

New Species of *Hemerodromia* Meigen from Fiji (Diptera: Empididae)¹

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Abstract. Thirteen species of *Hemerodromia*: *H. dromodromoa* n. sp., *H. iqasoa* n. sp., *H. kumia* n. sp., *H. moqimoqilia* n. sp., *H. raradamua* n. sp., *H. senivaua* n. sp., *H. spiculata* n. sp., *H. subiqasoa* n. sp., *H. votovotoa* n. sp., *H. vucea* n. sp., *H. vulacia* n. sp., *H. vutivutia* n. sp., and *H. walingi* n. sp. (Diptera, Empididae, Hemerodromiinae) are described and illustrated from Fiji. A key to males is given.

INTRODUCTION

The empidid genus *Hemerodromia* Meigen includes about 130 described species distributed across the Palaearctic, Nearctic, Neotropical, Afrotropical and Indomalayan Realms and there are undescribed species from Australia and Oceania. Immature stages are aquatic, and require usually well oxygenated water for development (Vaillant 1981, Smith 1989, Vaillant & Gagneur 1998). The fauna is particularly abundant and diverse around flowing waters in humid tropical and temperate forest biotopes and around the water margins at higher latitudes and altitudes. Adult flies are small, from 2–4 mm long, with strongly raptorial front legs presumably employed in predatory activity. They are often captured in Malaise traps, especially near flowing water, and have been observed running on gravels and more frequently on riparian vegetation marginal to water bodies. The present work describes 13 new species of *Hemerodromia* from Fiji.

MATERIALS AND METHODS

This study is based on dried and alcohol-preserved material from the Fiji Arthropod Survey funded by US National Science Foundation and the Schlinger Foundation. Types and vouchers are deposited in the Bishop Museum, Honolulu (BPBM), Fiji National Insect Collection, Suva (FNIC), Canadian National Collection of Insects, Ottawa, Canada (CNC), and National Museum of Wales, Cardiff, UK (NMWC). Morphological terms are essentially those of McAlpine (1981) and Stuckenberg (1999). Interpretation of the male genitalia follows Sinclair (2000).

Morphological abbreviations used are: C₁, front coxa; F₁, front femur; T₁, front tibia. Orientation was denoted by: av, anteroventral; pd, posterodorsal, pv, posteroventral. The front femora bear two rows of long setae ventrally between which is a double row of much

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shorter peg-like setae (Fig. 40). This study employs the term spine to describe setae of the outer rows and denticle denotes shorter setae between these rows. The femoral formula (Plant 2007) records the number of spines or denticles in each series starting from the most anterior and working posteriorly. Thus a femoral formula of 7/15/16/6 indicates that there are 7 av spines, 15 av denticles, 16 pv denticles and 6 pv spines. In a few species, the apical part of either row of denticles is laterally displaced from the basal part forming a disjunction in linearity of the row. Inter-sexual differences in femoral formula occur (although in most cases the sample size is too low to accurately quantify) and in males of many species, the basal denticle of the pv series (which usually originates from a slight basal swelling) is larger and distinctly separated from main series by a short bare area (Fig. 40).

Colour is *ground colour*, and any colouration due to dusting is not mentioned as it was difficult to interpret in fluid-preserved specimens. Colour descriptions should be treated with caution as in the predominantly yellow species, the intensity of yellow colour varies somewhat and when darker markings occur, they can be variable. Insufficient material was available to properly assess this range of variation.

In addition to full locality / date / collector data, almost all specimens are labelled with a unique reference (prefixed FBA) and some with a collection site lot number (prefixed FJ).

SYSTEMATICS

Hemerodromia Meigen

Hemerodromia Meigen, 1822: 61. Type species: *Tachydromia oratoria* Fallén, 1815, des. Rondani, 1856: 148. [Suspension of I.C.Z.N. rules required to validate Rondani's type species designation, and to set aside earlier type designations by Westwood (1840: 132) and Desmarest *in* d'Orbigny (1845: 528) in the interests of stability and common usage; see Melander (1928: 252), Collin (1961: 715).]

Diagnosis. *Hemerodromia* (Fig. 39) is readily distinguished from other members of the tribe Hemerodromiini *sensu* Sinclair & Cumming (2006) as amended by Plant (2007) by the following combination of characters. Wing (Fig. 41) with fork R_{4+5} and M_{1+2} present, cells $bm+dm$ fused, cell cup absent. Vein Sc fused with C basally, becoming more or less separated about level with radiocubital node. Vein h absent. Head strongly dorsoventrally flattened, eyes with anterior ommatidia enlarged (especially in males). Postpedicel shortly lanceolate, arista no longer and with basal article present but weakly differentiated. Thorax with only notopleural and sometimes scutellar setae well developed; acrostichal and dorsocentral setulae usually present but minute. Front femur always with two rows of minute black denticles and with adjacent posteroventral and anteroventral rows of more normal setae variably developed (Fig. 40).

Characteristics of Fijian *Hemerodromia*. *Hemerodromia* occurs in all faunal realms excepting Antarctica. The genus appears to be well founded (although *H. radialis* Collin from New Zealand differs especially in wing venation and is undoubtedly incorrectly assigned to *Hemerodromia*; and some South African forms have cell cup partially developed) and although the generic diagnosis accommodates this relatively homogeneous fauna, regional variations do occur for which several informal species-groups have been proposed by MacDonald (1998) in the Nearctic Realm and by Vaillant & Gagneur (1998) in the Palaearctic. These species-groups were based primarily on the shape, size and setation of the epandrium and cerci, degree of elongation of the female terminalia, the

presence or absence of a basal process on the front femur and an apical spur on the front tibia. Vaillant & Gagneur (1998: 381) considered that the *H. melangyna* Collin-group was sufficiently distinct to warrant generic status but did not erect a genus for it.

In the absence of a formal or phylogenetic analysis, and without studying the wider world fauna, we consider it unwise to speculate unduly on the affinities of Fijian *Hemerodromia*. However, setation of the head is well developed in Fijian *Hemerodromia*, with a pair of vertical setae in particular being well developed (usually much weaker in at least the Palaearctic species) and being contiguous with 2–3 not much smaller postocular setae. The scutellum always bears a pair of strong erect setae (present otherwise in the *H. melangyna*-group), vein R_5 and M_1 are distinctly convergent (but not as markedly as in *H. fusca* Yang & Yang from China). An apicoventral spur is always present on the front tibia but the basal process on the front femur is at most, weakly developed in the Fijian species. *Hemerodromia vucea* n. sp. is distinctive amongst Fijian species on account of an enormously enlarged hypandrium (Fig. 25) and is perhaps rather disparate from the other species that have more normal hypandria and share overall similarities in the morphology of the epandrium and cercus.

Separation of species relies heavily on male external genital morphology. Determination of females is problematical and in most cases probably unfeasible without associated males. The shape and pigmentation of tergite 10, sternite 10, and the cerci are useful characters but subject to intraspecific variation in the extent of dark colouration.

KEY TO MALES OF FIJIAN *HEMERODROMIA*

Determination of species should always be confirmed by reference to genital morphology described in the species accounts.

1. Thorax predominantly brown **raradamua** Plant & Sinclair, n. sp.
- . Thorax predominantly yellow (Fig. 39) 2
2. Hypandrium greatly inflated, egg-shaped (Fig. 25) **vucea** Plant & Sinclair, n. sp.
- . Hypandrium otherwise 3
3. Scutum with at least faint brown longitudinal linear marking 4
- . Scutum entirely yellow 5
4. Scutum posteriorly with dark median line (basal pv denticle on F_1 not separated from rest of series by a short bare area) **votovotoa** Plant & Sinclair, n. sp.
- . Scutum with pale brown lateral stripes which fade laterally (basal pv denticle on F_1 separated from rest of series by a short bare area; Fig. 40) **kumia** Plant & Sinclair, n. sp.
5. Genitalia entirely deep black; at least one of double row of denticles beneath F_1 with linear disjunction subapically 6
- . Genitalia yellow or only partly black; both rows of denticles beneath F_1 without linear disjunction subapically 8
6. Anteroventral series of denticles on F_1 with linear disjunction subapically; epandrium and hypandrium densely pilose 7
- . Both av and pv series of denticles on F_1 with linear disjunction subapically; epandrium and hypandrium not densely pilose (Fig. 31) **vutuvutia** Plant & Sinclair, n. sp.

7. Phallus not extending beyond cercus, lacking spicules (Figs. 12–13)
 **moqimoqilia** Plant & Sinclair, **n. sp.**
- . Phallus extending beyond cercus, with spicules on apical portion (Fig. 35)
 **spiculata** Plant & Sinclair **n. sp.**
8. Genitalia entirely yellow, only cercus darkened apically 9
- . Genitalia bicoloured yellow and black 10
9. Male cercus very narrow and sharply incurved apically (Figs. 6, 7)
 **iqasoa** Plant & Sinclair, **n. sp.**
- . Male cercus broad and truncate in lateral view, apical third more gradually incurved
 (Figs. 37, 38) **subiqasoa** Plant & Sinclair, **n. sp.**
10. Cercus subapically with pointed, inwardly directed process (Figs. 1, 19) 11
- . Cercus otherwise 12
11. Cercus with short subapical process, less than width of cercus (Fig. 1) , postgonite not
 emerging dorsally from inner face **dromodromoa** Plant & Sinclair, **n. sp.**
- . Cercus without subapical process, but with sharply pointed postgonite emerging dor-
 sally on inner face, reaching almost to tip of cercus (Fig. 19)
 **senivaua** Plant & Sinclair, **n. sp.**
12. Hypandrium rounded apically; cercus in lateral view with distinct dorsoapical
 hooked process (Fig. 32) **watlingi** Plant & Sinclair, **n. sp.**
- . Hypandrium with sharply pointed and curved apical process (Fig. 28); cercus rather
 apically broadened **vulacia** Plant & Sinclair, **n. sp.**

***Hemerodromia dromodromoa* Plant & Sinclair, new species**

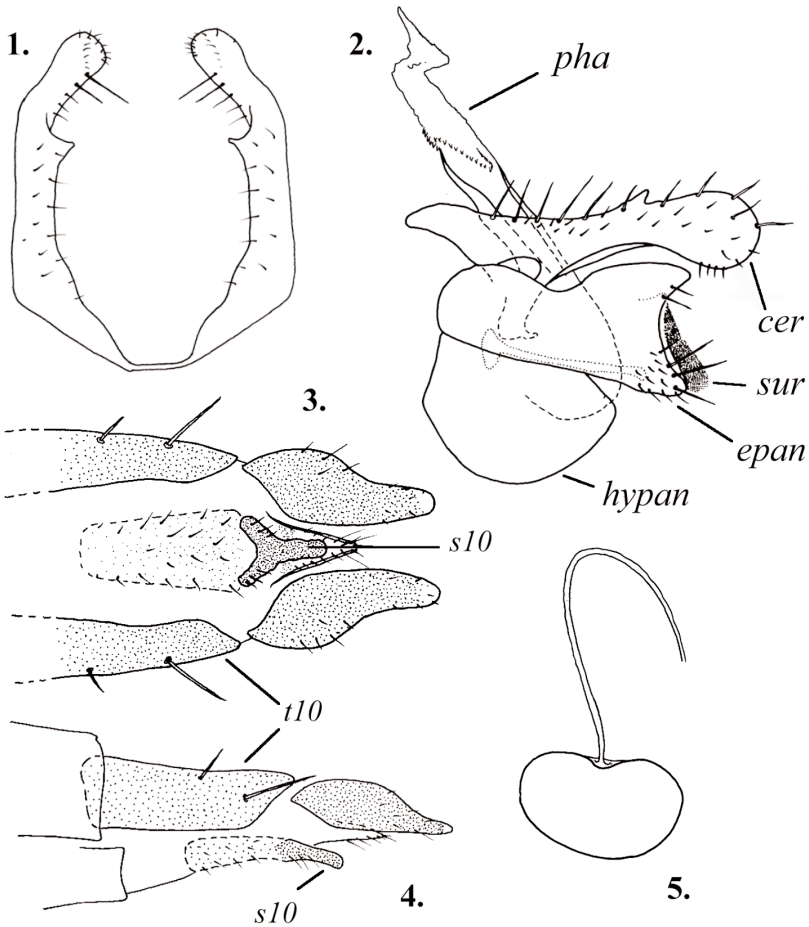
(Figs. 1–5, 39)

Diagnosis. A yellow species, characterized in the male by partly-coloured black and yellow genitalia with apically lobed cerci bearing a small inwardly directed pointed process.

Description. Male. (Fig. 39). *Head.* Strongly dorsoventrally flattened, yellow, all setae whitish, ocellar triangle black, front of frons and antennae whitish. Eyes iridescent black, ommatidia conspicuously enlarged anteriorly; narrowly separated on face which bears fine upturned setulae. Frons with 1–2 frontal setulae. A pair of fine vertical setae midway between anterior ocellus and eye margin contiguous with 2–3 postocular setae (longest posteriorly). Occiput bearing scattered fine hairs; clypeus with rather dense short downwardly directed pile. Antenna with scape and pedicel bearing distinct short dorsal setulae; postpedicel short lanceolate, about 1.5 x as long as wide, style slightly shorter than postpedicel with inconspicuous basal article and apical sensillum.

Thorax. Elongate, hardly arched below; yellow, all setae yellowish, very small and fine except one notopleural and pair of scutellars, separated by less than length of seta.

Legs. Whitish yellow. C_1 about as long as distance between C_1 and C_2 , 5 x as long as wide with a few pale dorsoapical setae. F_1 rather longer than C_1 , 4.5–5.0 x as long as wide, evenly inflated, widest 0.5 from base. Femoral formula 6–7/15–17/15–16/6–7; denticles black, becoming closer together and the two rows converging distally, in linear series without distal discontinuity but basal denticle of pv series (which originates from a slight basal swelling) rather larger and distinctly separated from main series by short bare area; spines yellow, becoming weaker and shorter distally. T_1 0.8 x as long as F_1 , evenly curved, ventral face shallowly concave; about 15–18 sharply pointed spine-like setae ventrally on distal 0.8, almost as long as T_1 is deep with adjacent av series of smaller setulae; dorsal ciliation of decumbent short pale setulae denser distally; slight apicoventral exten-



Figures 1–5. *Hemerodromia dromodromoa*. 1. Male cerci, dorsal view; 2. Male terminalia, lateral view; 3. Female terminalia, ventral view; 4. Female terminalia, lateral view; 5. Female spermatheca and duct. Abbreviations: *cer* – cercus; *epan* – epandrium; *hypan* – hypandrium; *pha* – phallus; *sur* – surstylus; *s10* – sternite 10; *t10* – tergite 10.

sion on T_1 bearing strong black spur, longer than T_1 is deep, sharply pointed and rather dorsoventrally flattened. Mid and hind legs slender, lacking strong setae but T_3 with dorsal setae rather longer and strong ‘comb’ of short setae posteroapically.

Wing. Membrane faintly yellowish tinged, veins yellow; fork R_{4+5} less than 90° and slightly distal of fork M_{1+2} ; R_5 and M_1 convergent apically; second submarginal cell (r_4) rather long, vein R_5 about 3 x as long as R_4 . Halteres whitish yellow.

Abdomen. Yellow with pale setae most conspicuous on hind margin of posterior sternites. Cercus (Fig. 1) black, narrow, with rounded apical lobe, small pointed subapical process directed

internally 0.6 from base also visible in lateral view (Fig. 2), distinctly setose. Epandrium (Fig. 2) black distally, sometimes brownish yellow proximally, somewhat Y-shaped, constricted medially but distally blunt-ended with posterior margin slightly concave and bearing distinct setae, particularly posteroventrally. Surstylus with apex usually visible in lateral view as rather paler flattened plate, behind and slightly longer than epandrial lobe. Hypandrium yellow, sometimes brownish posterolaterally, rather rounded, not reaching to end of epandrium, not markedly inflated, lacking strong setae; pair of lanceolate postgonites flanking base of phallus, slightly shorter than sclerotized portion of phallus. Phallus, whitish, when extended visible part almost as long as cercus.

Female. Very similar to male but F_1 with basal denticle of pv series not separated from main series. Ventral spines on F_1 stronger, especially basal pair. Abdomen with tergite 10 black, rather elongate, bearing one long and one shorter lateral seta (Figs. 3–4). Cercus shining black, tip paler; broad basally, narrowing apically; sternite 10 Y-shaped, black. Spermatheca (Fig. 5) flattened ovate, black with narrow pale duct.

Types. *Holotype* ♂ FIJI: **Taveuni:** 5.6 km SE Tavuki Vlg., Mt Devo, 1187 m, 27 Dec 2002–3 Jan 2003, Malaise 1, coll. Schlinger. M. Tokota'a, 15.843°S, 179.996°W [FBA 161515]. Holotype deposited in FNIC. *Paratypes:* 108♂, 69♀ [FBA 020471, 057722, 042923, 042925–042926, 070329, 110280–110281, 146365, 005116–005130, 041395–041419, 053629–053639, 056730–056739, 095501–095506, 113318–113320, 129297–130308, 147690–147698, 149319–149323, 150181–150201, 150765–150766, 161516–161524, 153763–153772, 162060–162062, 162900–162904]; topotypic, all captured in Malaise traps between 800 m and 1200 m in all months between June and January except September (BPBM, CNC, FNIC, NMWC). *Additional material:* 1♂, 5♀, same data as paratypes (FNIC).

Etymology. From the Fijian 'dromodromo' meaning yellow, in reference to the yellow colour of the species.

Hemerodromia iqasoa Plant & Sinclair, new species

(Figs. 6–8)

Diagnosis. An entirely yellow species only darkened on the ocellar triangle, tip of male cercus and wing veins basally. Best distinguished by shape of the male cercus being very narrow and strongly incurved apically.

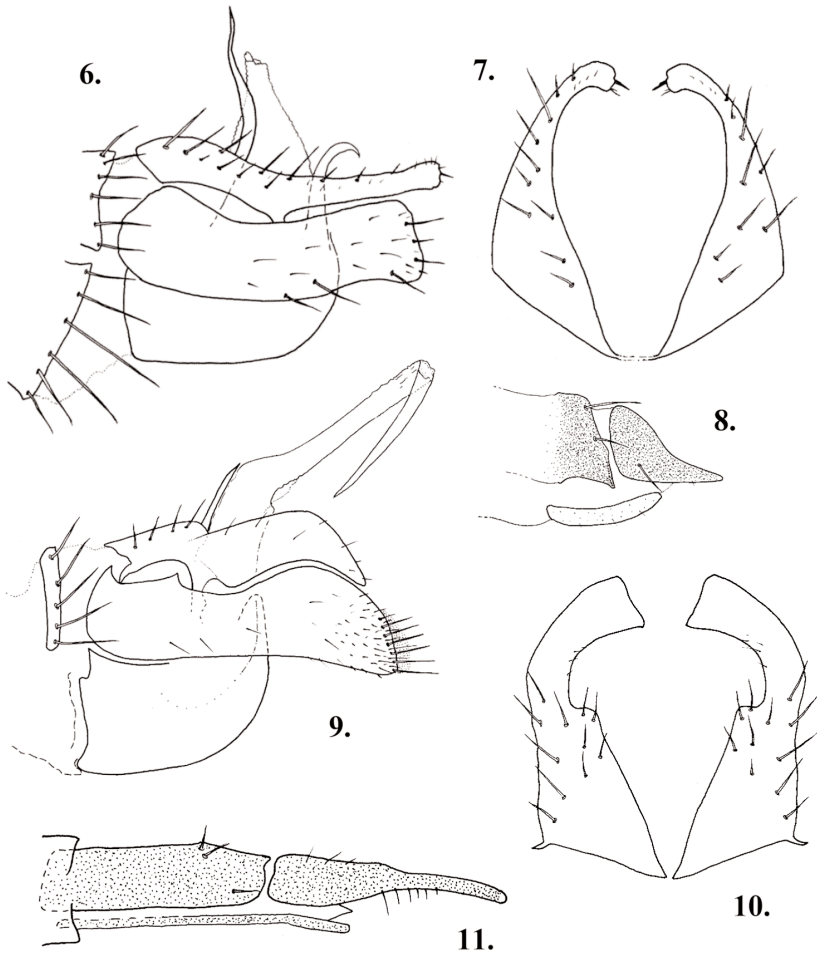
Description. Male. Very similar to *H. dromodromoa* n. sp., differing as follows:

Legs. Femoral formula 6–7/16–18/15–17/5–7, both series of denticles linear and convergent apically, basal denticle of pv series slightly larger and distinctly separated from main series by short bare area.

Wing. Veins brownish yellow, usually distinctly darker basally, especially about base of R_{2+3} beyond apex of cell br, vein Cu at base of cell $bm+dm$ and posterior wing margin at extreme base. Fork R_{4+5} almost 90° and about level with fork M_{1+2} .

Abdomen. Entirely yellow including hypopygium (Fig. 6), only cerci somewhat darkened apically. Tergite 8 and sternite 8 with distinct long yellow bristles on posterior margins. Cercus (Fig. 7) very narrow, strongly incurved distally, bearing 2–3 very short, erect setulae apically and with longer setae dorsally. Epandrium narrow, slightly constricted medially, with distinct setae posteroventrally and apically. Postgonite apically curved and sharply pointed, distally emergent above cercus in lateral view. Hypandrium bare. Phallus apparently broad.

Female. The single female included in the type series was recognized only by association with males. Very similar to male and to female of *H. dromodromoa* n. sp. F_1 femoral formula 8/18/18/6, basal denticle of pv series not larger or separated from the rest; basal pair of spines, very strong, yellow. Fork R_{4+5} rather less than 90°. Cerci (Fig. 8) black, short, broad, almost triangular basally, nar-



Figures 6–11. *Hemerodromia* spp. **6–8.** *Hemerodromia iqasoa*. **6.** Male terminalia, lateral view; **7.** Male cerci, dorsal view; **8.** Female terminalia, lateral. **9–11.** *Hemerodromia kumia* **9.** Male terminalia, lateral view; **10.** Male cerci, dorsal view; **11.** Female terminalia, lateral view.

row apically, with distinct lateral seta. Tergite 10 black distally, bearing two pairs of distinct setae, yellow and weakly sclerotized proximally. Sternite 10 pale yellow, apparently with only minute setulae.

Types. *Holotype* ♂ FIJI: **Viti Levu:** 3.8 km N Veisari stlmt., log rd to Waivudawa, 12.xii.2002–3.i.2003, 300 m, Malaise 2, Schlinger, Tokota'a, 18.079°S, 178.363°E [FBA 103830]. *Holotype* is deposited in FNIC. *Paratypes:* **Viti Levu:** 1♂, 4.8 km N Veisari Stlmt., log rd to Waivudawa, 300 m, 12.xii.2002–3.i.2003, Malaise 1, Schlinger, Tokota'a, 18°4'30"S, 178°21'43"E, [FBA 177563] (CNC); 3♂, 1♀, Savuione Trail, FJ-1 Malaise 21.x–18.xi.2004 N. Irwin E. Schlinger M. Tokoka'a 17°40'S 177°33'E, 450 m, [FBA

049166–049167, 049170] (CNC, FNIC, NMWC); 1♂, 1 km E Abaca Vlg., Koroyanitu Natl. Pk., 800 m, Savuione Trail, 17°40'S, 177°33'E, 26.x–5.xi.2002, Malaise, E. Schlinger, Tokota'a, FJVL01_MO1_05, [FBA 083637] (NMWC).

Etymology. From the Fijian 'iqaso' meaning a hook or hook-shaped in reference to the shape of the postgonite.

Hemerodromia kumia Plant & Sinclair, **new species**

(Figs. 9–11, 40)

Diagnosis. A yellow species with pale brown lateral stripes on the scutum which fade laterally. Best distinguished by the male genitalia in which the cercus is broad, and apically decurved in lateral view.

Description. Male. Similar to *H. dromodromoa* n. sp., differing chiefly as follows:

Thorax. Scutum yellow dorsally, sharply contrasting with brown stripe along line of acrostichal setulae but which grades to more brownish yellow laterally. Postpronotal lobe brownish, suture between it and lateral margins of scutum contrastingly yellow.

Legs. Femoral formula 6–8/17–18/16–19/6; double rows of denticles beneath F_1 , becoming smaller and converging distally (Fig. 40), without linear discontinuity in either row, basal pv denticle clearly separated from others in series but only slightly larger. Spines distinct. T_1 with about 17 sharply pointed spine-like setae ventrally and strong, sharply pointed apical spur obviously longer than T_1 is deep.

Wing. Veins yellowish, slightly darker basally. Fork R_{4+5} almost right angular, only slightly beyond fork M_{1+2} .

Abdomen. Yellow; small brown median submarginal mark on tergites 2–6; ventrum pale. Hypopygium (Fig. 9) yellow with hypandrium apically, epandrium distally and cerci black. Cercus broad (Fig. 10), apically decurved in lateral view (Fig. 9); distinctly incurved, abruptly narrowed, then much expanded apically with flattened tip (appearing much broader distally than shown in Fig. 10 when viewed in dorsolateral aspect). Epandrium long, distinctly constricted medially, rounded and with distinct setae apically. Hypandrium short, bare. Phallus long, whitish, apical section sharply pointed.

Female. Very similar to the male but brown markings of thorax less distinct. Basal pv denticle of F_1 not separated from others of series by bare area and spines rather stronger. Terminalia elongate (Fig. 11); cercus black, extreme apex pale, not greatly broadened basally; sternite 10 back, very long and almost overlapped laterally by lower margin of tergite 10.

Types. *Holotype* ♂ FIJI: **Vanua Levu:** 6 km NW Kilaka, 15–28.vi.2004, Batiqere Range, Malaise, 146 m, Schlinger, Tokata'a, FJVN58d_M01_07, 16.8153°S, 178.9864°E [FBA 072356]. *Holotype* is deposited in FNIC. *Paratype:* 1♂, same data as holotype but 61 m, 3–10.vi.2004, Malaise 3, 16.811°S, 178.988°E [FBA 115312] (FNIC); 1♀, same data as holotype but FJ-58E, 24.vi.–21.vii.2004, 178°59'290"E, 16°48'412"S, M.E. Irwin, E. Schlinger, M. Tokota'a, 98 m, Malaise [FBA 028297] (FNIC).

Etymology. From the Fijian 'kumi' meaning beard, in reference to the distinct setae apically on the epandrium of this species.

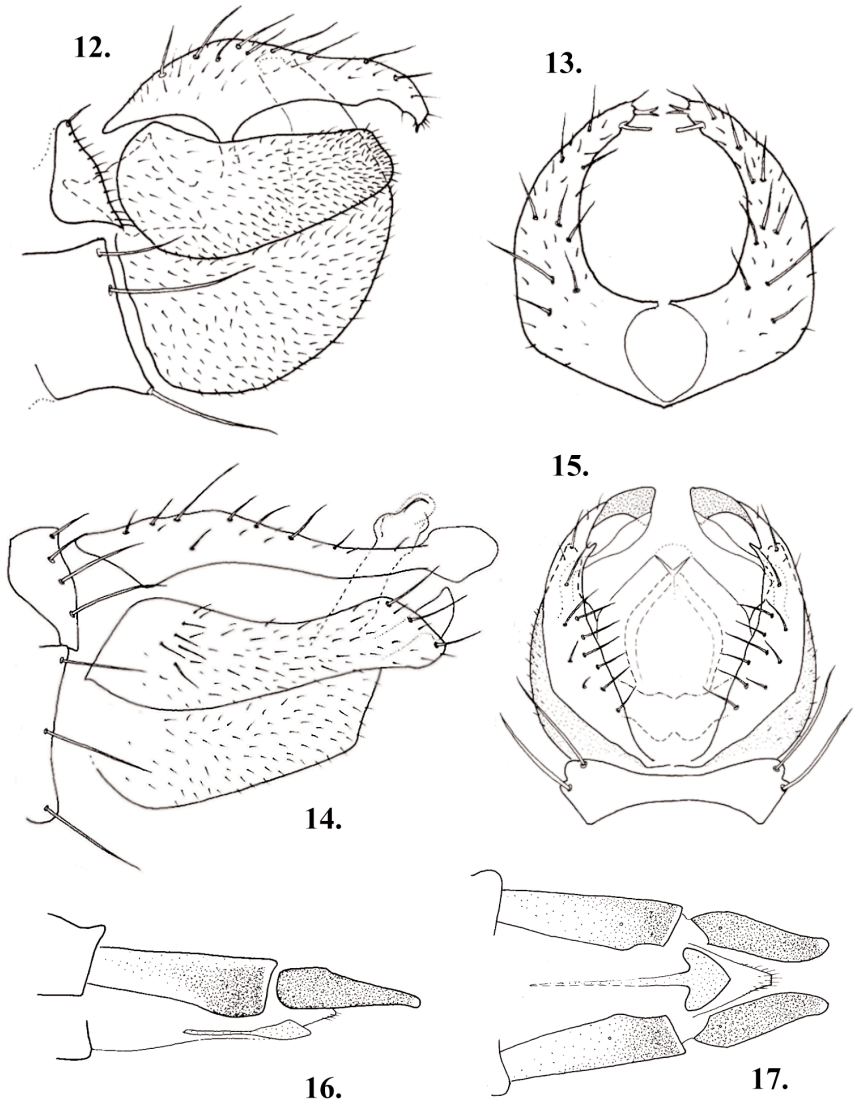
Hemerodromia moqimoqilia Plant & Sinclair, **new species**

(Figs. 12, 13)

Diagnosis. A yellow species with abdomen brown dorsally and denticles of F_1 arranged in discontinuous rows. The male genitalia are deep black, rather rounded, with distinctive cerci and densely pilose epandrium and hypandrium.

Description. Male. Similar to *H. dromodromoa* n.sp., differing as follows: *Thorax.* Darker yellow.

Legs. C_1 rather more slender, 7–8 x as long as wide. F_1 with the two series of denticles slight-



Figures 12–17. *Hemerodromia* spp. **12–13.** *Hemerodromia moqimoqilia*. **12.** Male terminalia, lateral view; **13.** Male cerci, dorsal view; **14–17.** *Hemerodromia raradamua*. **14.** Male terminalia, lateral view; **15.** Male cerci, dorsal view; **16.** Female terminalia, lateral view (setae not shown); **17.** Female terminalia, ventral view (setae not shown).

ly diverging distally; av series with distal two denticles in a line discontinuous with proximal series and positioned slightly more ventrally; pv denticles in two discontinuous rows, proximal row of 8–9 rather evenly and widely spaced, and clearly differentiated from distal row of 6–8 more closely apposed denticles. T_1 with apical spur shorter, hardly as wide as T_1 is deep.

Wing. Membrane clear; veins darker, brownish yellow.

Abdomen. Tergites 2–6 with broad brown markings dorsally; tergite 7 yellow; tergite 8 narrow, blackish. Vent pale yellow but pregenital sternite darkened on posterior margin. Hypopygium (Fig. 12) deep black, rather rounded in lateral view. Cercus (Fig. 13) narrow, bluntly pointed and slightly down-turned apically, bearing distinct setae dorsally and 2–3 short stout setae on inner face apically. Epandrium and hypandrium densely covered with minute setulae. Hypandrium with left and right lobes separated ventrally by narrow pale membranous area. Phallus apparently short, tip not emerging beyond cerci.

Female. Unknown.

Type. *Holotype* ♂ FIJI: **Taveuni**; 5.5 km SE Tavuki Vlg., Malaise, rainforest, 30.vi–14.viii.2004, Schlinger, Tokota'a, FJTA8b_MO2_02, 16.843°S, 179.996°W, 1188 m [FBA 070328]. Holotype is deposited in FNIC.

Etymology. From the Fijian 'moqimoqili' meaning globular, in reference to the rather globular male genitalia of the species.

Hemerodromia raradamua Plant & Sinclair, new species

(Figs. 14–17, 41)

Diagnosis. Readily recognized in the male as being the only predominantly brown species known from Fiji, with darkened wing veins and all black genitalia with cercus long, narrow, apically incurved and broadened into a rather rounded plate.

Description. Male. *Head.* Brown, ocellar triangle black; all setae whitish or yellow; antennae white.

Thorax. Brown, more yellowish brown on postpronotal area and along line of acrostichal setulae anteriorly.

Legs. Yellow but rather darker than in *H. dromodromoa* n. sp. Denticles of F_1 rather numerous, femoral formula 8/20/17/7, basal denticle of pv series not separated from rest of series by bare area. T_1 with about 20 sharply pointed spine-like setae ventrally.

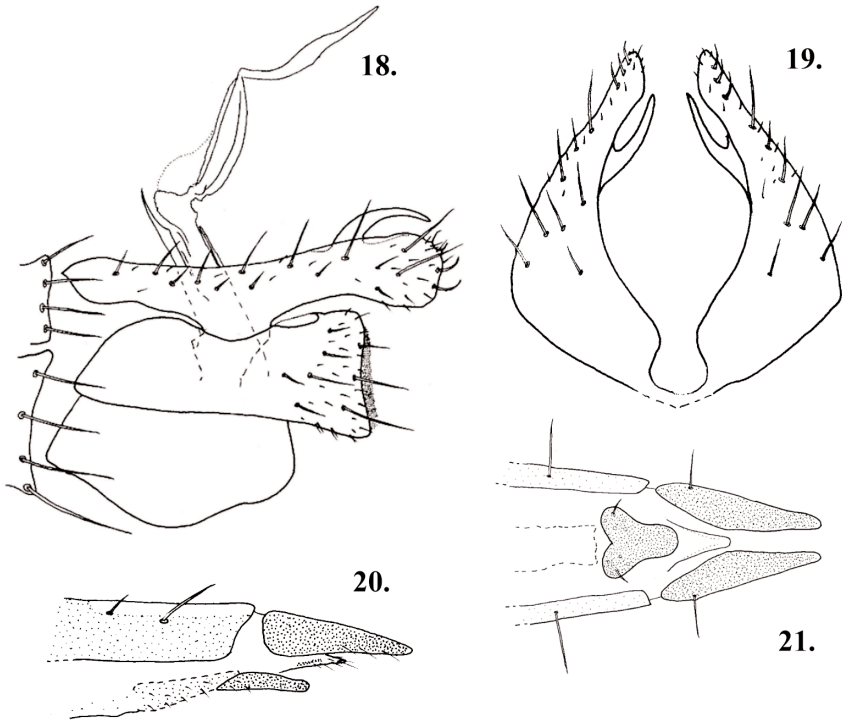
Wing. Membrane faintly tinged brown, veins dark, brownish (Fig. 41).

Abdomen. Brown dorsally, whitish ventrally with sternites 1–5 narrowly brown at extreme anterior margin and pregenital sternite yellowish. Hypopygium (Figs. 14–15) dark brown. Cercus long, narrow, apically incurved and broadened into a thin rather rounded plate. Epandrium narrow, evenly constricted medially, almost as long as cercus, bearing minute setulae and with longer setae basally and apically. Hypandrium rather thickly minutely setulose. Phallus short, hardly emerging above cerci.

Female. Similar to male but head and pleurae yellowish. (one female paratype is paler still, being only rather vaguely darkened on scutum and with abdomen paler; it is probably teneral. Femoral formula 7/20/19/6. Wing veins paler brown. Terminalia (Figs. 16–17) very similar to *H. senivaua* n. sp. but sternite 10 rather more arrow-shaped than heart-shaped.

Types. *Holotype* ♂ FIJI: **Viti Levu**: PABITRA Wabu Baseline Survey, 1034 m 17–20.xi.2003, Malaise samples collected from Delena Veikoi 17.5833°S 178.0833°E [FBA 053108]. Holotype is deposited in FNIC. *Paratypes*: 2 ♀, same data as holotype (FNIC).

Etymology. From the Fijian 'raradamu' meaning brown, in reference to the brown colour of this species.



Figures 18–21. *Hemerodromia senivaua*. 18. Male terminalia, lateral view; 19. Male cerci, dorsal view; 20. Female terminalia, lateral view; 21. Female terminalia, ventral view.

Hemerodromia senivaua Plant & Sinclair, new species
(Figs. 18–21)

Diagnosis. A yellow species with partly coloured black and yellow male genitalia, very similar to *H. dromodromoa* n. sp. distinguished primarily by presence of a strong, sharply pointed postgonite emerging subapically on the inner face of the male cercus. Females doubtfully distinguished.

Description. Male. Very similar to *H. dromodromoa* n. sp., differing as follows:

Legs. Femoral formula 7/17–18/15–17/6–7, rows of denticles converging distally, basal denticle of pv series rather larger and distinctly separated from main series by a short bare area. T₁ with apical spur longer than T₁ is deep at tip.

Abdomen. Hypopygium (Fig. 18) yellow with cercus and epandrium black distally. Cercus (Fig. 19) narrow, similar to *H. dromodromoa* n. sp. but sharply pointed postgonite emerging subapically on inner face and extending almost to tip of cercus and very apparent in lateral view. Epandrium slightly constricted medially; hardly concave, almost linear apically. Surstylus apparently similar to *H. dromodromoa* n. sp. but hardly extending beyond epandrial lobe. Hypandrium bare. Phallus whitish and pale brown, apically pointed; when fully extended, fully 3 x as long as hypopygium.

Female. Identified only by association with males. Femoral formula 5–7/18–20/17/6–7. Cerci

(Figs. 20–21) more slender and more evenly narrowed apically than in *H. dromodromoa* n. sp., only extreme apex pale. Sternite 10 heart-shaped. Tergite 10 yellowish to brownish with at least mid line dorsally yellow and apparently weakly sclerotized

Types. *Holotype* ♂ FIJI: **Taveuni:** Tavuki Vlg., Mt Devo, 734 m., 30.vi–14.viii.2004, Malaise, E.I. Schlinger, M. Tokota'a, FJTA9a_MO5_02, 16.831°S, 179.99°W [FBA 071171]. Holotype is deposited in FNIC. *Paratypes:* 1♂, 5♀, same data as holotype [FBA 071172–071177] (FNIC, NMWC); 1♂, same data as holotype except 892 m, 31.vii–14.viii.2004, 16.837°S, 179.973°W [FBA 113321] (CNC); 2♂, Devo Forest Reserve, 800 m, 3–10.i.2003, FJ-9 malaise, M. Irwin, E. Schlinger, M. Tokota'a, 16°50'S 170°59'E [FBA 042920–042921] (BPBM); 3♂, 1♀, Mt. Devo, Malaise, 10–16.i.2003, FJ-7,8,9, M. Irwin, E. Schlinger, M. Tokota'a [FBA 038643–038646] (BPBM, FNIC); 1♂, 5.6 km SE Tavuki Village, Malaise, rainforest, 3–10.i.2003, E. Schlinger, M. Tokota'a, 16.843°S 179.965°E, FJTABA_M01-12 [FBA 057692] (CNC).

Etymology. From the Fijian 'senivau' meaning light yellow (literally the flower of *Hibiscus tilaceus*) in reference to the yellow colour of the species.

Hemerodromia spiculata Plant & Sinclair, new species

(Figs. 35, 36)

Diagnosis. A yellow species with abdomen brown dorsally and denticles of F₁ arranged in discontinuous rows. The male genitalia are deep black, rather rounded, with distinctive cerci and spicule-like projections on the phallus.

Description. Male. Similar to *H. dromodromoa* n. sp., differing as follows: *Thorax.* Scutellar setae more widely separated by greater than length of seta.

Legs. F₁ with the two series of denticles slightly diverging distally; av series with distal three denticles in a line discontinuous with proximal series and positioned slightly more ventrally; pv denticles in two discontinuous rows, proximal row of 7 rather evenly and widely spaced, and clearly differentiated from distal row of 9 more closely apposed denticles. T₁ with apical spur shorter, hardly as wide as T₁ is deep, with hooked apex.

Wing. Membrane clear; veins brownish yellow.

Abdomen. Tergites 2–6 distinctly pigmented; tergite 7 yellow; tergite 8 narrow, blackish. Ventrums pale yellow but pregenital sternite darkened on posterior margin. Hypopygium (Fig. 35) deep black, rather rounded in lateral view; epandrium and hypandrium densely pilose. Cercus (Fig. 36) narrow, bluntly pointed and strongly up-turned apically, bearing distinct setae dorsally and 2–3 short stout setae on inner face apically, including broad flattened modified seta. Epandrium rounded, shorter than cercus. Surstylus hook-like, directed medially. Hypandrium with left and right lobes separated ventrally by narrow pale membranous area; apex with flattened rectangular pair of postgonites. Phallus with membranous half clothed in some 10 sharp spicules.

Female. Unknown.

Type. *Holotype* ♂ FIJI: **Viti Levu:** 4 km WSW Colo-i-Suva Village, Mt. Nakobalevu, 300 m, 12.iv.2004, Malaise 1, Schlinger, Tokota'a, 18.057°S, 178.42°W [FBA 188354]. Holotype is deposited in FNIC.

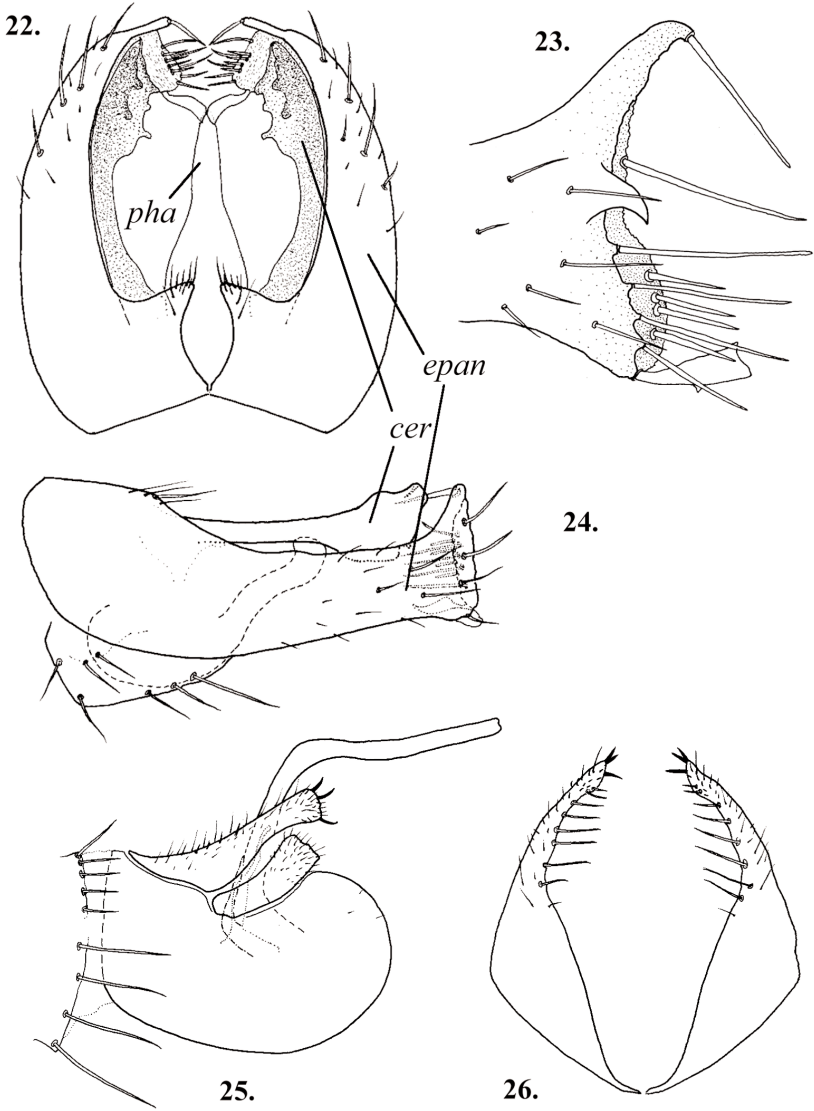
Etymology. Named in reference to the spiculate phallus of the male.

Hemerodromia subiqasoa Plant & Sinclair, new species

(Figs. 37, 38)

Diagnosis. An entirely yellow species only darkened on the ocellar triangle, tip of male cercus and wing veins basally. Best distinguished by shape of the male cercus being stout, incurved apically and apex truncate in lateral view.

Description. Male. Very similar to *H. dromodromoa* n. sp., differing as follows:



Figures 22–26. *Hemerodromia* spp. 22–24. *Hemerodromia votovotoa*. 22. Male terminalia, dorsal view; 23. Male, apex of left epandrial lamella, slightly oblique posterior view; 24. Male terminalia, lateral view; 25–26. *Hemerodromia vucea*. 25. Male terminalia, lateral view; 26. Male cerci, dorsal view. Abbreviations: *cer* – cercus; *epan* – epandrium; *pha* – phallus.

Legs. Femoral formula 6/16/17/6, both series of denticles linear and convergent apically, basal denticle of pv series slightly larger and distinctly separated from main series by short bare area.

Wing. Veins brownish yellow, usually distinctly darker basally, vein Cu at base of cell bm+dm and posterior wing margin at extreme base. Fork R_{4+5} almost 90° and distal to fork M_{1+2} .

Abdomen. Entirely yellow including hypopygium (Fig. 37), only cerci darkened apically. Cercus (Fig. 38) strongly incurved distally, with pointed apex dorsally; bearing 4–5 very short setulae along inner apical margin; apex truncate in lateral view. Epandrium broad basally, slightly constricted medially and truncate apically, with distinct setae posteroventrally and apically. Postgonite apically curved and sharply pointed. Hypandrium bare. Phallus broad, tubular.

Female. Unknown.

Type. *Holotype* ♂ FIJI: **Viti Levu:** 4.8 km N Veisari Stlmt., log rd to Waivudawa, 300 m, 12.xii.2002–3.i.2003, Malaise 1, Schlinger, Tokota'a, 18.175°S, 178.362°E [FBA 177565]. *Holotype* is deposited in FNIC.

Etymology. Named in reference to its similarity to *H. iqasoa* and their hooked postgonite.

Hemerodromia votovotoa Plant & Sinclair, new species

(Figs. 22–24)

Diagnosis. A yellow species similar to *H. dromodromoa* n. sp. but with a dark median line on scutum, abdomen brown dorsally and cell r_4 short. The male genitalia are yellow with black cerci almost enclosed within epandrial lamellae which bear characteristically arranged strong setae.

Description. Male. Similar to *H. dromodromoa* n. sp., differing as follows:

Thorax. Yellow with narrow, diffuse edged, brown median stripe posteriorly on scutum.

Legs. Yellow, F_1 with femoral formula approximately 7/14/16/6, basal denticle of pv series not separated from rest of series by bare area. T_1 rather short, about 0.65–0.7 x as long as F_1 .

Wing. Veins brownish yellow, slightly darker basally, almost black on posterior margin at extreme base. Fork R_{4+5} about 70°, noticeably beyond fork M_{1+2} ; cell R_4 rather short, vein R_5 about 2.5 x as long as R_4 .

Abdomen. Greyish yellow, tergites 2–6 brown dorsally. Hypopygium (Figs. 22–24) yellow with cerci black. Cercus narrow, inwardly curved, more or less hidden between epandrial lamellae in lateral view; spatulate apically, bearing distinct, short, blunt protuberances on inner face. Epandrium narrow, slightly constricted medially, spatulate apically (Fig. 23) with short triangular process mid way along rather concave apical margin; apically with inner row of 4–5 evenly sized stout setae and an outer row of 6–7 longer setae; dorsal seta of outer row, long, straight, inwardly directed; ventral seta of same row strongly differentiated and flattened. Hypandrium short, 0.5 x as long as epandrial lobes, bearing several distinct yellow setae. Phallus short, hidden between lamellae.

Female. Unknown

Type. *Holotype* ♂ FIJI: **Viti Levu:** Navai village, FJ-11A, Malaise, 24.x–8.xi.2003, M. Irwin, E. Schlinger, M. Tokoka'a, 17.37°S, 177.59°E, 700 m [FBA 031550]. *Holotype* is deposited in FNIC.

Etymology. From the Fijian 'votovotoa' meaning bristly, in reference to the setose epandrium of this species.

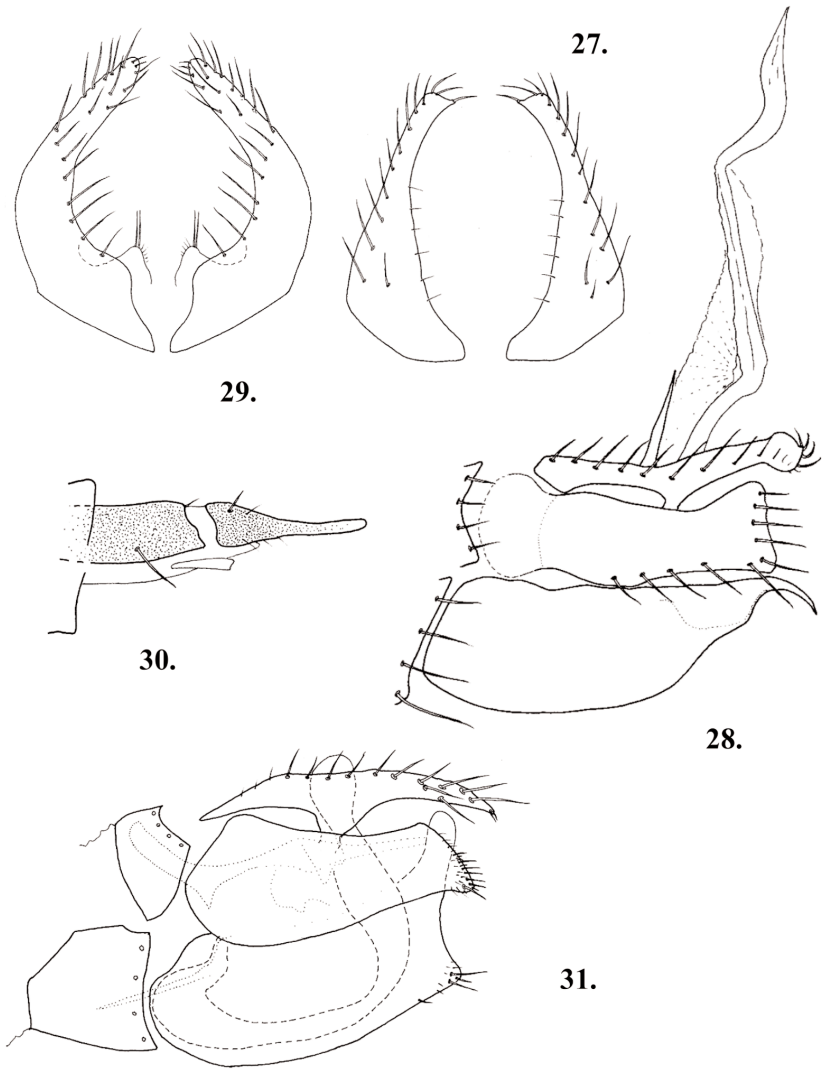
Hemerodromia vucea Plant & Sinclair, new species

(Figs. 25, 26)

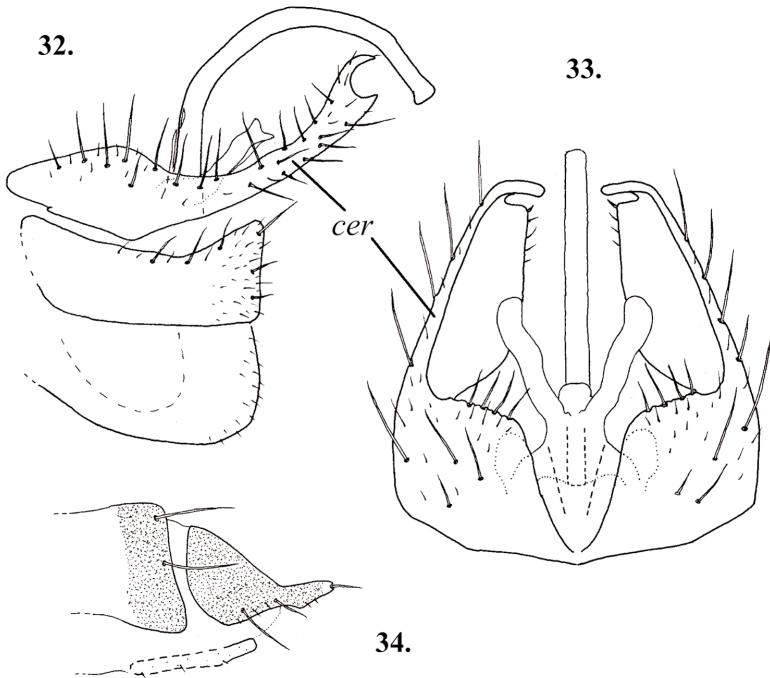
Diagnosis. A yellow species very similar to *H. dromodromoa* n. sp. but with distinctive male genitalia in which the epandrium is very small while the hypandrium is very conspicuously inflated and egg-shaped.

Description. Male. Very similar to *H. dromodromoa* n. sp., differing as follows:

Wing. Vein C yellow, other veins darker, Cu at base of cell bm+dm and posterior wing margin



Figures 27–31. *Hemerodromia* spp. 27–28. *Hemerodromia vulacia*. 27. Male cerci, dorsal view; 28. Male terminalia, lateral view; 29–31. *Hemerodromia vutivutia*. 29. Male cerci, dorsal view; 30. Female terminalia, lateral view; 31. Male terminalia, lateral view.



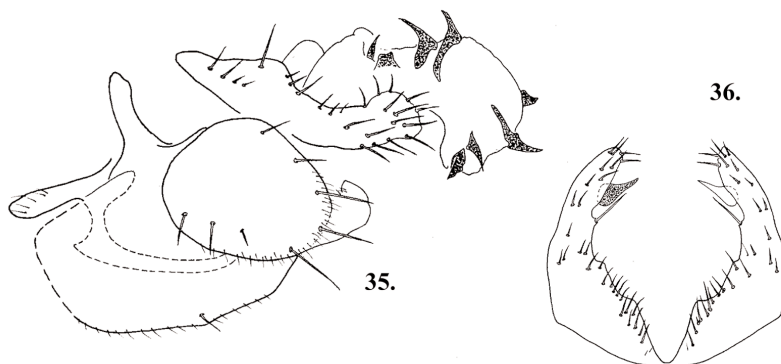
Figures 32–34. *Hemerodromia watlingi*. **32.** Male terminalia, lateral view; **33.** Male terminalia, dorsal view; **34.** Female terminalia, lateral view. Abbreviations: *cer* – cercus.

at extreme base blackish.

Abdomen. Hypopygium yellow with cerci, epandrium and small part of hypandrium adjacent to epandrium, deep blackish. Cercus (Fig. 26) apically narrowed, blunt-ended in lateral view, more pointed viewed dorsally; apically with several short, strong, blunt black setae. Epandrium short and narrow, only 0.5 x as long as cercus, rather densely setulose distally (on dissection, the epandrial apex is seen to be hook-like and there is a broad subapical process, curved anteriorly) Hypandrium (Fig. 25) very large, greatly inflated, egg-shaped, a few pale setae apically but otherwise bare. Phallus white, long, reflexed posteriorly, apically blunt.

Female. A single female (FBA 109112, FNIC) associated with the male holotype and 4 females (FBA 187161–187164) associated with a male paratype are probably this species. However, they are indistinguishable from females of *H. iqasoa* n. sp. and are not included in the type series.

Types. *Holotype* ♂ FIJI: **Viti Levu:** Koroyanita Eco Pk., 0.5 km N Abaca vlg., 800 m, 12–19.xi.2002, Malaise, Schlinger, Tokota'a, 17.667°S, 177.55°E [FBA 109111]. Holotype is deposited in FNIC. *Paratypes:* **Viti Levu:** 1♂ [FBA 081927] (FNIC), as in holotype but Savuione Trail, 17° 33'E, 177°33'E, 7–12.x.2002, FJCL01_M01_02; 1♂ [FBA 037116] (CNC); 1♂ [FBA 187165] (BPBM), same as previous, 17°40'E, 177°33'E, 11–19.iii.2003, Malaise, FJ 11-C, E. Schlinger, M. Tokota'a, 17°37'S, 177°59'E, 700 m, 24.x–8.xi.2003; 1♂ [FBA 049171] (FNIC) same data as FBA 037116 but FJ-1,



Figures 35–36. *Hemerodromia spiculata*. 35. Male terminalia, lateral view; 36. Male cerci, dorsal view.

21.x–18.xi.2003, 17°40'S, 177°33'E, 450 m; 1♂ [FBA 177567] (BPBM), 4.8 km N Veisari Stlmt., log rd to Waivudawa, 300 m, 12.xii.2002–3.i.2003, Malaise 1, Schlinger, Tokota'a, 18°4'30''S, 178°21'43''E.

Etymology. From the Fijian 'vuce' meaning swollen, in reference to the hugely inflated hypandrium.

***Hemerodromia vulacia* Plant & Sinclair, new species**

(Figs. 27, 28)

Diagnosis. A yellow species, very similar to *H. dromodromoa* n. sp., males of which are best distinguished by the sharply pointed and curved posterior hypandrial process.

Description. Male. Very similar to *H. dromodromoa* n. sp., differing as follows:

Legs. Femoral formula 6/16/16/6.

Abdomen. Hypopygium (Fig. 28) yellow with cerci, epandrium and hypandrium darkened apically. Cercus (Fig. 27) narrow, slightly incurved, apically rather broadened in lateral view with several minute curved apical setulae. Epandrium long, slightly constricted medially, broadened apically with almost linear posterior margin bearing distinct setae. Hypandrium long, reaching to end of epandrium, with a sharply pointed and decurved posterior hypandrial process. Phallus long, apically pointed.

Female. Unknown.

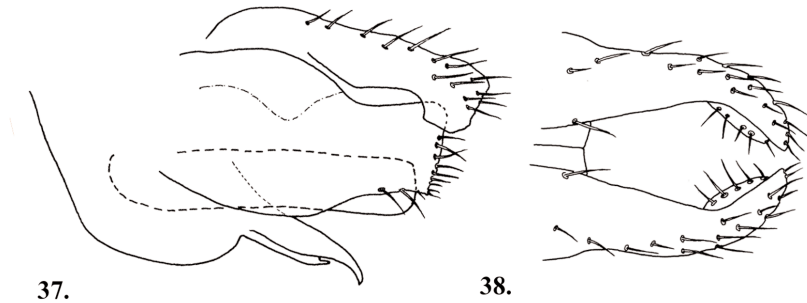
Type. Holotype ♂ FIJI: **Vanua Levu:** 6 km NW Kilaka, 3–15.vi.2004, Batiqere Range, Malaise, 113 m, Schlinger, Tokata'a, FJVN59c_M02_06, 16.7317°S, 178.997°E [FBA 069261]. Holotype is deposited in FNIC.

Etymology. From the Fijian 'vulaci' meaning unnaturally pale, in reference to the pale yellow colour of the species.

***Hemerodromia vutivutia* Plant & Sinclair, new species**

(Figs. 29–31)

Diagnosis. A yellow species with abdomen darkened dorsally and in the male, a disjunction between basal and distal rows of denticles of both av and pv series. The species is best distinguished by the male genitalia which are deep black and characteristically shaped.



Figures 37-38. *Hemerodromia subiqasoa*. 37. Male terminalia, lateral view; 38. Male cerci, dorsal view.

Description. Male. Similar to *H. dromodromoa* n. sp., differing as follows:

Thorax. Entirely yellow apart from rather well defined, minute black spot on extreme front of postpronotal area, either side of thoracic ‘collar’.

Legs. Yellow. Femoral formula 7/14/18/7; basal av and pv spines quite strong, otherwise all spines rather weak, almost hair-like; av denticles arranged in two discontinuous rows, basal series of about 10 denticles distally becoming more anteriorly positioned, distal series of 4 denticles more ventrally situated and obviously discontinuous with basal series; pv denticles also in two discontinuous rows, basal series of about 11 denticles more widely spaced and obviously discontinuous with distal series of about 7 denticles which are more closely apposed and displaced posteriorly; basal denticle of pv rows larger and distinctly separated from others by short bare area.

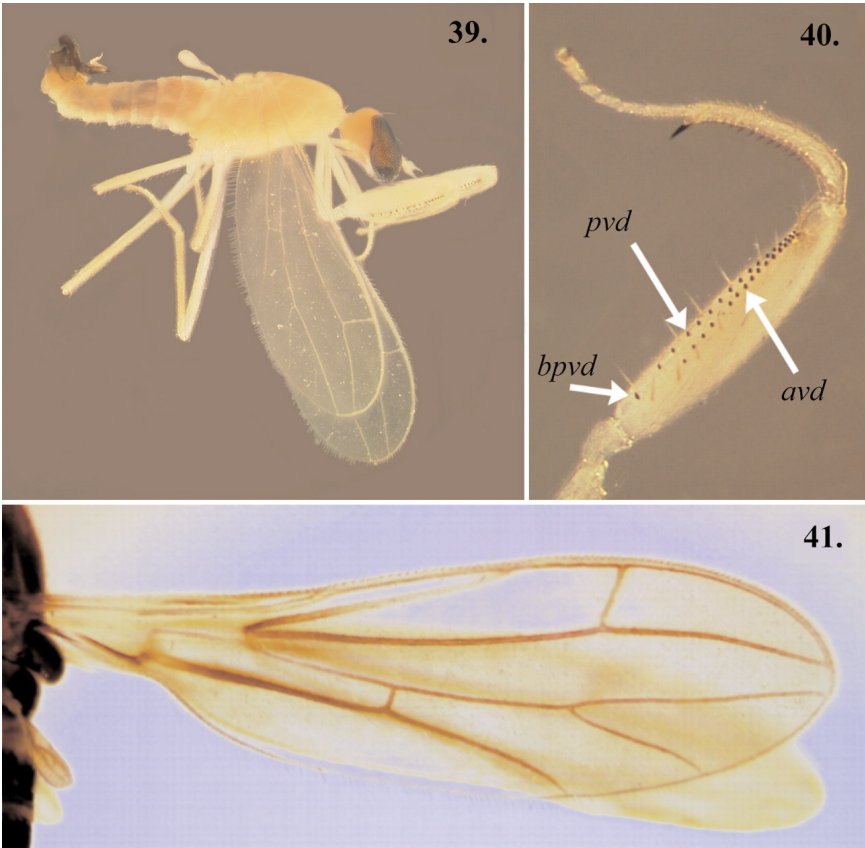
Wing. Veins brownish yellow; fork R_{4+5} about 80° , clearly distal to fork M_{1+2} .

Abdomen. Tergites darkened, becoming progressively darker distally. Ventrums pale. Hypopygium (Fig. 31) deep black with cerci slightly paler. Cercus (Fig. 29) narrowed distally in lateral view, broader in dorsal view, gradually incurved. Epandrium rather narrowed distally with apical pubescence and a few strong setae. Hypandrium abruptly slightly concave apically with a few distinct setae amongst smaller setulae posteroapically. Postgonite rounded apically, just visible above apex of epandrial lobe in lateral view. Phallus, short, rather broad, hardly visible above cerci in lateral view.

Female. Very similar to male but femoral formula about 8/20/18/7. No obvious discontinuity between basal and distal denticles of av or pv series; basal pv denticle not differentiated or separated from others and all spines (especially basal pair) stronger. Cercus (Fig. 30) with apical process narrow, elongate, paler apically. Sternite 10 whitish yellow, weakly sclerotized. Tergite 10 black, posterior margin rather irregular.

Types. *Holotype* ♂ FIJI: **Viti Levu:** PABITRA Wabu Baseline Survey, 1034 m 17–20.xi.2003 Malaise samples collected from Delena Veikoi 17.5833°S , 178.0833° [FBA 053109]. *Holotype* is deposited in FNIC. *Paratype:* 1 ♀, same data as holotype, [FBA 053110] (FNIC).

Etymology. From the Fijian ‘vutivutia’ meaning hairy, in reference to the apically pilose epandrium of this species.



Figures 39–41. *Hemerodromia* spp. **39.** *Hemerodromia dromodromoa*, male habitus; **40.** *Hemerodromia kumia*, front right leg in oblique anteroventral view (note that tibia and tarsal segments are foreshortened); **41.** *Hemerodromia raradamua*, wing. Abbreviations: *avd* – anteroventral denticles; *bpvd* – basal posteroventral denticle; *pvd* – posteroventral denticles.

***Hemerodromia watlingi* Plant & Sinclair, new species**
(Figs. 32–34)

Diagnosis. An entirely yellow species with a distinctive bicoloured hypopygium with narrow apically hooked cercus bearing an incurved flattened plate distally.

Description. Male. Similar to *H. dromodromoa* n. sp., differing as follows:

Legs. F₁ with femoral formula 6–7/13–15/12–15/6–7; basal denticle of pv series not separated from main series by a short bare area (but bare area *is* present in one paratype). T₁ about 0.7 x as long as F₁ with 13–15 sharply pointed spine-like setae ventrally

Abdomen. Hypopygium (Figs. 32, 33) black with basal 0.1 of cerci and 0.5 of epandrium yellow; hypandrium yellow except a small pd blackened patch. Cercus in lateral view (Fig. 32) swollen basally, narrow and almost parallel-sided distally with dorsoapical hooked process; broad inwardly directed flattened plate distally appearing much broader in dorsal view. Epandrium narrow, hardly

constricted medially, much shorter than cercus, with small but distinct setae apically and dorsally on distal half. Hypandrium with minute setulae apically, otherwise bare. Phallus white, parallel-sided, blunt apically, evenly curved posteriorly, clearly visible above cercus in lateral view.

Female. Very similar to male and *H. dromodromoa* n. sp. female but wing veins brownish yellow, darker basally, especially vein Cu at base of cell bm+dm and posterior wing margin at extreme base. Femoral formula 6–7/17/15/6. Terminalia (Fig. 34) similar to *H. iqasoa* n. sp. but cercus with narrow apical process slightly angular and slightly upturned, bearing 2 longer setae laterally and with apex distinctly white from which a short but distinct seta emerges. Tergite 10 yellow to black (black in FBA 083699 but distinctly yellowish in FBA 049169) bearing 2–3 distinct setae. Sternite 10 whitish yellow, hardly differentiated from adjacent membrane, bearing only a few minute setulae.

Types. *Holotype* ♂ FIJI: **Viti Levu:** 1 km E Abaca Vlg., Koroyanita Ntl. Pk., 800 m, Savuione Trail, 17°40'E, 177°33'E, E. Schlinger, Tokota'a, Malaise, FJVL01_M01_07, 12–19.xi.2002 [FBA 083698]. *Holotype* is deposited in FNIC. *Paratypes:* **Viti Levu:** 1 ♂, 4.8 km N Veisari Stlmt., log rd to Waivudawa, 300 m, 12.xii.2002–3.i.2003, Malaise 1, Schlinger, Tokota'a, 18°4'30"S, 178°21'43"E [FBA 177564] (BPBM); 1 ♂ [FBA 083699] (FNIC), data as in holotype; 1 ♂ [FBA 081926] (CNC), data as holotype but FJVL01_M01_02, 7–12.x.2002; 1 ♂, 1 ♀ [FBA 049168–049169] (NMWC), data as holotype but FJ1 21.x–18.xi.2003, 450 m, M. Irwin, E. Schlinger, M. Tokota'a.

Etymology. Named in honour of Dick Watling who has done much to encourage the study and conservation of Fijian wildlife.

GENERAL DISCUSSION

Ten of the new species of *Hemerodromia* were confined to montane wet forest or cloud forest above 300 m and three from lowland wet forest below 150 m. All the Fijian species thus appear to be restricted to humid forest biotopes, but there are no data available concerning proximity to streams or other water bodies. Two or three species were often observed to be sympatric, collected together in the same malaise traps.

Each of the three major Fijian islands has an apparently endemic complement of *Hemerodromia* species; eight species from Viti Levu, three from Taveuni and two from Vanua Levu (Table 1) All the species appear to be fairly closely related with the possible exception of *H. vucea* n. sp., with its enormously enlarged hypandrium, and *H. votovotoa* in which the cerci are distinctly internalised and hidden by the epandrium in lateral view. The Fijian plate, on which the archipelago sits, has experienced extensive compression and extension throughout the Tertiary and Quaternary which has created differential updoming, uplift and subsidence across the islands (Heads 2006). It is speculated that ancestral *Hemerodromia* populations radiated in response to lateral migrations of habitat along developing island arcs and altitudinal habitat displacements during island orogenesis.

ACKNOWLEDGEMENTS

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Table 1. Distribution of *Hemerodromia* among major islands of Fiji.

| Species | Taveuni | Vanua Levu | Viti Levu | Altitude (m) |
|-----------------------|----------|------------|-----------|--------------|
| <i>H. dromodromoa</i> | x | | | 800–1200 |
| <i>H. iqasoa</i> | | | x | 300–800 |
| <i>H. kumia</i> | | x | | 61–146 |
| <i>H. moqimoqilia</i> | x | | | 1188 |
| <i>H. raradamua</i> | | | x | 1034 |
| <i>H. senivava</i> | x | | | 734–892 |
| <i>H. spiculata</i> | | | x | 300 |
| <i>H. subiqasoa</i> | | | x | 300 |
| <i>H. votovotoa</i> | | | x | 700 |
| <i>H. vucea</i> | | | x | 300–800 |
| <i>H. vulacia</i> | | x | | 113 |
| <i>H. vutivutia</i> | | | x | 1034 |
| <i>H. watlingi</i> | | | x | 300–800 |
| Total | 3 | 2 | 8 | |

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