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TAXONOMIC STATUS OF THE AUSTRALIAN MAYFLY GENERA JAPPA AND ULMEROPHLEBIA (EPHEMEROPTERA: LEPTOPHLEBIIDAE)

Y. J. Bae, J. C. P. Faull1, and I. C. Campbell2

ABSTRACT: The Australian mayfly genera Jappa and Ulmerophlebia are considered as monotypic genera. Their adult and larval stages are undescribed and their egg stages are newly described. Additional taxonomic and phylogenetic discussions are provided.

KEY WORDS: Ephemeroptera, Leptophlebiidae, Jappa, Ulmerophlebia, Australia.

The Australian mayfly genera Jappa Harker and Ulmerophlebia Demoulin (Leptophlebiidae) are unique among Ephemeroptera because of the convergent adaptation with the burrowing mayflies (Ephemeridae) from the Northern Hemisphere (Campbell, 1990; Bae and McCafferty, 1991, 1995). Members of the Ephemeridae do not occur in Australia, and these are the genera of Ephemeroptera most closely adapted to hyperbetic habitats in Australia. The larvae are generally found under cobble or boulder-sized stones embedded in sand and silt substrate in mid-sized to large lowland streams (Riek, 1970; Peters and Campbell, 1991; Edmunds and McCafferty, 1996).

The larvae of Jappa possess a characteristic head with a two-pronged frontal process or "cephalic tusks" (Fig. 1) that is analogous to the mandibular tusks of Ephemeridae, in particular those of Potamanthinae (see Bae and McCafferty, 1991: Figs. 11-14), while the larvae of Ulmerophlebia lack such structure (Fig. 2). Despite this morphological difference, the generic distinction of the genera has been continuously questioned by mayfly taxonomists not only because their general morphology in adult and larval stages is similar, but because generic concepts have not been well defined.

Harker (1954) established the genus Jappa based on adult and larval stages. At that time, forewing length was used to distinguish "a burrowing type larva" with tusk-like head frontal processes or "horn" used as the major defining character. Demoulin (1955) erected the genus Ulmerophlebia to include a species, Euphymerus mioberti Ulmer, described as (an adult only) by Ulmer (1916), but did not compare it with Jappa. Previously, Ulmer (1920) redefined E. mioberti with Delatidium Eaton; and Demoulin (1955) distinguished Ulmerophlebia from Delatidium mainly by wing and genital characters.

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Williams (1968) mentioned a possible congenic status of Jappa and Umerophila based on personal communication with E. F. Riek. Riek (1970), in the Ephemeroptera chapter of the textbook "The Insects of Australia," placed all burrowing Australian leptophlebiids, i.e., Jappa and Umerophila, into Jappa without any explanations. Peters and Campbell (1991) also followed the previous classification by Riek (1970) in the second edition of the textbook. Suter (1986) provided a historical background of Umerophila and described the larval stage of Umerophila for the first time based on a second species, U. pipiens Suter, but was conservative in clarifying the generic status of the Umerophila and Jappa. Dean (1999) gave larval diagnoses of Jappa and Umerophila when he provided larval keys to three nominal and four unnamed species of Jappa and four unnamed species of Umerophila, but still did not resolve the generic status.

For the above reason, the generic concepts of Jappa and Umerophila have not been fully resolved. The purpose of this study is to clarify and delineate the genera and provide detailed redictions of adult, larval, and egg stages.

Type and voucher specimens and additional fresh materials of all previously known species of Jappa and Umerophila (see Species included, pp. 5, 7) are housed mainly in the Museum of Victoria, Australian National Insect Collection in Canberra, and Monash University and were examined for this study. Terminology, measurement, and other general methods are after Bae and McCafferty (1991).
Williams (1968) mentioned a possible congeneric status of *Jappa* and *Ulmerophlebia* based on personal communication with E. F. Riek. Riek (1970) in the Lepidoptera chapter of the textbook "The Insects of Australia," placed all burrowing Australian leptophlebiids, i.e. *Jappa* and *Ulmerophlebia*, into *Jappa* without any explanations. Peters and Campbell (1991) also followed the previous classification by Riek (1970) in the second edition of the textbook. Suter (1986) provided a historical background of *Ulmerophlebia* and described the larval stage of *Ulmerophlebia* for the first time based on a second species, *U. pipinna* Suter, but was conservative in clarifying the generic status of the *Ulmerophlebia* and *Jappa*. Dean (1999) gave larval diagnoses of *Jappa* and *Ulmerophlebia* when he provided larval keys to three nominal and four unnamed species of *Jappa* and four unnamed species of *Ulmerophlebia*, but still did not resolve the generic status.

For the above reasons, the generic concepts of *Jappa* and *Ulmerophlebia* have not been fully resolved. The purpose of this study is to clarify and delineate the genera and provide detailed redescriptions of adult, larval, and egg stages.

Type and voucher specimens and additional fresh material of all previously known species of *Jappa* and *Ulmerophlebia* (see species included, pp. 5, 7) are housed mainly in the Museum of Victoria, Australian National Insect Collection in Canberra, and Monash University and were examined for this study. Terminology, measurement, and other general methods are after Bae and McCafferty (1991).
Mandible denticulated margins with very long hairlike setae row; ventral surface with transverse row of 9-10 hairlike setae; inner incisor slightly smaller to 10 large outer incisors; incisor with 2.3 apical row and 0.4 lamellar denticles, prostheca rudimentary, with well-developed flanges. Hypopharynx apicolarly curved and apically pointed. Maxilla with dense hairlike setae on media margins; maxillary palp segment 1 0.27-0.52 mm, segment 2 0.27-0.48 mm, and segment 3 0.21-0.37 mm in length; segments 1 and 2 with sparse hairlike setae anterior margin; segments 3 indistinctly dentated from segment 2, with pronounced outer margin, and with distal developed seta flag along outer margin. Labial palps dorsoventrally elongated and ventrally divided, with dense hairlike setae; paraglossa with dense hairlike setae flag dorsally, labial palp segment 1 0.26-0.39 mm, segment 1 0.1-0.40 mm, and segment 2 0.23-0.25 mm in length; segment 1 indistinctly dentate from segment 2, apically pointed, with dense hairlike setae flag along outer margin, and with dense setal row along inner margin. Thorns: Proventriculus amalgamated margins round; basalar margin with row of spines to dense hairlike setae. Forelimbs 1.67-3.86 mm, foretibia 1.67-3.86 mm, foretarsus 0.11-0.15 mm, and forefoot 0.03-0.05 mm in length (Forewing/foretibia length ratio 0.2-0.3). Forewings with dense hairlike setae flag along anterior and posterior margins and basal area on dorsal surface. Foretibas with dense hairlike setae flag (shadow area rowed along inner and outer margin, dorsoventrally bun, with outer seta flag (taking seta on 23 apical to entire outer margin; humeri with dense hairlike setae on dorsal and lateral surfaces, black with apically darker, with 15-16 tarsal teeth, 3.9 basal. Midlegs and hindlegs heavily setose; length femur+tibia=costa+claw. Abdomen: Terga light brown to light purplish brown, mostly with submedian and subalar dark purplish brown stripes, with very long hairlike setae covered on 0.2-0.3 dorsal area along median line, and with hairlike setae row along lateral margin; abdominal segment 8-9 with moderately to well-developed postmedian projections. Setae base (sterna 9-10 sometimes with hairlike setae). Gills on abdominal segment (1-2, double; both lamellate with indistinct to distinct tract, with single apical filament; gill lamella over part strongly expanded apicodistally, and with fine row on 17-22 apical gill lamella over part with fine row on entire margin apical filament extending, margin with fine row; gills 4.13-8.26 mm in length, 0.78-1.31 mm in width, and 1.30-2.28 mm in flattened length, with weakly to strongly developed apical expansion. Caudal filament segments with whorls of setae. Eggs: Egg (Fig. 3) oval, long axis 124 mm, short axis 80 mm. Case light yellow in nature, white in alcohol. Egg surface (Fig. 4) with ca. 780 knob-terminated teardrop relatively evenly distributed throughout egg surface; diameter of knob-terminated teardrop 5.9-5.5 mm. Polar caps absent. Micropylar several, scattered, tangerine, sperm guide circular, 2.6-3.3 mm in diameter.

Diagnosis. Adults of Jappa possess greater numbers of C-Sc crossveins (20-30) in the forewings and more or less evenly distributed C-sc crossveins in the hindwings (excluding one species), while those of Ulmerophlebia possess fewer C-sc crossveins (12-19) in the forewings and sparsely concentrated C-sc crossveins in the hindwings. The hindwing vein Sc of Jappa ends relatively distally (length of 5c/distance from base of 5c to apex of distal margin = 0.89) compared with that of Ulmerophlebia (0.76). The veins of Jappa are relatively longer (length of petio / height of forepetio segment 1 = 0.45-0.56) than those of Ulmerophlebia (0.08-0.31). The construction in the medial margin of forepetio segment 1 of Jappa is relatively abrupt (angle 80-110°), while that of Ulmerophlebia is relatively gradual (angle 135-150°). The larvae of Jappa can easily be distinguished from those of Ulmerophlebia and any other leptophilid genera by the cephalic tufts (Fig. 1). In addition, the body size of Jappa in both the adults and larvae (adult: 9.4-16.5 mm, larva: 10.4-23.5 mm) is generally larger than that of Ulmerophlebia (adult: 6.9-8.7 mm, larva: 5.5-10.0 mm).


Distribution. NSW, NT, northern WA, QLD, and VIC.

Remarks. There are several other species previously considered as, or assigned to, Jappa. Jappa tarsis Harker (1954) [Holotype stage: M; locality: Tasmania, Cradle Mts; deposition: British Museum (Natural History)] was subsequently identified as Tylarpholebia Dean by Dehn (1999). Jappa is not considered present in Tasmania.

Lepitophlebia furnicata Eaton (1871) [Type stage: M; locality: Melbourne; deposition: Melbourne Museum = Museum of Victoria, recombined with Asalophlebia Eaton by Eaton (1884), was considered in Jappa by Dehn (1999). However, the type specimen was not preserved in the Museum of Victoria when it was checked in 2001 and there is little evidence that this species belongs to Jappa based on Eaton's original description (Eaton, 1871) and redescriptions (Eaton, 1884).

Lepitophlebia striigata Eaton (1871) [Type stage: F; locality: North Australia; deposition: McLaughlin Collection in British Museum (Natural History), recombined with Asalophlebia by Eaton (1884) and Dendrolimidae by Ulmer (1920), was also considered in Jappa by Dehn (1999). The original description (Eaton, 1871) and redescriptions (Eaton, 1884) of the species do not clearly substantiate the
Mandible dorsolateral margins with very long hair-like setal row; central surface with transverse row of 10-20 hair-like setae; inner incisors slightly smaller to as large as outer incisors; incisors with 2-3 apical teeth and 0-4 lateral decuscles; produced radially, with well-developed fringe. Hypopharynx superlingulae laterally curved and apically pointed. Maxillae with dense hair-like setae field medially 3-4 on galealcalicular crown, mixed with rowed conical setae medially 1/2 on galealcalicular crown. With one pronounced conical seta medially, and with rowed dense hair-like setae on medial margin; maxillary palp segment 1 0.27-0.52 mm, segment 2 0.37-0.48 mm, and segment 3 0.19-0.37 mm in length; segment 1 and 2 with sparse hair-like setae alone outer margin; segment 3 insetically demarcated from segment 2, with pronounced outer margin, and with strongly developed setal field along outer margin. Labial glossae dorsoventrally elongated and ventrally stalked, with dense hair-like setae; paraglossae with dense hair-like setal field dorsoapically; labial palp segment 1 0.28-0.59 mm, segment 2 0.31-0.40 mm, and segment 3 0.22-0.32 mm in length; segment 3 insetically demarcated from segment 2, apically pointed, with dense hair-like setal field along outer margin, and with stout setal row along inner margin. Thorax: Pronotum anterolateral margins rounded; lateral margins with row of sparse to dense hair-like setae. Forefemora 1.67-4.88 mm, forctibite 1.67-4.61 mm, foretarsi 0.71-1.63 mm, and foreclaws 0.24-0.61 mm in length (foretibial/forefemoral) 1.06-1.65, forefemora with long hair-like setal fields, along anterior and posterior margins, and baso-medial area on dorsal surface; forctibite with dense hair-like setal field (filtering setae) rowed along inner and outer margins (somewhat medially, and with stout setal field (microsetae) on 0.75 apically; outer margin; foretarsi with dense hair-like setae on dorsal and lateral surfaces; foreclaws passively darkened, with 10-15 apical teeth 3/4 basally. Midlegs and hindlegs heavily setose; length (meso- to tarsus claw. (Halum) Terga light brown to light purplish brown, mostly with submedian and submarginal dark reddish brown stripes, with very long hair-like setae covered on 1/2-3/4 dorsal area along median line, and with hair-like setal row along lateral margins; abdominal segment 8-9 with moderately to well-developed posteralateral projections. Sterna bare (sterna 9-10 sometimes with hair-like setae. Gills on abdominal segment 1-2, double, both lamellate with indistinct to distinct.
Ulermerophlebia by Dean (1999), but the original description of the adult (e.g. wings) by Harker (1950) does not support its placement in Ulermerophlebia.

DISCUSSION

In the phylogeny of the Asulapalaeoptera (Leptophlebiidae), the genera Jappa and Ulermerophlebia have been hypothesized to constitute a basal clade, including Hapshiphephlebia, Asulapalaeoptera, Acanthophlebia, Aprosia, and Kataysharia (Pescador and Peters, 1980; Towns and Peters, 1980, 1996; Campbell, 1993; Christidis, 2001). This clade, also known as the Hapshiphephlebia lineage, was defined by the synapomorphies of lateral setae of the larval abdomen and incisor denticle of the right mandible (Pescador and Peters, 1980).

From our comprehensive examinations of the species of Jappa and Ulermerophlebia and the species of related outgroup genera, we recognize an additional clade consisting of Jappa and Ulermerophlebia. This clade is defined by the synapomorphies of 1) a setose body, 2) gills marginally clothed with fine setae, 3) a median denticle anteriorly on the labrae, 4) submedial setal fields ventrally on the labra, and 5) lateral spines on the larval abdomen. Jappa and Ulermerophlebia are thus distinct monophyletic sister groups. Jappa is defined by the synapomorphies of 1) cephalic setae, 2) a hairlike setal field ventrally on the mandible, 3) double rows of hairlike setae (filtering setae) dorsally on the tibiae, and 4) long hairlike setal field along median abdomen. The cephalic setae of Jappa are unique in Leptophlebiidae. The cephalic setae are arched and apically convergent and upward. They also bear basodorsal tubercles and setal fields at basomedial, subbasolateral, and apicodorsal areas. The body setation in Jappa is more specialized in having double rows of filtering setae on inner and outer margins of tibiae and broad setal fields on forefemora and along the median line of dorsal abdomen.

The monophyly of the Ulermerophlebia is supported by the synapomorphy of the unique "shovel-like" chyphed development (Fig. 2). The chyphes of Ulermerophlebia is flattened and somewhat elongated and possesses subdorsal tubercles and hairlike setal fields in the subbasolateral and subapicodorsal areas.

Although the adults of Jappa Ulermerophlebia clade retain many plesiomorphic characters shared with other Hapshiphephlebia lineage, the larvae are quite specialized as shown herein. The hairy body is associated with the fossorial habit of the members of Jappa Ulermerophlebia clade and the cephalic setae and shovel in Jappa and Ulermerophlebia, respectively, are evidently burrowing devices. In particular, the cephalic setae of Ulermerophlebia are analogous to the mandibular setae of the Pianamobidae in Ephemereoida, their Laurasian counterpart (Bae, McCafferty, 1991, 1995), in terms of functional morphology and burrowing behavior. As evidenced above, the genera Jappa and Ulermerophlebia are distinct monophyletic groups that are here recognized at the generic level. Presumably, this will confirm with a strict phylogenetic classification if indeed the Jappa-

Ulermerophlebia clade, which is unique among Australian leptophlebiids being a burrowing mayfly group, is recognized as a distinct tribe as suggested for groups among the superfamilies of Leptophlebiidae by Peters (1980). That classification can be adopted when the generic phylogenies of the Australian Leptophlebiidae are completed.

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LITERATURE CITED


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A NEW SPECIES OF PLATYCEPHALA FROM CHINA (DIPTERA: CHLOROPIDAE: CHLOROPINAE)\(^1\)

Showen An\(^2\) and Ding Yang\(^2\)

ABSTRACT. The genus Platyccephala is newly recorded from Guangxi, with the description of a new species P. guangxiensis. Remarks on its relationship with the close species P. anhuiensis Yang and Yang, 1995, are given.

KEY WORDS: Diptera, Chloropidae, Chloropininae, Platyccephala, China.

The genus Platyccephala Falten belongs to the subfamily Chloropininae, and is characterized by the following features: Body large; head distinctly longer than high; frontal triangle occupying large part of from, reaching anterior margin of from with broadened apex; arista slender with short pubescence (Kamniyi, 1983). Until now the genus Platyccephala contained seventeen species worldwide, of which eleven are known from the Oriental Realm (Sabrosky, 1977), Cherian, 1978, Kamniyi, 1983, Yang and Yang, 1994, 1995, 1997, An and Yang, 2003) and six from the Palaeartic Realm (Nartshuk, 1984). Eight species are known from China (An & Yang, 2003). The major references dealing with Pla-

cycephala are as follows: Anderson (1977), Cherian (1978), Kamniyi (1983).

In this paper, one species of the genus Platyccephala from Guangxi is de-
scribed as new to science. Types are deposited in the Insect Collections of the China Agricultural University, Beijing.

Platycephala guangxensis An and Yang, NEW SPECIES

(Figs. 1-8)

Diagnosis. Head triangular in profile, about 1.5 times as long as high. Frontal triangle trapezoidal, polished brownish yellow with two blackish lateral spots. Thorax black; propleuron brown with dark brown spot at posterior margin; ptero-

pleuron blackish brown with pale upper part. Legs pale yellow.

Description. Male. Body length 5.5-6.5 mm, wing length 3.8-4.6 mm.

Head (Figs. 1-2): blackish brown, triangular in profile, about 1.5 times as long as high; front strongly produced beyond anterior level of eye, in profile about 0.3 times as long as axis of eye; gena posteriorly broadened posteriorly, anteriorly strongly narrowed below eye; palps about 0.07 times as broad as long axis of eye. Frontal triangle emporedial, polished brownish yellow, occupying most of from and reaching to anterior margin, medially produced with two blackish lateral spots, and with malleus transverse grooves occupying median longitudinal area in front of ocelli; occipital triangle black, axis between eyes and frontal triangle depressed and broadened. Occipitalnlx

abyss and propleuron; gena and frons (in front of eye) brown. Stomal and bristles on head blackish brown. Antenna (Fig. 1): brown with palpi grey pubescent; pedicel 0.8 times as long as flagellum; flagellum nearly rectangular, 1.6 times as long as wide, modified spicily, with blackish brown anterior and

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