

TWO NEW GENERA OF LEPTOPHLEBIIDAE  
(INSECTA: EPHEMEROPTERA) FROM SOUTH-WESTERN AUSTRALIA

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**Abstract**

Dean, J.C., 1987. Two new genera of Leptophlebiidae (Insecta: Ephemeroptera) from south-western Australia. *Mem. Mus. Vict.* 48: 91-100.

The genera *Nyungara* and *Bibulmena* are established for three species of leptophlebiid mayflies from south-western Australia. Diagnostic features of the two genera are presented, and descriptions are provided of the male imago, female imago and nymph of both *N. bunni* sp. nov. and *B. kadjina* sp. nov., and the male imago and female imago of *N. ellitasha* sp. nov. Both genera are known only from south-western Australia, and are perhaps endemic to the region.

**Introduction**

The mayflies of Western Australia are poorly known, and only two publications have included species identifications. Ulmer (1908) recorded the leptophlebiids *Atalophlebia furcifera* Eaton and *Atalophlebia inconspicua* Eaton and the baetid *Baetis soror* Ulmer from south-western Australia, and in a later publication (Ulmer, 1916) he recorded the baetid *Cloeon viridis* Klapálek from the Kimberley district of north-western Australia. The type locality of *A. inconspicua* is Adelaide and there have been no additional records from Western Australia. Confirmation of Ulmer's identification will require examination of his original material. I have, however, examined the holotype of *A. furcifera* which is lodged in the Museum of Victoria and Ulmer's figures certainly do not represent this species. The type locality of *A. furcifera* is Melbourne and there is no evidence that the distribution extends to Western Australia. Riek (1970), without giving details of species identifications, has reported that one species of *Tasmanocoenis* and one species of a genus close to *Atalonella* occur in Western Australia. In the present paper three new species of Leptophlebiidae are described from south-western Australia, and two new genera are established to accommodate them. Additional species have been recognised, and these will be described as more material becomes available.

*Material and methods*

Much of the material on which the descriptions are based has been collected by Dr Stuart Bunn during an ecological study of the macroinvertebrates of several small streams flowing through jarrah forests in the Darling Range. Precise locations of his study sites were given by Hynes and Bunn (1984). Additional material has been examined from the collections held by the Museum of Victoria, Melbourne. Colour descriptions and measurements are based on ethanol preserved specimens. Holotypes have been lodged in the Museum of Victoria and paratypes have been lodged in the Museum of Victoria (NMV) or retained in the author's collection (JCD).

Genitalia and nymphal parts have generally been drawn free-floating, and subsequently prepared for detailed examination by clearing in potassium hydroxide or mounting in polyvinyl alcohol-lactophenol mountant. Although slide preparation causes distortion of genitalia it is considered essential if details of spines and setae are to be examined. Wings have been dry mounted, photographed and transparencies projected onto a wall for tracing. All measurements have been made using an eye-piece graticule.

**Nyungara gen. nov.**

*Diagnostic features.* Imago. Forewing (Fig. 1)

*Nyungara* gen. nov.

*Diagnostic features.* Imago. Forewing (Fig. 1) hyaline, costal and subcostal cells in apical third of wing translucent, whitish. Length-width ratio 3.2-3.8. Basal to the bulla 3 to 5 costal cross veins, and 10 to 15 costal cross veins distal to the bulla.  $MP_2$  attached by cross vein to  $MP_1$  at 0.26-0.32 distance from base to wing margin.  $ICu_1$  not linked to CuA-CuP cross vein; base of  $ICu_1$  attached to CuA by cross vein.  $ICu_1$  and  $ICu_2$  parallel as wing margin approached. Forewing 6.7-9.7 times length of hindwing, which is greatly reduced. Hindwing with pronounced angular projection on costal margin (Figs. 2, 11). Vein Sc joining costal margin at 0.65-0.85 wing length. Fork MP without an intercalary. Tarsal claws similar, each with an apical hook and an opposing ventral flange (Fig. 9). Male imago with penis lobes fused in basal half, either partially fused or separated by narrow cleft in apical half (Figs. 6, 7, 10). Each lobe with sub-apical dorsal spine, directed inwards. Length of styliger plate along midline 0.31-0.36 maximum width. Female imago with a small genital extension on posterior margin of sternum 7. Ninth sternum of female imago with shallow apical cleft, width of cleft 2.7-3.7 times depth (Fig. 8).

Subimago. Wings uniformly pale grey-brown.

Mature nymph. Antennae about twice length of head. Mouthparts as in Figures 17-22. Lateral margins of clypeus diverging to anterior, labrum slightly wider than clypeus. Width of labrum about twice length, anterior margin with 5 broad denticles, extending over at least half maximum width of labrum. Outer margins of mandibles somewhat angular, tufts of hairs at midpoint. Incisors slender, prosthecal tuft well-developed. Galea-lacinia of maxilla with about 14 sub-apical ribbon-like pectinate setae, and sclerotised comb-like seta at inner end of row. Maxillary palp moderately small, middle segment with simple setae only. Labium with glossae not turned under ventrally, slightly dorsal to paraglossae. Terminal segment of labial palp narrow, approximately 3.0 times as long as broad. Terminal segment about 0.7 times as long and 0.65 times as wide as middle segment. Foreleg (Fig. 13) with sharp spines and scattered hairs along outer margin of femur. Tibia with scattered hairs along outer mar-

gin, and about 40 simple spines on ventral margin. Ventral margin of tarsus with 5-6 simple spines, tarsal claw with ventral teeth, progressively larger apically (Fig. 14). Postero-lateral spines on abdominal segments 5 (small) to 9. Gills double, on abdominal segments 1 to 7. Each lamella lanceolate, without lateral tracheae, similar on all segments (Fig. 15). Segments at mid-length of caudal filaments with apical whorl of triangular denticles and long setae (Fig. 16).

*Type species.* *Nyungara bunny* sp. nov.

*Etymology.* From Nyungar, a collective name the aboriginal people of south-western Australia used for themselves.

*Remarks.* The genus *Nyungara* can be distinguished from all other leptophlebiid genera by the following combinations of characters:

Imago: (1) forewing with  $ICu_1$  not connected to CuA-CuP cross vein (Fig. 1); (2) hindwing reduced, with pronounced angular projection on costal margin (Figs. 2, 11); (3) claws of a pair alike, with an apical hook and an opposing ventral flange (Fig. 9); (4) penis lobes with a sub-apical spine (Figs. 7, 10).

Nymph: (1) labrum broader than clypeus; (2) width of labrum about twice length (Fig. 17); (3) anterior denticles of labrum broad based, extending over at least half of maximum width of labrum (Fig. 17); (4) tarsal claws with ventral teeth, progressively larger apically (Fig. 14); (5) postero-lateral spines on abdominal segments five to nine; (6) gills double, lanceolate, on abdominal segments one to seven; (7) tracheae of gills without lateral branches (Fig. 15).

*Nyungara* is close to *Atalonella* Needham & Murphy which has representatives in both South America and eastern Australia. Peters and Edmunds (1972) designated *A. ophis* from Chile as the type species of *Atalonella* and provided information on the diagnostic characters of the genus. Adults of *Nyungara* are readily distinguished from *Atalonella* by several features including the reduced size of the hindwing, the well-developed costal projection on the hindwing, and the presence of sub-apical spines on the penis lobes. However, differences between nymphs of the two genera are slight. The five denticles on the anterior margin of the labrum of *Nyungara*

are broadly based and extend over at least half of the width of the labrum, whereas in *Atalonella* the denticles are narrowly based, with the middle denticle clearly larger than the laterals. In addition, the gill lamellae of *Nyungara* lack lateral tracheae while described nymphs of *Atalonella* possess gills with well-developed lateral tracheae. Within Australia leptophlebiid mayflies with *Atalonella*-like nymphs fall into at least four species-groups. The genus *Nyungara* is established here for one group which includes two species from south-western Australia. A second group of species can clearly be referred to the genus *Atalonella*, sensu Peters and Edmunds (1972), while a third group includes *Atalophlebia lucida* Ulmer for which Demoulin (1955) has established the genus *Thraulophebia*. Unfortunately, many species in the complex have been inadequately described and generic placements must await further studies.

***Nyungara bunnii* sp. nov.**

Figures 1-9, 12-22

Leptophlebiidae species C, Bunn et al. (1986).

*Type material.* Holotype: Western Australia, Foster Brook, North Dandalup, S. Bunn, 22 Sep 1983, NMV T-8132(♂ imago reared from nymph).

Paratypes: Western Australia. Foster Brook, North Dandalup, S. Bunn, 23 Jul 1982, NMV T-8133(♂ imago reared from nymph, wings, forelegs, genitalia and nymphal parts on slides; figs. 1-6, 9, 16, 17, 20-22). Waterfall Gully, Jarrahdale, S. Bunn, 30 Aug 1982, JCD(♂ imago reared from nymph, genitalia cleared, fig. 7). Waterfall Gully, Jarrahdale, S. Bunn, 30 Aug 1982, NMV T-8134(♀ imago reared from nymph, fig. 8). Waterfall Gully, Jarrahdale, S. Bunn, 16 Sep 1981, NMV T-8158(♀ nymph, mouthparts and legs on slide, figs. 12-15, 18, 19).

*Other material examined.* Western Australia. Seldom Seen Brook, Jarrahdale, S. Bunn, various dates (1 ♂ imago, 1 ♀ imago, 8 nymphs). Waterfall Gully, Jarrahdale, S. Bunn, various dates (1 ♂ imago, 4 ♀ imagos, 1 ♂ subimago, 3 ♀ subimagos, 29 nymphs).

*Description.* Imago. Body length: ♂ 6.3-7.8 mm, ♀ 6.8-7.5 mm.

Forewing: ♂ 7.0-7.7 mm, ♀ 7.1-7.8 mm.

Male imago: Head and thorax medium brown. Upper portion of eyes orange-brown, lower portion black. Eyes separated on meson of head by distance of from half to almost full width of median ocellus. Forelegs brown, articulations of femora and tibiae, and tibiae and tarsi darker. Ratios of segments in forelegs 0.68: 1.00(2.60 mm):

0.05: 0.32: 0.28: 0.21: 0.10. Mid- and hind-legs paler, yellow-brown, darker brown around articulations of femora and tibiae. Forewing 6.7-7.7 times length of hindwing. Costal projection of hindwing at 0.55-0.60 wing length; vein Sc joining wing margin at 0.65-0.70 wing length (Fig. 2). Abdominal terga brown, anterior third of most segments pale and often hyaline (Figs. 3, 4). Sterna paler yellow-brown. Penes reaching almost to middle of basal segment of forcep (Figs. 5, 6). Apices of penis lobes either in contact or separated by very narrow cleft (Fig. 6).

Female imago: General colour similar to male imago. Abdominal terga more uniformly brown, but with pair of small pale spots on anterior third of most segments. Eyes separated on meson of head by distance about 4 times maximum width of an eye. Forewing 7.7-8.1 times length of hindwing. Genital extension on sternum 7 broad and evenly rounded, projecting about 0.2 times length of sternum 8. Width of apical cleft on ninth sternum 2.8 to 3.2 times depth.

Nymph: Body length of mature nymph 6.2-6.7 mm. Head and thorax predominantly medium-brown, washed with paler yellow-brown as in Figure 12. Legs yellowish-brown, pale brown bands at about two-thirds length of femora, at base and middle of tibiae, and near middle of tarsi. Abdomen pale brown, terga with pair of small pale spots on anterior third of most segments. Sterna pale yellow-brown, usually without obvious markings.

*Etymology.* The species is named for Dr S. Bunn who collected the material.

***Nyungara ellitasha* sp. nov.**

Figures 10, 11

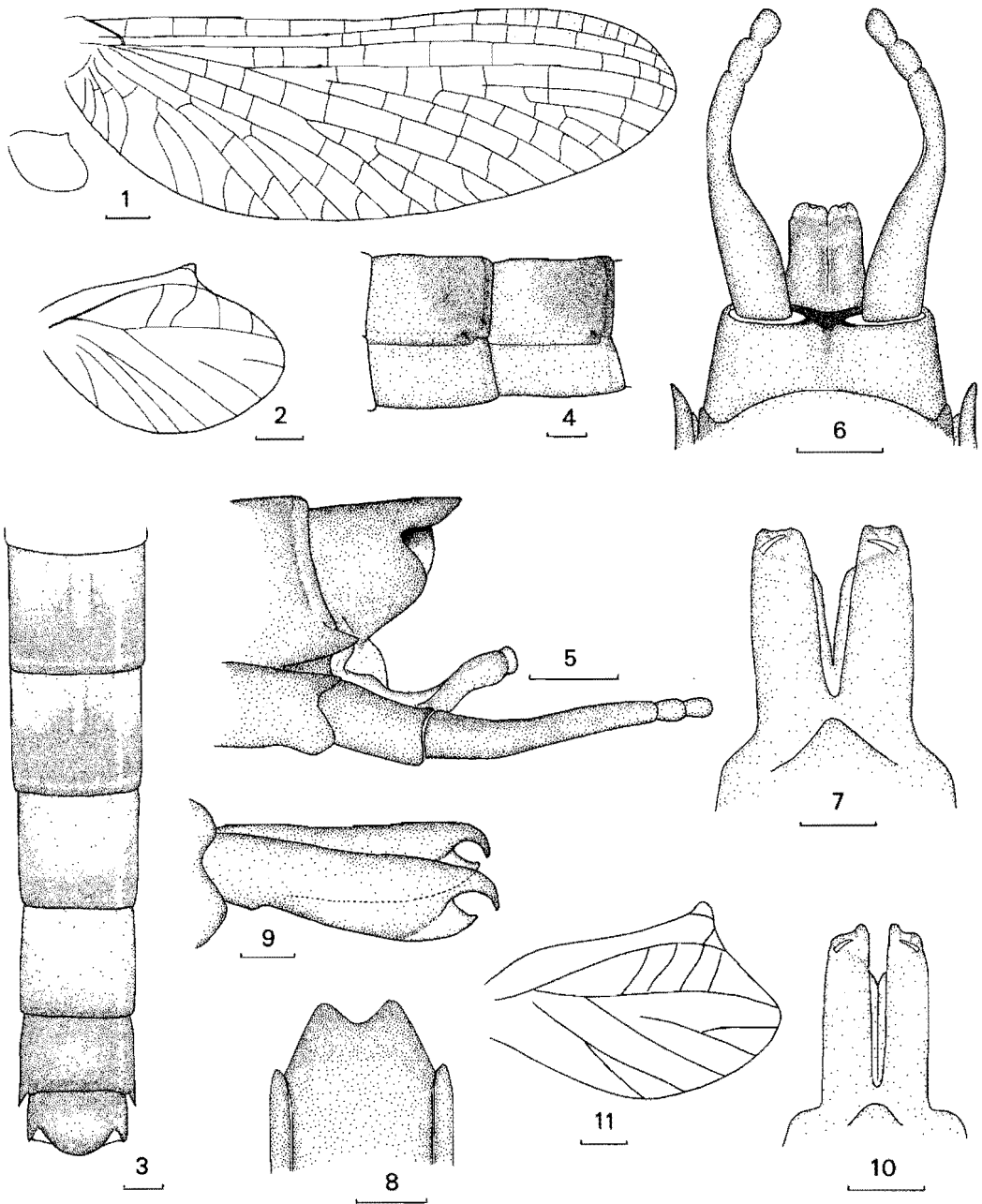
*Type material.* Holotype: Western Australia, Wungong Brook, Jarrahdale, S. Bunn, 6 Oct 1983, NMV T-8135(♂ imago, genitalia cleared, fig. 10).

Paratypes: Type locality, NMV T-8136(♂ imago, wings, genitalia and foreleg on slides, fig. 11); JCD(♂ imago, wings on slide); NMV T-8137(♀ imago).

*Other material examined.* Western Australia. Wungong Brook, Jarrahdale, S. Bunn, 6 Oct 1983 (5 ♂ subimagos). Carbanup River, Marybrook-Vasse Road, J. Blyth, 5 Dec 1979 (4 ♂ imagos).

*Description.* Imago. Body length: ♂ 4.8-6.0 mm, ♀ 5.8 mm.

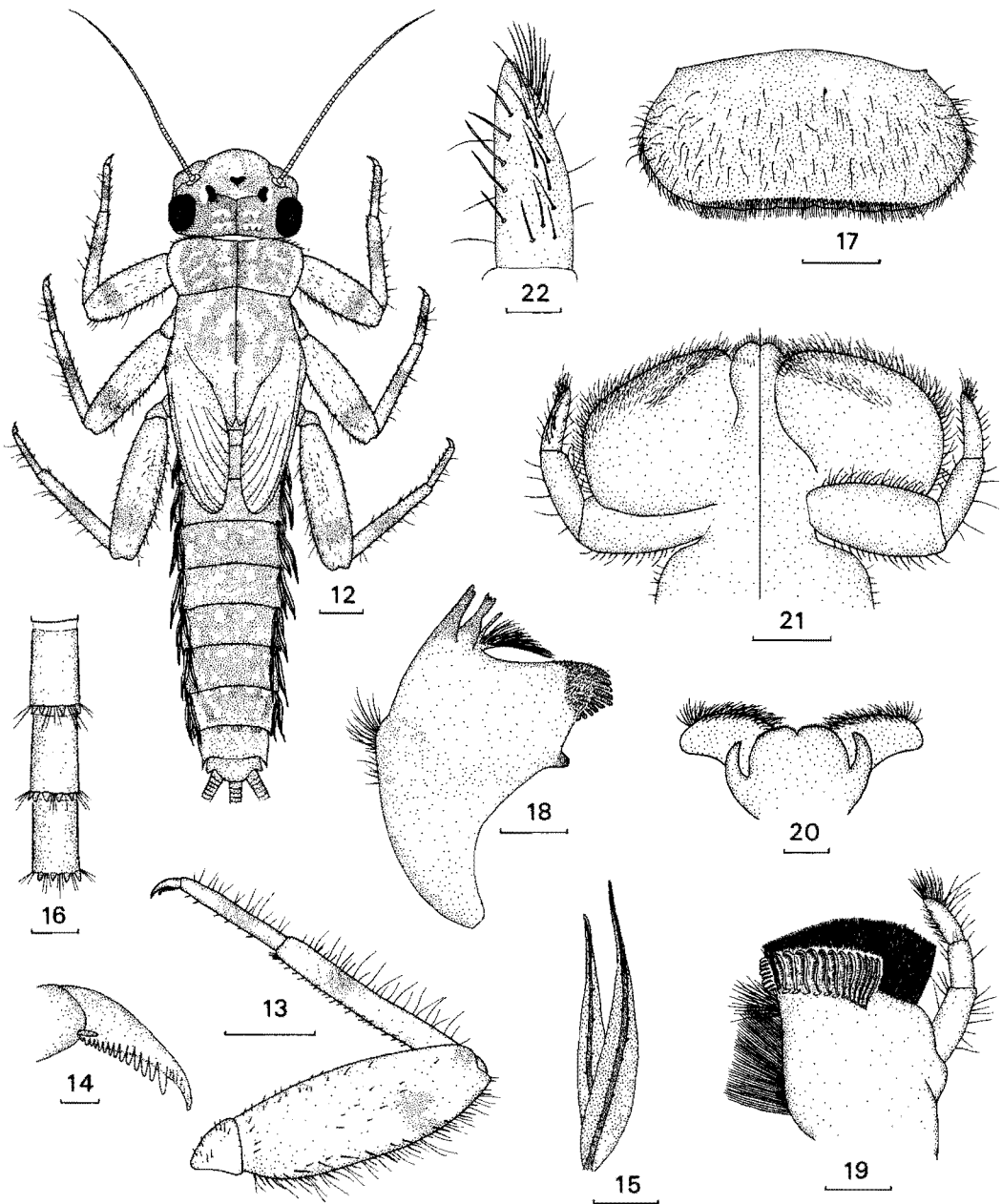
Forewing: ♂ 4.8-5.9 mm.



Figures 1-9. *Nyungara bunni*, imago. 1, wings, male imago; 2, hindwing enlarged, male imago; 3, abdominal segments 5 to 10, dorsal, male imago; 4, abdominal segments 5 and 6, lateral, male imago; 5, male genitalia, lateral; 6, male genitalia, ventral; 7, penis lobes, dorsal; 8, ninth sternum, ventral, female imago; 9 fore tarsal claws, male imago.

Figures 10-11. *Nyungara ellitasha*, imago. 10, penis lobes, dorsal; 11, hindwing, male imago.

Scale lines: 0.02 mm (Fig. 9); 0.1 mm (Figs. 7, 10, 11); 0.2 mm (Figs. 2-6, 8); 0.5 mm (Fig. 1).



Figures 12-22. *Nyungara bunni*, nymph. 12, whole nymph; 13, foreleg; 14, tarsal claw; 15, gills, abdominal segment four; 16, cercus midlength; 17, labrum; 18, left mandible, dorsal; 19, left maxilla, ventral; 20, hypopharynx; 21, labium, dorsal (left) and ventral (right) aspects; 22, terminal segment of labial palp, dorsal.  
 Scale lines: 0.05 mm (Figs. 14, 16, 22); 0.2 mm (Figs. 15, 17-21); 0.5 mm (Figs. 12, 13).

Male imago: Head and thorax brown. Upper portion of eyes orange-brown, lower portion black. Eyes either in contact on meson of head, or separated by distance less than width of median ocellus. Forelegs brown, darker at articulations. Ratios of segments in forelegs 0.67: 1.00(1.84 mm): 0.06: 0.35: 0.35: 0.31: 0.12. Forewing 8.5-9.7 times length of hindwing. Costal projection of hindwing at 0.75-0.80 length of wing, vein Sc joining wing margin at 0.80-0.85 wing length (Fig. 11). Abdominal terga brown, paler than head and thorax. Usually no obvious markings although in some specimens a pair of inconspicuous pale spots on anterior third of some segments. Sterna pale brown. Apical third of penis lobes separated by narrow cleft (Fig. 10). Apices of penis lobes oblique, with inner angles projecting further than outer angles. Base of penis narrowing abruptly.

Female imago: (Only single specimen available for examination, both forewings damaged.) General colour similar to male imago. Abdominal terga uniformly pale brown, no obvious markings. Sterna pale yellow-brown. Eyes separated on meson of head by distance about 4 times maximum width of eye. Genital extension on sternum 7 broad, rounded, reaching about 0.2 along sternum 8. Width of apical cleft on ninth sternum 3.7 times depth.

Nymph: Unknown.

*Etymology.* The species is named for my children, Elliot and Natasha.

*Remarks.* *Nyungara ellitasha* is readily distinguished from *N. bunni* by the smaller size, the greater reduction of the hindwing and the more distal location of the costal projection of the hindwing. The penis lobes are more delicate, with the apices somewhat oblique as opposed to the more rounded apices of *N. bunni*. In addition, the base of the penis narrows abruptly in *N. ellitasha* whereas the narrowing is more gradual in *N. bunni*.

#### **Bibulmena gen. nov.**

*Diagnostic features.* Imago. Forewing hyaline; male imago with costal and subcostal cells hyaline except in apical third of wing, where they are translucent, whitish (Fig. 23), female imago with all costal and subcostal cells shaded pale brown.

Length-width ratio of forewing about 3.1. Basal to bulla 7-10 costal cross veins, about 20 costal cross veins distal to bulla. In apical third of wing costal cross veins anastomosed.  $MP_2$  attached by cross vein to  $MP_1$  at about 0.18 distance from base to wing margin.  $ICu_1$  lined to  $CuA-CuP$  cross vein.  $ICu_1$  and  $ICu_2$  diverging as wing margin approached. Forewing about 4.5 times length of hindwing. Costal margin of hindwing with shallow concavity just beyond midpoint (Fig. 24). Vein Sc joining costal margin at about 0.9 wing length. Hindwing with about 9 costal and 7 subcostal cross veins. Fork of  $MP$  with intercalary. Tarsal claws similar, each with apical hook and opposing ventral flange (Fig. 30). Length of styliger plate of male a little over 0.3 times maximum width. Penis reaching to about middle of basal segment of forcep (Fig. 28). Lobes downturned, each with pointed lateral projection (Figs. 27, 28). Each lobe with series of internal setae (Fig. 29). Female imago with short genital extension on posterior margin of sternum 7. Sternum 9 of female with shallow apical cleft, approximately 3.1-3.7 times as wide as deep (Fig. 31).

Subimago. Wings uniformly grey, costal and subcostal cells of female grey-brown.

Mature nymph. Antennae about twice length of head. Mouthparts as in Figures 37-42. Labrum slightly wider than clypeus, width-length ratio 1.8-1.9. Lateral margins rounded, anterior margin with shallow concavity and 5 broad, squat denticles. Secondary hair fringe set back from anterior margin almost 0.3 of labrum length. Outer margin of mandibles moderately curved, tuft of hairs at about midpoint, and basal to this some finer and shorter hairs. Incisors slender, with 3 apical teeth. Protheca slender, pointed with subapical tooth at about two-thirds length. Galealacinia of maxilla with row of about 20 subapical ribbon-like pectinate setae, and at inner end of row a sclerotised comb-like seta. Maxillary palp moderately short, middle segment with simple setae only. Terminal segment 0.75-0.80 times length of middle segment. Labium with glossae turned under ventrally, thus laying ventral to the plane of the paraglossae. Labial palp with terminal segment slender, length 2.5-2.8 times maximum width. Inner margin with series of small denticles, as well as some longer hairs. Terminal segment about 0.85 length and 0.80 width of mid-

dle segment. Foreleg (Fig. 33) with numerous sharp spines and scattered long hairs along outer margin of femur. Tibia with long hairs along outer margin, and numerous bipectinate spines along ventral surface. Ventral margin of tarsus with 25-30 simple spines. Tarsal claw smooth (Fig. 34). Posterolateral spines on abdominal segments 6 (small) to 9. Gills double, on abdominal segments 1 to 7. Lamellae similar on all segments, narrowing at about two-thirds length and with single apical filament (Fig. 35). Caudal filaments with basal segments bearing apical whorl of triangular denticles and long setae, segments at midlength with setae only (Fig. 36).

*Type species.* *Bibulmena kadjina* sp. nov.

*Etymology.* From Bibulmen, an aboriginal tribe of south-western Australia.

*Remarks.* The genus *Bibulmena* can be distinguished from all other leptophlebiid genera by the following combination of characters.

Imago: (1) forewing with ICu, connected to CuA-CuP cross vein (Fig. 23); (2) costal margin of hindwing without projection, but with shallow concavity just beyond midpoint (Fig. 24); (3) apical third of forewing with costal cross veins anastomosed (Fig. 23); (4) claws of a pair alike, with an apical hook and an opposing ventral flange (Fig. 30); (5) sternum 9 of female with an apical cleft (Fig. 31).

Nymph: (1) labrum slightly wider than clypeus; (2) labium with glossae curved under ventrally, ventral to paraglossae (Fig. 41); (3) terminal segment of labial palp with series of small denticles along inner margin (Fig. 42); (4) tarsal claws smooth (Fig. 34); (5) gills double, on abdominal segments 1 to 7, lamellae similar on all segments (Fig. 35).

Comparison of imagos suggests that *Bibulmena* is closely related to *Atalophlebia*, however the morphology of the nymph, in particular the size and shape of the labrum and the form of the labial palps and the incisors of the mandibles, clearly differentiates *Bibulmena* from *Atalophlebia* and also from all other genera in the *Hapsiphlebia* lineage (sensu Pescador and Peters, 1980). Character states used by Pescador and Peters to delineate phyletic lineages in southern hemisphere Leptophlebiidae suggest that *Bibulmena* belongs in the *Atalonella* lineage. While

many nymphal characters are shared with *Atalonella* and related genera, the ventrally curved glossae and the denticles on the inner margin of the terminal segment of the labial palp, as well as many features of adult wing venation, suggest that *Bibulmena* is in fact intermediate between the *Hapsiphlebia* and *Atalonella* lineages. In this regard *Bibulmena* is similar to the South American genera *Penaphlebia* and *Massartella*. However, the nymph is distinguished from these two genera by the smooth tarsal claws and the absence of pectinate setae from the second segment of the maxillary palp.

### *Bibulmena kadjina* sp. nov.

Figures 23-42

Leptophlebiidae species B, Bunn et al. (1986).

*Type material.* Holotype: Western Australia, North Dandalup River, North Dandalup, S. Bunn, 1 Jun 1984, NMV T-8138 (♂ imago, reared from nymph).

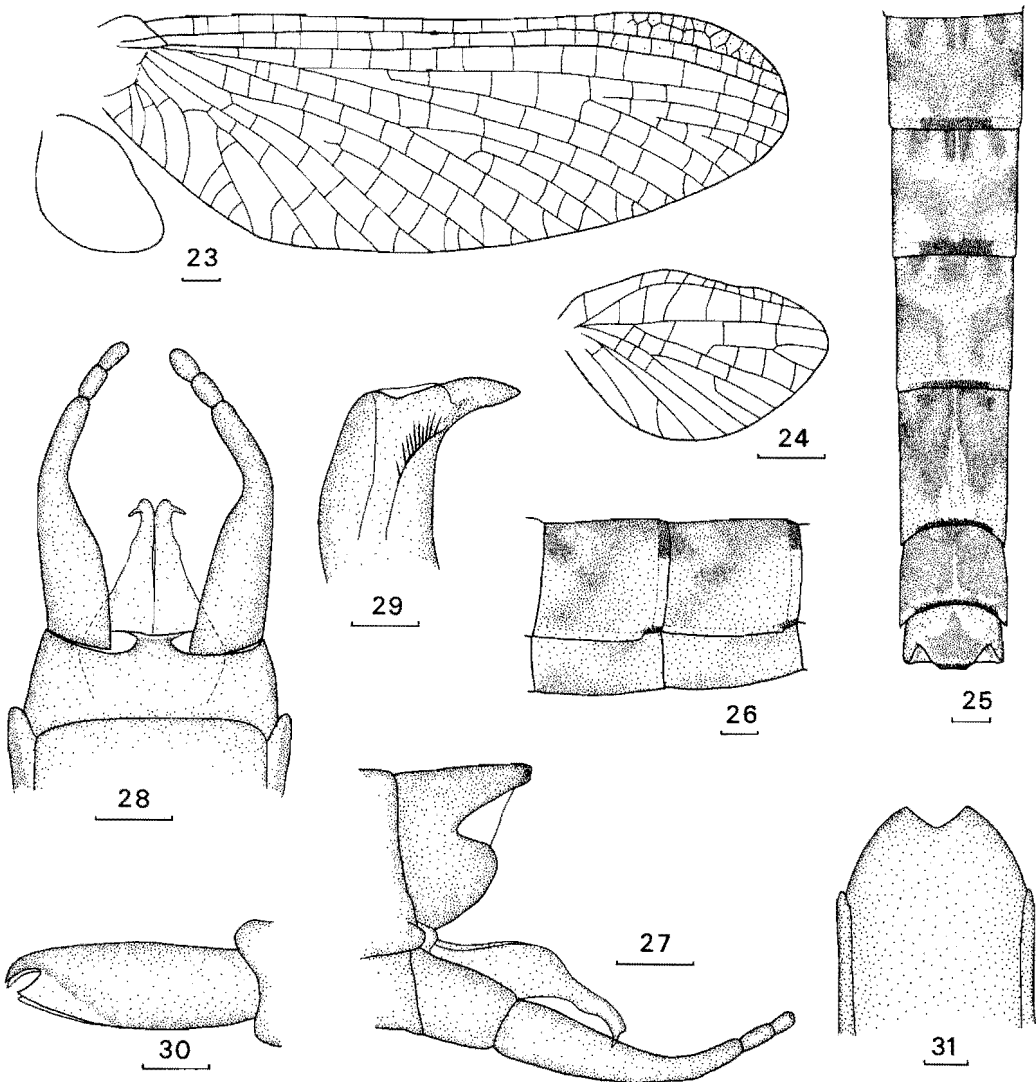
Paratypes: Western Australia, Foster Brook, North Dandalup, S. Bunn, 3 May 1983, NMV T-8160 (♂ imago, reared from nymph, wings genitalia and nymphal parts on slides, figs. 23-30, 34, 36, 37, 42). Foster Brook, North Dandalup, S. Bunn, 8 Sep 1983, NMV T-8139 (♀ imago, fig. 31). Wungong Brook, Jarrahdale, S. Bunn, 2 Dec 1981, NMV T-8159 (♀ nymph, legs and mouthparts on slide, figs. 32, 33, 35, 38-41).

*Other material examined.* Western Australia. Carbanup River, Marybrook-Vasse road, J. Blyth, 5 Dec 1979 (1 ♂ imago, 1 ♀ imago). North Dandalup River, A. Wells, 4 Sep 1980 (1 nymph). Serpentine River, Jarrahdale, A. Wells, 11 Sep 1980 (1 nymph). North Dandalup River, North Dandalup, S. Bunn, various dates (1 ♂ subimago, 1 ♀ subimago). Wungong Brook, Jarrahdale, S. Bunn, various dates (2 ♀ ♀ imagos, 7 nymphs). Dirk Brook, Jarrahdale, S. Bunn, 26 Jan 1983 (1 ♂ subimago). Augustus River, Collie, S. Bunn, 30 Oct 1983 (1 ♀ imago). Seldom Seen Brook, Jarrahdale, S. Bunn, various dates (11 nymphs). Foster Brook, North Dandalup, S. Bunn, 19 May 1981 (3 nymphs).

*Description.* Imago. Body length: ♂ 9.2-9.9 mm, ♀ 10.0-11.9 mm.

Forewing: ♂ 9.2-9.6 mm, ♀ 11.4-13.4 mm.

Male imago: Upper portion of eyes orange-brown, lower portion black. Eyes either in contact on meson of head, or separated by distance less than half width of median ocellus. Pronotum pale yellow-brown, black markings along anterior margin and mesal half of posterior margin, longitudinal black lines on midline, halfway between midline and lateral margin, and along lateral margin. Meso- and meta-thorax darker yellow-brown, variously washed with black-



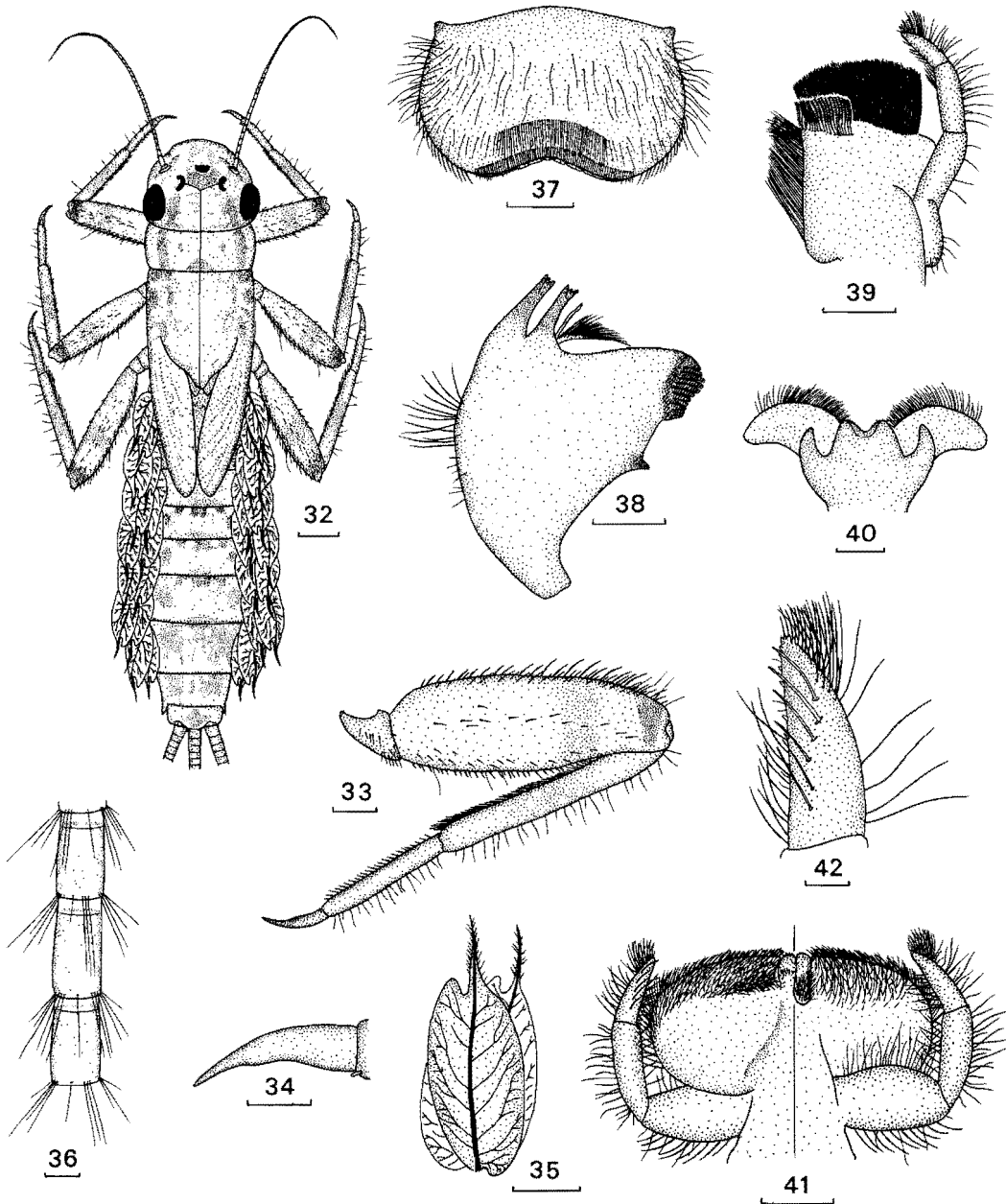
Figures 23-31. *Bibulmena kadjina*, imago. 23, wings, male imago; 24, hindwing enlarged, male imago; 25, abdominal segments 5 to 10, dorsal, male imago; 26, abdominal segments 5 and 6, lateral, male imago; 27, male genitalia, lateral; 28, male genitalia, ventral; 29, apex of penis lobe, dorsal; 30, fore tarsal claws, male imago; 31, ninth sternum, ventral, female imago. Scale lines: 0.04 mm (Figs. 29, 30); 0.2 mm (Figs. 25-28, 31); 0.5 mm (Figs. 23, 24).

brown. Forelegs golden brown, dark brown-black pigmentation at apices of femora and tibiae, less conspicuous dark bands at about two-thirds length of femora. Mid- and hind-legs slightly paler, dark markings at apices of femora only. Ratios of segments in foreleg 0.79: 1.00(2.70 mm): 0.06: 0.44: 0.41: 0.37: 0.15. Forewing hyaline, costal and subcostal cells in apical third of

wing translucent, whitish. Costal cross veins, especially in basal half of wing, washed with thin band of brown. Abdominal terga brown, pattern of darker maculae as in Figures 25 and 26. Sterna brown, no conspicuous markings. Genitalia as in Figures 27 to 29.

Female imago: Colour generally similar to male imago. Eyes separated on meson of head





Figures 32-42. *Bibulmena kadjina*, nymph. 32, whole nymph; 33, foreleg; 34, tarsal claw; 35, gills, abdominal segment four; 36, cercus midlength; 37, labrum; 38, left mandible, dorsal; 39, left maxilla, ventral; 40, hypopharynx; 41, labium, dorsal (left) and ventral (right) aspects; 42, terminal segment of labial palp, dorsal.

Scale lines: 0.05 mm (Figs. 36, 42); 0.1 mm (Fig. 34); 0.2 mm (Figs. 33, 37-41); 0.5 mm (Figs. 32, 35).

by distance 2.5-3.0 times the maximum width of eye. Forewings hyaline, all costal and subcostal cells uniformly shaded pale brown. Costal cross veins highlighted with thin band of brown. Abdomen slightly more reddish-brown than male imago, pattern of darker maculae similar. Genital extension on segment 7 broad, rounded, slightly flattened at apex; extending 0.1-0.2 length of sternum 8.

**Nymph:** Body length of mature nymph 9.0 to 10.0 mm. General colour yellow-brown, darker brown markings as in Figure 32. Legs yellow-brown, dark brown markings at apices of femora, less conspicuous brown bands at two-thirds length of femora, middle of tibiae, and middle of tarsi. Abdominal sterna yellow-brown, with no obvious markings. Gills narrowing at about two-thirds length, with single apical filament. Inner margin with rounded indentation at level of narrowing. Lateral tracheae well developed.

**Etymology.** From *kadjin*, an aboriginal word for a deceased person's spirit or soul.

#### Acknowledgments

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study. Dr Arturs Neboiss, Mr David Cartwright, and two anonymous referees kindly commented on the draft manuscript.

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