

## The *Plagiozopelma flavipodex* Species Group (Diptera: Dolichopodidae: Sciapodinae) from Fiji, Vanuatu, and the Solomon Islands<sup>1</sup>

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**Abstract.** Nine new species of *Plagiozopelma* Enderlein (Diptera: Dolichopodidae: Sciapodinae) are described, keyed and figured: *P. spinicaudum*, **n. sp.**, *P. tokotaii*, **n. sp.**, *P. devoense*, **n. sp.**, and *P. vitiense*, **n. sp.** (all from Fiji), *P. laffooni*, **n. sp.**, *P. efatense*, **n. sp.**, *P. santense*, **n. sp.**, and *P. bellicum*, **n. sp.** (all from Vanuatu), and *P. sukapisu*, **n. sp.** (from the Solomon Islands). These new species all belong in the *flavipodex* species Group. The island of Taveuni in the Fiji Group is the easternmost limit of this genus in the Pacific. The Fijian species *Plagiozopelma tokotaii*, *P. devoense*, and *P. spinicaudum* share an unusual setation on the female thorax, with 2 strong posterior setae and 2–3 weak anterior hairs, normally a secondary sexual character state found only in males.

### INTRODUCTION

*Plagiozopelma* is a widespread Old World tropical genus of Sciapodinae (Dolichopodidae) found primarily in moist forest habitats. Most species have a delicate appearance with long pale yellow legs and often a very long male arista. The genus was redefined and summarized in Bickel (1994).

This paper was initiated to describe four species of Fijian *Plagiozopelma* collected by the Terrestrial Arthropod Survey of Fiji, but expanded to include undescribed species from nearby island groups, four from Vanuatu, and one from the Solomon Islands. The Fijian fauna, which is at the eastern Old World limit of *Plagiozopelma*, can thus be seen in a wider context of congeners.

### MATERIALS AND METHODS

This study is based on material from the following collections: Natural History Museum, London (BMNH), Bishop Museum, Honolulu, (BPBM), and the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM).

The left lateral view of the hypopygium or male genital capsule is illustrated for all species. In describing the hypopygium, 'dorsal' and 'ventral' refer to morphological position prior to genitalic rotation and flexion. Thus, in figures showing a lateral view of the hypopygium, the top of the page is morphologically ventral, while the bottom is dorsal. Morphological terminology follows Bickel (1994). The CuAx ratio is the length of the m-cu crossvein/ distal section CuA. The position of features on elongate structures such as leg segments is given as a fraction of the total length, starting from the base. The relative lengths of the podomeres should be regarded as representative ratios and not measurements. The ratios for each leg are given in the following formula and punctuation: trochanter + femur; tibia; tarsomere 1/ 2/ 3/ 4/ 5. The following abbreviations and terms are used: FSSC, Female secondary sexual character(s), non-genitalic characters found only on the female body; MSSC, Male secondary sexual character(s), non-genitalic characters found only on the male body; I, II, III: pro-, meso-, metathoracic legs; C, coxa; T, tibia; F, femur; ac, acrostichal setae; ad, anterodorsal; av, anteroventral; dc, dorsocentral setae;

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dv, dorsoventral; pd, posterodorsal; pv, posteroventral; t, tarsus; t1-5, tarsomeres 1 to 5. On the figures, arrows indicate diagnostic features.

## SYSTEMATICS

### Genus *Plagiozopelma* Enderlein

**Diagnosis.** *Head:* frons usually shining, highly polished; vertical seta present in females, but absent or present as weak hair in males; face usually bulging in males (MSSC), but conforming with curvature of eyes in females; male clypeus usually narrowed and separated from margins of eyes; male scape often swollen and vase-like; pedicel with only weak setae; male first flagellomere conical with dorsoapical to apical arista; female first flagellomere subrectangular with dorsoapical to dorsal arista.

*Legs:* coxa I usually with 3–7 strong lateral spine-like setae, more strongly developed in females than males, although CI sometimes with 3 strong black distolateral setae; tibiae and femora in both sexes with few major setae.

*Wing:* crossvein m-cu slightly sinuous to straight.

*Abdomen:* terga with only short setae; hypopygial peduncle (segment 7) with tergum and sternum both well-developed; aedeagus with dorsal angle; cercus usually deeply forked, with subequal dorsal and ventral arms.

**Remarks.** *Plagiozopelma* occurs across the Oriental, Afrotropical, and Australasian tropics but is especially diverse on the Indian subcontinent. It is discussed in detail in Bickel (1994).

#### KEY TO *PLAGIOZOPELMA* SPECIES GROUPS FROM AUSTRALIA AND THE WESTERN PACIFIC, AND TO MALES OF SPECIES IN OF THE *FLAVIPODEX* GROUP FROM FIJI, VANUATU AND THE SOLOMON ISLANDS

1. Vertex and frons usually with pruinosity; male frons often with hairs on lateral slope; male scape rarely swollen and vase-like; pedicel often with long ventral and dorsal setae; CI without lateral spine-like setae; FI and TI usually with long setae (Old World tropics) ..... .. **Chrysosoma** Guérin-Ménéville
- . Frons highly polished metallic blue-green; male frons bare or with single weak vertical seta only; male scape often swollen and vase-like; pedicel with only weak setae; CI with 3–7 strong lateral spine-like setae (stronger in females than males); FI and TI in both sexes usually without major setae (Old World tropics) ..... .. **Plagiozopelma** Enderlein .. 2
2. Five strong dc present in both sexes; head circular in anterior view; face and clypeus elongate; pleura with silvery pruinosity; CI with 3–5 strong black distolateral spine-like setae; III3–5 each slightly flattened (MSSC); m-cu straight; epandrium with flat dorsal surface; cercus lobate (Australia, New Guinea, Solomons) ..... .. **angustifacies** Group
- . Male usually with 2 strong posterior dc and 3–4 weak hair-like dc anteriorly; head wider than high; vertex and frons polished metallic green-blue; other features various ..... .. 3
3. Male scape not strongly swollen; arista distinctly shorter than body and simple; male III3–5 dorsoventrally flattened, padlike; male It<sub>1</sub> with four long posterior crocheted hairs distally; epandrium elongate subtriangular; cercus with elongate blade-like arm subtended basally by shorter inner arm (Australia, New Guinea) ..... .. **terminiferum** Group
- . Male scape swollen and vase-like; male arista as long as or longer than body, and often with apical flag; male III3–5 unmodified; male It<sub>1</sub> rarely with long posterior hairs; epandrium not as prolonged; cercus as two subequal arms, outer dorsal arm and inner ventral arm (Orient, Australasia to Fiji) ..... .. **flavipodex** Group .. 4

- 4. Apex of male arista with flattening or flag ..... 5
- Apex of male arista simple, unmodified ..... 8
- 5. Apical arisal flag rounded and orbiculate, black with white base (Figs 1b, 1f) ..... 6
- Apical arisal flag obovate (Figs 1d, 1h) ..... 7
- 6. Basitarsus I longer than tibia I; large, wing length > 4.0 mm; arisal flag (Fig. 1b); hypopygium (Fig. 1a); surstylus curved and somewhat flattened; dorsal cercal arm clavate (widespread: Asia, Australia, New Guinea, Northern Marianas Is) ..... **P. flavipodex** Becker
- Basitarsus I shorter than tibia I; smaller, wing length < 3.5 mm; arisal flag (Fig. 1f); hypopygium (Fig. 1e); surstylus somewhat expanded apically; dorsal cercal arm elongate, with setae as figured (Vanuatu) ..... **P. santense**, n. sp.
- 7. Apical arisal flag narrow obovate and black (Fig. 1d); hypopygium (Fig. 1c); dorsal cercal arm elongate and straight ventral cercal arm straight (Vanuatu) ..... **P. laffooni**, n. sp.
- Apical arisal flag obovate and white (Fig. 1h); hypopygium (Fig. 1g); dorsal cercal arm narrow and slightly curved, with long apical seta; ventral cercal arm with distinct subapical bend (Vanuatu) ..... **P. efatense**, n. sp.
- 8. Pleural cuticle at least one third yellow, in distinct contrast to metallic blue-green color elsewhere on thorax ..... 9
- Pleura mostly metallic blue-green or dark brown, with at most yellow cuticle above coxae or on metapleuron ..... 10
- 9. Entire pleura and anterior slope of mesonotum yellow; basitarsus I with fine whitish ventral pile along its length; basitarsus III distinctly white, and distal tarsomeres infuscated; hypopygium (Fig. 2d); dorsal cercal arm curved with long dorsoapical seta; ventral cercal arm split along distal third ... (Fiji) ..... **P. devoense**, n. sp.
- Pleura metallic green dorsad of imaginary line extending from coxa I base to just below halter base, and pleura ventrad of this “line” yellow to coxal bases; basitarsus I with 3–4 short ventral setae at very base; basitarsus III yellow; hypopygium (Fig. 2a); dorsal cercal arm slightly clavate; ventral cercal arm with distinct expansion just beyond mid-length ... (Fiji) ..... **P. vitiense**, n. sp.
- 10. Tibia I with 5–6 fine pale curved posterior setae along distal fifth; basitarsus I with pv row of some 20 weak curved decumbent setae along length; tibia II more than 1 1/2 length of femur II; hypopygium (Fig. 2f); dorsal cercal arm with 3 long apical setae; ventral cercal arm with 2 long dorsal subapical setae ... (Solomon Islands) ..... **P. sukapisu**, n. sp.
- Tibia I bare of curved posterior setae; basitarsus I with at most short ventral setae near base; tibia II less than 1 1/2 length of femur II; cercus not as above ..... 11
- 11. Hypopygium (Fig. 2c); surstylus distally expanded and subtriangular; dorsal cercal arm with lateral row of long setae; ventral cercal arm with 4–5 strong ventral setae on distal third .. (Fiji) ..... **P. spinicaudum**, n. sp.
- Surstylus not distally expanded and subtriangular, but with dorsoapical digitiform projection (Figs. 2b, 2e) ..... 12
- 12. Basitarsus I with short ventral setae along length; hypopygium (Fig. 2e); dorsal cercal arm without long dorsoapical seta; ventral cercal arm with group of pale distal subapical hairs, with two short curved subapical setae. ... (Vanuatu) ..... **P. bellicum**, n. sp.
- Basitarsus I unmodified; hypopygium (Fig. 2b); dorsal cercal arm with long dorsoapical seta; ventral cercal arm bare with short curved subapical setae ... (Fiji) ..... **P. tokotaai**, n. sp.

### THE *PLAGIOZOPELMA FLAVIPODEX* SPECIES GROUP

**Diagnosis.** *Head:* vertex, frons, and face highly polished metallic blue-green or bronze green; vertical seta in male reduced to weak hair on frons, but strong and well-developed in female; male face slightly bulging (Fig. 1d), with some grey pruinosity ventrally and laterally; female face wider than that of male, and with frontoclypeal suture not strongly marked; male scape swollen and vase-like (MSSC) (group autapomorphy); male first flagellomere almost conical with apical to dorsoapical arista; female first flagellomere shorter with dorsoapical arista; male arista often with apical flag (MSSC), and male arista usually longer than body (MSSC); female arista always unmodified, and about half body length.

*Thorax:* mesonotum and scutellum usually shining metallic blue-green; setae black; 2 pairs strong ac present; males with dc comprising 2 strong posterior setae and 2–3 weak anterior hairs (MSSC), while females have 4 strong dc setae (although in three Fijian species, females also have 2 strong posterior setae and 2–3 weak anterior hairs); 1 postalar, 2 postsutural supra-alar, 2 presutural intra-alar, 2 notopleural, 1 presutural supra-alar, and 1 weak postpronotal setae present; median scutellar setae strong, lateral scutellars reduced to tiny hair or absent.

*Legs:* CI with 5–7 strong lateral spine-like setae, more strongly developed in females than males (FSSC) (group autapomorphy), and female CI sometimes with additional anteromedian setal fields (FSSC); female TII usually with offset ad-pd setal pair in basal quarter; III<sub>1</sub> with ventral seta at very base.

*Wing:* hyaline; crossvein m-cu straight.

*Abdomen:* elongate; sparsely haired with only 2 pairs strong marginal setae on each tergum; male postabdomen (Fig. 1c): hypopygial peduncle (segment 7) with well developed tergum and sternum; hypopygium usually subtriangular; hypandrial arm elongate, usually reaching at least to apex of aedeagus; surstylus fused to epandrium without external evidence of suture; epandrium with 2 short setae along ventral margin; cercus bifid, with two elongate subequal arms, an external dorsal arm and internal ventral arm.

**Remarks.** The *flavipodex* Group comprises about 70 described species, found throughout most of the Oriental and Australasian tropics, as well as Melanesia (see review in Bickel, 1994). Species extend as far east as Fiji and the Northern Marianas. Most species are associated with rainforest and are frequently collected in yellow pans or Malaise traps near creeks.

This group is based around *Plagiozopelma flavipodex*, a widespread Oriental-Australasian species. Most group members have a delicate appearance with long pale yellow legs and often a very long male arista. Males of most species have an arista that is longer than the body, and sometimes an apical flattening or arista flag (MSSC).

Nine species in the *flavipodex* Group are newly described here, from Fiji (4 spp.), Vanuatu (4 spp.), and the Solomon Islands (1sp.).

#### *Plagiozopelma flavipodex* (Becker) (Fig 1a, b)

**Diagnosis. Male:** length 4.2–5.0 mm; wing: 4.0–4.7 × 1.5 mm.

*Head:* clypeus tapering and covered with grey pruinosity; palp and proboscis yellow; antenna yellow; first flagellomere elongate, conical; arista with apical flag (Fig. 1b) orbiculate, black with white base (MSSC); ventral postcranium with pale setae.

*Thorax:* shining metallic green with bronze reflections; scutellum blue; pleura with some grey pruinosity.

*Legs:* all coxae and remainder of legs entirely yellow; I: 4.3; 4.8; 5.5/ 1.8/ 1.2/ 0.6/ 0.4; CI with 6–7 pale lateral setae; TI bare; It<sub>1</sub> distinctly longer than TI, It<sub>1</sub> with some short ventral setulae in basal quarter; II: 5.3; 8.2; 6.9/ 2.2/ 1.6/ 0.4/ 0.3; TII with ad setae at 1/6, pd at 1/4 and pv at 4/5, although position of setae may be somewhat variable among specimens; III: 7.3; 11.4; 4.2/ 2.3/ 1.3/ 0.7/ 0.3; TIII with row of short dorsal setae.

**Wing:** hyaline; crossvein m-cu straight; CuAx ratio: 1.2; lower calypter pale with dark brown rim and pale setae; halter yellow with infuscated club.

**Abdomen:** metallic bronze-green with some silvery pruinosity; hypopygium (Fig. 1a); epandrium yellow with brown cercus, surstylus and hypandrium; epandrial lobe elongate but decumbent, along epandrial margin, and with two strong setae; surstylus curved and somewhat flattened, with ventral subapical setae; dorsal cercal arm almost clavate, with dark brown setose "club"; ventral cercal arm bare except for pale subapical hairs, as figured.

**Female:** similar to male except lacking MSSC and as noted: arista simple, CI with additional anteromedian setae as well as lateral setae; TII with offset ad-pd setal pair in basal quarter; TIII with strong ad at 1/4 and 4–5 dorsals.

**Material Examined.** See Bickel (1994, 1995).

**Remarks.** *Plagiozopelma flavipodex* is widespread throughout the Indo-Pacific region, from lowland Nepal to New Guinea and northeastern Australia, and extending to the Philippines, Guam, Northern Marianas, Sundaland, and Christmas Island (Bickel, 1994). It is often abundant at lowland sites. Its wide distribution may be the result of both natural dispersal and accidental human introduction.

### *Plagiozopelma laffooni* Bickel, new species

(Figs. 1c, d)

**Description. Male:** length 3.7–3.8 mm; wing: 3.0 × 1.0 mm.

**Head:** (Fig. 1d); clypeus tapering and covered with grey pruinosity; palp and proboscis yellow; antenna yellowish; arista with apical flag, narrow obovate and black (MSSC).

**Thorax:** mesonotum and pleura metallic green with bronze reflections, but pleural cuticle yellow immediately dorsad of CII; metapleuron yellow ventrally and brown dorsally; pleura with grey pruinosity.

**Legs:** all coxae and remainder of legs entirely yellow, with only distalmost tarsomeres infuscated; CI with 6 pale yellow lateral spine-like setae; I: 3.6; 3.7; 2.8/ 1.2/ 0.8/ 0.6/ 0.4; TI bare; It1 distinctly shorter than TI, and with some short ventral setae at very base; II: 3.8; 5.7; 4.0/ 1.5/ 1.0/ 0.5/ 0.4; TII with ad seta at 1/5, and with short subapical ad seta; III: 5.7; 8.0; 2.8/ 1.5/ 1.0/ 0.5/ 0.4; TIII with some short dorsal setae.

**Wing:** CuAx ratio: 1.1; lower calypter pale with dark brown rim and pale setae; halter yellow with infuscated club.

**Abdomen:** elongate; metallic bronze-green with some grey pruinosity; postabdomen (Fig. 1c); epandrium yellow with brown cercus, surstylus and hypandrium; epandrial lobe with long and short setae; surstylus with dorsoapical digitiform projection; dorsal cercal arm elongate, narrow with setae as figured; ventral cercal arm elongate and bare except for group of long pale subapical hairs, as figured.

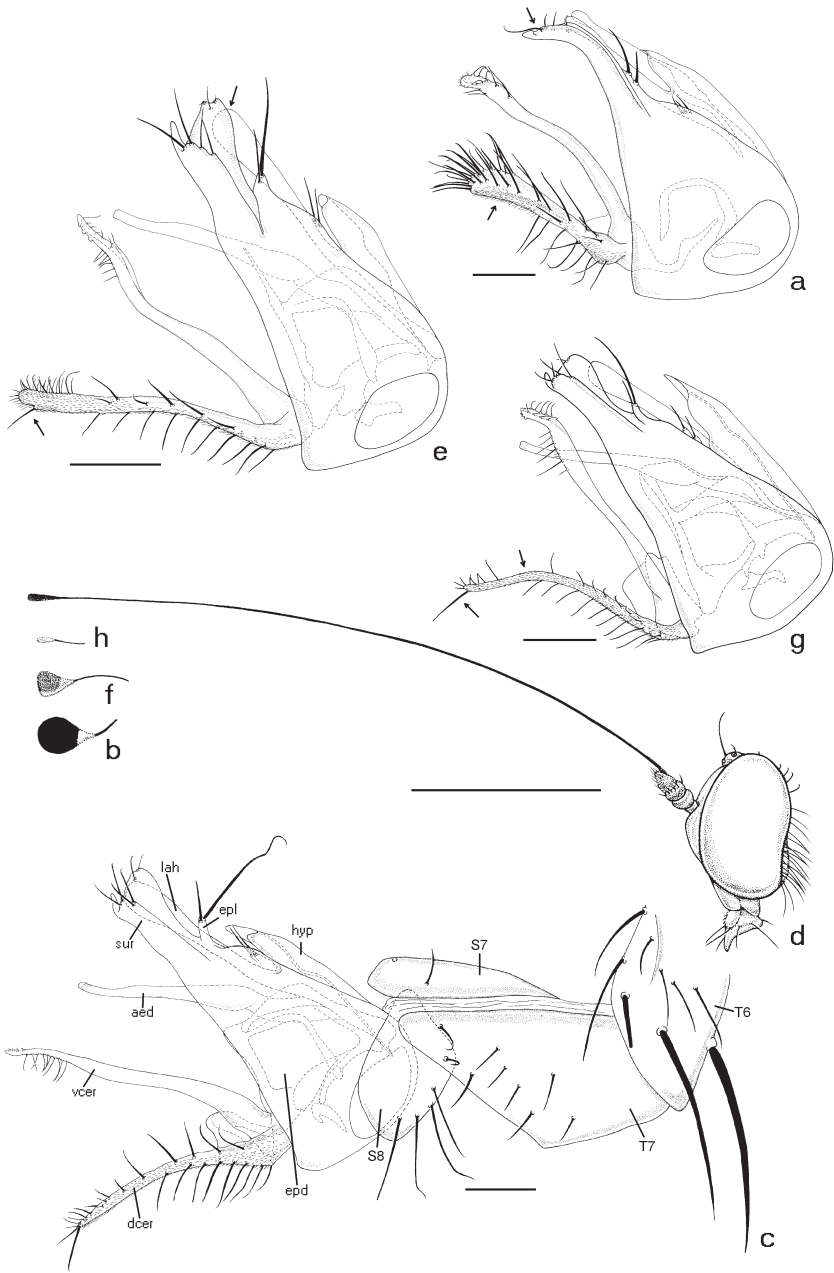
**Female:** similar to male except lacking MSSC and as noted: arista simple, TI and TII with similar setation; TIII with ad seta at 1/5, and also with dorsal setae.

**Types.** Holotype ♂, 12♂, 18♀ paratypes, VANUATU: **Espirito Santo:** Second Channel, x.1944, J. Laffoon (USNM). Paratype ♂, same but ix.1944 (USNM).

**Other material:** VANUATU: **Espirito Santo:** 4♂, 8♀, no locale, ix.1944, K.L. Knight (USNM); ♂, no locale, viii ix.1929, L.E. Cheesman (BMNH). **Malekula:** ♂, Ounua, iii–iv.1929, L.E. Cheesman (BMNH). **Epi:** ♂, 12.vi.1925, P.A. Buxton (BMNH). **Lamen:** 11♂, 8♀, 0–100 m, i–ii.1976, N.L.H. Krauss. **Ambrym:** ♂, 0–100 m, xii.1984, N.L.H. Krauss (BPBM).

**Remarks.** *Plagiozopelma laffooni* is known from the adjacent islands of Espirito Santo, Malekula and Ambrym in the Vanuatu archipelago. Males can be readily recognized by the black obovate arista flag (Fig. 1d).

**Etymology.** The species is named in honor of Jean Laffoon, long time Professor of Entomology at Iowa State University, who collected in Vanuatu (then the New Hebrides) during World War II.



*Plagiozopelma santense* Bickel, new species

(Fig. 1e, f)

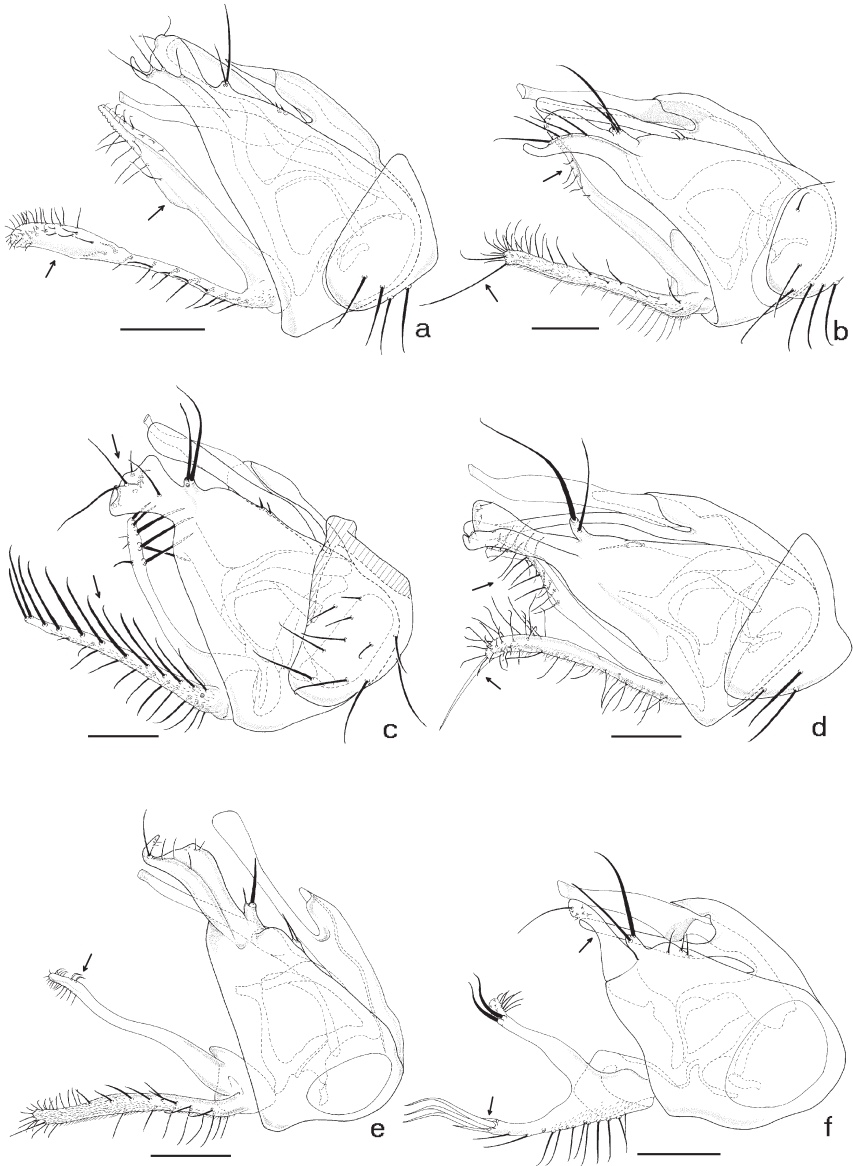
**Description. Male:** length 3.2–3.3 mm; wing:  $3.0 \times 0.9$  mm.**Head:** clypeus tapering and covered with grey pruinosity; palp and proboscis yellow; antenna yellow but slightly infuscated; arista longer than body, and with apical flag (Fig. 1f) orbiculate, black with white base (MSSC).**Thorax:** mesonotum and pleura metallic green with bronze reflections, but mesopleura yellow just dorsad of CII; metepimeron yellow ventrally and brown dorsally.**Legs:** all coxae and remainder of legs entirely yellow, with only distalmost tarsomeres infuscated; CI with 6 pale yellow lateral spine-like setae; I: 3.0; 3.2; 2.5/ 1.0/ 0.6/ 0.4/ 0.3; TI bare; ItI distinctly shorter than TI; II: 3.5; 4.8; 3.8/ 1.0/ 0.8/ 0.4/ 0.3; TII with ad seta at 1/5, and with short subapical ad seta; III: 4.7; 7.0; 2.4/ 1.4/ 0.8/ 0.5/ 0.3; TIII with some short dorsal setae.**Wing:** CuAx ratio: 1.2; lower calypter pale with dark brown rim and pale setae; halter yellow with infuscated club.**Abdomen:** elongate; metallic bronze-green with some grey pruinosity; hypopygium (Fig. 1e); epandrium yellow with brown cercus, surstylus and hypandrium; epandrial lobe stout with one strong and one slightly weaker seta; surstylus somewhat expanded apically, with dorsoapical digitiform projection, and with setae as figured; dorsal cercal arm elongate, with distal setae as figured and with short dorsoapical seta; ventral cercal arm curved and bare except for group of pale subapical hairs, as figured.**Female:** similar to male except lacking MSSC and as noted: arista simple, TI and TII with similar setation; TIII with ad seta at 1/5, and also with dorsal setae.**Types.** Holotype ♂ (BPBM 16,566), paratype ♂, VANUATU: **Espirito Santo**, 1.5 km NE of Luganville, 11.iii.1964, R. Straatman (BPBM).**Other material:** VANUATU: 2♀, **Espirito Santo**, 1.5 km NE of Luganville, 12.iv.1964, R. Straatman. ♂, **Anatom** (= Aneytioum), Anelgaohat, 0–200 m, xi.1978, N.L.H. Krauss (BPBM).**Remarks.** *Plagiozopelma santense* is known from the rather distantly separated islands of Espirito Santo and Anatom, Vanuatu. Males can be readily recognized by the large spatulate aristal flag which is black with a white base, similar to that found on the widespread *P. flavipodex*. However the two species are readily separated by the relative lengths of the male fore tibia and basitarsus, and genitalic differences, as noted in the key.**Etymology.** The species is named for the island of Espirito Santo, shortened in everyday speech to “Santo.”*Plagiozopelma efatense* Bickel, new species

(Figs. 1g, h)

**Description. Male:** length: 3.2 mm; wing  $3.0 \times 1.0$  mm.**Head:** clypeus tapering, with yellow cuticle near distal margin; palp and proboscis yellow; antenna yellow; arista longer than body; arista with small apical flag (Fig. 1h), obovate and white (MSSC).**Thorax:** mesonotum and pleura metallic green with bronze reflections, but with yellow cuticle just dorsad of CII; metepimeron yellow ventrally and dark brown dorsally.**Legs:** all coxae and remainder of legs entirely yellow with distal tarsomeres infuscated; CI with 6 lateral pale spine-like setae; I: 3.6; 3.7; 2.9/ 1.1/ 0.8/ 0.6/ 0.4; TI bare; ItI shorter than TI; II: 4.0; 6.2;

**Fig. 1.** *Plagiozopelma flavipodex*: **a.** hypopygium, left lateral view; **b.** male arista, apex. *P. laffooni*: **c.** male postabdomen, left lateral view; **d.** male head, left lateral view. *P. santense*: **e.** hypopygium, left lateral view; **f.** male arista, apex. *P. efatense*: **g.** hypopygium, left lateral view; **h.** male arista, apex. Legend: aed, aedeagus; dcer, dorsal arm of cercus; epd, epandrium; epl, epandrial lobe; hyp, hypandrium; lah, lateral arm of hypandrium; S7, S8, sternum 7, 8; sur, surstylus; T6, T7, tergum 6, 7; vcer, ventral arm of cercus.





**Fig. 2.** *Plagiozopelma* male hypopygia, left lateral view. **a.** *vitiense*; **b.** *tokotaai*; **c.** *spinicaudum*; **d.** *devoense*; **e.** *bellicum*; **f.** *sukapisu*.



4.2/ 1.3/ 1.0/ 0.5/ 0.3; TII bare; III: 5.8; 8.5; 4.0/ 1.6/ 1.2/ 0.6/ 0.3; TIII with some short dorsal setae.

**Wing:** CuAx ratio: 1.0; lower calypter pale with dark brown rim and pale setae; halter yellow with infuscated club.

**Abdomen:** metallic blue-green with some grey pruinosity; vestiture sparse, with only 2 pairs of dorsal setae on each tergum; sternum 8 with short weak setae; hypopygium (Fig. 1g); epandrium yellow with brown cercus, surstylus and hypandrium; surstylus slightly expanded distally, with dorsoapical digitiform projection; epandrial lobe with 1 strong seta and 1 weak seta; dorsal cercal arm narrow and slightly curved, with long apical seta; ventral cercal arm with distinct subapical bend, with setae as figured.

**Female:** unknown.

**Types.** Holotype ♂ (BPBM 16,565) VANUATU: **Efate**, Port Vila, 0–100 m, i.1972, N.L.H. Krauss (BPBM).

**Remarks.** *Plagiozopelma efatense* can be separated from all related Vanuatu members of the genus by its entirely white obovate arisal flag (Fig. 1h). Also, the male basitarsus I is shorter than tibia I.

**Etymology.** The species is named for the island of Efate in Vanuatu.

### *Plagiozopelma bellicum* Bickel, new species

(Fig. 2e)

**Description. Male:** length 3.2 mm; wing:  $2.7 \times 1.9$  mm.

**Head:** clypeus tapering and covered with grey pruinosity; palp and proboscis yellow; antenna yellowish; arista simple, about two-thirds body length.

**Thorax:** mesonotum and pleura metallic green with bronze reflections, except for yellow area on meron, just dorsad of CII.

**Legs:** all coxae and remainder of legs entirely yellow; CI with 6 strong spine-like setae; I: 3.0; 3.3; 2.7/ 1.0/ 0.8/ 0.6/ 0.3; TI bare; It1 with short ventral setae along length; II: 4.7; 5.5; 4.0/ 1.4/ 0.8/ 0.5/ 0.3; TII with anterior seta at 1/5, and with anteroapical seta; III: 4.5; 7.2; 2.5/ 1.5/ 1.0/ 0.7/ 0.3; TIII with only a few short dorsal setae.

**Wing:** CuAx ratio: 1.1; lower calypter pale with dark brown rim and pale setae; halter with yellow stalk and brown club.

**Abdomen:** elongate; metallic bronze-green with matt areas over tergal overlap; sparsely haired with only 2 pairs of marginal setae on each tergum; hypopygium (Fig. 2e); epandrium yellow with brown cercus, surstylus and hypandrium; epandrial lobe stout, with longer and rather short setae; surstylus with prolonged dorsoapical digitiform projection; dorsal cercal arm with setae as figured; ventral cercal arm bare except for group of pale distal subapical hairs, with two short curved subapical setae.

**Female:** unknown.

**Types.** Holotype ♂, VANUATU: **Espiritu Santo**, Segond Channel, viii.1944, J. Laffoon (USNM).

**Remarks.** *Plagiozopelma bellicum* is a small-sized species known only from Espiritu Santo, Vanuatu. It is the only Vanuatu species without an apical arisal flag. The hypopygium of *P. bellicum* is closest to that of the Fijian *P. tokotaai*.

**Etymology.** The species epithet “*bellicum*” is from the Latin, meaning “of war”, referring to that fact this species was collected on Espiritu Santo during World War II.

### *Plagiozopelma vitiense* Bickel, new species

(Fig. 2a)

**Description. Male:** length 3.2 mm; wing:  $2.8 \times 1.0$  mm.

**Head:** clypeus tapering, yellow at very apex; palp and proboscis yellow; scape and pedicel brownish; first flagellomere yellow; arista elongate, simple and slightly shorter than body length.

*Thorax*: metallic blue-green on mesonotum and extending onto pleura, so that the metallic color is restricted dorsad of imaginary line extending from base of CI to just below halter base, while pleura yellow between this "line" and coxal bases.

*Legs*: all coxae and remainder of legs entirely yellow, except distal tarsomeres infuscated; CI with 6 strong spine-like setae; I: 3.2; 3.3; 2.4/ 1.0/ 0.6/ 0.4/ 0.3; TI bare; It1 distinctly shorter than TI, and with 3–4 short ventral setae at very base, distinct from adjacent vestiture; II: 3.8; 4.8; 3.7/ 1.2/ 0.8/ 0.4/ 0.3; TII with ad at 1/5; III: 5.5; 7.2; 2.6/ 1.6/ 1.0/ 0.7/ 0.3; TIII with short dorsal setae.

*Wing*: CuAx ratio: 1.1; lower calypter pale with dark brown rim and pale setae; halter with yellow stalk and brown club.

*Abdomen*: elongate; metallic bronze-green with some silvery pruinosity; sparsely haired with only 2 strong dorsals on each tergum; hypopygium (Fig. 2a); epandrium yellow with brown cercus, surstylus and hypandrium; epandrial lobe very short, with elongate and short seta; surstylus with dorsal digitiform projection; dorsal cercal arm slightly clavate, with brown setose "club"; ventral cercal arm bare except for distinct expansion just beyond mid-length, and with some subapical hair-like setae as figured.

**Female**: similar to male except lacking MSSC and as noted: pleura also with division, dorsally blue-green, and ventrally yellow; TI with row of 3 short dorsal setae near 1/4; It1 also with 3–4 short ventral setae at very base; TII with strong ad at 1/5, and short pd at 2/3.

**Types**. Holotype ♂ (BPBM 16,564), paratype 2♂, 4♀, FIJI: **Viti Levu**, Nausori Highlands, 500–700m, xi.1976, N.L.H. Krauss (BPBM, Acc. No. 1977.29).

**Other material**: FIJI: 1♂, 3♀, **Ovalau**, Levuka, 0–200 m, xii.1978, N.L.H. Krauss (BPBM). **Viti Levu**: 2♂, Vuda Prov., Savuione Trail, Koroyanitu Village, 17°40'S 177°33'E, 450 m, disturbed mid-elevation moist forest, Malaise trap, 12–19.x.2002, M. Irwin, M. Tokotaai & E. Schlinger; Naitasiri Prov., old trail to Mt. Tomaniivi, from Navai Village 17°37'S 177°59'E, 700m, gymnosperm dominated rainforest: ♂, 23.ix.2004; ♂, 18.x.2004; ♀, 30.vii.2004, M. Tokotaai & E. Schlinger; ♂, 2♀, Tilivaleva, 305–366 m, 25.iii.1970, N.L.H. Krauss; 1♂, 1♀, Korotongo, 0–100 m, iii.1981, N.L.H. Krauss (BPBM).

**Remarks**. *Plagiozopelma vitiense* is known from several localities on Viti Levu as well as Ovalau. This species is distinctly smaller than its congeners in Fiji, and can be recognized in both sexes by the distinctive pleural color, dorsally blue-green, and ventrally yellow. As well, both sexes have 3–4 short ventral setae at the very base of basitarsus I.

**Etymology**. The specific epithet is based on "Viti", the indigenous Fijian name for the Fiji islands.

### *Plagiozopelma tokotaai* Bickel, new species

(Fig. 2b)

**Description. Male**: length 3.8–3.9 mm; wing:  $3.2 \times 1.3$  mm.

*Head*: palp and proboscis yellow; antenna brown but yellowish along ventral surface; first flagellomere conical; arista black, simple and very long, at least one and a half times body length (MSSC); ventral postcranium with abundant pale setae.

*Thorax*: mesonotum and all pleura metallic blue-green, with some grey pruinosity; dc with 2 strong posterior setae and 3–4 weak anterior hairs; metepimeron dorsally metallic blue-green, ventrally yellow.

*Legs*: all coxae and remainder of legs yellow, except CII with brown vertical stripe, and distal tarsomeres infuscated; CI with 6 strong pale spine-like setae; I: 5.0; 5.2; 4.5/ 1.8/ 1.2/ 0.7/ 0.4; TI with very short ad at 1/5; It1 unmodified; II: 5.2; 8.2; 6.0/ 1.6/ 1.2/ 0.6/ 0.4; TII with ad seta at 1/6, pd seta at 1/8 and 3/10; III: 7.0; 10.7; 4.5/ 2.0/ 1.2/ 0.6/ 0.4; TIII with some scattered longer setae.

*Wing*: CuAx ratio: 1.3; lower calypter pale with dark brown rim and pale setae; halter stalk yellow at base, with brownish club.

*Abdomen*: elongate; metallic bronze-green with some grey pruinosity; hypopygium (Fig. 2b); epandrium yellow with dorsal cercal arm, surstylus and hypandrium; epandrial lobe rather short, with

strong and weak seta; surstylus curved and somewhat flattened, with dorsoapical digitiform projection; dorsal cercal arm with setae as figured and with long dorsoapical seta; ventral cercal arm bare except for some pale subapical hairs, as figured.

**Female:** similar to male except lacking MSSC and as noted: dc also with 2 strong posterior setae and 3–4 weak anterior hairs; TIII with ad seta at 1/5 and subapically, and pd at 1/2.

**Types.** Holotype ♂ (BPBM 16,562), paratypes, 3♂ FIJI: **Viti Levu:** Naitasiri Prov., Navai Village, Veilaselase Track, 17°37'S 177°59'E, 700 m, gymnosperm dominated rainforest, Malaise trap, 28.xii.2004, M. Tokotaai & E. Schlinger (FJVL11-M02); paratypes, 1♂, 2♀, same, but 23.ix.2004 (FJVL-11-M02); paratypes 5♂, 1♀ same but 6.xi.2004 (FJVL11-M01); paratype ♂, same but 23.xii.2004 (FJVL11-M02) (BPBM).

**Other material:** FIJI: 1♂, 3♀, **Ovalau,** Lovoni Valley, 50–200 m, 27.xii.1969, N.L.H. Krauss (BPBM). **Viti Levu:** 3♀, Naitasiri Prov, old trail to Mt. Tomaniivi from Navai Village, 17°37'S 177°59'E, 700 m, gymnosperm dominated rainforest, Malaise trap, 30.viii.2004, M. Tokotaai & E. Schlinger (FJVL11-M03, BPBM); ♂, ♀, 8 miles up Sigatoka Valley, 6.viii.1972, D.E. Hardy; ♂, Lami, 0–200 m, xii.1978, N.L.H. Krauss; ♂, Kalekana to Mt Korobaba (nr Lami), 250 m, 14–16.x.1979, G.A. Samuelson (BPBM).

**Remarks.** *Plagiozopelma tokotaai* is known from several sites on Viti Levu, at least from mid-elevations near 700 m and the nearby island Ovalau.

The three species *Plagiozopelma tokotaai*, *P. spinicaudum* and *P. devoense* are unusual in having the female thorax with 2 strong posterior setae and 2–3 weak anterior hairs, normally a secondary sexual character state found only in males (see discussion above).

**Etymology.** This species is named in honor of Moala Tokota'a, who has coordinated the field trapping program of the Fiji Arthropod Survey.

### *Plagiozopelma spinicaudum* Bickel, new species

(Fig. 2c)

**Description. Male:** length 2.7–3.0 mm; wing: 2.6 × 0.8–3.0 × 1.2 mm.

**Head:** palp, proboscis and associated setae yellow; antenna brown, but yellowish ventrally; arista simple, and about as long as body.

**Thorax:** mesonotum, scutellum and most of pleura metallic green, although metapleuron dorsally metallic blue-green and ventrally yellow; dc with 2 strong posterior setae and 3–4 weak anterior hairs.

**Legs:** all coxae and remainder of legs yellow, except tarsomeres distad of basitarsi infuscated; CI with 6 strong spine-like setae; I: 4.2; 4.5; 3.7/ 1.5/ 0.8/ 0.6/ 0.3; TI bare; II: 5.0; 6.7; 5.0/ 1.4/ 1.0/ 0.6/ 0.3; TII with short ad at 1/6 and subapically, and short pd at 1/5; III: 6.0; 8.5; 3.8/ 1.7/ 1.0/ 0.6/ 0.3; TIII with some short dorsal setae.

**Wing:** CuAx ratio: 1.2; lower calypter pale with dark brown rim and pale setae; halter yellow with brown club.

**Abdomen:** elongate; metallic bronze-green with some silvery pruinosity; sparsely haired with only 2 strong dorsals on each tergum; segment 7 brown; sternum 8 yellow; hypopygium (Fig. 2c); epandrium yellow with hypandrium, dorsal cercal arm and apex of ventral cercal arm brown; epandrial lobe short pedunculate with 2 strong setae; surstylus distally expanded and subtriangular, and with setae as figured; dorsal cercal arm with lateral row of long setae; ventral cercal arm with 4–5 strong ventral setae on distal third.

**Female:** similar to male except lacking MSSC and as noted: dc also with 2 strong posterior setae and 3–4 weak anterior hairs; TII with ad at 1/5 and subapically and pd near 1/3.

**Types.** Holotype ♂ (BPBM 16,561) (FBA 001794) 5♀ paratypes (FBA 001790, 001792, 001796–001798) FIJI: **Viti Levu:** Naitasiri Prov., Colo-i-Suva Forest Park, Waisila Ck, 18°03'S, 178°26'E, 150 m, 26–27.x.2004, yellow water traps, D.J. Bickel (BPBM).

**Other material:** FIJI: **Ovalau:** 4♂, 3♀, Levuka, 0–200 m, xii.1978, N.L.H. Krauss (BPBM). **Viti Levu:** ♂, Naitasiri Prov., headwaters of Veisari River, W. of Suva, upper Waivudawa Ck, 290 m.,

18°04'21.9"S. 178°21'48.2"E, 23.i.2005, D.J. Bickel & M. Tokota'a (AMS); 2 ♂, 4 ♀, Naitisiri Prov., Navai Village, Eteni, 700 m., 17°37'S. 177°59'E, Malaise FJ-11A, 6.vi–15.vii.2003, M. Irwin, et al. (BPBM). 4 ♂, 9 ♀, Lami, 0–200 m. iii.1972, xii.1978, N.L.H. Krauss; ♂, Navai, 800–900 m, 8.x.1971, N.L.H. Krauss; ♂, Nukura Forest, 60–130 m, 15.x.1979, N.L.H. Krauss; ♂, ♀, Tacirua, 16.xii.1978, N.L.H. Krauss (BPBM).

**Remarks.** *Plagiozopelma spinicaudum* is known from Viti Levu and the nearby island of Ovalau. It can be readily recognized the apically expanded surstylus, the row of lateral setae on the dorsal cercal arm, and the subapical group of strong setae on the ventral cercal arm. *P. spinicaudum* has female thorax setation similar to that of *P. tokotaai*, q.v.

**Etymology.** The epithet "*spinicaudum*" is from the Latin, *spina* (spine) and *cauda* (tail), referring to subapical group of spinelike setae on the ventral arm of the cercus.

***Plagiozopelma devoense* Bickel, new species**

(Fig. 2d)

**Description. Male:** length 3.9 mm; wing: 3.7 × 1.3 mm.

**Head:** vertical seta as weak black hair on frons; face slightly bulging, with some grey pruinosity ventrally and laterally; clypeus tapering and with grey pruinosity; palp and proboscis yellow; scape and pedicel brownish; first flagellomere yellow, conical; arista simple, about as long as body length.

**Thorax:** dorsum mostly metallic green with bronze reflections; entire pleura and anterior slope of mesonotum yellow; setae black; 2 pairs strong ac present with tiny seta anterior; dc with 2 strong posterior setae and 3–4 weak anterior hairs (MSSC); lateral scutellar setae absent.

**Legs:** all coxae and remainder of legs yellow, except CII with brown lateral stripe, basitarsus III distinctly white, and distal tarsomeres infuscated; CI with 6 pale spine-like setae; CII with pale anterior seta; CIII with pale lateral seta; I: 5.0; 5.2; 5.0/ 2.0/ 1.5/ 1.0/ 0.4; TI bare; TI and It<sub>1</sub> subequal; It<sub>1</sub> not flattened, but with fine whitish ventral pile along its length; II: 5.6; 8.3; 6.3/ 2.0/ 1.3/ 0.7/ 0.5; TII with short ad-pd setal pair at 1/8, and with pd seta at 1/3; III: 7.8; 11.0; 4.7/ 2.3/ 1.5/ 0.8/ 0.6; TIII with 3–4 larger setae along dorsal row, and with some short av setae; IIIIt<sub>1</sub> distinctly white, contrasting with yellow TIII and brown distal tarsomeres, and with some short ventral setulae.

**Wings:** CuAx ratio: 0.8; lower calypter pale with dark brown rim and pale setae; halter stalk yellow at very base, but with distal stalk and club brownish.

**Abdomen:** elongate; metallic bronze-green with some silvery pruinosity; sparsely haired with only 2 strong dorsals on each tergum; segment 7 and sternum 8 brownish; sternum 8 with only short weak hairs; hypopygium (Fig. 2d); epandrium yellow, with brown dorsal cercal arm and hypandrium; epandrial lobe short with strong and weaker seta; surstylus slightly expanded distally; dorsal cercal arm curved with some setae and long dorsoapical seta; ventral cercal arm split along distal third, and with setae as figured.

**Female:** similar to male except lacking MSSC and as noted: similar thoracic color with yellow pleura; dc also with 2 strong posterior setae and 3–4 weak anterior hairs.

**Types.** Holotype ♂ (BPBM 16,563) FIJI: Taveuni: Cakaudrove Prov.: Devo Peak Tower, 179° 58'E 16°51'S, 1200 m, cloud forest, Malaise trap, FJ-8, 31.x–21.xi.2002, M. Irwin, E. Schlinger, & M. Tokoka'a (FBA001623); paratypes: ♂, ♀, Devo Peak Forest Reserve, 179°59'E 16°50'S, 800 m, Malaise trap, 10–16.i.2003, & ♀, same but 3–10.i.2003 (FBA 041108, 038948, 042704) (BPBM).

**Remarks.** *Plagiozopelma devoense* is known from 800–1200 m on Taveuni Island, Fiji. However, the species can be identified by the yellow pleura and the long apical seta on the dorsal arm of the cercus. This species is possibly endemic to Taveuni.

**Etymology.** This species is named for its type locality, Devo Peak.

*Plagiozopelma sukapisu* Bickel, new species

(Fig. 2f)

**Description. Male:** length 3.7 mm; wing: 2.7 × 0.9 mm.*Head:* palp yellow with dark brown setae; proboscis yellow; antenna brown; first flagellomere conical; arista long, only slightly shorter than body length, and simple.*Thorax:* mesonotum and pleura, including metepimeron metallic green with bronze reflections, and with some grey pruinosity.*Legs:* coxae yellow, but CII with some infuscation laterally; remainder of legs entirely yellow; CI with 6 pale spine-like setae; I: 4.3; 4.8; 3.4/ 1.3/ 1.0/ 0.6; TI with 5–6 fine pale curved posterior setae along distal fifth (MSSC); It1 with pv row of some 20 pale weak curved decumbent setae along length (MSSC); II: 4.5; 7.5; 6.0/ 1.8/ 1.2/ 0.6/ 0.4; TII very long, almost twice length FII; TII with short ad seta at 1/5; III: 6.0; 10.8; 4.8/ 2.0/ 1.3/ 0.8/ 0.4; TIII with row of short dorsal setae.*Wing:* CuAx ratio: 1.7; cross vein dm-cu slightly curved; lower calypter pale with dark brown rim and pale setae; halter yellow with slightly infuscated club.*Abdomen:* elongate; metallic bronze-green with some silvery pruinosity; sparsely haired with only 2 strong dorsals on each tergum; hypopygium (Fig. 2f); epandrium mostly dark brown; dorsal cercal arm yellow, ventral arm brown; epandrial lobe with 2 strong setae; surstylus lobate with long apical seta; cercal arms broadly joined at base; dorsal cercal arm with 3 long apical setae; ventral cercal arm with 2 long dorsal subapical setae and group of ventral subapical setae, as figured.**Female:** unknown.**Types.** Holotype ♂ (BPBM 16,567), SOLOMON ISLANDS: Santa Ysabel, Sukapisu, 900 m, light trap, 19.vi.1960, C.W. O'Brien (BPBM).**Remarks.** *Plagiozopelma sukapisu* is known from the type locality at 900 m on Santa Ysabel, Solomon Islands.**Etymology.** The specific epithet "*sukapisu*" is an indigenous place name and is treated here as a noun in apposition.PHYLOGENETIC RELATIONSHIPS OF THE MELANESIAN  
*PLAGIOZOPELMA*Two species groups of *Plagiozopelma* extend into Melanesia. The *angustifacies* group includes the Solomon Islands *P. arctifacies* (Parent), three described species from New Guinea and Australia, as well as undescribed species (Bickel, 1994). This group will not be considered any further here.The *flavipodex* species group includes the nine central Pacific species treated here. What are the phylogenetic relationships among these nine species? Do they display synapomorphies that suggest phylogenetic and biogeographical relationships?

All species have distinctive character states that allow identification using male secondary sexual characters (MSSC) and/or genitalic structure, as is the case in most Sciapodinae (Bickel, 1994). Most of these characters comprise minor variations in the color, form and setation of the male cercus and legs, and few are strong enough to provide unequivocal synapomorphies among species. Rather, they reflect variable expression of a suite of potential characters/ character states possibly used in species recognition. Two characters warrant further discussion:

1. Male apical arista flag (MSSC). Males of most *flavipodex* Group species have an apical flattening or flag (Figs 1b, d, f, h) at the end of a long arista, and this MSSC might be a synapomorphy for the entire Group. However it is absent in all four Fijian species, one of the four Vanuatu species, and the single Solomon Island species. The secondary loss of the arista flag (to an *apparent* unmodified plesiomorphic state) in these species may represent single or multiple homoplastic changes. I suggest at least two cases of secondary loss of the arista flag, once in the Solomon Island *P. sukapisu* (which has genitalic

structures distinct from the Fiji and Vanuatu species) and at least once for a clade that might comprise the single Vanuatu species, *P. bellicum* and all the Fijian species.

Here it should be noted that at least two of the Vanuatu species, *P. laffooni* (Fig. 1d) and *P. efatense* (Fig. 1h), show highly reduced arisal flags, which may reflect an evolutionary trend away from prominent flags (as displayed in widespread *P. flavipodex*, Fig. 1b, and Vanuatu endemic *P. santense*, Fig. 1f), possibly towards losing the flags altogether.

2. Modified female thoracic chaetotaxy. Three Fijian species, *Plagiozopelma toko-taai*, *P. devoense*, and *P. spinicaudum* have the female dorsocentral setation with 2 strong posterior setae and 2–3 weak anterior hairs, a strong synapomorphy which makes them sister taxa. Normally, this is a male secondary sexual character state found in many genera of Sciapodinae. In most *Plagiozopelma* and other sciapodine genera, females display the unmodified condition, where all 4–5 dorsocentral setae are more or less equally strong. Here is another case of a male secondary sexual character becoming incorporated into the female phenotype. A similar expression of “male” thoracic chaetotaxy in the female phenotype occurs in some Australian *Amblypsilopus* species (discussion in Bickel, 1994). The fourth Fijian species, *P. vitiense*, has normal unmodified female chaetotaxy.

### BIODIVERSITY AND BIOGEOGRAPHY

The Melanesia faunal composition noted here, from Fiji (4 spp.), Vanuatu (4 spp.) and the Solomon Islands (1 sp.) suggests that even from initial surveys, the *flavipodex* Group is well developed in the western Pacific. Of these, the Solomon Islands fauna is most under-represented in collections. Only a single male was found in the BPBM collection, described here as *P. sukapisu*, collected from 900 m on Santa Ysabel. This leads me to suspect that with its elevation and geographic complexity, the Solomon Islands has a rich but uncollected endemic fauna.

Both Vanuatu and Fiji probably have a few additional undescribed species. The three Viti Levu species seem reasonably widespread and broadly sympatric, and all also occur on the nearby offshore island of Ovalau. The single Taveuni species is known only from upland sites. I have not seen material from Vanua Levu.

Biogeographically, the Melanesian *flavipodex* Group fauna is probably derived via island stepping-stone dispersal from a Sundaland-Papuan source (Bickel, 1997). The group displays both widespread inter-island dispersal ability (for example, the distribution of *P. flavipodex* itself) and local endemism. The genus does not occur on New Caledonia (Bickel, 2002) or in temperate Australia/ New Zealand and it has no Gondwanan connections. There is no evidence of *Plagiozoplema* occurring east of the Fiji Group.

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### LITERATURE CITED

- Bickel, D.J.** 1994. The Australian Sciapodinae (Diptera: Dolichopodidae), with a review of the Oriental and Australasian faunas, and a world conspectus of the subfamily. *Records of the Australian Museum, Supplement* 21, 394 pp.

- . 1997. Restricted and widespread taxa in the Pacific: biogeographic processes in the fly family Dolichopodidae (Diptera), pp. 331-346. In, A. Keast & S. Miller (eds.), *The origin and evolution of Pacific Island biotas, New Guinea to eastern Polynesia: Patterns and processes*. SPB Academic Publishing bv, Amsterdam. viii + 531 pp.
- . 2002. The Sciapodinae of New Caledonia (Diptera: Dolichopodidae). *Zoologia Neocaledonica, Mémoires de Museum National d'Histoire naturelle, Paris*. **187**: 11-83.

