below under *P. novaguineensis* for reasons discussed under that species.

Psyttalia muesebecki (Fischer)

Austroopius muesebecki Fischer, 1963a: 182.
Psyttalia muesebecki: Wharton, 1987: 63.

Description. Frons and vertex polished and sparsely setose. Clypeus in profile slightly bulged medially; labrum visible in frontal view; gap between mandible and ventral margin of clypeus distinct. Notauli deep at anterior margin, ending before level of tegula and absent posteriorly. Midpit absent; propodeum smooth with median longitudinal carina absent. Sternaulus impressed, short, with just a trace of sculpture. Wing with second submarginal and discal cells infumate. Forewing 2RS shorter than 3RSa; (RS+M)b absent, 2RS in line with m-cu; 2RS thickened medially, junction of 2RS and m-cu thickened. Hindwing RS and m-cu absent. Petiole with dorsal lateral carinae elevated on basal 0.3, diverging and less well developed posteriorly. Metasomal tergum 2 smooth and polished. Ovipositor sheath longer than metasoma. Entire body yellow/orange in coloration.

Distribution. New Caledonia: Noumea.

Type locality. Noumea, New Caledonia.

Material examined. None.

Host associations. Bactrocera psidii (7).

Comments. Psyttalia muesebecki can be readily distinguished from other species of *Psyttalia* by the absence of a propodeal carina. No material was examined in this study.

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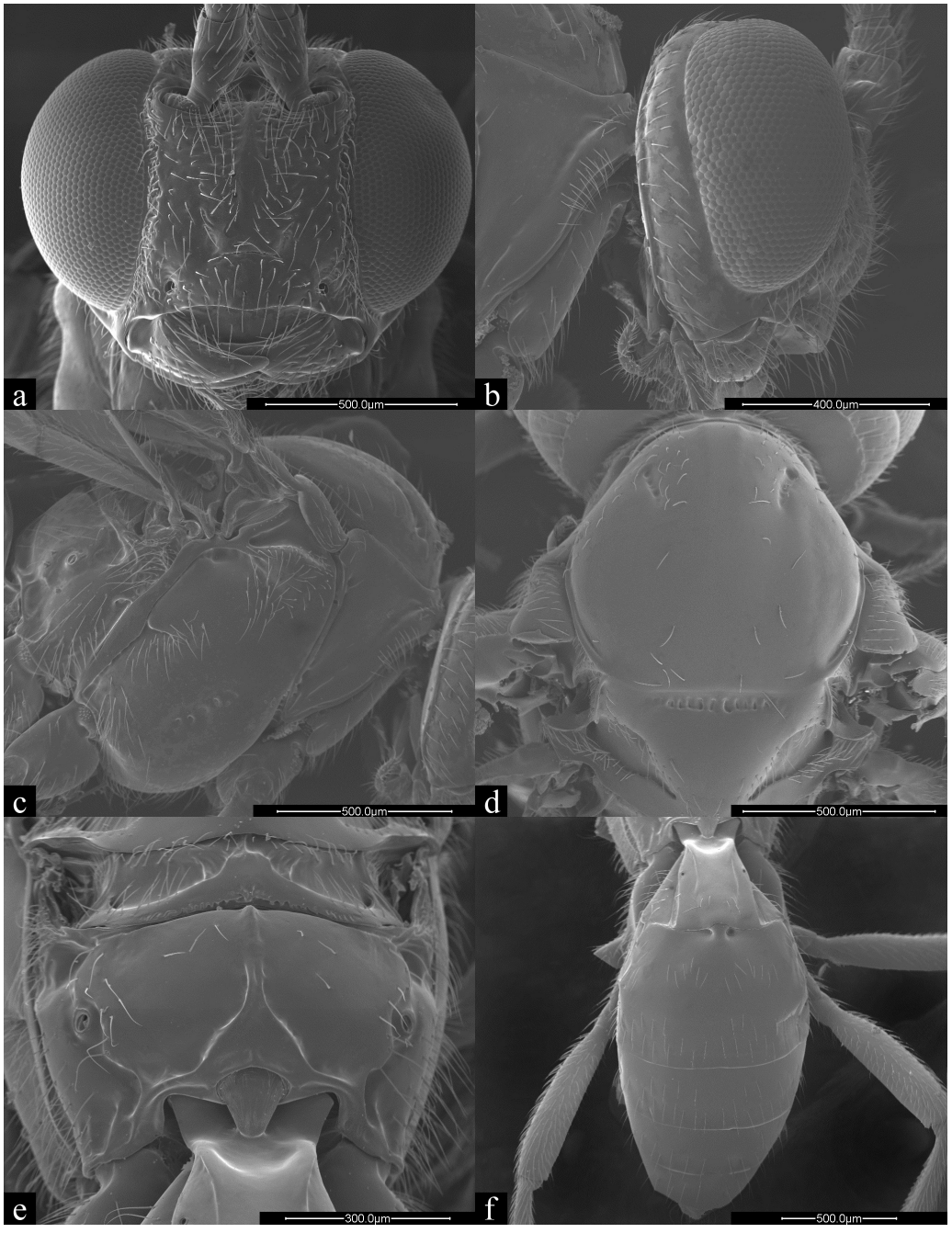

Fig. 14. *Psyttalia novaguineensis*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view; e, propodeum, dorsal view; f, metasoma, dorsal view.

***Psyttalia novaguineensis* (Szépligeti)**

(fig. 14)

Austroopius novaguineensis Szépligeti, 1900: 64.
Austroopius novoguineensis: Fischer, 1963a: 184.
Psyttalia novaguineensis: Wharton, 1987: 63.

Description. Frons and vertex polished and sparsely setose. Posterior ocelli margined laterally with deep anteriorly diverging grooves. Occipital carina well developed; clypeus in profile slightly bulged medially; labrum visible in frontal view; gap between mandible and ventral margin of clypeus distinct. Notauli deep at anterior margin, ending before level of tegula and absent posteriorly. Midpit absent; propodeum smooth with a median longitudinal carina. Sternaulus shallow, finely crenulate. Wing coloration variable (see discussion). Forewing r arising slightly basad midpoint of stigma, 2RS shorter than 3RSa; (RS+M)b absent, 2RS in line with m-cu; 2RS thickened

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medially, junction of 2RS and m-cu thickened. Hindwing RS and m-cu absent. Petiole with dorsal lateral carinae elevated, diverging posteriorly, but extending to posterior margin. Metasomal tergum 2 smooth and polished. Ovipositor sheath 1.5 times longer than metasoma. Entire body yellow/orange in coloration.

Distribution. Australia: Far north eastern Queensland. Papua New Guinea: collected from low altitude regions of the main island of New Guinea, the Gazelle Peninsular of East New Britain and Duke of York Island.

Type locality. Freidrich-Wilhelmshafen (now Madang), Papua New Guinea.

Material examined. GU: 38♂, 57♀, 3 sex undetermined; QDPIF: 25♂, 75♀.

Host associations. Bactrocera aglaiae (1), *B. barringtoniae* (1), *B. calophylli* (Perkins & May) (1), *B. endiandrae* (1), *B. fagraea* (1), *B. frauenfeldi* (1), *B. kraussi* (1), *B. musae* (1), *B. neohumeralis* (1), *B. penefurva* (1), *B. tinomiscii* (1), *B. visenda* (1), *B. (Bulladacus)* sp. (1), and *B. (Gymnodacus)* sp. (1).

Comments. Psyttalia novaguineensis is defined by Fischer (1963a) as having a uniformly hyaline or yellowish wing. The wing of *P. fijiensis*, in contrast, was described by the same author as having a broad infuscated band across the middle of the forewing. An indistinct band matching this description was visible in only a very few previously determined specimens of that species. However, several of the undetermined specimens examined by us have infuscate mottling all across the basal half of the wing. The infuscation appears to be more distinct in the males but there is also variation across females. The colour pattern is different from the broad median band described for *P. fijiensis*. A careful examination of material from northeastern Queensland, including both reared and unreared material, indicates that at least five species of *Psyttalia* occur in this area, four of which have an '*Austroopius*' wing vein pattern (*sensu* Fischer, 1963a: with a medially thickened 2RS). The most obvious difference among these species is in the length of the ovipositor. The reared material falls into three general categories: (i) ovipositor sheath about as long as mesosoma; (ii) ovipositor sheath nearly twice as long as mesosoma; and (iii) ovipositor sheath more than twice length of mesosoma. Previously undetermined material in which the ovipositor sheath is nearly twice as long as the mesosoma is tentatively placed under the name *P. novaguineensis*, since they most closely fit the redescription by Fischer (1963a). Note, however, that Szépligeti (1900) originally described the ovipositor of this species as very short. Further study is required in order to correctly place these specimens.

Utetes cf. *albimanus*

(fig. 15)

Description. Frons and vertex densely setose; and densely but finely punctate. Frons with median pit adjacent anterior ocellus, posterior ocelli margined laterally with weak, anteriorly diverging grooves. Occipital carina well developed. Clypeus in profile weakly protruding, overhanging base of

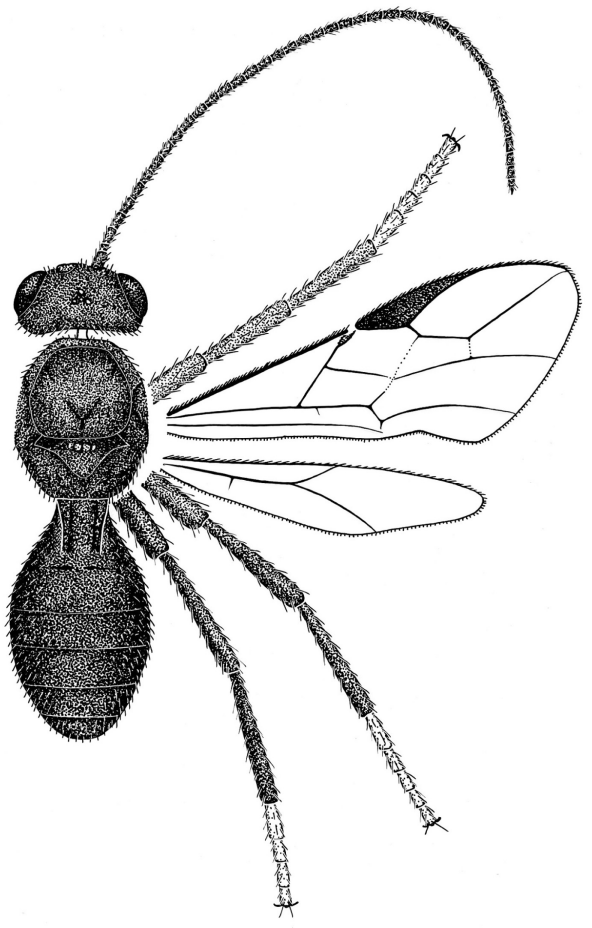

Fig. 15. *Utetes* cf. *albimanus*. Habitus.

labrum; clypeus in frontal view large and hemispherical, ventral margin thin, truncate to weakly convex; labrum visible in frontal view; gap between mandible and ventral margin of clypeus distinct but not large. Antennae 41 segmented. Notauli deep from anterior margin to level of tegula and absent or nearly so posteriorly. Midpit long, narrow, deep. Propodeum rugose throughout. Sternaulus broad, deep, crenulate throughout. Wings infumate. Forewing r arising from midpoint of stigma, 2RS slightly shorter than 3RSa, (RS+M)a weakly sinuate; (RS+M)b absent, m-cu entering second submarginal cell. Hind wing RS and m-cu absent. Basal carina on posterior side of hind tibia well developed (fig. 17). Petiole with dorsal lateral carinae strongly elevated over basal half, much weaker posteriorly, but extending to posterior margin. Metasomal tergum 2 smooth and polished. Head and mesosoma dark brown to black; metasoma dorsally black. Coxae and trochanters brown to dark brown, fore femur and tibia yellow brown, mid and hind femur and tibia brown to dark brown, tarsi 1–4 white, 5th tarsus brown.

Distribution. Papua New Guinea: Lae.

Material examined. GU: 1♂. Label data: Papua New Guinea: Morobe Province, Lae, Omsis Forest 16.ii.2000 ex *Gnetum gnemon* fruit containing *Bactrocera (Bulladacus)* sp. n. 1♂.

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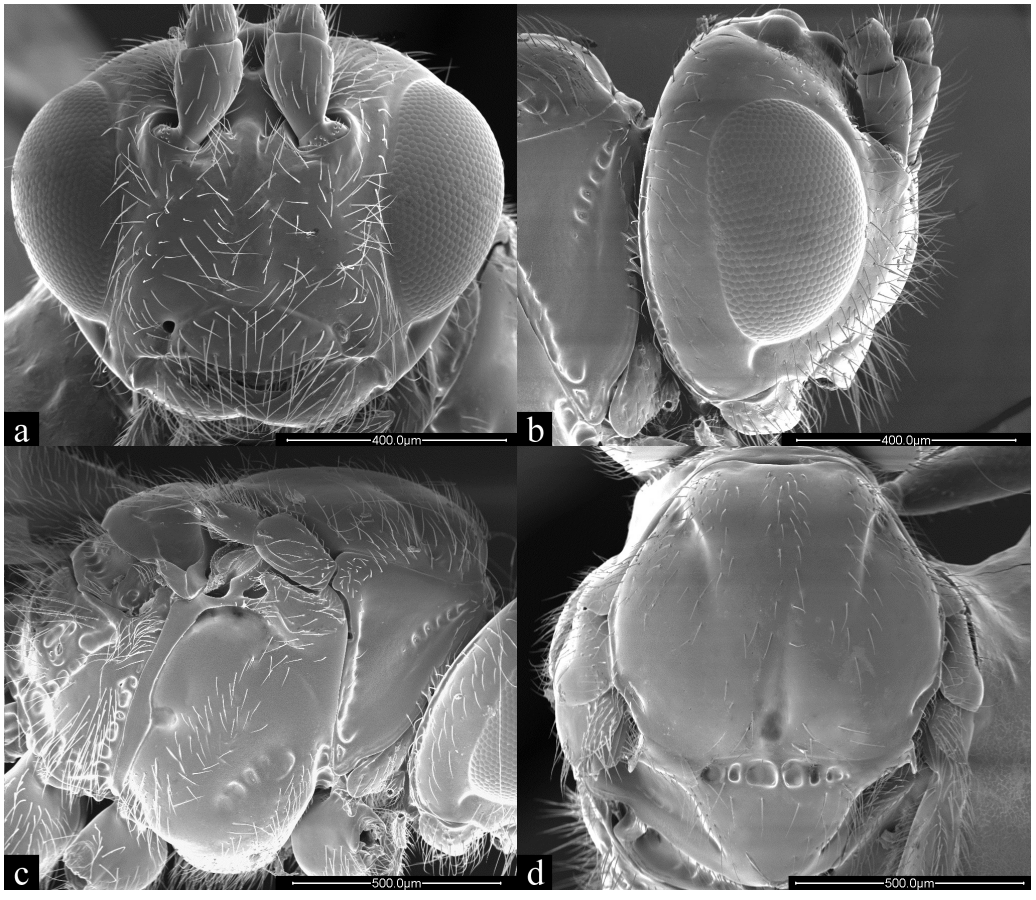

Fig. 16. *Utetes perkinsi*. a, head, anterior view; b, head, lateral view; c, mesosoma, lateral view; d, mesonotum, dorsal view.

Comments. Information based on a single male. The tibial carina and small, but distinct, gap between clypeus and mandibles clearly place this species in the genus *Utetes* Foerster as delimited by Wharton (1997). The holotype of *Utetes albimanus* (Szépligeti), in the Hungarian Natural History Museum was examined by R.A.W. and appears to be identical, but some slight uncertainty must remain because the holotype is damaged and some features therefore cannot be compared. The second submarginal cell is somewhat shorter than in many species of *Utetes*, but the general pattern of wing venation is otherwise typical of *Utetes*.

Utetes perkinsi (Fullaway)

(fig. 16)

Opius perkinsi Fullaway, 1950: 66.
Opius (Opius) perkinsi: Fischer, 1963b: 210.
Opius (Utetes) perkinsi: Fischer, 1987: 223.
Utetes perkinsi: Wharton, 1997: 30.

Description. Frons and vertex polished and very sparsely setose and punctate. Frons with median pit adjacent anterior ocellus, posterior ocelli margined laterally with weak, anteriorly diverging grooves. Occipital carina well developed. Clypeus in profile weakly protruding, overhanging base of labrum; clypeus in frontal view large and hemispherical, ventral margin thin, truncate to weakly convex; labrum visible in frontal view; gap between mandible and ventral margin of clypeus distinct but not large. Notauli deep from anterior margin to level of tegula, continuing very weakly posteriorly. Midpit long, narrow, deep; propodeum weakly rugulose to rugose, usually with irregular transverse carina. Sternaulus broad, deep, weakly crenulate throughout. Wings infumate. Forewing r arising basad midpoint of stigma, 2RS notably shorter than 3RSa, (RS+M)a sinuate; (RS+M)b absent, m-cu entering second submarginal cell. Hind wing RS and m-cu absent. Basal carina on the posterior side of the hind tibia well developed (fig. 17). Petiole with dorsal lateral carinae strongly elevated over basal two-thirds, much weaker posteriorly, but extending to posterior margin. Metasomal tergum 2 smooth and polished. Head dark red-brown to black; mesosoma yellow-orange; apical metasomal terga black. Fore and mid legs yellow orange, except tarsi 5 brown to dark brown. Hind coxa and trochanter brown, femur, tibiae and tarsi dark brown.

Distribution. Australia: Far north eastern Queensland.

Type locality. Deeral, Australia.

Material examined. ASCU: 1♂, 2♀; QDPIF: 1♂, 5♀.

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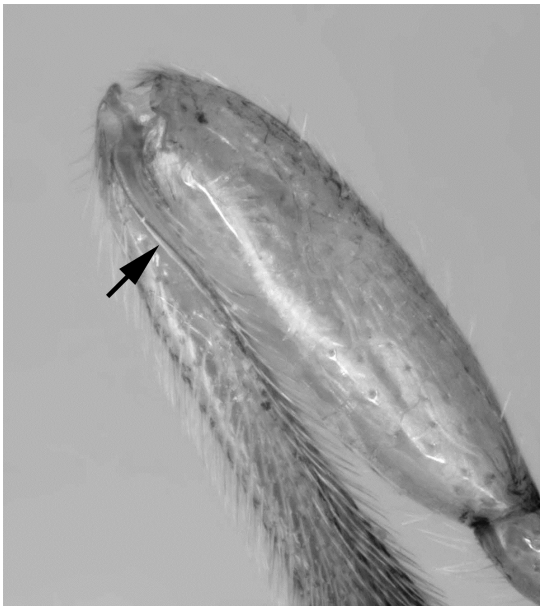

Fig. 17. Hind femur and tibia showing tibial carina (arrow) typical of *Utetes*.

Host associations. *Bactrocera cacuminata* (2), *B. jarvisi* (2), *B. kraussi* (1, 2), *B. laticaudus* (2), *B. neohumeralis* (1), and *B. tryoni* (2, 3).

Comments. *Utetes perkinsi* is similar to *U.* cf. *albimanus* in having a basal carina on the posterior side of the hind tibia. These species can be separated from each other on the basis of coloration and notauli development.

Species released in the region for biological control but not recovered

Diachasmimorpha fullawayi Silvestri

This species can be readily distinguished from other species of *Diachasmimorpha* in the presence of two small teeth along the midline at the apex of the clypeus. Additionally, the first flagellomere is slightly shorter than the second, the notauli are often weakly sculptured basally, the forewing 1 cu-a is not widely separated from 1 M and the lateral margin between the notaulus and tegula is more distinctly carinate. African species in the genus *Diachasmimorpha*, such as *D. fullawayi*, lack the subapical sinuation of the ovipositor found in the species native to the South Pacific Region. Small numbers of *D. fullawayi* were released in Australia (New South Wales) in 1932–33 from Hawaii, but did not establish (Waterhouse, 1993).

Fopius vandenboschi Fullaway

Fopius vandenboschi can be readily distinguished from other species of *Fopius* in having metasomal tergum 2 longitudinally striate and setose, and petiole dark brown, remainder of abdomen yellow orange. See also *F.* cf. *vandenboschi* discussion. This species was released in Australia in 1958–59 to control *B. tryoni*, but failed to establish (Waterhouse, 1993). Some specimens examined in this study are likely to be from this release as the label data gives the dates of collection between August 1958 and February 1959. There have been no recorded collections of *F. vandenboschi* in the region since 1959.

Psyttalia concolor Szépligeti and *Psyttalia humilis* Silvestri

These species, which are virtually identical to one another, can be readily distinguished from the species of *Psyttalia* native to the South Pacific region by the relatively short forewing r (2RS about twice length to r) in combination with (RS + M)b present and more distinctly thickened basally than apically. *Psyttalia humilis* was introduced to the Cook Islands (1927 from Hawaii), Australia (1932 and 1933 from Hawaii), and Fiji (1935 from Hawaii). *Psyttalia concolor* was introduced to New Caledonia (1966 from France). None of these introductions was successful (Waterhouse, 1993).

Psyttalia incisi Silvestri

This species can be readily distinguished from other species of *Psyttalia* in having (RS + M)b long and somewhat uniformly thickened throughout its length and forewing vein 2RS about twice as long as r. *Psyttalia incisi* was introduced to Fiji (1951 and 1954 from Hawaii) and Australia (1958–59 from Hawaii) but establishment was not successful.

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