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Gunther Theischinger orcid.org/0000-0002-5207-2626
Zacariah D. Billingham orcid.org/0000-0002-6163-9073
Ivor Growns orcid.org/0000-0002-8638-0045

Ozeoura—a New Genus of Chioneinae (Insecta: Diptera: Tipuloidea: Limoniidae) from Australia

Gunther Theischinger[1,2]*, Zacariah D. Billingham[3,4] and Ivor Growns[5]

[1] Australian Museum Research Institute, Australian Museum,
1 William Street, Sydney NSW 2010, Australia

[2] Water Science, Office of Environment and Heritage, NSW Department of Planning and Environment,
PO Box 29, Lidcombe NSW 1825, Australia

[3] Water Sciences, Natural Resources and Heritage,
GHD, 180 Lonsdale Street, Melbourne Vic. 3000, Australia

[4] Department of Ecology, Environment and Evolution,
La Trobe University, Bundoora Vic. 3086, Australia

[5] School of Environmental and Rural Science,
University of New England NSW 2351, Australia

theischingergunther@gmail.com

Abstract. *Ozeoura* g. nov. (subfamily Chioneinae, family Limoniidae) is established for nine Australian species, four previously known species and five newly described here: *Ozeoura billeang* sp. nov., *O. bonelya* sp. nov., *O. lottheggi* sp. nov. and *O. narahdarn* sp. nov., all from tropical Queensland, and *O. dingo* sp. nov. from northeastern New South Wales. The taxonomy of *Ozeoura* is discussed, a key for separating males is presented and the larval and pupal stages are described and figured.

Keywords. *Ozeoura*; new genus; Diptera; Tipuloidea; Limoniidae; freshwater ecosystem.

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This paper proposes a new genus, *Ozeoura* g. nov., to receive four species of Australian chioneine limoniid crane flies, previously included in *Baeoura* Alexander, 1924 along with an additional five species described as new. *Ozeoura* is endemic to Australia, primarily occurring in the east along the Great Dividing Range, with a single species present in Tasmania (Fig. 1). They are rather rarely encountered, generally in close proximity to waterways in forested areas (Figs 2, 3) of alpine and temperate and tropical rainforest environments.

Ozeoura (Fig. 4) is morphologically similar to the New World genus *Cryptolabis* Osten Sacken, 1860 and to *Baeoura*, a genus virtually restricted to the Old World. Together the three genera likely constitute a closely related

* author for correspondence

group, with *Baeoura* and *Cryptolabis* far more specious than *Ozeoura*, containing 71 and 59 species respectively (Oosterbroek, 2018). Wing venation and male genital structure are useful morphological characters for separating the three genera in this group, and while the species included in *Baeoura* and *Ozeoura* are rather uniform in wing venational and male genital characters, *Cryptolabis*, even *Cryptolabis (Cryptolabis)*, in its present concept, is very variable in these features and may be polyphyletic.

Owing to the similarities within this group of genera and the apparent polyphyly of *Cryptolabis* the historic placement of the four described Australian species of *Ozeoura* has been tenuous. Alexander (1926, 1931) first assigned three species to *Cryptolabis (C. tonnoiri, C. tasmanica* and *C. convoluta)*, he then later moved these three species to *Baeoura* (Alexander, 1978) along with a fourth species (*B. hemmingseni*) which was described as new. Theischinger (1996) followed Alexander (1978), illustrating as *Baeoura* what is here considered to be *Ozeoura*, citing the number of Australian *Baeoura* species as four and not including *Cryptolabis* in the key to the Limoniinae of Australia.

Through detailed examination of Australian material, preliminarily identified as belonging in *Baeoura*, and by examining specimens of the type species of *Baeoura*, *Cryptolabis (Cryptolabis)* and *Cryptolabis (Procryptolabis)* (these being *Baeoura nigrolateralis* Alexander, 1920, *Cryptolabis (Cryptolabis) paradoxa* Osten Sacken, 1860 and *Cryptolabis (Procryptolabis) argentinensis* Alexander, 1923), the present study has determined that all Australian species examined represent, based on wing venation and male genital features, a homogeneous unit indicating a monophyly, suggesting that the previous assignment of Australian material to *Baeoura* or *Cryptolabis* was problematic and highlighting the need for a new genus to accommodate the Australian species.

This paper therefore establishes *Ozeoura* to receive not only the four species described by Alexander but also an additional five species identified and described as new. It also provides a key for the identification of male *Ozeoura* specimens and gives the first detailed illustrations of the male genitalia of *Baeoura nigrolateralis* and *Cryptolabis (Cryptolabis) paradoxa.* Adult and immature stages of the new genus are associated using morphology and molecular techniques and the larvae and pupae are described and figured.

1

2

3

Figures 1–3. *(1)* Occurrence records of Australian *Ozeoura* (then *Baeoura*), as of December 2017. *(2, 3)* Habitats of *Ozeoura* spp.; *(2) O. convoluta*, Big River, Glen Valley Victoria; *(3) O. tonnoiri*, Bakers Creek, Reefton Victoria.

Materials and methods

Pinned material and material in 70% ethanol from institutional and private collections were studied. More recently adult specimens were collected by sweeping a hand net through vegetation or by light trapping with an ultraviolet black light. Aquatic larval and pupal specimens were collected from waterway substrates in sections of moderate to high flow velocity using the rapid bioassessment sampling techniques recommended by the Environmental Protection Authority Victoria (EPA, 2003). Following collection all specimens were preserved in 100% ethanol. As a result of different methods of preservation, the coloration of specimens may have changed in different ways from the natural state. Geospatial coordinates are derived from a GPS using map datum WGS84 (precision ±50 m). Coordinates for collections made earlier than 1997 are derived from maps, or are inferred, and have ±1 km precision.

The type material of the new species is lodged in in the Australian Museum (AM) in Sydney and in the Australian National Insect Collection (ANIC) in Canberra. Other material studied comes from the Natural History Museum (NHM) in London, the Alexander Collection in the Smithsonian Institution in Washington D.C. (USNM), the Canadian National Collection, Agriculture and Agri-Food Canada in Ottawa, from the Museum of Victoria (MV) and from the research collection of the second author (ZB).

Tissue for molecular analysis was dissected from the coxal and pleural segments in adults and the mid-abdominal segments in larvae. Tissues were sent to the Canadian Centre for DNA Barcoding (CCDB) at the University of Guelph for DNA extraction, amplification and sequencing using standard in-house protocols (available via *ibolproject.org*). Sequences were generated for the mitochondrial cytochrome c oxidase I (CO1) gene using universal forward and reverse primers (C_LepFolF and C_LepFolR respectively) developed by Folmer *et al*. (1994). CO1 sequence data was aligned using the Geneious algorithm in Geneious 9.0.5 (Kearse *et al*., 2012), The Geneious platform was also used to construct a phylogenetic tree using the Tamura-Nei distance model with 1,000 bootstrap replicates and to produce p-distance values. Sequences generated from this study have been deposited on BOLD and GenBank, BINs and Accession Numbers are detailed in Table 1.

For previously described species in the Systematics section (p. 450), some possibly diagnostic venational and hypopygial characters, if available in the original descriptions and illustrations, are presented with an updated discussion. The new species are described, illustrated and discussed in detail. Differential diagnoses are given for all species. In order to most reliably, clearly and sometimes in slightly different aspects, show structural details, photos and line drawings (camera lucida) are used. Australian Aboriginal words for naming species were sourced from Reed & Reed (1965).

The illustrations of the male terminalia (hypopygium) and larval head capsule are from specimens cleared in KOH and displayed in glycerol. Descriptive terminology follows Alexander & Byers (1981), McAlpine (1981) and Brown *et al*. (2009). The wing venational terms given in brackets refer to the system used in the recent *Manual of Afrotropical Diptera*, based on Wootton & Ennos (1989) and Saigusa (2006).

A strongly sclerotized posteromedian structure, very variable in shape, between the gonocoxites/gonostyli and always associated with the tip of the aedeagus is considered as an aedeagal guide in descriptions and key of this paper. It was, for more than 50 years, variously termed "phallosomic structure", "may be tergite", "possible tergal structure" and "apparent tergite" by Alexander (1926–1978).

Abbreviations as used in figures. *a* or *ae*—aedeagus; *c*—cercus or cerci; *e*—epandrium; *gcx*—gonocoxite; *gst*—gonostylus; *ht*—hypoproct; *od*—outer gonostylus; *t9*—tergite 9; *bt CuA1* (= *m-cu*)—basal transverse section of vein CuA1.

Table 1. BOLD BINs and GenBank Accession Numbers for specimen sequences used in this study.

species	BIN	accession number
Amphineurus (Amphineurus) kandu	ACM3216	MG895839
Erioptera (Erioptera) lucerna	ACM3486	MG895840
Gonomyia (Leiponeura) skusei	ABW4448	MG895833
Molophilus (Molophilus) fergusonianus	ABA7041	MG895832
Ozeoura sp larva	ABX1154	MG895834
Ozeoura sp larva	ABX1154	MG895842
Ozeoura sp larva	ABX1154	MG895837
Ozeoura sp larva	ABX1154	MG895841
Ozeoura sp larva	ABX1154	MG895838
Ozeoura sp larva	ABX1152	MG895836
Ozeoura sp larva	ABX1152	MG895835
Ozeoura sp adult	ABX1152	MG895843

Systematics

Adults

Ozeoura g. nov.

Theischinger & Billingham

Figs 4, 5, 9, 15–50

Type species: *Ozeoura billeang* Theischinger & Billingham sp. nov.

Diagnosis. Tiny (wing 3.5–5.0 mm) limoniid tipuloids. Head with rostrum short, antenna 16-segmented. Thorax short and narrow, with V-shaped thoracic suture developed; no tibial spurs, claws simple. Wings of normal size. Wing venation, with the terms in brackets referring to the system used in the recent Afrotropical Manual, based on Wootton & Ennos (1989) and Saigusa (2006) (Fig. 5): Rs markedly longer than R2+3+4, originating at, to slightly beyond, midway between levels of humeral crossvein and R2 (well before level of Sc2), and running in direct and straight alignment with vein R5; R2+3 almost straight, markedly shorter than R2+3+4 which is distinctly curved and also markedly longer than r-m; dm open; CuA2 (CuA), A1 (CuP) and A2 (A1) almost straight. Male terminalia (Fig. 9) with at least the phallosomic parts withdrawn into the body; base of gonocoxites not covered by epandrium, cerci and hypoproct jutting out freely (8 of 9 species) or covered (1 of 9 species); gonocoxites very short (8 of 9 species) or moderately long (1 of 9 species), ventrally completely fused only in 1 of 9 species; one pair of gonostyli, simple to complex, terminal; aedeagal guide prominent between gonostyli and strongly sclerotized; aedeagus strongly convoluted. Female terminalia: ovipositor with valves short and fleshy, very small and blunt.

Etymology. The generic name refers to the known distribution of the new genus which is considered to be possibly restricted to Australia (Oz) and the morphologic similarity to *Baeoura*. Gender feminine.

Discussion. *Ozeoura* g. nov. is similar to both *Baeoura* and *Cryptolabis*. It can be distinguished from the type species of both these genera by having Rs in direct and straight alignment with vein R5 (Fig. 5) versus Rs ending in cell R4 (*Baeoura*, Fig. 6) or aligned with R5 at a distinct angle (*Cryptolabis*, Figs 7, 8). Rs is long (originating well before Sc2), and CuA2 (CuA) is at the most evenly and widely curved (almost straight) in *Ozeoura* (Fig. 5) versus Rs short (originating well beyond level of Sc2) and CuA2 (CuA) distinctly bowed at bt CuA1 (m-cu) in *Cryptolabis (Cryptolabis) paradoxa* (Fig. 7) and *Cryptolabis (Procryptolabis) argentinensis* (similar to Fig. 8). *Ozeoura* has only one pair of terminal gonostyli (Fig. 9) versus subterminal gonostyli (Fig. 10) in *Baeoura nigrolateralis* and two pairs of gonostyli in *Cryptolabis (Procryptolabis)* (Fig. 14). *Ozeoura* generally has the base of the gonocoxites not covered by the epandrium (Fig. 9) versus covered in *Baeoura nigrolateralis* (Fig. 10), *Cryptolabis (Cryptolabis) paradoxa* (Figs 11–13) and *Cryptolabis (Procryptolabis)* (Alexander, 1929). This means cerci and hypoproct jut out freely in eight of nine species of *Ozeoura*. Only in *Ozeoura* the aedegus is strongly convoluted versus simply or at most sinuously curved. Future detailed studies may show that some of the numerous species placed in *Cryptolabis* belong elsewhere. Some may be found to be closer to *Ozeoura* than to *C. paradoxa* and even belong in *Ozeoura* which is at the present considered Australian versus the New World (mainly Neotropical) in *Cryptolabis* and almost exclusively Old-World in *Baeoura*.

Phylogenetic position of *Ozeoura* g. nov. Using larval and pupal morphology Oosterbroek & Theowald (1991) have *Baeoura, Cryptolabis*, *Cladura* Osten Sacken, 1860 and *Chionea* Dalman, 1816 as basal monophyletic group, next to the Chioneinae. They discuss the following characters:

Character 36: "Last larval segment constricted" is given as a synapomorphy for the Eriopterinae. Also found in *Ozeoura* (see under larva below: "terminal abdominal segment constricted at base, considerably narrower than the preceding segment").

Character 37: Pupal "sheaths of middle legs the shortest" is given as a synapomorphy for the Eriopterinae. Also found in *Ozeoura* (see under pupa below: "fore and hind leg sheaths noticeably longer than the mid leg sheath").

Character 38: "Pupae without respiratory horns". Also in *Ozeoura* (see under pupa below: "mesothorax smooth and lacking respiratory horns").

Character 39: "Labral papilla". Also found in *Ozeoura* (see under larva below: "cylindrical papillae"). This places *Ozeoura* (as can be expected) in the *Baeoura-Chionea* clade.

Characters 40 ("Last larval segment not constricted"), 41 ("Spiracular lobes absent") and 48 ("Larvae with ventral creeping welts") place *Ozeoura* outside the *Cladura-Chionea* clade.

In the large phylogenetic study of Petersen *et al*. (2010) *Cladura* and *Chionea* are given as a well-resolved sister-group but *Baeoura* and *Cryptolabis* are not taken into account. Therefore, concerning the phylogenetic position of *Ozeoura*, Oosterbroek & Theowald (1991) is apparently the only reference paper.

Ozeoura convoluta (Alexander, 1931) comb. nov.

Figs 15–19, 39

Cryptolabis (Cryptolabis) convoluta Alexander, 1931: 29.
Baeoura convoluta (Alexander, 1931).–Alexander, 1978: 170.

Material examined. **New South Wales:** Holotype ♂: Australia, Brooklana, Eastern Dorrigo (AC); 2♂♂, Bimberamala (AM); 1♂, Upper Hastings River, Werrikimbi N.P., G. Theischinger (AM); 1♂, 2♀♀, Wilson River Res., 15 km NW Bellangry, 7-xii-1986, G. Theischinger (AM). **Victoria:** 7♂♂, 6♀♀, Cobungra River, Anglers Rest, 15-i-1982, A. Wells (AM); 1♂, same locality, 4-ii-1974, A. Neboiss (MV); 14♂♂, 10♀♀, Gibbo River-Morass Creek jn 1-ii-1974, A. Neboiss (MV); 1♂, 1♀, Wellington-Carey River jn, 15-ii-1977, A.A. Calder (ANIC). **Queensland:** 1♂, Freshwater Creek nr Cairns, 11-vii-1993, M. Ball (AM).

From the original description of *Cryptolabis convoluta* Alexander, 1931. "Venation: r-m before or close to the fork of Rs; m-cu nearly its own length beyond the fork of M" (Fig. 15). "Hypopygium: Basistyles short and stout. Dististyle fleshy, provided with long setae, those at the

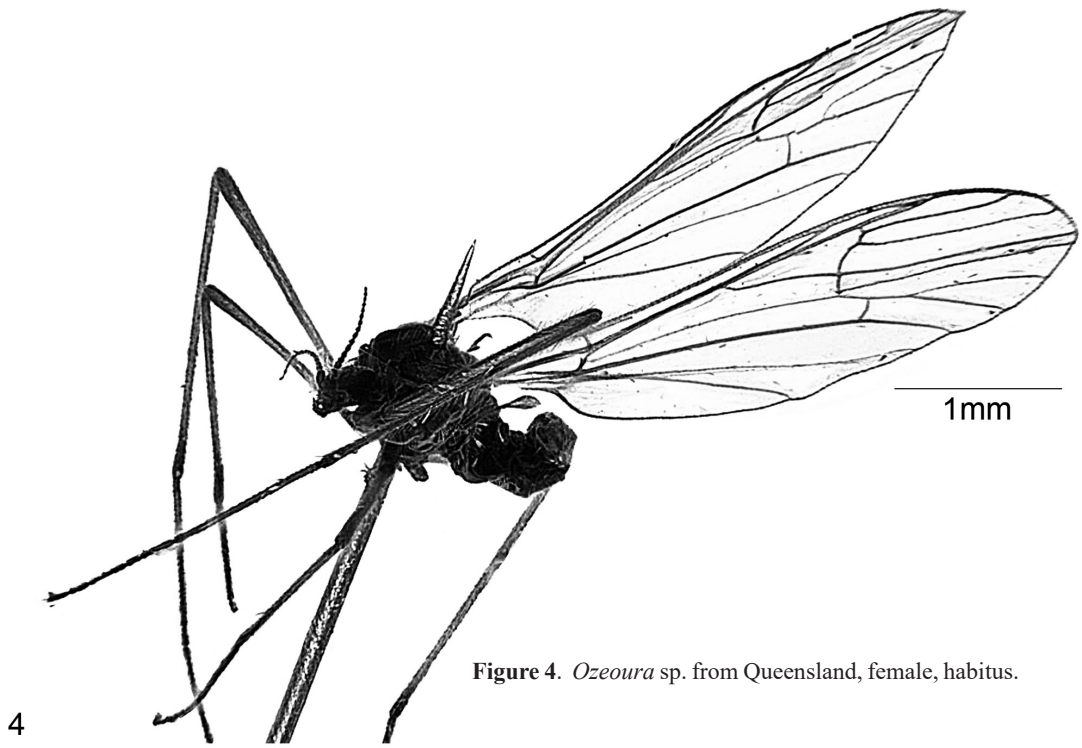


Figure 4. *Ozeoura* sp. from Queensland, female, habitus.

apex more spinous, with one or two similar stout setae on the lateral face. Aedeagus elongate, convoluted, beyond the base directed cephalad, thence bent on itself and directed caudad, narrowed apically. Phallosomic structure massive, the posterior portion microscopically roughened, the caudal margin with a broad V-shaped notch" (Figs 16, 18, 19).

Discussion. Males of *Ozeoura convoluta*, *O. hemmingseni* and *O. tasmanica* share a massive square aedeagal guide which is bilobed in *O. convoluta* and *O. hemmingseni* only. Whereas the tropical *O. hemmingseni* has differentiated gonostyli, they are simple in the more southeastern species *O. convoluta*, *O. tasmanica* and *O. tonnoiri,* the only species with the aedeagal guide spine-like. The characters most useful for the identification of male *O. convoluta* are the massive bilobed aedeagal guide together with very bulky hairy simple gonostyli. *Ozeoura convoluta,* ranging from tropical northeastern Queensland to Victoria, is apparently the most widely distributed species of the genus.

Ozeoura hemmingseni (Alexander, 1978) comb. nov.

Figs 20–22, 40, 44

Baeoura hemmingseni Alexander, 1978: 168.

Material examined. Holotype ♂: Australia, Atherton (AC); (slide of wing, see Fig. 20); parts of holotype supposedly deposited in ANIC were not found; 1 paratype ♂ (slide of terminalia, see Fig. 22).

From the original description of *Baeoura hemmingseni* Alexander, 1978. Venation: "Sc1 relatively short, nearly one-half Rs; R2+3+4 suberect, R5 in direct alignment with Rs; vein 2nd A long" (Fig. 20). "Hypopygium with the apparent tergite, t, a subquadrate yellow structure, posterior margin bilobed, with shallow median emargination; surface of plate with abundant short erect setae. Dististyle, d, distinctive (shown in two aspects in figure); a simple structure, basal two-thirds more expanded, bearing a short-clavate dusky more basal lobe provided with scattered erect slender setae and a paler subapical more slender lobe with six long stout yellow setae; apical third of style narrowed into a long straight darkened rod, apex obtuse, without setae. Phallosome, p, about as shown, narrowed outwardly, the enclosed darkened aedeagus, a, short and stout, strongly coiled basally" (Figs 21, 22).

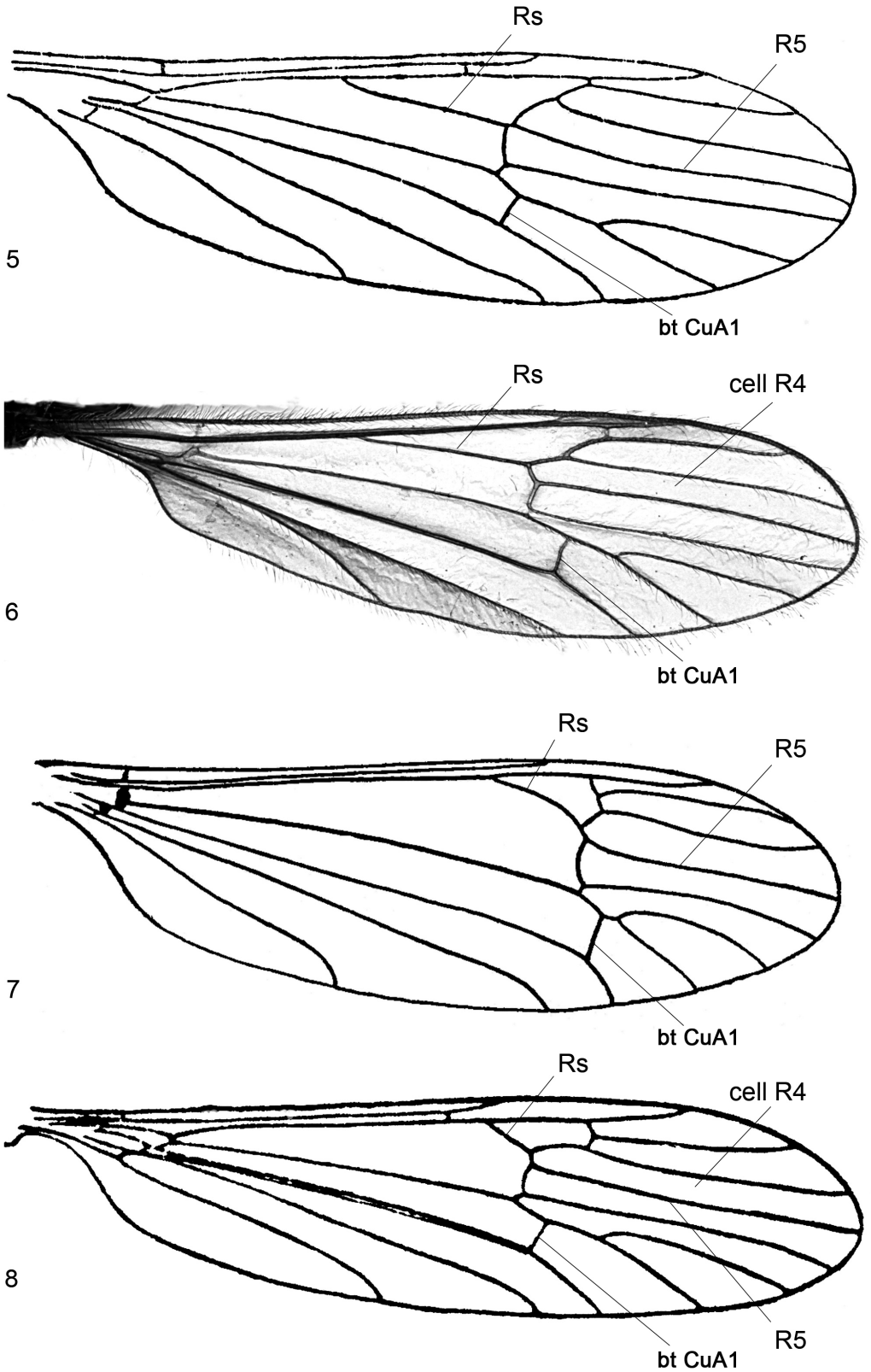
Discussion. Differences between males of *Ozeoura convoluta*, *O. hemmingseni, O. tasmanica* and *O. tonnoiri* are described above, under *O. convoluta.* The characters most useful for the identification of male *O. hemmingseni* are the massive bilobed aedeagal guide together with the elongate differentiated gonostyli. In the original description Alexander (1978) describes the gonostylus as bearing a short-clavate dusky more basal lobe, but two basal lobes can be detected in the paratype slide. *Ozeoura hemmingseni* is known only from the type locality, Atherton in tropical Queensland.

Ozeoura tasmanica (Alexander, 1926) comb. nov.

Figs 23, 24, 38

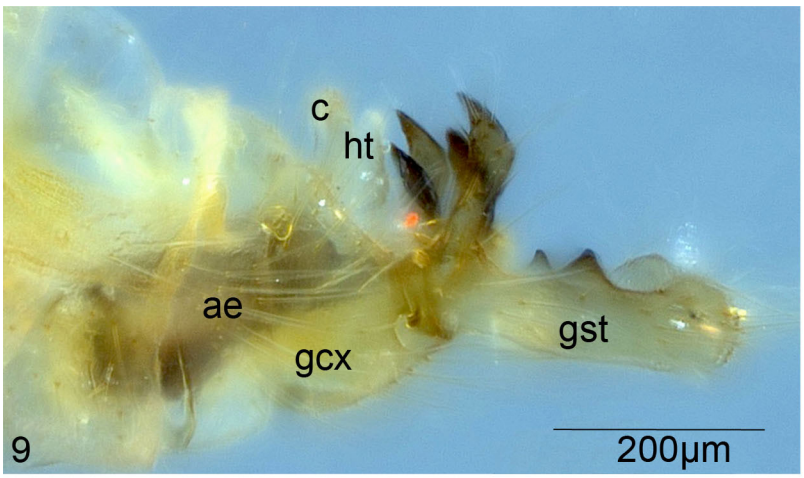
Cryptolabis tasmanica Alexander, 1926: 178.
Baeoura tasmanica (Alexander, 1926).–Alexander, 1978: 170.

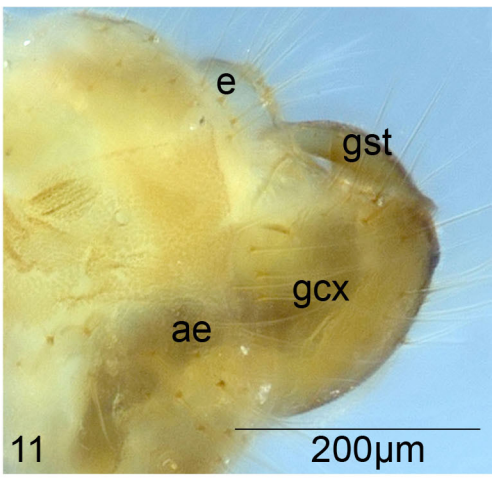
Material examined. **Tasmania:** Holotype ♂, Australia, Tasmania, Burnie, January 31, 1923, A. Tonnoir (ANIC); only thorax, 1 leg, 1 wing, base of abdomen and badly damaged slide on the pin left; 1♀ (paratype), same data as holotype (ANIC); 1♀ (allotype), Tasmania, Geeveston, December 7, 1922, A. Tonnoir (ANIC).

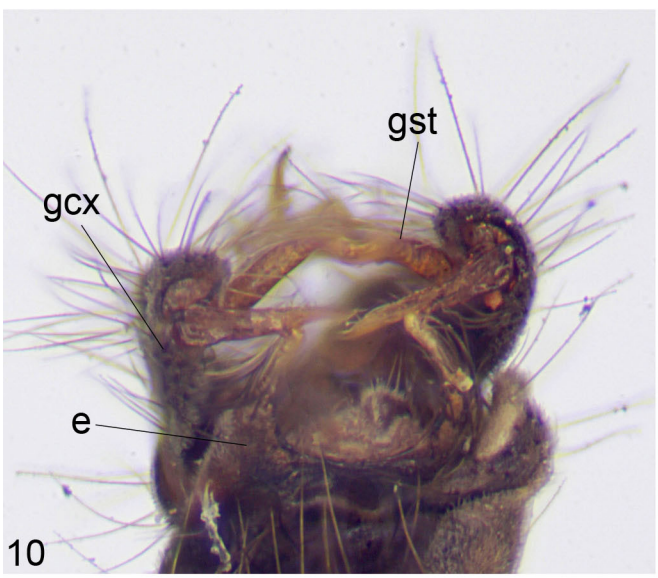


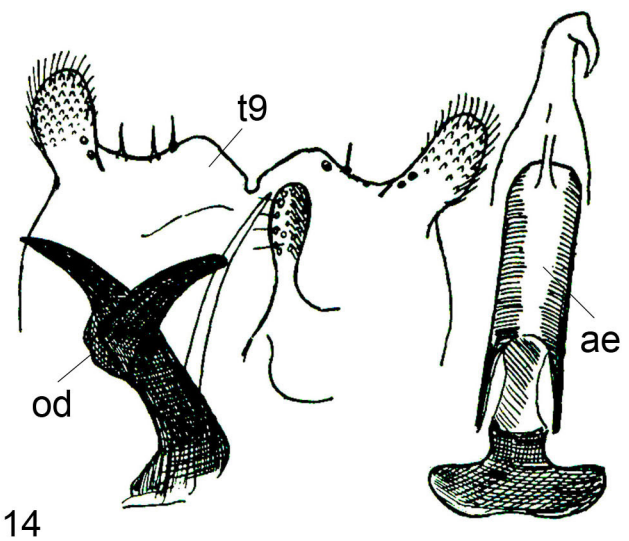
Figures 5–8. Wing venation. *(5) Ozeoura tasmanica*, modified from Alexander (1926); *(6) Baeoura nigrolateralis*, holotype; *(7) Cryptolabis (Cryptolabis) paradoxa,* modified from Alexander (1919); *(8) Cryptolabis (Procryptolabis) barilochensis,* modified from Alexander (1947).

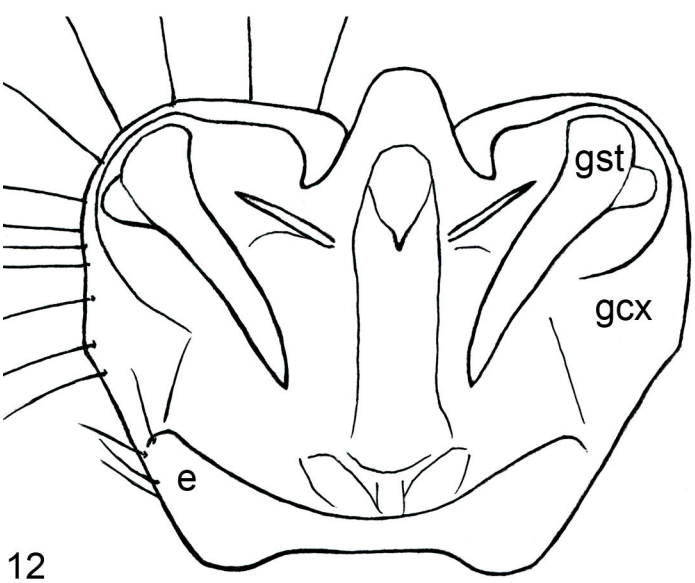
From the original description of *Cryptolabis tasmanica* Alexander, 1926. "Venation: m-cu less than its length beyond the fork of M" (Fig. 23). "Hypopygium: Dististyle (d) entirely fleshy, not at all produced into a spine, provided with conspicuous setae that are larger and more striking at the apex. Basistyle (b) very broad, the mesal apical angle with two dense groups of setae. The spinous structure in *tonnoiri* that was suggested as possibly being tergal is here represented by a massive, roughly quadrate structure (t?), the caudal margin truncated and microscopically serrulate. The phallosome (p) is less elongate, more bulbous at base, the apex not conspicuously blackened, the basal bars slender and widely divergent" (Fig. 24).

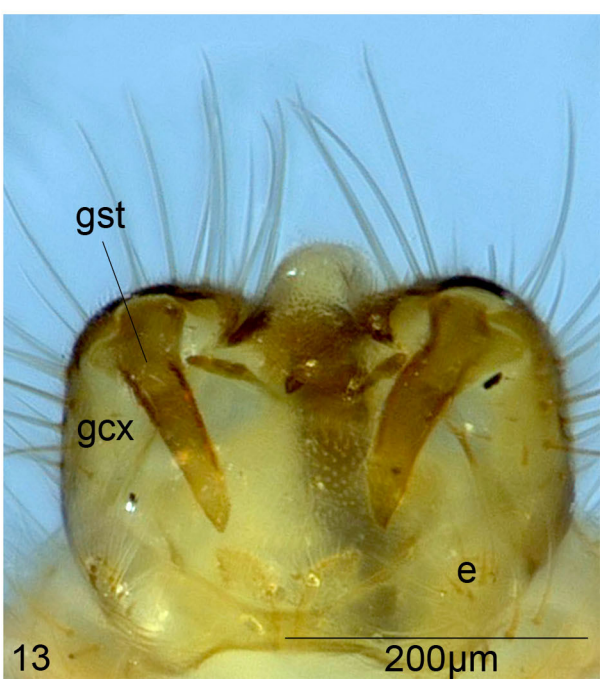




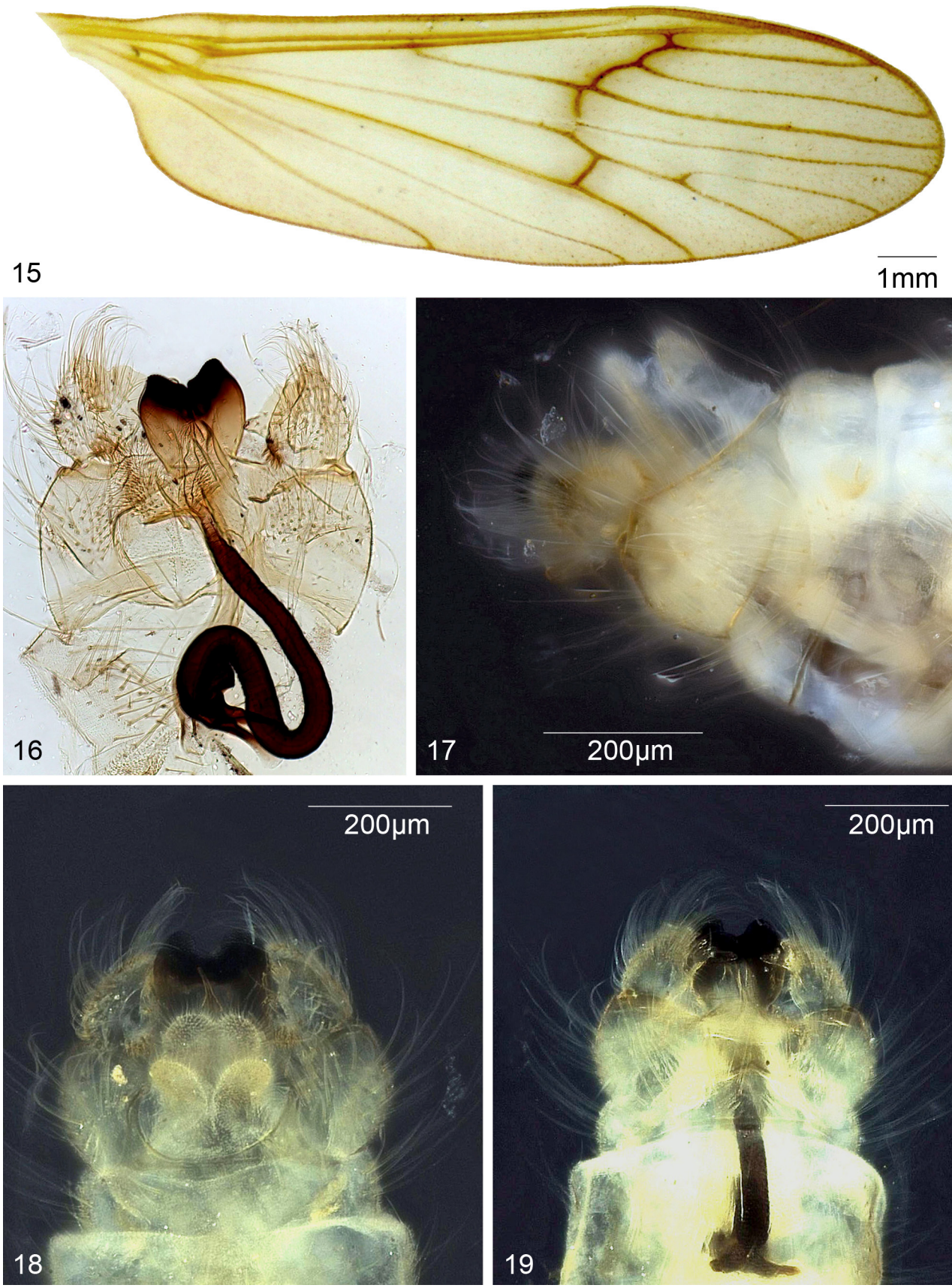




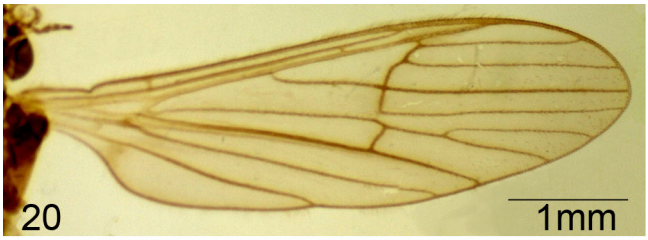


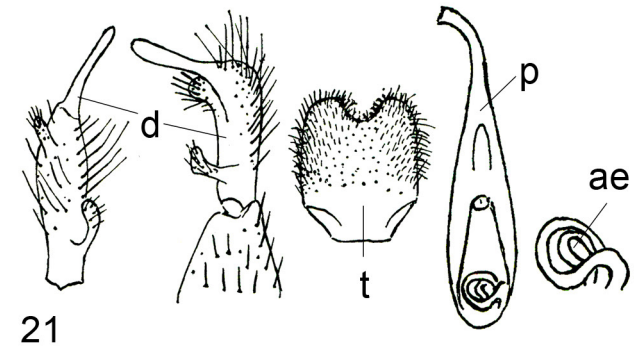


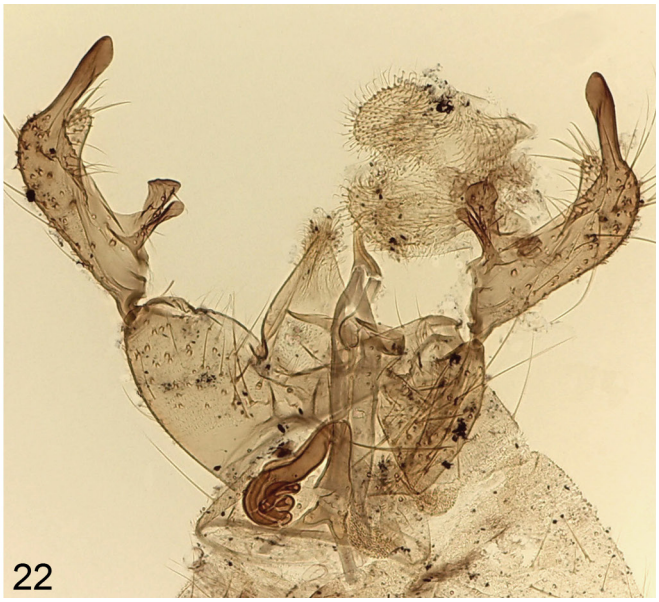
Figures 9–14. Male terminalia. *(9) Ozeoura billeang,* lateral; *(10) Baeoura nigrolateralis*, holotype, dorsal; *(11–13) Cryptolabis (Cryptolabis) paradoxa*: 11, lateral; 12, 13, dorsal; *(14) Cryptolabis (Procryptolabis) barilochensis,* modified from Alexander (1929). Abbreviations: *a or ae,* aedeagus; *c,* cercus; *e,* epandrium; *gcx,* gonocoxite; *gst*, gonostylus; *ht,* hypoproct; *od*, outer gonostylus; *t9,* tergite 9.



Figures 15–19. *Ozeoura convoluta* (Alexander), male. *(15)* paratype, wing; *(16–19)* terminalia: 16, paratype, slide; 17–19, from Queensland: 17, lateral; 18, dorsal; 19, ventral.

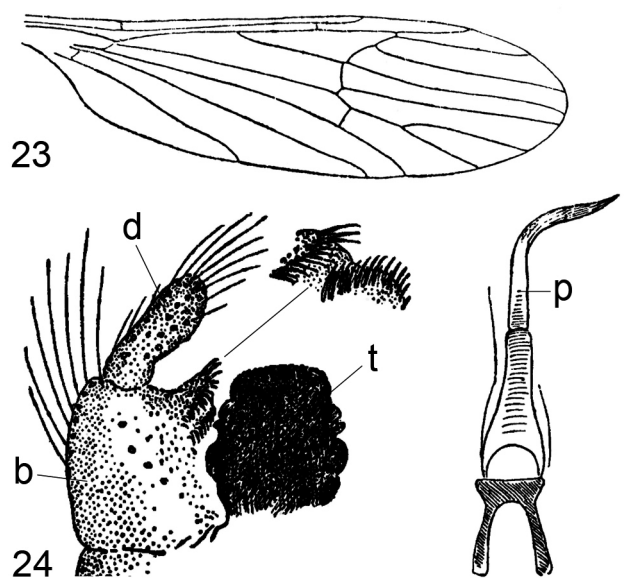






Figures 20–22. *Ozeoura hemmingseni* (Alexander), wing, hypopygial details. *(20)* holotype, slide; *(21)* modified from Alexander (1978); *(22)* paratype.

Discussion. Differences between males of *Ozeoura convoluta*, *O. hemmingseni, O. tasmanica* and *O. tonnoiri* are described above, under *O. convoluta.* The characters most useful for the identification of male *O. tasmanica* are the massive truncate aedeagal guide together with very simple, apically rounded gonostyli. *Ozeoura tasmanica* is apparently restricted to Tasmania.



Figures 23, 24. *Ozeoura tasmanica* (Alexander), modified from Alexander (1926). *(23)* wing; *(24)* terminalia details.

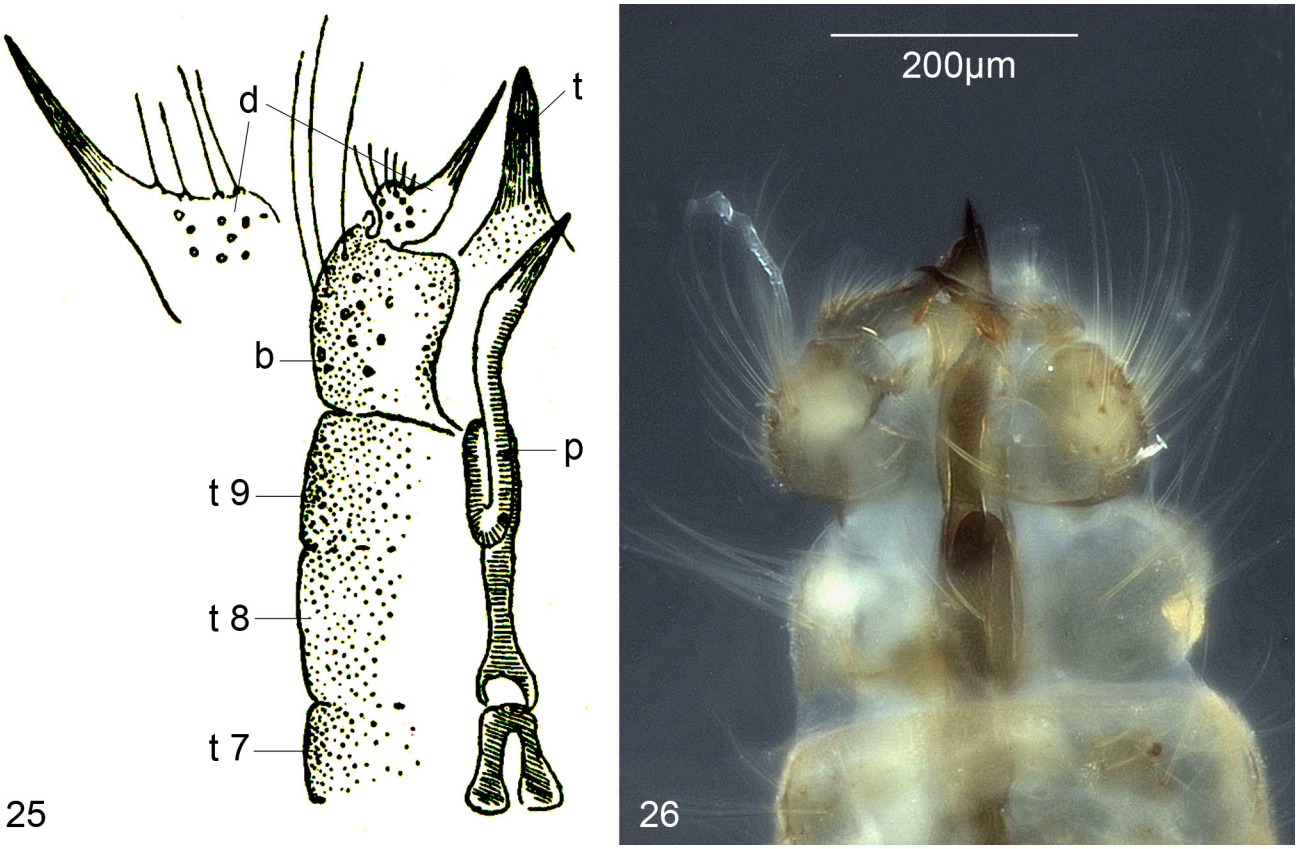
Ozeoura tonnoiri (Alexander, 1926) comb. nov.

Figs 25, 26, 45

Cryptolabis tonnoiri Alexander, 1926: 174.
Baeoura tonnoiri (Alexander, 1926).–Alexander, 1978: 170.

Material examined. **New South Wales:** Holotype ♂ in ANIC, Australia, New South Wales, Narara, November 3, 1921, A. Tonnoir; only head, thorax, 1 wing, base of abdomen and badly damaged slide on the pin left. 1♂, Cathedral Rock, 13-ii-1992, G. Theischinger (AM); 1♂, Dingo Tops Forest Park, 950 m, rainforest, malaise, 20-ii–23. iii.1993, G. Williams (AM). **Victoria:** 1♂, Lima East, along Moonee Creek off Monee Monee Creek Track (-36.85987° 145.93786°), 11-xi-2012, Z. Billingham; 2♂♂, Cabbage Tree Creek, along Arte River by Arte River Ralls (-37.57160° 148.76613°), 7-i-2015, Z. Billingham; 1♂, Powelltown, along Blackwood Creek off Reids Mill Walking Track (-37.86039° 145.76248°), 17-i-2016, Z. Billingham (ZB). 2♂♂, 1♀, Erinundra Plateau, Result Creek Falls, 900m, 6-xii-1994, B. Sinclair (AM). **ACT:** 1♂, 1♀, Blundell's, 21-i-1931, A.L. Tonnoir (ANIC).

From the original description of *Cryptolabis tonnoiri* Alexander, 1926. "Venation: Sc1 ending opposite the fork of R2+3, Sc2 opposite the fork of Rs, the latter in alignment with R4+5; m-cu near mid-length of M3+4, the petiole of cell M3 a little longer than m-cu". "Hypopygium with the basistyles stout, their bases nearly glabrous, the outer lateral portions with setae that become long and conspicuous near the outer lateral angles. Dististyle (d) fleshy at base, the apex produced into a slender, straight, black spine, the tip acute. From between the styli juts a powerful median spine, whose homologies cannot be stated, but which may represent the tergite (t?). The phallosome (p) is a stout, sinuous, or slightly convoluted blackened tube that extends back into the abdomen to the seventh segment, the apex terminating into a long acute spine, the base with two bars that are broadly expanded at tips, the notch between very deep and narrowly U-shaped" (Figs 25, 26).



Figures 25, 26. *Ozeoura tonnoiri* (Alexander), terminalia and details. *(25)* dorsal, modified from Alexander (1931); *(26)* ventral, specimen from Australian Capital Territory.

Discussion. Differences between males of *Ozeoura convoluta*, *O. hemmingseni, O. tasmanica* and *O. tonnoiri* are described above, under *O. convoluta.* The characters most useful for the identification of male *O. tonnoiri* are the powerful spine-tipped aedeagal guide and simple acutely pointed gonostyli. *Ozeoura tonnoiri* is known from a number of localities in eastern New South Wales, Australian Capital Territory and Victoria.

Ozeoura billeang sp. nov. Theischinger & Billingham

Figs 5, 9, 27, 28, 42

Holotype ♂, ANIC 040810, Australia, Queensland, -15.23° 145.12°, 7 km N of Hope Vale Mission (at light), 4-x-1980, D. H. Colless; specimen dry, pinned, terminalia preserved (glycerol) in microvial on the pin. **Paratypes**: 2♂♂ (ANIC 040811, 040812), same data as holotype.

Description ♂ (♀ unknown).

Head: including rostrum, palp, scape and pedicel pale to dark greyish brown, antennal flagellum slightly paler, side of vertex pale to medium yellow.

Thorax: Pronotum pale to dull yellow. Remainder pale to dark greyish brown; scutellum and mediotergite with or without ill-defined brownish yellow lateral patch, a small irregular ill-defined brownish yellow patch may be present at about the junction of the pleura. Legs with coxa, trochanter and femur pale to dark greyish yellow, tibia, tarsus and claws pale to dark greyish brown. Wing base and halter brownish yellow, remainder of wing suffused with pale greyish brown.

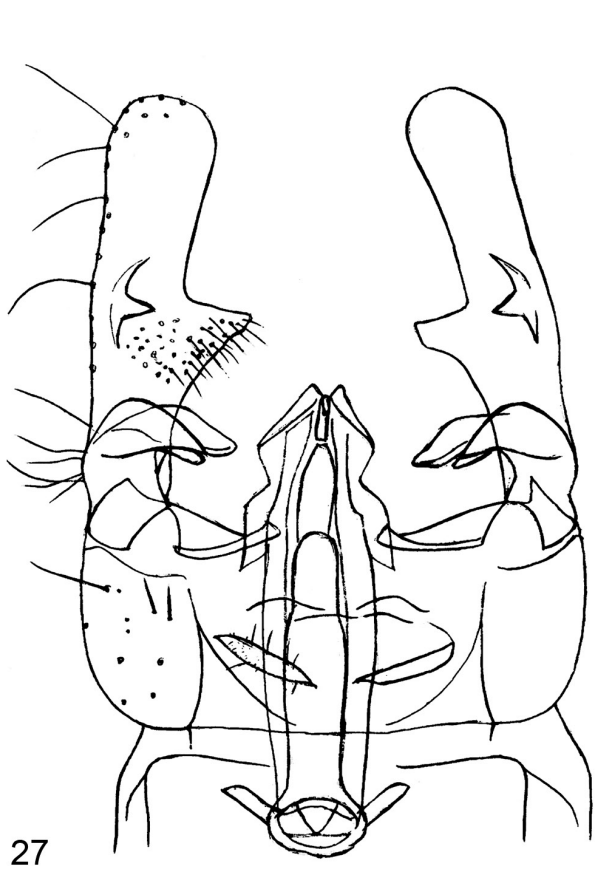
Abdomen: greyish brown.

Terminalia (Figs 9, 27, 28): Gonocoxites only about half as long as gonostyli; gonostyli with apex rounded and with mesal tooth and dorsal spine at about mid-length, and including a trifid basal dorsomesal structure that appears bifid from most aspects as the middle lobe is very small and between the two other lobes. Aedeagus with apical portion simple and very thin; aedeagal guide ending in two small subtriangular lobes; epandrium not covering base of gonocoxites.

Dimensions: Wing length 3.6–4.0 mm.

Etymology. Billeang is from one of Australia's Aboriginal languages and is a word for "bat"; a noun in apposition to the generic name alluding to small, crepuscular, flight.

Discussion. *Ozeoura billeang* sp. nov. is very similar to *O. bonelya* sp. nov., differing from it by the simply rounded apex of the gonostyli and the slightly bilobed rather parallel sided aedeagal guide versus apically bird-head-shaped gonostyli and a subtriangular aedeagal guide. In both of these species the gonostyli bear a mesal tooth and have a three lobed dorsomesal basal structure, whereas in *O. lottheggi*, the species similar to both of them the apically conical gonostyli do not bear a mesal tooth and have four basal lobes. Thus, the most useful diagnostic characters of *O. billeang* are the apically rounded gonostyli with mesal tooth, dorsal spine and trifid dorsomesal basal structure and the slightly bilobed rather parallel sided aedeagal guide. *Ozeoura billeang* is known only from the type locality, 7 km N of Hope Vale Mission, in tropical northeastern Queensland.



Figures 27, 28. *Ozeoura billeang* sp. nov., holotype male, terminalia, dorsal.

Ozeoura bonelya sp. nov.
Theischinger & Billingham

Figs 29, 30, 43

Holotype ♂, ANIC 040813, Australia, Queensland, The Boulders, Babinda, 10-v-1967, D. H. Colless; specimen dry, pinned, terminalia preserved (glycerol) in microvial on the pin.

Description ♂ (♀ unknown).

Head: including rostrum, palp, scape and pedicel dark brownish grey, antennal flagellum slightly paler, side of vertex greyish yellow to dull orange.

Thorax: Pronotum pale yellowish brown. Remainder with scutum dark greyish to blackish brown, scutellum, mediotergite, laterotergite and pleura greyish brown. Legs with coxae and trochanter yellowish brown, femur greyish yellow, tibia, tarsus and claws greyish brown. Wing base and halter greyish yellow, remainder of wing suffused with pale grey.

Abdomen: greyish brown.

Terminalia (Figs 29, 30): Gonocoxites only about half as long as gonostyli; gonostyli with tooth-shaped mesal lobe at about mid-length, with bird-head-shaped mesally directed apex and with a dorsomesal, trifid basal structure that appears bifid from most aspects as the middle lobe is very small and between the two other lobes; aedeagus with apical portion simple and very thin; aedeagal guide widely triangular; epandrium not covering base of gonocoxites.

Dimensions: Wing length 3.5 mm.

Etymology. Bonelya is from one of Australia's Aboriginal languages and is a word for "bat"; a noun in apposition to the generic name alluding to small, crepuscular, flight.

Discussion. The differences between male *Ozeoura bonelya* sp. nov., *O. billeang* sp. nov. and *O. lottheggi* sp. nov. are described above, under *O. billeang*. The most useful diagnostic characters of *O. bonelya* are the apically bird-head-shaped gonostyli with mesal tooth and trifid dorsomesal basal structure and the subtrianglar aedeagal guide. *Ozeoura bonelya* is known only from the type locality, The Boulders, Babinda, in tropical northeastern Queensland.

Ozeoura lottheggi sp. nov.
Theischinger & Billingham

Figs 31–33, 48

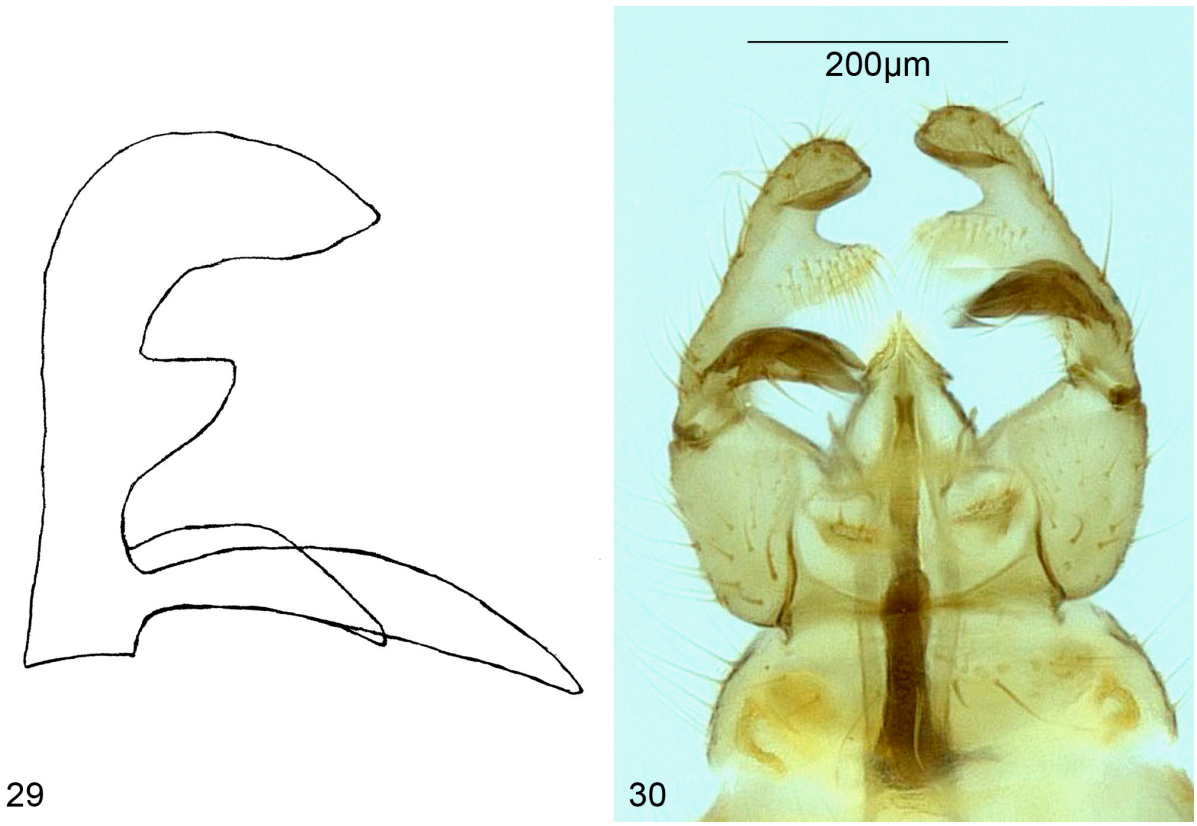
Holotype ♂, ANIC 040814, Australia, Queensland, -17.03° 145.12°, 3 km N by E of Mt Tip Tree, at light, 20-x-1980, D. H. Colless; specimen dry, pinned, terminalia preserved (glycerol) in microvial on the pin.

Description ♂ (♀ unknown).

Head: on top largely brownish yellow to medium brown; rostrum, palp and antenna medium to dark brown, side of vertex greyish yellow to dull orange.

Thorax: Pronotum greyish yellow. Remainder with scutum blackish brown, scutellum, mediotergite, laterotergite, pleura and meron greyish brown. Legs brownish yellow to yellowish brown, increasingly darker from coxa to tarsus. Wing base and halter brownish yellow, remainder of wing suffused with yellowish brown.

Abdomen: brown.



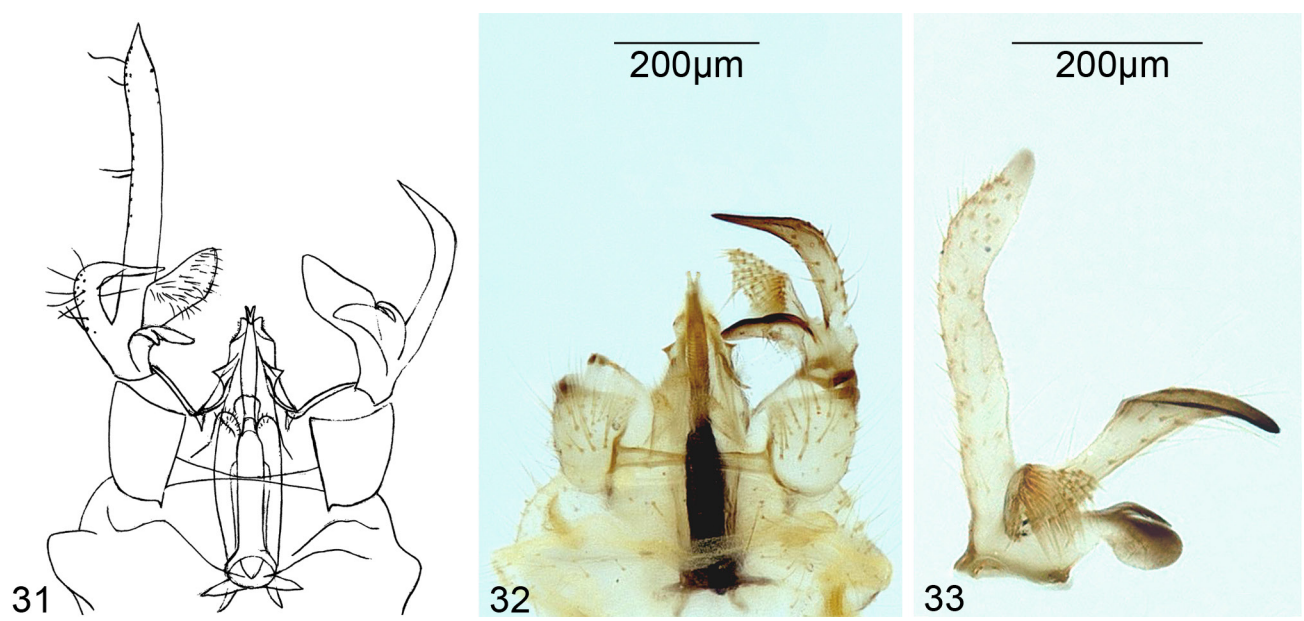
Figures 29, 30. *Ozeoura bonelya* sp. nov., holotype male, terminalia. *(29)* gonostyle; *(30)* dorsal.

Terminalia (Figs 31–33): Gonocoxites short; the straight slender pointed gonostyli at least twice as long as gonocoxites and with four basal lobes of various shapes and sizes; aedeagus with apical portion very thin and apparently bifid; aedeagal guide rather narrow with triangular lobe each side and ending in two small subtriangular lobes; epandrium not covering base of gonocoxites.

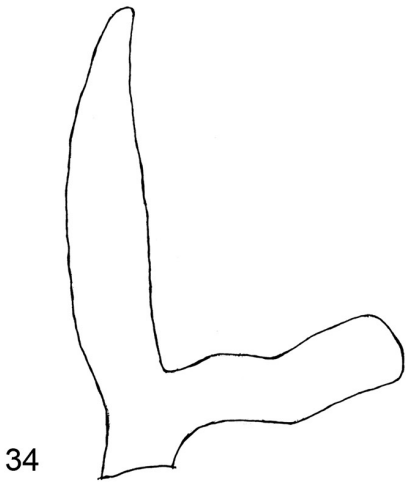
Dimensions: Wing length 4.8 mm.

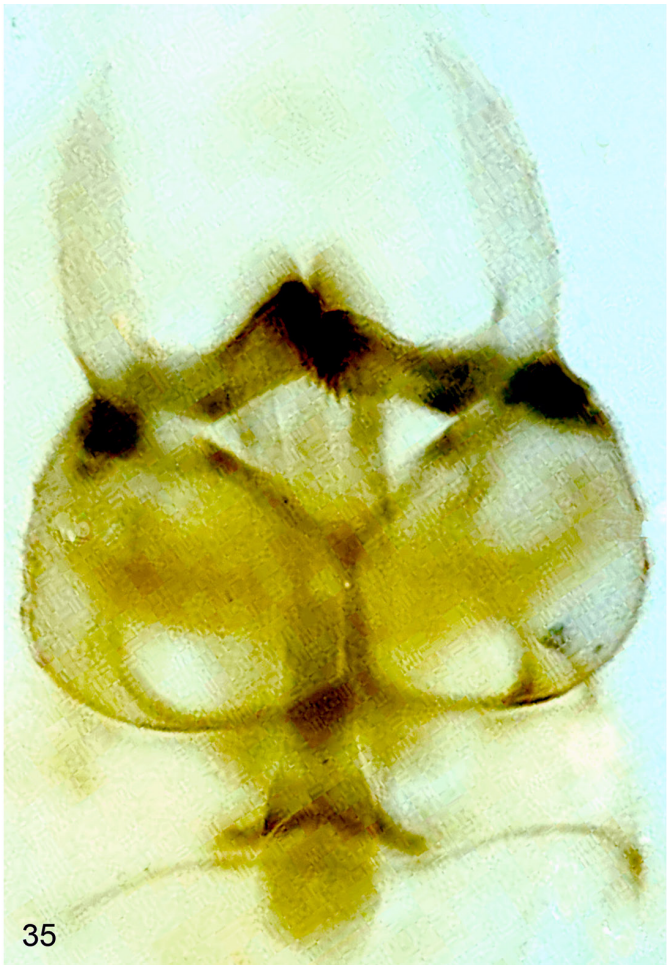
Etymology. Lottheggi is from one of Australia's Aboriginal languages and is a word for "bat"; a noun in apposition to the generic name alluding to small, crepuscular, flight.

Discussion. The differences between male *Ozeoura bonelya* sp. nov., *O. billeang* sp. nov. and *O. lottheggi* sp. nov. are described above, under *O. billeang*. The most useful diagnostic characters of male *O. lottheggi* are the apically conical gonostyli with four basal lobes of various size and shape but without mesal tooth at about mid-length, and the rather narrow trapezoidal aedeagal guide. *Ozeoura lottheggi* is known only from the type locality, 3 km N by E of Mt Tip Tree, in tropical northeastern Queensland.



Figures 31–33. *Ozeoura lottheggi* sp. nov., holotype male, terminalia. *(31, 32)* dorsal; *(33)* gonostylus.





Figures 34, 35. *Ozeoura dingo* sp. nov., holotype male, terminalia. *(34)* gonostylus; *(35)* ventral.

Ozeoura dingo sp. nov.
Theischinger & Billingham

Figs 34, 35, 46, 47

Holotype. ♂ AM K.421141, Australia, New South Wales, Dingo Tops Forest Park, 950 m, rainforest, malaise, 20 Feb.–23 Mar. 1993, G. Williams; specimen in 70% ethanol, therefore bleached, terminalia preserved (glycerol) in microvial in glassvial together with specimen. **Paratype**: 1♂ (terminalia missing), same data as holotype, AM K.421142.

Description ♂ (♀ unknown).

Head: including rostrum, palp and antenna yellow.

Thorax: Pronotum whitish yellow. Remainder yellow, slightly darkened to brownish at anterior face of prescutum. Legs whitish yellow. Wing and halter yellowish white.

Abdomen: yellowish white.

Terminalia (Figs 34, 35): Gonocoxites short and ventrally completely fused; gonostyli about as long as gonocoxites, slim with apical third continuously narrowing, and basally with a medially directed, somewhat bowed lobe with apex rounded, darkened and setose; aedeagus convoluted, with apical portion simple and very thin; aedeagal guide largely parallel sided, distally bilobed.

Dimensions: Wing length 4.5 mm.

Etymology. Dingo after the type locality Dingo Tops Forest Park; it is treated as a noun in apposition to the generic name.

Discussion. Male *Ozeoura dingo* sp. nov. does not appear particularly close to any of the other *Ozeoura* species. It stands out from all of them by ventrally completely fused gonocoxites and two-armed gonostyli which at the present time seem to be the only available useful characters for its identification. *Ozeoura dingo* is known only from the type locality, Dingo Tops Forest Park in northeastern New South Wales, where it was found to coexist with *O. tonnoiri*.

Ozeoura narahdarn sp. nov.
Theischinger & Billingham

Figs 36, 37, 41

Holotype ♂, ANIC 040815, Australia, Queensland, Moses Creek, 4 km N by E of Mt Finnegan (at light), 15-x-1980, D. H. Colless; specimen dry, pinned, terminalia preserved (glycerol) in microvial on the pin. **Paratypes** 1♂ (AM K.421143), Australia, Queensland, Cape Tribulation, Pilgrim Sands, 16-i-1992, G. Theischinger; 1♂ (AM K.421144), Australia, Queensland, Tully River Gorge, 8-iv-1997, G. Theischinger & L. Mueller.

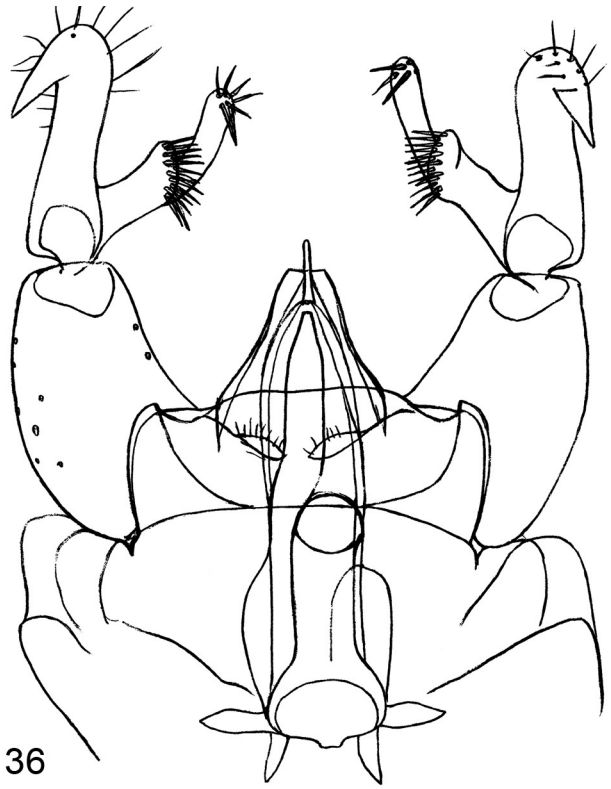
Description ♂ (♀ unknown).

Head: with top brownish yellow to pale brown; rostrum, palp and antenna medium brown, side of vertex greyish yellow to dull orange.

Thorax: Pronotum dull yellow. Remainder yellowish brown, only anterior portion of prescutum dark to blackish brown and scutellum and mediotergite pale greyish brown. Legs brownish yellow becoming increasingly but only slightly darker from coxa to middle of tarsus, only apical portion of tarsus dark greyish brown. Wing base and halter brownish yellow, remainder of wing suffused with pale grey.

Abdomen: greyish brown.

Terminalia (Figs 36, 37): Gonocoxites long, at least as long as gonostyli which are forked near the base with one arm bowed and pointed and the other (mesal) arm with



Figures 36, 37. *Ozeoura narahdarn* sp. nov., holotype male, terminalia, dorsal.

additional branch, both with apex rounded and strongly setose; aedeagus with apical portion simple and thin; aedeagal guide roughly narrowly trapezoidal; epandrium apparently bilobed and partly covering base of gonocoxites.

Dimensions: Wing length 4.2 mm.

Etymology. Narahdarn is from one of Australia's Aboriginal languages and is a word for "bat"; a noun in apposition to the generic name alluding to small, crepuscular, flight.

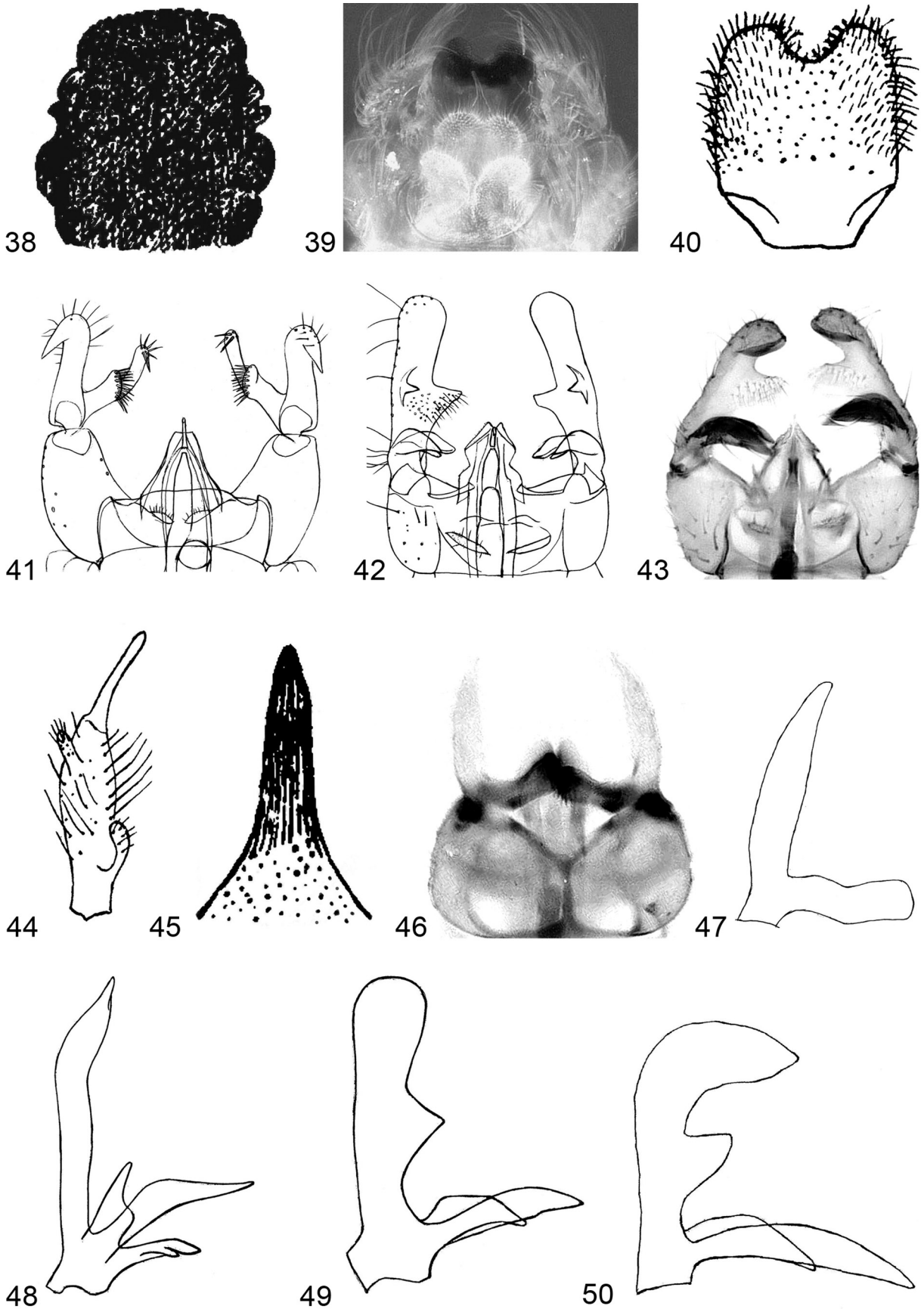
Discussion. Male *Ozeoura narahdarn* sp. nov. differs significantly from all other species assigned here to *Ozeoura* by having much longer gonocoxites and an epandrium covering their base, which, together with the particular shape of gonostyli and aedeagal guide, are the characters useful for its identification. However *O. narahdarn* fits well into genus *Ozeoura* based on wing venation, number and position of gonostyli and geographic distribution. *Ozeoura narahdarn* is known from three localities, all in tropical Queensland: Moses Creek, 4 km N by E of Mt Finnegan; Cape Tribulation, Pilgrim Sands; Tully River Gorge.

Key to the males of *Ozeoura* g. nov.

For explanation of the term *aedeagal guide*, see above under *Material and methods*.

1	Aedeagal guide compact, almost square (Figs 38–40)	2
——	Aedeagal guide at least caudally much narrower than long (Figs 41–43, 45, 46)	4
2	Aedeagal guide with caudal margin truncate (Fig. 38)	*tasmanica*
——	Aedeagal guide with caudal margin bilobed (as in Figs 39, 40)	3
3	Gonostyli simple without distinct mesal lobes (Fig. 39)	*convoluta*
——	Gonostyli complex with mesal lobes (Fig. 44)	*hemmingseni*
4	Aedeagal guide terminates in a simple powerful spine (Fig. 45)	*tonnoiri*
——	Aedeagal guide roughly rectangular, trapezoidal or subtriangular or bilobed (Figs 41–43, 46)	5
5	Epandrium covering base of elongate gonocoxites (Fig. 41)	*narahdarn*
——	Epandrium not overing base of roughly square gonocoxites (Figs 42, 43, 46)	6

... / key continues on p. 462



Figures 38–50. Male terminalia: aedeagal guide (ag), gonostylus (g), epandrium (e), basal portion of terminalia dorsal (t), of *Ozeoura* spp. *(38) O. tasmanica*, ag; *(39) O. convoluta*, t; *(40) O. tasmanica,* ag; *(41) O. narahdarn,* t; *(42) O. billeang,* t; *(43) O. bonelya,* t; *(44) O. hemmingseni*, g; *(45) O. tonnoiri*, ag *(46) O. dingo,* t, ventral; *(47) O. dingo*, g; *(48) O. lottheggi,* g; *(49) O. billeang*, g; *(50) O. bonely,* g.

6 Gonocoxites ventrally fused (Fig. 46); gonostyli with only one basal mesal lobe (Fig. 47) ..... *dingo*

—— Gonostyli with four basal lobes or bifid/trifid basal structure (Figs 48–50) 7

7 Gonostyli with basal lobes only (Fig. 48) ..... *lottheggi*

—— Gonostyli with bifid/trifid basal structure and mesal tooth at about half-length (Figs 49, 50) 8

8 Aedeagal guide narrowly rectangular to trapezoidal, slightly bilobed (Figs 42) ..... *billeang*

—— Aedeagal guide widely triangular (Figs 43) ..... *bonelya*

Immature stages

The immature stages of *Baeoura* and *Cryptolabis* are thought to be entirely aquatic and are similar to each other morphologically, as outlined by Oosterbroek and Theowald (1991). Wood (1952) provided a brief description of the larval and pupal stages of *Baeoura claripennis* Alexander, 1921 (included within the genus *Erioptera* Meigen at the time) and Hynes (1963) gave detailed descriptions of *Cryptolabis magnistyla* Alexander, 1962 larva and pupa. There is no published account of these or similar immature crane flies in Australia. By examining larval and pupal specimens sourced from aquatic macroinvertebrate surveys, as a component of routine water quality monitoring programs in Victoria, New South Wales and Tasmania, a number of larval and pupal specimens have been discovered which are morphologically very similar to those described for *Baeoura* and *Cryptolabis.* Given the apparent close affinities of *Ozeoura* to *Baeoura* and *Cryptolabis*, it is possible these larval and pupal specimens are the immature stages of *Ozeoura*. Hynes (1963) reared larvae in an artificial stream in the laboratory to confirm association of the immature stages with adult *Cryptolabis*, however without access to such a facility the present study utilizes molecular techniques to associate larval and adult stages of *Ozeoura.*

Ozeoura pupa

Figs 51–53

Material examined. **Victoria:** 1, Bindi, Tambo River at Blackfellows Flat (-37.05809° 147.827985°), 29-xi-2011, Z. Billingham; 1, Humevale, Jacks Creek off Road 10 (-37.4689° 145.16974°), 14-xii-2011, Z. Billingham; 2, Weeragua, Cann River West Branch off Monaro Hwy (-37.37295° 149.19899°), 11-xii-2012, Z. Billingham; 3, Mitta Mitta, Snowy Creek off Omeo Hwy (-36.54554° 147.40903°), 13-xii-2012, Z. Billingham; 1, Harrietville, Ovens River off Mill Rd (-36.90145° 147.05372°), 14-xii-2012, Z. Billingham; 2, Nariel Valley, Nariel Creek off Benambra-Corryong Rd (-36.44357° 147.82987°), 14-xii-2012, Z. Billingham; 5♂ *Beaoura convoluta* pharate pupae, Weeragua, Cann River West Branch off Monaro Hwy (-37.37295° 149.19899°), 10-xi-2015, Z. Billingham; 2♂ *Beaoura convoluta* pharate pupae, Glencairn, Macalister River (-37.52180° 146.56665°), 12-xi-2015, Z. Billingham; 2♂ *Beaoura convoluta* pharate pupae, Glen Valley, Big River off Omeo Hwy (-36.93300° 147.47300°), 28-xi-2015, Z. Billingham; 1♂ *Beaoura convoluta* pharate pupa, Buchan, Buchan River (-37.49570° 148.17200°), 1-xii-2015, Z. Billingham (ZB). (All Victoria).

Description. Elongate cylindrical in form, the terminal segment noticeably narrower than the remainder of abdomen. Head and thorax off-white to pale yellow, abdomen concolorous or darkening to brown in some mature specimens (Fig. 51). Head with pronounced cephalic crest along the vertex, multiple long setae arising from the furrow formed between this crest and the antennal sheaths. Mesothorax smooth and lacking respiratory horns (Fig. 52). Wing pads not extending beyond the second abdominal segment. Leg sheaths not exceeding the third abdominal segment, the fore and hind leg sheaths noticeably longer than the mid leg sheath. Abdominal integument lacking armature and only sparsely setose. The dorsal surface of the cauda may bear the vestigial remains of the larval spiracular lobes, appearing as small curled finger-like processes or as little more than raised lumps. Dorsal cauda also bearing paired lobes, each with U-shaped distal margin, the edges drawn into fine points (Fig. 53). Cauda ventrally rounded and smooth.

Discussion. The absence of thoracic respiratory horns and the setose cephalic crest readily distinguishes the pupae of *Ozeoura* from any other known Australian limoniid pupae. Pharate male pupae can be identified to species through dissection of the cauda, insufficient material is available to identify species specific characters among non-pharate and female specimens.

Ozeoura larva

Figs 54–57

Material examined. **New South Wales:** 3, Dingo Forest, Caparra Creek off Rumba Dump Trail (-31.70148° 152.19244°), 14-iv-1997, NSW OEH; 2, Sandy Hill, Macleods Creek off Macleods Creek Rd (-28.96709° 152.27192°), 6-v-1997, NSW OEH; 1, Douglas Park, Nepean River off Douglas Park Drive (-34.19159° 150.71113°), 9-xii-1997, NSW OEH; 1, Tom Groggin, Murray River By Tom Groggin Camp Ground (-36.54413° 148.12866°), 24-iii-1998, NSW OEH; 4, Backwater, Backwater Creek off Horseshoe Bend Fire Trail (-30.06242° 151.92784°), 10-v-1998, NSW OEH; 2, Nightcap, Terania Creek by Terania Creek Picnic Ground (-28.56845° 153.31098°), 11-v-1998, NSW OEH; 3, Wadbilliga, Wadbilliga River off Wadbilliga Rd (-36.27666° 149.61194°), 26-v-1998, NSW OEH; 1, Wombeyan Caves, Mares Forest Creek off Mares Forest Rd (-34.31759° 149.92180°), 26-v-1998, NSW OEH; 2, Jinden, Jinden Creek off Jinden Ridge Rd (-35.88256° 149.56436°), 26-v-1998, NSW OEH; 2, New South Wales, Wandella, Paddy's Creek off Paddy's Fire Trail (-36.33407° 149.80830°), 2-vi-1998, NSW OEH; 4, Wonboyn North, Wonboyn River off Wonboyn Link Track (-37.25665° 149.88505°), 3-vi-1998, NSW OEH; 1, Nightcap, Terania Creek by Terania Creek Picnic Ground (-28.56845° 153.31098°), 8-x-1998, NSW OEH; 5, Never Never, Rosewood River off Rosewood Creek Track (-30.36494° 152.80733°), 9-x-1998, NSW OEH; 1, Wombeyan Caves, Mares Forest Creek off Mares Forest Rd (-34.31759° 149.92180°), 03-xi-1998, NSW OEH; 8, Jinden, Jinden Creek off Jinden Ridge Rd (-35.88256° 149.56436°), 09-xi-1998, NSW OEH; 4, Tallaganda, Mulloon Creek by Mulloon Camp Ground (-35.43827° 149.56962°) 09-xi-1998, NSW OEH; 16, Wandella, Paddy's Creek off Paddy's Fire Trail (-36.33407° 149.80830°), 10-xi-1998, NSW OEH; 4, Tom Groggin, Murray River By Tom Groggin Camp Ground (-36.54413° 148.12866°),

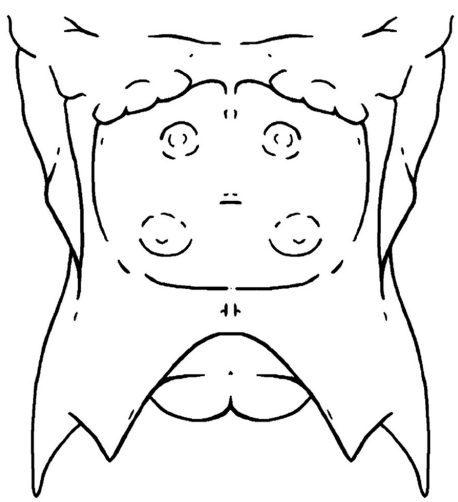
Figure 51. *Ozeoura convoluta* pupae.

11-xi-1998, NSW OEH; 3, Geehi, Swampy Plain River by Geehi Camp Ground (-36.37875° 148.17781°), 11-xi-1998, NSW OEH; 11, Wonboyn North, Wonboyn River off Wonboyn Link Track (-37.25665° 149.88505°), 13-xi-1998, NSW OEH; 2, Upper Kangaroo River, Kangaroo River off Upper Kangaroo River Rd (-34.68807° 150.60078°), 13-xi-1998, NSW OEH; 1, Conjola, Bunnair Creek off Calgaroo Rd (-35.23277° 150.40397°), 22-xii-1998, NSW OEH; 7, Tom Groggin, Murray River By Tom Groggin Camp Ground (-36.54413° 148.12866°), 25-iii-1999, NSW OEH; 10, Geehi, Swampy Plain River by Geehi Camp Ground (-36.37875° 148.17781°), 25-iii-1999, NSW OEH; 2, Rocky River, Nelson Creek off Rocky River Rd (-29.07364° 152.34743°), 19-iv-1999, NSW OEH; 4, Dingo Forest, Caparra Creek off Rumba Dump Trail (-31.70148° 152.19244°), 21-iv-1999, NSW OEH; 14, Megalong Valley, Megalong Creek off Nellies Glen Rd (-33.73025° 150.24451°), 29-ix-1999, NSW OEH; 3, Wolgan Valley, Wolgan River off Wolgan Rd (-33.30052° 150.12407°), 29-ix-1999, NSW OEH; 3, Tuckers Nob, Never Never River off Promised Land Rd (-30.35981° 152.90500°), 11-x-1999, NSW OEH (ZB). **Victoria:** 2, Benambra, Tambo River (-36.99945° 147.88255°), 1-v-2011, Z. Billingham; 5, Warburton, Yarra River off Whitegum Dr (-37.72144° 145.76951°), 14-ix-2011, Z. Billingham; 1, McMahons Creek, Starvation Creek off Road 17 (-37.75735° 145.85014°), 27-ix-2011, Z. Billingham; 1, Healesville, Donnelly Creek off Donnelly Weir Rd (-37.62945° 145.53388°), 11-x-2011, Z. Billingham; 3, Healesville, Graceburn Creek off Road 1 (-37.65375° 145.56664°), 11-x-2011, Z. Billingham; 3, Reefton, Bakers Creek off Road 12 (-37.72794° 146.05417°), 3-xi-2011, Z. Billingham; 4, Reefton, Woods Creek off Road 11 (-37.72866° 146.06235°), 3-xi-2011, Z. Billingham; 5, Bindi, Tambo River at Blackfellows Flat (-37.05809° 147.82798°), 29-xi-2011, Z. Billingham; 17, Bindi, Tambo River upstream of Blackfellows Flat (-37.05820° 147.83888°), 29-xi-2011, Z. Billingham; 3, Humevale, Jacks Creek off Road 10 (-37.46896° 145.16974°), 14-xii-2011, Z. Billingham; 1, Reefton, Bakers Creek off Road 12 (-37.72827° 146.05439°), 19-iii-2012, Z. Billingham; 1, East Warburton, Yarra River off Whitegum Dr (-37.72144° 145.76951°), 3-iv-2012, Z. Billingham; 7, Rawson, Coopers Creek (-37.96061° 146.40477°), 19-iv-2012, Z. Billingham; 1, The Basin, Dobsons Creek off Basin Olinda Rd (-37.85657° 145.32459°), 15-x-2012, Z. Billingham; 4, Glencairn, Macalister River (-37.52230° 146.56620°), 5-xii-2012, Z. Billingham; 2, Weeragua, Cann River West Branch off Monaro Hwy (-37.37295° 149.19899°), 11-xii-2012, Z. Billingham; 2, Shannonvale, Big River off Omeo Hwy (-36.93300° 147.47300°), 12-xii-2012, Z. Billingham; 1, Suggan Buggan, Suggan Buggan River (-36.95260° 148.32520°), 12-xii-2012, Z. Billingham; 9, Mitta Mitta, Snowy Creek at Omeo Hwy (-36.54600° 147.41045°), 13-xii-2012, Z. Billingham; 20, Nariel Valley, Nariel Creek off Benambra-Corryong Rd (-36.44357° 147.82987°), 14-xii-2012, Z. Billingham; 12, Harrietville, Ovens River off Mill Rd (-36.90145° 147.05372°), 14-xii-2012, Z. Billingham; 2, Matong North, Dandongadale River (-36.80725° 146.63114°), 15-xii-2012, Z. Billingham; 9, McMahons Creek, Starvation Creek off Starvation Creek Rd (-37.71905° 145.80258°), 17-xii-2012, Z. Billingham; 2, Reefton, Tributary of Alderman Creek off Road 19 (-37.72178° 145.94089°), 17-xii-2012, Z. Billingham; 13, McMahons Creek, O'Shannassy River (-37.70119° 145.79151°), 2-v-2013, Z. Billingham; 7, Reefton, Woods Creek off Road 11 (-37.72898° 146.06312°), 27-xi-2013, Z. Billingham; 1, Reefton, Tributary of Alderman Creek off Road 19 (-37.72178° 145.94089°), 28-iv-2014, Z. Billingham; 2, Rawson, Coopers Creek (-37.95948° 146.40448°), 30-iv-2014, Z. Billingham; 2, Rawson, Coopers Creek (-37.95948° 146.40448°), 12-xi-2014, Z. Billingham; 6, Reefton, Woods Creek off Road 11 (-37.72898° 146.06312°), 10-xii-2014, Z. Billingham; 3, Reefton, Armstrong Creek off Armstrong Creek Rd (-37.63615° 145.86061°), 11-xii-2014, Z. Billingham; 1, Clonbinane, Plenty River at Road 54 (-37.45954° 145.16346°), 11-xii-2014, Z. Billingham; 7, Weeragua, Cann River West Branch off Monaro Hwy (-37.37295° 149.19899°), 11-x-2015, Z. Billingham; 3, Glencairn, Macalister River (-37.52230° 146.56600°), 12-xii-2015, Z. Billingham; 2, Jamieson, Goulburn River off Mansfield Woods Point Rd (-37.33836° 146.13557°), 17-xi-2015, Z. Billingham; 1, Shannonvale, Big River

off Omeo Hwy (-36.93300° 147.47300°), 28-xi-2015, Z. Billingham; 1, Reefton, Yarra River at Rd 12 (-37.73295° 146.06704°), 21-xi-2017, Z. Billingham (ZB). **Tasmania:** 2, South Springfield, Forester River (-41.27069° 147.51335°), 2-xii-2013, GHD; 1, Tayene, St. Patrick River (-41.31784° 147.49182°), 4-xii-2013, GHD (ZB).

Description. Mature larvae long cylindrical and rarely exceeding 11mm (Figs 55–57). Off white to yellow in colour, a short downy pubescence, which thickens noticeably around the groves in the thoracic segments and the base of the terminal abdominal segment, lends a deep gold to brown colour to some individuals. Head capsule with frontoclypeal apotome elongate rectangular, moderately sclerotised throughout, the posterior margin minutely notched. Genae heavily sclerotised along the margins, central area lightly sclerotised to membranous. Eye spots on dorsolateral margin of head capsule, just anterior to the articulation of the genae with the frontoclypeal apotome and posterior to the antennal pedestal. Antenna two segmented beyond the pedestal, not extending further than the distal margin of the labrum. First antennal segment elongate, terminally bearing two short stout setae and a third long fine seta reaching approximately three quarters the length of the maxillary palp; the second antennal segment short, globose and fleshy. At the anterior margin of the frontoclypeal apotome arise two "cylindrical papillae" their distal ends heavily setose so as to form a brush like structure, Hynes (1963) describes these structures in *Cryptolabis* as belonging to the labrum, this is difficult to discern but is most likely the case also in *Ozeoura*. The labrum is large and triangular in shape, fleshy and greatly setose along its distal margin and ventral surface (Fig 57). The thick labral setation obscures much of the structure of the ventral oral cavity. The mandibles however are discernible through dissection, 7–8 toothed and with molar surface often bearing a setal tuft (Fig 57). The basal sections of the maxilla are obscured, the greatly developed, membranous, maxillary palp is clearly discernible and extends anteriorly well beyond the labral brush. Terminal abdominal segment constricted at base, considerably narrower than the preceding segment. Spiracular disc with four lobes, the shorter dorsal pair not exceeding half the length of the longer ventral pair. Spiracles not evident. Ventrally bearing four anal papillae, the distal pair, when fully extended, somewhat longer than the proximal pair (Fig 56).

Molecular results. Seven larval specimens of the *Baeoura*/*Cryptolabis* morphotype were dissected and their tissues used to generate CO1 sequences. These larval CO1 sequences were compared against CO1 sequence data from adult specimens of *Ozeoura* and four widespread and commonly occurring Australian chioneine genera: *Amphineurus* Skuse, *Erioptera* Meigen, *Gonomyia* Meigen and *Molophilus* Curtis. The phylogenetic tree produced from the CO1 sequence data (Fig. 54) shows a clear and strong association of all larval specimens to the adult *Ozeoura*. P-distance values (Table 2) give further support to the association of the larval specimens to the *Ozeoura*, with genetic differences between larval and adult *Ozeoura* ranging from 0–3%, and differences between the larvae and the other chioneine genera ranging from 11–15%. While the establishment of divergence thresholds for species delineation is a point of some contention



Figures 52, 53. *Ozeoura* pupa. *(52)* head and thorax, lateral; *(53)* cauda, dorsal.

(Herbert *et al.,* 2003; Rubinoff *et al.,* 2006), the intrageneric divergence values (0–3%) compared against the intergeneric divergence (11–15%) illustrate a clear association of larval *Ozeoura* at the generic level.

Discussion. The structure of the spiracular disc readily distinguishes the larvae of *Ozeoura* from any other known Australian crane fly larvae. Insufficient material is available to identify species specific characters among larvae.

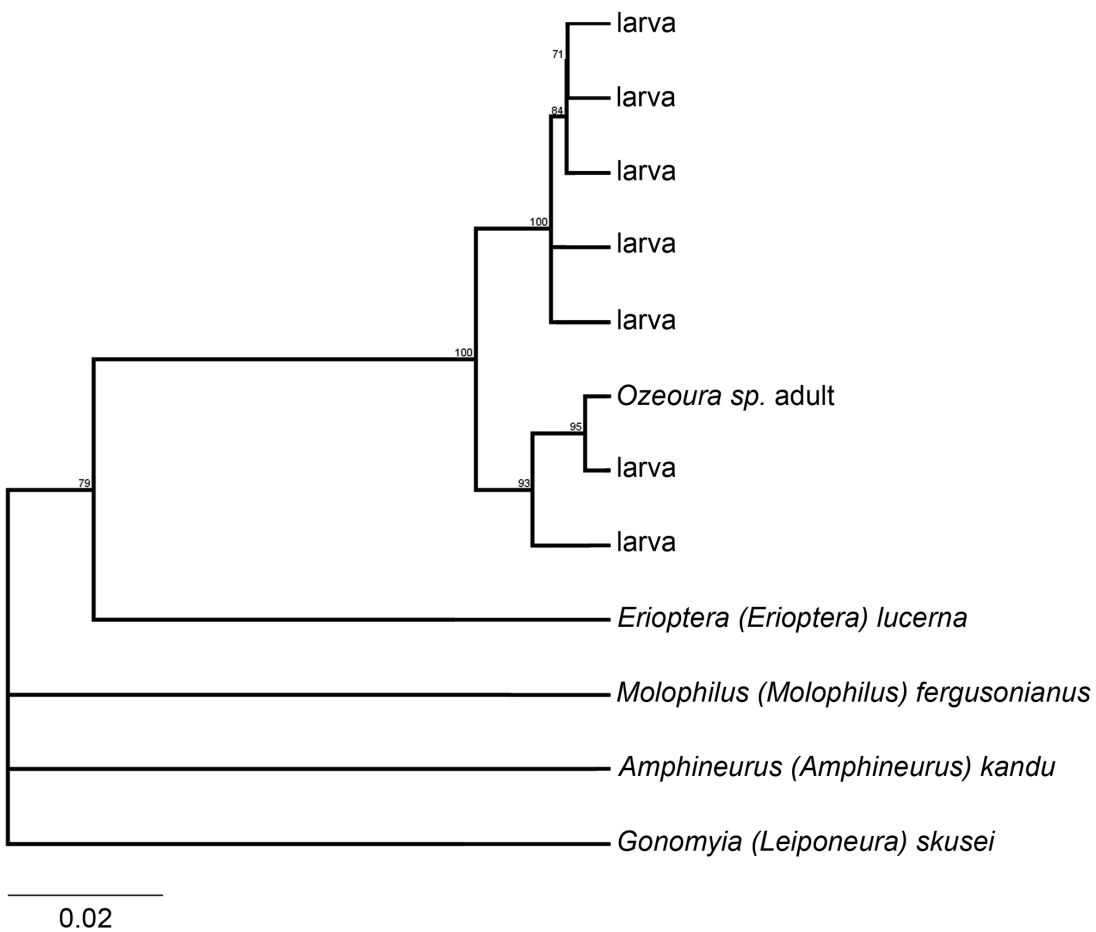
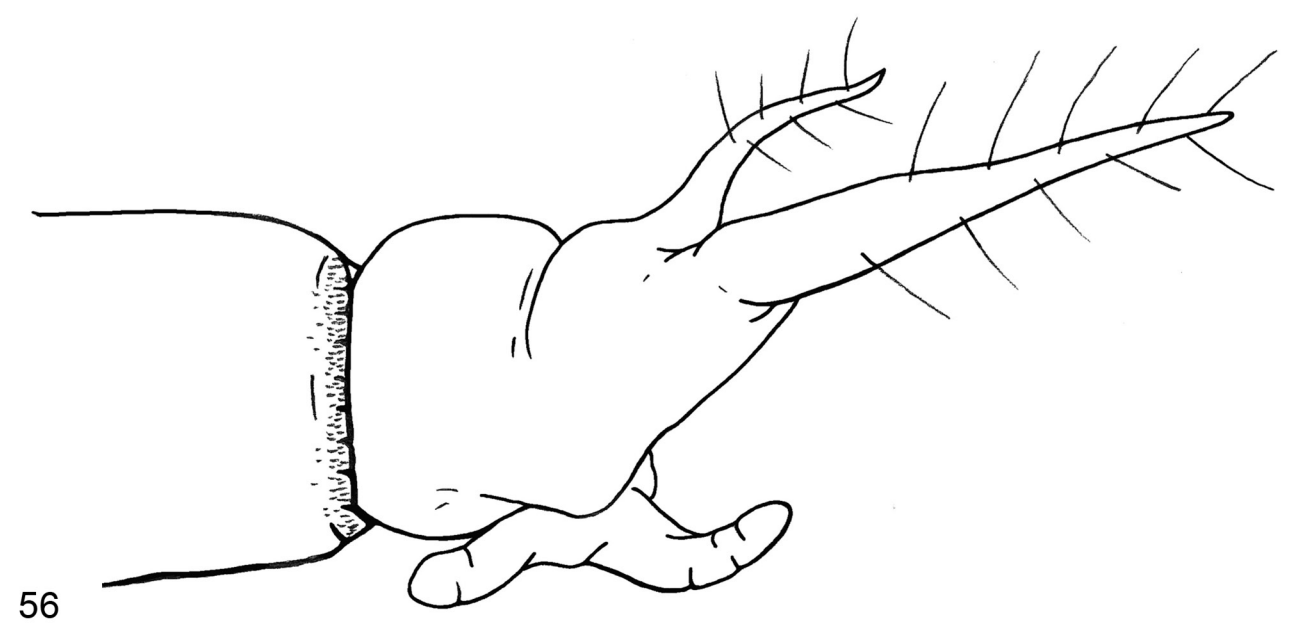


Figure 54. Phylogenetic tree produced using CO1 sequence data, Geneious 9.0.5 (Kearse *et al*., 2012).

Table 2. P-distance values between CO1 sequences produced for larval and adult specimens, Geneious 9.0.5 (Kearse *et al*., 2012).

	species	1	2	3	4	5	6	7	8	9	10	11	12
1	*Molophilus (Molophilus) fergusonianus*	—											
2	*Amphineurus (Amphineurus) kandu*	0.14	—										
3	*Gonomyia (Leiponeura) skusei*	0.13	0.14	—									
4	*Erioptera (Erioptera) lucerna*	0.12	0.14	0.12	—								
5	larva	0.14	0.15	0.13	0.11	—							
6	larva	0.14	0.15	0.13	0.11	0.00	—						
7	larva	0.14	0.15	0.13	0.11	0.01	0.00	—					
8	larva	0.14	0.15	0.13	0.11	0.00	0.00	0.00	—				
9	larva	0.14	0.15	0.13	0.11	0.00	0.00	0.00	0.00	—			
10	larva	0.14	0.15	0.14	0.11	0.03	0.03	0.03	0.03	0.03	—		
11	larva	0.14	0.15	0.14	0.11	0.03	0.03	0.03	0.03	0.03	0.02	—	
12	*Ozeoura* sp. adult	0.14	0.15	0.14	0.11	0.03	0.03	0.03	0.03	0.03	0.02	0.01	—



Figures 55, 56. *Ozeoura* larvae. *(55)* general habitus; *(56)* spiracular disc, lateral.

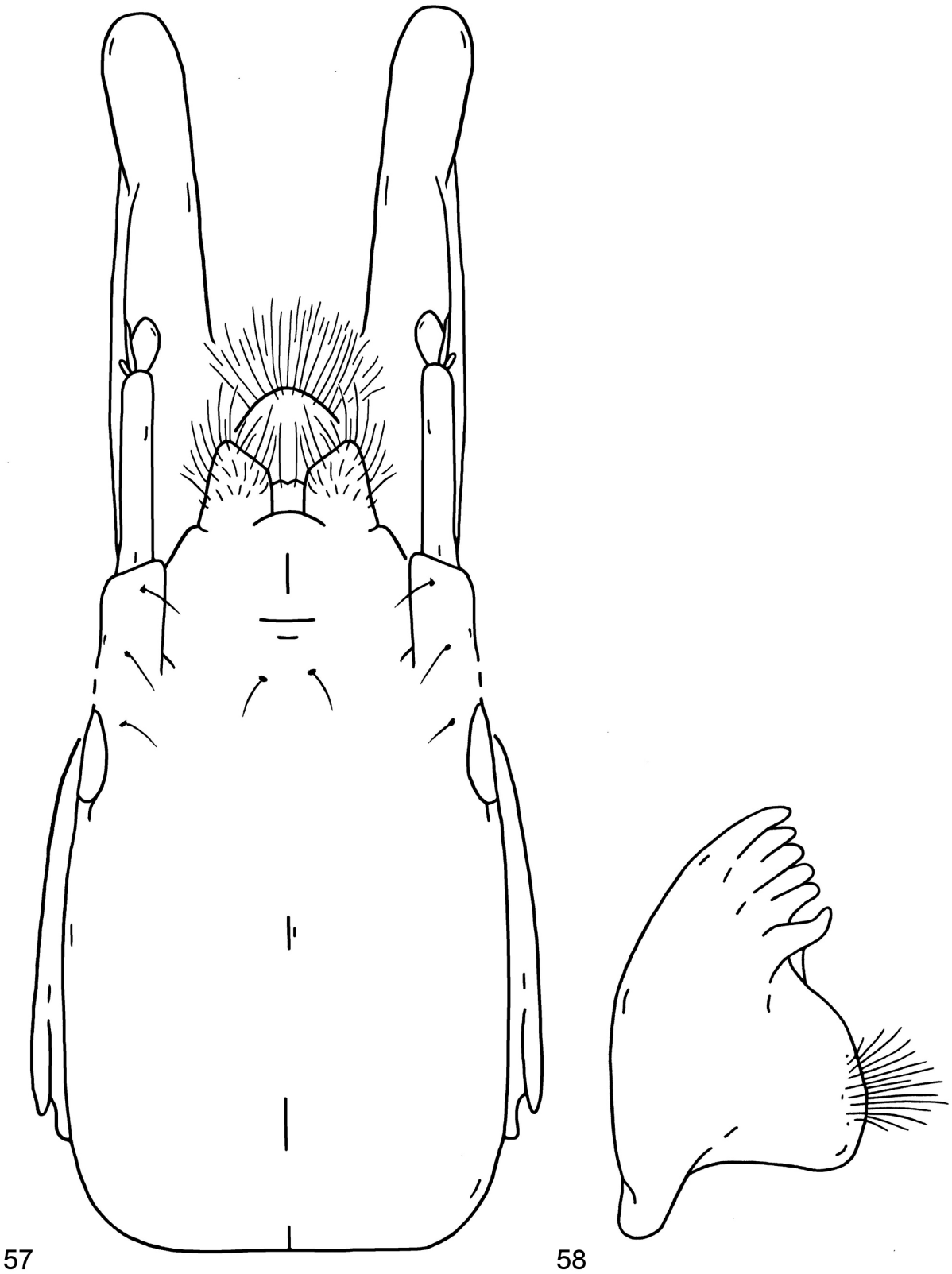


Figure 57, 58. *Ozeoura* larva. *(57)* head capsule, dorsal; *(58)* mandible.

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References

Alexander, C. P. 1919. The crane-flies of New York, Part I. Distribution and taxonomy of the adult flies. *Cornell University Agricultural Experiment Station Memoir* 25: 767–993. https://doi.org/10.5962/bhl.title.9245

Alexander, C. P. 1920. Undescribed species of African Crane-flies in the collection of the British Museum (Natural History); Tipulidae, Diptera.—Part I. Subfamily Limnobiinae. *The Annals and Magazine of Natural History* (9), vi: 1–44. https://doi.org/10.1080/00222932008632408

Alexander, C. P. 1923. Undescribed Crane-Flies from Argentina (Dipt.: Tipulidae). Part VI. *Entomological News* 34: 181–186.

Alexander, C. P. 1924. Undescribed species of Japanese crane flies. Part iv. *Annals of the Entomological Society of America* 17(1): 59–74. https://doi.org/10.1093/aesa/17.1.59

Alexander, C. P. 1926. New or little-known Tipulidae (Diptera).—XXXII. Australasian species. *The Annals and Magazine of Natural History* (9), 18: 169–193. https://doi.org/10.1080/00222932608633493

Alexander, C. P. 1929. *Diptera of Patagonia and south Chile based mainly on material in the British Museum (Natural History) Part I-Crane-Flies.* Bungay, Suffolk: Richard Clay & Sons Limited.

Alexander, C. P. 1931. New or little-known Tipulidae (Diptera).—XLVII. Australasian species. *The Annals and Magazine of Natural History* (10), 7: 17–36. https://doi.org/10.1080/00222933108673279

Alexander, C. P. 1947. Notes on the tropical American species of Tipulidae (Diptera). III.The specialized Eriopterini: *Rhabdomastix, Cryptolabis, Erioptera, Molophilus, Styringomyia, Tasiocera,* and allies. *Revista de Entomologia* 18(3): 317–360.

Alexander, C. P. 1978. New or insufficiently known Australasian crane flies. IV (Diptera, Tipulidae). IV. *Studia Entomologica* 20: 141–175.

Alexander, C. P., and G. W. Byers. 1981. Tipulidae. In: *Manual of Nearctic Diptera*, volume I. Ottawa: Research Branch, Agriculture Canada Monograph No. 27.

Brown, B.V., A. Borkent, J. M. Cumming, D. M. Wood, N. E. Woodley, and M. A. Zumbado. 2009. *Manual of Central American Diptera,* volume I. Ottawa, Ontario, Canada: NRC Research Press, 714 pp.

Environmental Protection Authority Victoria. 2003. *Rapid Bioassessment Methodology for Rivers and Streams*. Publication number 604.1, October 2003. Melbourne: Environment Protection Authority.

Folmer, O., M. Black, W. Hoen, R. Lutz, and R. Vrijenhoek. 1994. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* 3(5): 294–299.

Herbert P. D. N., A. Cywinska, S. L. Ball, and J. R. deWaard. 2003. Biological identifications through DNA barcodes. *Proceedings of the Royal Society of London B* 270: 313–321. https://doi.org/10.1098/rspb.2002.2218

Hynes, C. D. 1963. Description of the immature stages of *Cryptolabis magnistyla* Alexander (Diptera: Tipulidae). *The Pan-Pacific Entomologist* 39(4): 255–260.

Kearse, M., R. Moir, A. Wilson, S. Stones-Havas, M. Cheung, S. Sturrock, S. Buxton, S., A. Cooper, S. Markowitz, C. Duran, T. Thierer, B. Ashton, P. Mentjies, and A. Drummond. 2012. Geneious Basic: an integrated and extendable desktop software platform for the organization and analysis of sequence data. *Bioinformatics* 28(12): 1647–1649. https://doi.org/10.1093/bioinformatics/bts199

McAlpine, J. F. 1981. Morphology and terminology—adults. In: *Manual of Nearctic Diptera*, volume I. Ottawa: Research Branch, Agriculture Canada Monograph No. 27.

Oosterbroek, P. 2018. *Catalogue of the Craneflies of the World.* [Accessed January 2018] http://ccw.naturalis.nl

Oosterbroek, P., and Br. Theowald. 1991. Phylogeny of the Tipuloidea based on characters of larvae and pupae (Diptera, Nematocera) with an index to the literature except Tipulidae. *Tijdschrift voor Entomologie* 134: 211–267.

Reed, A. H., and A. W. Reed. 1965. *Aboriginal Words of Australia*. Hong Kong: Everbest Printing Co Ltd.

Rubinoff, D., S. Cameron, and K. Will. 2006. A genomic perspective on the shortcomings of mitochondrial DNA for "barcoding" identification. *Journal of Heredity* 97(6): 581–594. https://doi.org/10.1093/jhered/esl036

Saigusa, T. 2006. Homology of wing venation of Diptera. Unpublished handout distributed at the 6th International Congress of Dipterology, Fukuoka, Japan.

Theischinger, G. 1996. The Limoniinae (Diptera: Tipulidae) of Australia VIII. Preliminary key to the genus-group taxa. *Stapfia* 44: 117–144.

Wood, H. G. 1952. The Crane flies of the South West Cape (Diptera: Tipuloidea). *Annals of the South African Museum* 39: 1–327.

Wootton, R. J., and A. R. Ennos. 1989. The implications of function on the origin and homologies of the dipterous wing. *Systematic Entomology* 14: 507–520. https://doi.org/10.1111/j.1365-3113.1989.tb00300.x