Fiji Arthropods XI. Edited by Neal L. Evenhuis & Daniel J. Bickel. *Bishop Museum Occasional Papers* 98: 15–20 (2008).

A New Species of *Chalarus* Walker from Fiji (Diptera: Pipunculidae)[1]

JEFFREY H. SKEVINGTON
Agriculture and Agri-Food Canada, 960 Carling Avenue, K.W. Neatby Building, Ottawa, ON, K1A 0C6, Canada; e-mail: skevingtonj@agr.gc.ca

CHRISTIAN KEHLMAIER
State Natural History Collections Dresden, Museum of Zoology, Koenigsbruecker Landstrasse 159, D-01109 Dresden, Germany; e-mail: kehlmaier@web.de

Abstract: *Chalarus irwini* is described from Fiji. Diagnostic characters are illustrated and the possible relationship of the new species to other Old World *Chalarus* species is discussed.

INTRODUCTION

This is the third in a series of papers that ultimately aims to document the diversity of all Fijian Pipunculidae. Earlier papers documented the taxonomy of *Collinias* Aczél (Skevington, 2006) and *Tomosvaryella* Aczél, 1939 (Skevington & Földvári, 2007). Until the recent inventory of Fijian invertebrates, *Collinias vitiensis* Muir, 1906, was the sole representative of the Fijian pipunculid fauna (named from two specimens). From recent collecting efforts, we now know that over 25 species in seven genera are supported by a collection of 2180 specimens collected within the scope of the Fiji Arthropod Survey (Skevington & Földvári, 2007; Skevington, unpublished data). The bulk of the family's diversity occurs in the genus *Clistoabdominalis* and almost all Fijian pipunculid species are endemic.

Chalarus is a diverse, globally distributed pipunculid genus containing 42 described species including two nomina dubia (Jervis, 1992; De Meyer, 1996; De Meyer and Skevington, 2000). This number belies the true diversity of the group. *Chalarus* has received little attention from taxonomists and the true number of species might be around 200. No species have been described from Australia (where several are present), the Afrotropics, or the Indian subcontinent, and only one taxon has been described from North America so far where there are likely at least 25 species (J. Skevington, unpubl. data). The European species are currently under revision by the junior author. Other than this upcoming work, only three authors have ever attempted to review regional faunas of this genus (Jervis, 1992; Morakote & Hirashima, 1990; Rafael, 1990). Of these, only the last treated an entire biogeographical region and it was not comprehensive. *Chalarus* is previously undocumented from oceanic islands, but poor sampling could bias this as these flies are easily overlooked. For example, based on current knowledge, they are absent from New Caledonia, New Zealand, and Hawai'i (De Meyer, 2000; J. Skevington, unpubl. data). *Chalarus* are endoparasitoids of typhlocybine leafhoppers (Cicadellidae, Typhlocybinae) (Jervis, 1992). Records cited by Kapoor *et al.* (1987) of *Chalarus* attacking other groups of leafhoppers (Agallinae and Idiocerinae) are incorrect and are based on their

1. Contribution No. 2008-003 to the NSF-Fiji Arthropod Survey.

erroneous interpretations of Hardy (1943).

In the hope of obtaining more material, we waited until all of the material from the first few years of Fijian collecting was available to us before describing this species. *Chalarus* species are normally a major component of the pipunculid diversity so it is surprising that out of ~2200 Fijian pipunculids, we have only one specimen of *Chalarus*. We are convinced this perceived rarity is a sampling artifact and we will make more efforts to collect specimens of this genus in the future.

Superficially, members of *Chalarus* look very alike or are indistinguishable and dissection and study of the genitalia is, therefore, essential.

MATERIALS AND METHODS

The sole specimen examined will be deposited in FNIC (Fiji National Insect Collection, Suva, Fiji; currently held at Bishop Museum, Honolulu). Specimen preparation follows Skevington (2003). Photographs were taken through a Leica DM550B compound microscope and through a Canon EOS 10D camera equipped with a 65 mm macro lens. Leica Application Suite (LAS) was used to create a montage from multiple layers of photographs. Measurements were made using a graticule. Scale bars on the figures are all 0.1 mm.

The specimen is labeled with a unique reference number, in the format J. Skevington Specimen # *n* (shortened to follow the format JSS*n*). These numbers are used in a database of Pipunculidae specimens that JHS maintains (available upon request) and in the Fijian Arthropod Database (http://www.inhs.uiuc.edu/cee/fijimandala/).

Terminology and measurements are the same as those used by Skevington (2003, 2005) and Kehlmaier (2006). Genitalic terminology nomenclature follows Sinclair (2000) and is discussed by Kehlmaier (2006) and Skevington & Yeates (2001) with specific reference to Pipunculidae. For a recent summary of these items, see Skevington (2006). Abbreviations used in ratios in the description are as follows: LW: length of wing; MWW: maximum width of wing; LS: length of pterostigma; LSC: length of second costal section of wing; LTC: length of third costal section of wing; LFC: length of fourth costal section of wing ; LT35: maximum length of tergites 3 to 5; WT2: maximum width of tergite 2.

For details on the molecular methods used, see Skevington (2006).

TAXONOMY

Chalarus Walker

Chalarus Walker, 1834: 269. Type species: *Cephalops spurius* Fallén, 1816, by subsequent designation (Westwood, 1840: 135).

Chalarus is a very distinctive genus of tiny flies with reduced wing venation (discal cell open and anal vein poorly developed), closely related to *Verrallia* Mik, 1899 and *Jassidophaga* Aczél, 1939 within the subfamily Chalarinae (Rafael & De Meyer, 1992). They share several distinctive characters with other Chalarinae (none of which occur in Fiji): bristles present on frons and ocellar ridge, occiput narrow, head subhemispherical (flattened at back – round in other pipunculids), males dichoptic (only regularly encountered in *Dorylomorpha* Aczél outside of the Chalarinae), tergum and sternum 7 of females

fused to form syntergum, terga and sterna 6 and 7 of males fused to form synterga, epandrium small, gonopods enlarged and separate and phallus with two symmetric processes (can be reduced or lost secondarily). A key to the world genera of Pipunculidae is available in Skevington & Yeates (2001) and a key to Fijian genera is available in Skevington & Földvári (2007).

Chalarus irwini Skevington & Kehlmaier, **new species**
(Fig. 1)

Diagnosis. Male: *Chalarus irwini* is characterized by a narrow phallic shaft (Fig. 1D), considerably broadened phallic processes that show a strong rim (Fig. 1C) and are covered with fine bristles in their distal third (Fig. 1D), a distinctly elongated tip of distiphallus (Fig. 1D) and by all three ejaculatory ducts placed distally on the membranous tip of the distiphallus (Fig. 1D).

Description. Lengths: Body: 2.4 mm; wing: 2.5 mm.

Male. *Head*. Face black, silver pollinose. Labellum and palps light brown, the latter with two distal hairs on each. Eyes separated, all ommatidial facets of same size. Frons black, silver-grey pollinose in lower quarter. At its narrowest point width of 1.5 ommatidial facets. Antenna dark brown. Pedicel with three long upper and three lower bristles, two of the latter longer than flagellum which has an ovoid-kidney shape, typical for the genus, and is only slightly longer than wide. Vertex black. Ocellar triangle with two pairs of short ocellar bristles. Occiput black, hardly visible in lateral view.

Thorax. Postpronotal lobe, prescutum, scutum, scutellum, subscutellum and pleuron dark brown to black, sparsely brownish pollinose dorsally, more densely brown pollinose on pleuron. Dorsal surface of prescutum and scutum covered with rather widely spaced black hairs, as in other species of the genus, the longest ones towards the lateral and posterior margins (notopleural (1), supraalar and postalar (2) bristles). Scutellum with 2–3 pairs of long black marginal bristles, dorsally with one pair of short bristly hairs. Pleuron bare except anepimeron with 3 bristly hairs.

Legs. Entirely dark brown except tarsal segments which are light brown. All hairs mid to dark brown. Front legs missing (removed for DNA extraction); mid femur with 15 long hairs in posteromedial row, 7 shorter hairs in dorsal row, and 2 long posteroventral hairs at base of femur; hind femur with 4 long hairs in posterodorsal row and 7 shorter anterodorsal hairs. Pulvilli shorter than distitarsus.

Wing and halter. LW:MWW = 3.1. Wing surface with brownish tinge and covered with microtrichia except near base. Pterostigma brown and incomplete (LS:LTC = 0.8). LSC:LTC: LFC = 11.2: 6.8:1.0. Wing venation incomplete, as in other members of *Chalarus*. Halter pale brownish yellow.

Abdomen. Entirely dark brown and covered with sparse brown pollinosity. Hairs mid to dark brown and widely spaced. Dorsally and ventrally short, along lateral margins long. Tergites 1–4 almost parallel sided. LT35:WT2 = 1.0. Ventral aspect of abdomen with terminalia removed as in Fig. 1A.

Genitalia. Viewed laterally from left, surstylus as in Fig. 1E and dorsally as in Fig. 1F. Surstyli slightly asymmetrical, right surstylus with slightly more pronounced medial protuberance (“ventral process” sensu Jervis, 1992) (Fig. 1F). Gonopods essentially symmetrical (Fig. 1E). Subepandrial sclerite long and very narrow. Phallus with straight and narrow shaft (Figs 1C–D). Tip of distiphallus very long and apically rounded (Fig. 1D). Phallic processes slightly longer than membranous tip of distiphallus (compare Figs 1C with 1D), considerably broadened “tongue-shaped”, with distinct lateral rim and covered with small bristles on distal third, not orientated parallel with membranous tip of distiphallus but roughly 90° towards it (Fig. 1D). All three ejaculatory ducts placed distally on membranous tip of distiphallus (Fig. 1D). Ejaculatory apodeme parasol-shaped (Figs 1C-D).

Female unknown.

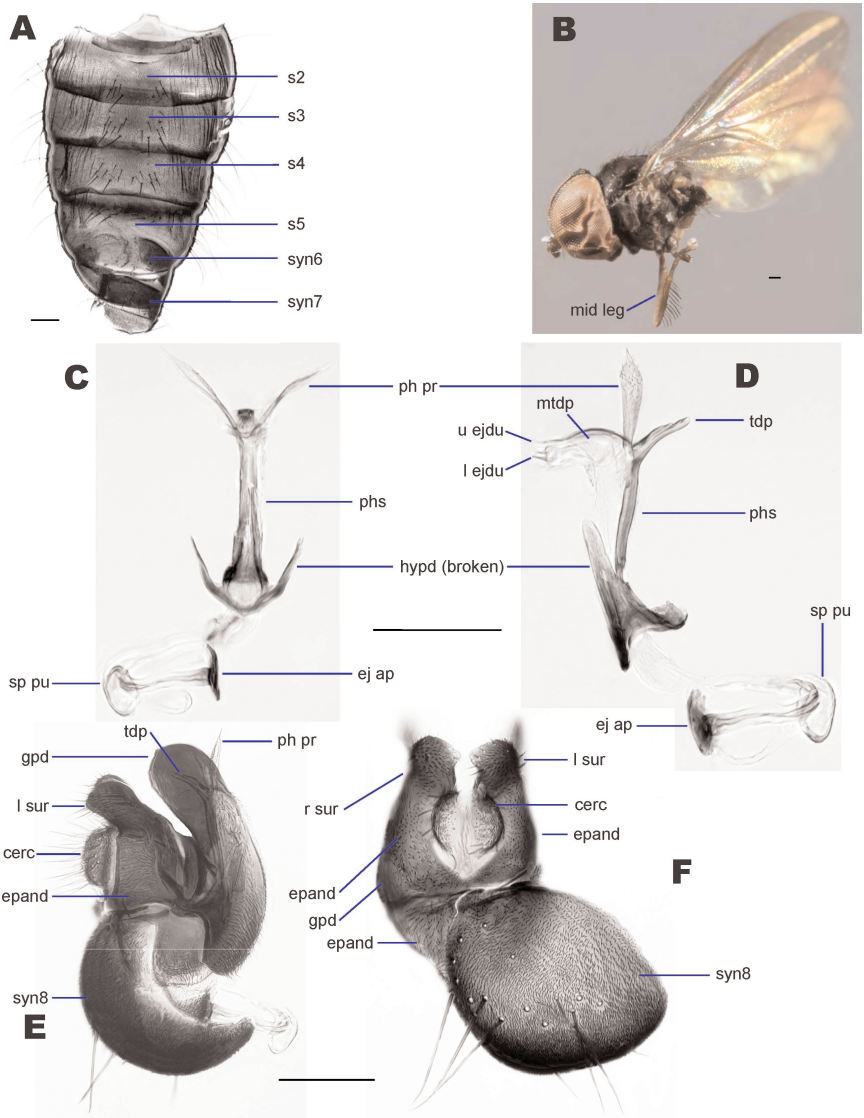

Figure 1. *Chalarus irwini* holotype (JSS15603). **A**. ventral of abdomen with genitalia removed. **B**. left lateral, abdomen removed. **C**. dorsal of phallus and associated structures. **D**. lateral of phallus and associated structures. **E**. left lateral of male terminalia. **F**. dorsal of male terminalia. Abbreviations: cerc = cercus; ej ap = ejaculatory apodeme; epand = epandrium; gpd = gonopod; hypd = hypandrium; l ejdu = lower ejaculatory ducts; l sur = left surstylus; mtdp = membranous tip of distiphallus; ph = phallus; ph pr = phallic process; phs = phallic shaft; r sur = right surstylus; s = sternite, sp pu = sperm pump; syn = syntergosternite; t = tergite; tdp = tip of distiphallus; u ejdu = upper ejaculatory duct. Scale bars = 0.1 mm.

Material examined. Holotype ♂ FIJI: **Kadavu**: Solodamu, 19°04' S, 178°07' E, 25 Aug–23 Oct 2003, 128 m, in coastal limestone forest, E.I. Schlinger, M. Irwin, M. Tokota'a, Malaise trap FJ-41B,[JSS 15603] (FNIC).

Etymology. Named after Mike Irwin, a prolific collector of flies who was involved with the collection of this specimen. We have examined over 2100 pipunculids collected by Mike in 12 countries, and there are undoubtedly many more specimens available that we have not yet seen. Few people have collected as many pipunculids from as many different parts of the world. He has been involved in collecting 176 of the known Fijian pipunculid specimens.

Remarks. We sequenced part of *cox1* (mitochondrial DNA from cytochrome c oxidase I) using 4 legs from the holotype (GenBank # DQ507246). Although only 273bp long, these data should help with future association of females and larvae with this species. We were unable to generate a complete barcode (650bp) and did not want to consume more of the holotype in an attempt to do so. Caution should thus be used when associating future specimens with this incomplete dataset. The data have also been incorporated into a working dataset (Kehlmaier & Assmann, unpubl.) to examine the relationships of this taxon with other Old World *Chalarus* species. Both morphological and molecular data suggest that *C. irwini* is more closely related to the European *C. brevicaudis* Jervis and *C. longicaudis* Jervis than any other species barcoded to date (note that no Australian *Chalarus* species have been barcoded yet). Uncorrected pairwise distance ranges between 7.7–8.1% for *C. brevicaudis* and 14.0–14.4% for *C. longicaudis* (Kehlmaier & Assmann, unpubl.). It is likely that as species in the Australasian and Oriental regions are discovered and studied, we will find that this genetic lineage constitutes numerous taxa separated by lower genetic distance. In most pipunculid genera studied, genetic distances between sister taxa are less than 5% (C. Kehlmaier & J. Skevington, unpubl. data). However, note that genetic distances between sister taxa in the 7 to 8% range were normal within Australian *Clistoabdominalis* species (Skevington *et al.* 2007). We are thus not suggesting that the Fijian species and the European species are sibling taxa, but there is a remote chance that they may be.

Compared to both European species, *C. irwini* has a narrow phallic shaft (instead of broad). The long tip of distiphallus is closest to *C. brevicaudis* (short in *C. longicaudis*) whereas the broadened phallic processes strongly resemble *C. longicaudis* with its strong rims and hairy tips (differently shaped in *C. brevicaudis* with weak rims and less hair). The Eastern Palaearctic *C. angustifrons* Morakote & Hirashima also belongs to this group but has almost twice as long and narrower phallic processes (other features: phallic shaft thin, tip of distiphallus long).

Note that the second author compared this new species to most described *Chalarus* species and concluded that it cannot be confused with any other species for which males are known.

Distribution. Presently only known from the island of Kadavu in Fiji.

ACKNOWLEDGMENTS

This study was supported in part by National Science Foundation grant DEB 0425790, funding from the Schlinger Foundation, and funding from Agriculture and Agri-Food Canada. These agencies and the Government of Fiji (especially the Ministries of

Environment and Forestry) are thanked for their support. Assistance with the DNA barcode analysis was provided by J. deWaard and P. Hebert (Canadian Centre for DNA Barcoding).

LITERATURE CITED

De Meyer, **M**. 1996. World catalogue of Pipunculidae (Diptera). *Institut Royal des Sciences Naturelles de Belgique, Documents de Travail* **86**: 1-127.

———. **& Skevington**, **J**.**H**. 2000. First addition to the world catalogue of Pipunculidae. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Entomologie* **70**: 5-11.

Hardy, **D**.**E**. 1943. A revision of Nearctic Dorilaidae (Pipunculidae). *University of Kansas Science Bulletin* **29**: 1–231.

Jervis, **M**. 1992. A taxonomic revision of the pipunculid fly genus *Chalarus* Walker, with particular reference to the European fauna. *Zoological Journal of the Linnean Society* **105**: 243–352.

Kapoor, **V**.**C**., **Grewal**, **J**.**S**. **& Sharma**, **S**.**K**. 1987. *Indian Pipunculids (Diptera: Pipunculidae).* A Comprehensive Monograph. Atlantic Publishers & Distributors, New Delhi, India. 201 pp.

Kehlmaier, **C**. 2006. The West-Palaearctic species of *Jassidophaga* Aczél and *Verrallia* Mik described up to 1966 (Diptera: Pipunculidae). *Stuttgarter Beiträge zur Naturkunde* (A) **697**: 1–34.

Morakote, **R**. **& Hirashima**, **Y**. 1990. A systematic study of the Japanese Pipunculidae (Diptera) Part II. The genus *Chalarus* Walker. *Journal of the Faculty of Agriculture, Kyushu University* **34**: 161–181.

Rafael, **J**.**A**. 1990. Revisão das espécies Neotropicais do gênero *Chalarus* Walker, 1834 (Diptera: Pipunculidae). *Iheringia* (Zoologia) **70**: 45–53.

———. **& De Meyer**, **M**. 1992. Generic classification of the family Pipunculidae (Diptera): a cladistic analysis. *Journal of Natural History* **26**: 637–658.

Sinclair, **B**.**J**. 2000. Morphology and terminology of Diptera male terminalia, pp. 53–74. *In* Papp, L. & Darvas, B. (eds.), *Contributions to a manual of Palaearctic Diptera (with special reference to flies of economic importance).* Volume 1. General and applied dipterology. Science Herald, Budapest. 978 pp.

Skevington, **J**.**H**. 2003. Revision of Australian *Eudorylas* Aczél (Diptera, Pipunculidae). *Studia Dipterologica* **9**: 621–672.

———. 2005. Revision of Nearctic *Nephrocerus* Zetterstedt (Diptera: Pipunculidae). *Zootaxa* **977**: 1–36.

———. 2006. Revision of Fijian *Collinias* Aczél (Diptera: Pipunculidae). *Bishop Museum Occasional Papers* **89**: 13–43.

———. **& Földvári**, **M**. 2007. Revision of Fijian *Tomosvaryella* Aczél (Diptera: Pipunculidae). *Bishop Museum Occasional Papers* **93**: 27–40.

———., **Kehlmaier**, **C**. **& Ståhls**, **G**. 2007. DNA Barcoding: Mixed results for big-headed flies (Diptera: Pipunculidae). *Zootaxa* **1423**: 1–26.

———. **& Yeates**, **D**.**K**. 2001. Phylogenetic classification of Eudorylini (Diptera: Pipunculidae). *Systematic Entomology* **26**: 421–452.