

Descriptions of new species and a new genus of leptophlebiid mayflies (Insecta: Ephemeroptera) from the Northern Territory, Australia

J. C. DEAN¹ AND P. J. SUTER²

¹ Environment Protection Authority, Freshwater Sciences, Ernest Jones Drive, Macleod, Victoria 3085
(john.dean@epa.vic.gov.au)

² Department of Environmental Management and Ecology, La Trobe University, PO Box 821, Wodonga, Victoria 3689
(p.suter@latrobe.edu.au)

Abstract

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Adults and nymphs of a new monotypic genus (*Manggabora* gen. nov.) and three new species of leptophlebiid mayflies (*Manggabora wapitja* sp. nov., *Atalophlebia gubara* sp. nov. and *Tillyardophlebia dostinei* sp. nov.) are described from Kakadu National Park in northern Australia.

Key words

mayflies, Leptophlebiidae, taxonomy, new species, new genus, Australia, Kakadu

Introduction

Although the Ephemeroptera (mayflies) of the Northern Territory have been reasonably well known since environmental monitoring programs were commenced in the early 1980s, their taxonomy has been neglected and most species remain undescribed. The first serious attempt to document the fauna was by Suter (1992) who sampled extensively in the Alligator Rivers Region, associated adults with immature aquatic stages by rearing, and produced identification keys to both adults and nymphs of recognised voucher species. This study formed the basis for inclusion of Northern Territory taxa in subsequent identification guides to Australian mayfly nymphs (Suter, 1997, 1999; Dean, 1999).

Suter (1992) recorded nine species of the family Leptophlebiidae placed in five genera, and Dean (1999) recognised ten species in seven genera. A recent attempt to collect additional material was only partially successful, primarily due to unsuitable conditions at the end of the dry season. Three new species are described below, and a new genus is erected to accommodate one of them.

Material has been preserved in alcohol, with parts of some specimens mounted on microscope slides. Terminology follows Peters et al. (1978). All type material is lodged in the Museum of Victoria, Melbourne (NMV). The following abbreviations are used for material examined: MI male imago; FI female imago; MSI male subimago; FSI female subimago; N nymph.

Family Leptophlebiidae

Subfamily Atalophlebiinae

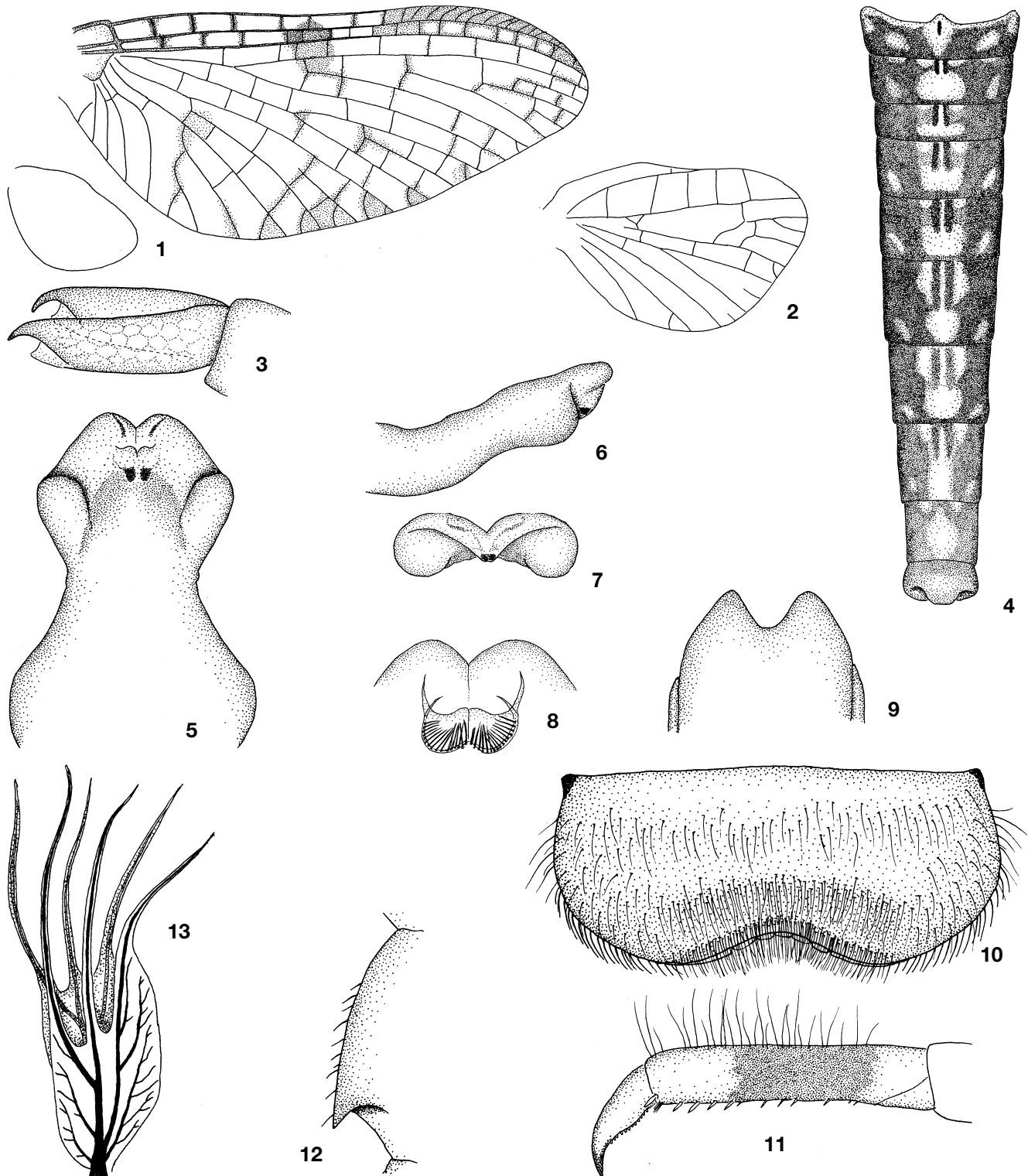
Atalophlebia gubara sp. nov.

Figures 1–13

Type material. Holotype: male imago, Gubara (Baroalba Springs), Kakadu National Park, Northern Territory, 12°49'S 132°53'E, 14 Aug 1999, J. Dean (NMV T-18498).

Paratypes: collected with holotype, 8 male imagos (NMV T-18499–T-18506).

Other material examined. **Northern Territory.** 3MI, 2N, Gubara (Baroalba Springs), 12°49'S 132°53'E, 14 Aug 1999, J. Dean; 1FSI, 1N, Gulungul Creek (Radon Springs), 12°45'S 132°55'E, 18 May 1988, P. Suter; 4N, Gulungul Creek (Radon Springs), 12°45'S 132°55'E, 13 Aug 1999, J. Dean; 3N, Manggabor Creek, Arnhem Land, 12°17'S 134°05'E, 26 Aug 1999, J. Dean; 1MSI, 1FI (both reared from nymphs), Walker Creek, Litchfield National Park, 13°05'S 130°42'E, 31 Aug 1999, J. Dean; 2MSI, 2FSI, (all reared from nymphs), 3FI, 2N, Magela Creek, Bowerbird Billabong, 12°47'S 133°02'E, 30 June 1990, P. Suter; 1N, Magela Creek, 1.5 km d/s Bowerbird Billabong, 12°46'S 133°02'E, 28 May 1988, P. Suter; 7N, Magela Creek, d/s Bowerbird Billabong, 12°47'S 133°02'E, 3 May 1990, D. Cartwright; 1N, South Alligator River, d/s Gimbat, 13°35'S 132°36'E, 2 May 1990, D. Cartwright; 1N, South Alligator River, Koolpin Crossing, 13°32'S 132°33'E, 18 Aug 1999, J. Dean; 1MI, 1FI, South Alligator River, Koolpin Crossing, 13°32'S 132°33'E, 14 Oct 1987, P. Dostine; 2N, South Alligator River, Coronation Hill, 13°36'S 132°37'E, 20 Apr 1987, P. Dostine.



Figs 1–13. *Atalophlebia gubara*. Male imago: 1, forewing and outline of hind-wing; 2, hind-wing enlarged; 3, foretarsal claws; 4, abdominal terga, dorsal; 5, penes lobes, ventral; 6, penes lobes, lateral; 7, penes lobes, apical; 8, penes lobes, ventral pockets (cleared slide preparation, spine-like setae internal). Female imago: 9, sternum, abdominal segment IX. Nymph: 10, labrum; 11, foretarsus; 12, lateral margin, abdominal segment V; 13, gill, abdominal segment IV.

Description. Imago. Length of male: body 6.8–7.9 mm, forewing 6.1–6.9 mm; Length of female: body 6.5–7.9 mm, forewing 6.0–7.0 mm. Head medium brown; antennae medium brown; male eyes with upper lobes medium brown, lower lobes grey, upper lobes separated by distance approximately equal to diameter of median ocellus. Thorax with meso- and metascutum medium brown; thorax laterally pale yellow, with small patches of dark brown pigment. Forelegs medium brown, femora with dark brown bands a little beyond midlength and at apex, tibiae with dark band at base and more heavily pigmented in apical half. Middle and hind legs paler, yellowish, femora with dark bands as in foreleg, tarsal segments also darker brown. Tarsal claws similar, with apical hook and opposing ventral flange (Fig. 3). Forewings hyaline, cross veins in costal and subcostal spaces washed with brown pigment; elsewhere in forewing many crossveins and cells washed with pale brown (Fig. 1). Male abdomen dark brown, pattern of paler yellow maculae, predominantly along midline (Fig. 4); abdominal sterna pale, with some darker brown markings. Penes narrow at midlength, broader in apical half, the two halves fused almost to apex; a pair of large ventro-lateral lobes at about three-quarters length, and closer to the apex a smaller ventro-median lobe (Figs 5–7); median lobe underlying deep pockets with internal spine-like setae (Fig. 8). Male imago with 3 apical filaments, dark brown in basal half and white in apical half. Female abdominal colour pattern similar to male; abdominal sternum 9 with posterior margin deeply excised (Fig. 9); strongly projecting egg guide on posterior margin of abdominal sternum 7. Subimago. Wings yellow-pale brown, forewing with suffusion of darker brown covering most cross veins. Abdominal colour pattern similar to imago but lateral pale areas more strongly developed. Nymph. General colour medium to dark brown, paler markings on abdominal terga; legs yellowish with brown bands on all segments. Labrum broad, width approximately 2.5 times length along median line (Fig. 10). Foretarsus with about 10 ventral spine-like setae, each seta less than one-sixth diameter of tarsus (Fig. 11). Abdominal segments 2–9 with relatively short posterolateral spines, those on segment V about one-eighth length of segment (Fig. 12). Gills on abdominal segments 1–7; all gills with upper and lower lamella tridigitate (Fig. 13).

Etymology. The species is named for the type locality.

Comments. Although previously undescribed, this species has been included in keys as *Atalophlebia* sp.1 (Suter, 1992) and *Atalophlebia* sp.AV16 (Dean, 1999). The species is distinguished from all other species of the genus by the structure of the male genitalia, and in the nymph by the shape of the gills, the size and number of ventral spines on the foretarsus and the short posterolateral abdominal spines.

Manggabora gen. nov.

Type species. *Manggabora wapitja* sp. nov.

Diagnosis. Imago. Forewing length-width ratio 2.8–3.0 (Fig. 14); membrane hyaline, except costal and subcostal cells in apical third of wing which are opaque, white; costal crossveins

basal to bulla very faint, difficult to see, crossveins elsewhere weakly developed; ICu, usually linked to CuA-CuP crossvein, terminating free in some individuals; ICu₁ and ICu₂ parallel as wing margin approached. Hindwing approximately 0.22 length of forewing; costal margin with shallow concavity a little beyond midlength; vein Sc joining costal margin at about 0.85 wing length (Fig. 15). Legs with tarsal claws dissimilar, one with an apical hook and opposing ventral flange, the other large, pad-like (Fig. 16). Male genitalia (Figs 19–22) with claspers three-segmented, penes extending beyond narrowing of claspers; penes lobes narrow, fused almost to apex, ventral surface with a robust, medial projection; each lobe with a stout, retractable apical spine. Female ninth sternum strongly projecting, posterior margin entire (Fig. 23). Subimago. Wings uniformly pale grey-yellow, without pattern. Mature nymph. Labrum a little broader than clypeus; maximum width about 2.3 times length along median line (Fig. 25); anterior margin overhanging medial notch; frontal setae sparse, arranged as narrow band. Mandibles (Figs 26, 27) with outer incisors slender; outer margin swollen at base of incisor. Maxillae with sub-apical row of 12–15 pectinate setae on ventral surface (Fig. 28). Labium with glossae slightly dorsal to paraglossae, not turned under ventrally (Fig. 29); labial palp with terminal segment about half length of middle segment, without spine-like setae along inner margin. Femora with long spine-like setae and hair-like setae along outer margin (Fig. 30); tarsi with all ventral spines similar in length; tarsal claws with ventral teeth (Fig. 31). Abdominal segments with posterolateral spines on segments 4 or 5–9; posterior margins of abdominal terga with an almost continuous series of very small triangular spines, about 10 µm long, interspersed with fewer long hair-like seta (Fig. 33); gills linear, lateral tracheae very weakly developed or absent (Fig. 32). Caudal filaments (Fig. 34) with apical whorl of flattened, triangular spines on each segment, and between each spine a series of 4 or 5 fine setae about half segment length.

Etymology. The genus is named after Manggabor Creek, Arnhem Land, one of the collection localities for the species. Feminine.

Remarks. *Manggabora* is a member of the *Austrophlebioides* lineage, as evidenced by the following features: (1) adult tarsal claws dissimilar; (2) forewing with ICu, usually linked to CuA-CuP crossvein; (3) sternum 9 of female with apical margin entire; (4) mouthparts of nymph with labrum broader than clypeus; (5) mandibles with outer incisors slender; (6) terminal segment of labial palp, short, about half length of middle segment. The lineage is restricted to the Southern Hemisphere, and includes the Australian genera *Austrophlebioides*, *Tillyardophlebia* and *Kirrara*. *Manggabora* can be distinguished from all other genera in the lineage by the following combination of characters: (1) penes lobes relatively slender, fused almost to apex, with large ventral projection near apex; (2) anterior margin of labrum overhanging central notch; (3) maxillae with only 12–15 pectinate setae in sub-apical row; (4) absence of elongate ventral spines from all tarsi; (5) posterolateral spines on abdominal segments 4 or 5–9 only.

Manggabora wapitja sp. nov.

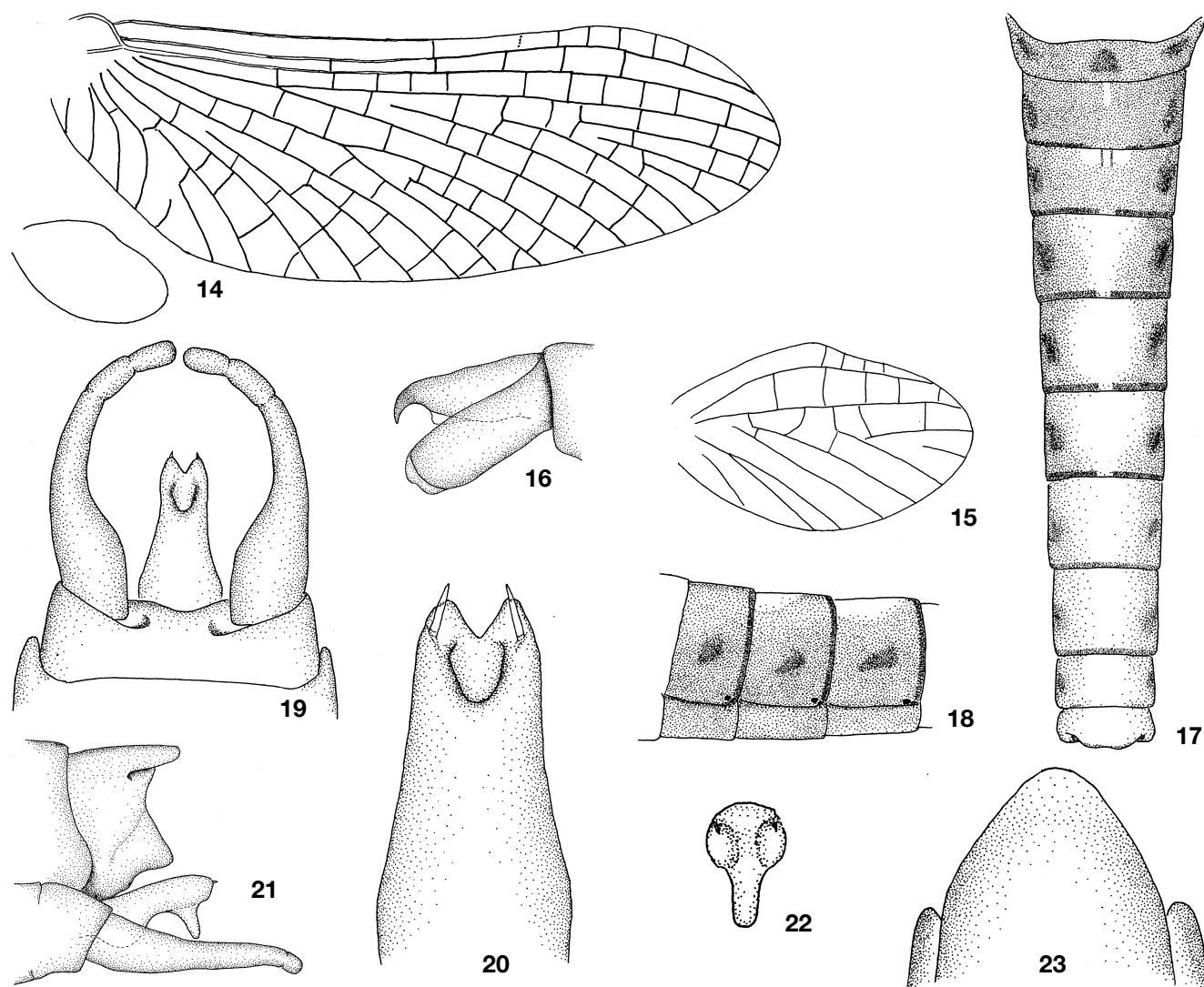
Figures 14–34

Type material. Holotype: male imago (reared from nymph), Coobanrbora Spring, Kakadu National Park, Northern Territory, 12°24'S 132°40'E, 21 Aug 1999, J. Dean (NMV T-18491).

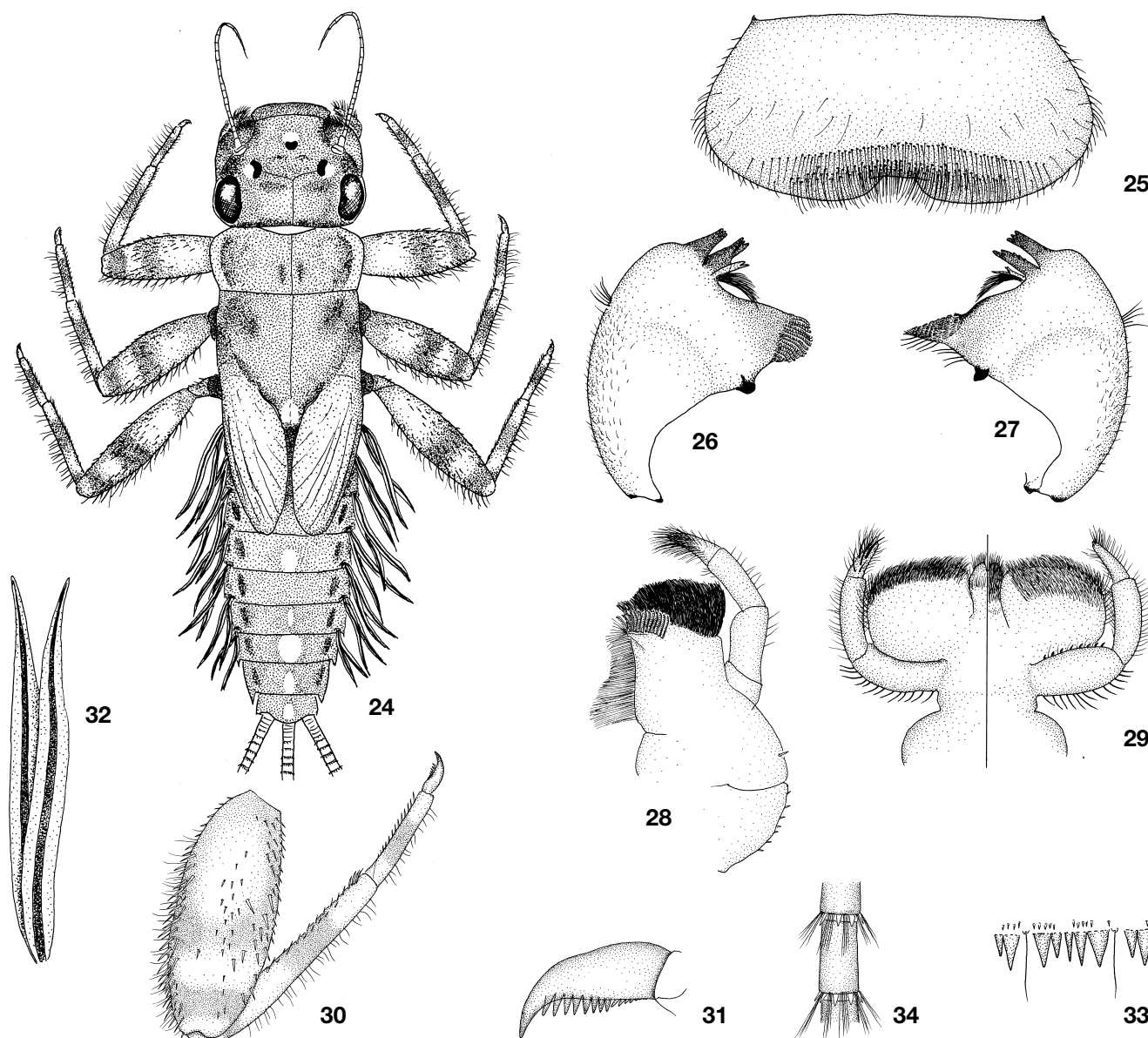
Paratype: male imago (reared from nymph; wings, legs and nymphal exuvia mounted on slides), collected with holotype (NMV T-18492).

Other material examined. **Northern Territory.** 10N, Coobanrbora Spring, Kakadu National Park, Northern Territory, 12°24'S 132°40'E, 21 Aug 1999, J. Dean; 1MI, 17N, Koolpin Gorge, Kakadu National Park, 13°30'S 132°35'E, 18 Aug 1999, J. Dean; 1MI, 1FSI, 11N, Walker Creek, Litchfield National Park, 13°05'S 130°42'E, 31 Aug 1999, J. Dean; 14N, Florence Falls, Litchfield National Park, 13°06'S 130°47'E, 31 Aug 1999, J. Dean; 1FSI, 21N, Tolmer Falls, Litchfield

National Park, 13°12'S 130°43'E, 31 Aug 1999, J. Dean; 2MI, 20N, Mann River, Arnhem Land, 12°22'S 134°08'E, 26 Aug 1999, J. Dean; 6N, Liverpool River, Arnhem Land, 12°21'S 134°07'E, 26 Aug 1999, J. Dean; 1FI, 22N, Manggabor Creek, Arnhem Land, 12°17'S 134°05'E, 26 Aug 1999, J. Dean; 1FI, 56N, Kambolgie Creek, Kakadu National Park, 13°31'S 132°23'E, 16–19 Aug 1999, J. Dean; 3N, Kambolgie Creek, Kakadu National Park, 13°31'S 132°23'E, 1 May 1990, D. Cartwright; 13N, Barramundie Gorge, Kakadu National Park, 13°19'S 132°26'E, 22 Aug 1999, J. Dean; 1FI, 3N, Gerowie Creek, 7 km N of Bukbukluk Lookout, Kakadu Highway, 13°26'S 132°16'E, 19 Aug 1999, J. Dean; 32N, creek 2 km N of Bukbukluk Lookout, Kakadu Highway, 13°29'S 132°15'E, 19 Aug 1999, J. Dean; 1FI, 1N, South Alligator River, Koolpin Crossing, 13°32'S 132°33'E, 18 Aug 1999, J. Dean; 13N, South Alligator River, Gunlom Road Crossing, 13°30'S 132°29'E, 19 Aug 1999, J. Dean; 2N, South Alligator River, d/s Gimbat, 13°35'S 132°36'E, 1 May 1990, D. Cartwright; 1MI, 1MSI, 1FSI, Jim Jim Creek, 3 km d/s Falls, 1 Sep 1979, J. Blyth; 2N, Magela



Figs 14–23 *Manggabora wapitja* Male imago: 14, forewing and outline of hind-wing; 15, hind-wing enlarged; 16, foretarsal claws; 17, abdominal terga, dorsal; 18, abdominal segments 3–5, lateral; 19, genitalia, ventral; 20, penes lobes, ventral; 21, genitalia, lateral; 22, penes lobes, apical. Female imago: 23, sternum, abdominal segment IX.



Figs 24–34 *Manggabora wapitja* Nymph: 24, nymph; 25, labrum; 26, left mandible, dorsal; 27, right mandible, dorsal; 28, left maxilla, ventral; 29, labium, dorsal (left of midline) and ventral (right of midline); 30, foreleg; 31, foretarsal claw; 32, gill, abdominal segment IV; 33, spines, posterior margin of abdominal tergum V; 34, terminal filament, midlength.

Creek, u/s Bowerbird Billabong, 3 May 1990, D. Cartwright; 16N, Radon Springs, Kakadu National Park, 12°45'S 132°55'E, 23 Apr. 1990, D. Cartwright; 4N, Gulungul Creek, Radon Springs, Kakadu National Park, 12°45'S 132°55'E, 13 Aug 1999, J. Dean; 25N, Baroalba Creek, Kubarra Pools, 12°49'S 132°52'E, 28 Apr 1990, D. Cartwright; 11N, Baroalba Creek, Gubarra Pools, 12°49'S 132°52'E, 14 Aug 1999, J. Dean; 6N, Harris Creek, u/s South Alligator River, 1 May 1990, D. Cartwright. **Western Australia.** 27N, King Edward River, Mitchell River Road, 25 Sep 1995, L. Metzeling.

Description. Imago. Length of male: body 4.7–5.0 mm, forewing 5.1–5.2 mm; Length of female: body 4.1–5.9 mm, forewing 4.9–6.3 mm. Head predominantly medium brown; antennae pale yellow; ocelli white, black at base; male eyes

with upper lobes pale orange-brown, in contact dorsally, lower lobes grey. Thorax with meso- and metascutum golden-yellow; lateral surfaces golden with some patches of medium brown. Forelegs with femora reddish-brown, tibiae pale yellow with apex medium brown, tarsi pale yellow; middle and hind legs uniformly pale yellow; forelegs of male with ratios of segment lengths 0.69–0.70; 1.00 (1.74–1.75 mm); 0.05; 0.27–0.31; 0.28; 0.18–0.21; 0.10–0.11; tarsal claws dissimilar, one claw with apical hook and ventral flange and the other expanded and pad-like, without terminal hook (Fig. 16). Forewings hyaline except for pterostigma, which is white and opaque; veins predominantly unpigmented (Fig. 14). Male abdomen reddish, dorsally pale tending to hyaline; each segment with narrow band of

medium brown along posterior margin and pair of weakly developed brown lateral markings (Figs 17, 18); abdominal sterna pale, tending to hyaline. Penes lobes (Figs 19–22) narrow, fused almost to apex, each lobe with a stout, retractable apical spine; subapically with a robust, medial projection on the ventral surface. Female abdominal colour pattern similar to male, although generally a little darker, reddish-brown; abdominal sternum 9 strongly projecting, without apical excision (Fig. 23). Subimago. Wings pale greyish-yellow, abdominal colour pattern similar to imago. Mature nymph. General colour yellow. Mouthparts as in Figs 25–29. Legs yellow, all segments banded; foretarsus with 10–15 ventral spine-like setae, relatively uniform in length; tarsal claws with ventral teeth (Figs 30, 31). Abdomen yellow, each segment with pair of brown lateral markings (Fig. 24); gills linear, lateral tracheae very weakly developed or absent (Fig. 32).

Etymology. The name *wapitja* is derived from the word for ‘digging stick’ in the Dätiwuy language of eastern Arnhem land (Ganambarr, 1999), and refers to the appearance of the male genitalia in lateral view.

Remarks. The genus is monotypic. Suter (1992) included this species in his keys as “Leptophlebiidae Genus A sp.1”, and Dean (1999) designated the nymph “Genus V sp.AV1”.

***Tillyardophlebia dostinei* sp. nov.**

Figures 35–47

Type material. Holotype: male imago (reared from nymph), Rockhole Mine Creek, Kakadu National Park, Northern Territory, 13°30'S 132°30'E, 24 Jun 1995, P. Dostine (NMV T-18493).

Paratypes: male imago (reared from nymph; wings, legs and nymphal exuvia mounted on slide, labelled specimen 01), Rockhole Mine Creek, Kakadu National Park, Northern Territory, 13°30'S 132°30'E, 24 Jun 1995, P. Dostine (NMV T-18494); male imago, 2 female imagos (all reared from nymphs), Rockhole Mine Creek, Kakadu National Park, Northern Territory, 13°30'S 132°30'E, 31 May 1995, P. Dostine (NMV T-18495–T-18497).

Other material examined. **Northern Territory.** 1MSI (reared from nymph), Rockhole Mine Creek, Kakadu National Park, Northern Territory, 13°30'S 132°30'E, 24 Jun 1995, P. Dostine; 3N, Rockhole Mine Ck, 2 May 1990, D. Cartwright.

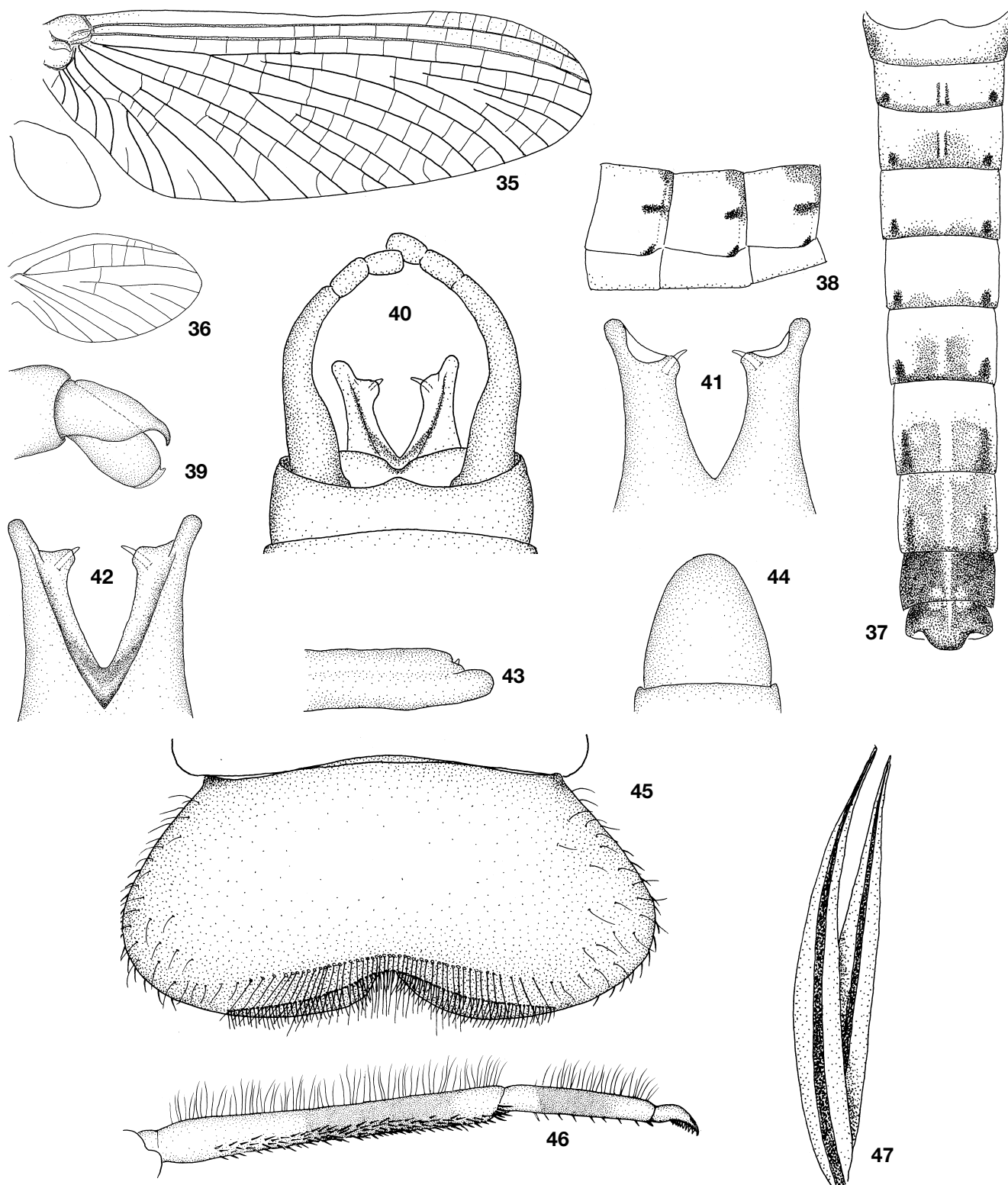
Description. Imago. Length of male: body 5.6–6.5 mm, forewing 6.0–6.6 mm; Length of female: body 5.5–5.6 mm, forewing 6.0–6.4 mm. Eyes of male with upper lobes brownish-pink, in contact dorsally, lower lobes black. Thorax orange-brown. Forewing with membrane hyaline (Fig. 35); costal and subcostal cells in apical third of wing translucent, whitish; length-width ratio 2.8–3.0; costal crossveins absent or weakly developed basal to the bulla, 10–15 distal to the bulla; MA forked at 0.37–0.39 wing length; MP₂ attached by crossvein to MP₁ at about 0.18 wing length; ICu₁ linked to CuA–CuP crossvein, ICu₂ and ICu₃ weakly diverging as wing margin approached. Hindwing 0.20–0.22 length of forewing; costal margin convex at about midlength, relatively straight basal and distal to midpoint (Fig. 36); vein Sc joining costal margin a little less than 0.9 wing length; hindwing with 3–5 costal crossveins and 5–6 subcostal crossveins, all weakly developed. Legs pale, not banded, but slightly darker brown at apex of

femur and tibia; tarsal claws dissimilar, one claw with an apical hook and without an opposing ventral flange, the other large, pad-like (Fig. 39); forelegs of male with ratios of segment lengths 0.72–0.73; 1.00 (2.4 mm); 0.07–0.08; 0.31–0.32; 0.29–0.30; 0.22; 0.08–0.09. Abdomen predominantly pale yellow, restricted dark brown markings on segments 1–6, more strongly developed markings on segments 7–9 (Figs 37, 38). Male genitalia with claspers three-segmented, narrowing gradually at about one-third length (Fig. 40); penes extending beyond narrowing of claspers, lobes moderately broad, widely separated in apical two-thirds and fused in basal third; each lobe with a stout, inwardly directed subapical spine and a ventral longitudinal ridge (Figs 41–43). Female ninth sternum with posterior margin entire, strongly convex, protruding beyond apex of segment 10 (Fig. 44). Mature nymph. Head prognathous. Mouthparts: Clypeus with lateral margins slightly diverging to anterior. Labrum clearly broader than clypeus, width about 2.4 times length along median line; 2 setal fringes close to anterior margin, each fringe extending across more than half width of labrum; anterior margin with broad central notch, the base of which is concealed beneath an overhanging canopy (Fig. 45). Mandibles with incisors slender. Maxillae with subapical row of about 25 pectinate setae. Legs with tibiae and tarsi relatively slender (Fig. 46); tibiae with ventral spine-like setae relatively dense right to apex; tarsi with 10 or fewer ventral spine-like setae, relatively uniform in length; tarsal claws with ventral teeth, progressively larger apically. Abdominal segments without setae on lateral margins, strongly developed posterolateral spines on segments 2–9. Gills present on abdominal segments 1–7, each gill narrowly lanceolate without lateral tracheae (Fig. 47).

Etymology. The species is named for Peter Dostine, who collected the type material and associated nymphs with adults.

Remarks. This species was not included in the original keys to mayflies of the Alligator Rivers region presented by Suter (1992). The nymph has previously been designated *Tillyardophlebia* sp.AV8 (Dean, 1999), albeit with a comment that the species should perhaps be placed in a new genus. While we have opted to retain the species in *Tillyardophlebia* pending completion of further study of two undescribed Queensland species and a detailed phylogenetic analysis, we are of the opinion that these three northern Australia species will eventually be transferred to a new genus. The nymphs of the species from northern and southern Australia are very similar, with no obvious characters to justify generic separation. In the imagos, however, there are clear differences in the structure of the male genitalia. The species from south-eastern Australia form a monophyletic group with long, narrow and widely separated penes lobes, each lobe bearing a large curved ventral spine (*Tillyardophlebia* sensu stricto). Species from northern Australia have more robust penes lobes, which are fused either in the basal third or along most of their length, and each lobe has a single subapical spine.

Although confirmed material of this species has only been collected from the type locality, it is probably more widely distributed. We have examined nymphs from Manning Gorge in north-western Australia which we believe are conspecific.



Figs 35–47 *Tillyardophlebia dostinei* Male imago: 35, forewing and outline of hind-wing; 36, hind-wing enlarged; 37, abdominal terga, dorsal; 38, abdominal segments 4–6, lateral; 39, foretarsal claws; 40, genitalia, ventral; 41, penes lobes, dorsal; 42, penes lobes, ventral; 43, penes lobes, lateral. Female imago: 44, sternum, abdominal segment IX. Nymph: 45, labrum; 46, foretibia and foretarsus; 47, gill, abdominal segment IV

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