Australian Journal of Entomology (2000) **39**, 111–117

Description and distribution of a new species of *Nousia* Navás (Ephemeroptera: Leptophlebiidae: Atalophlebiinae) from south-eastern Australia

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Abstract *Nousia wiltkorringae* sp. n. is described as a new species of the genus *Nousia* (subgenus *Australonousia*) from south-eastern Australia. It is commonly found in macroinvertebrate surveys. Nymphs and adults were associated by rearing. The distribution of the species is recorded along with notes on the apparent habitat requirements.

Key words Ephemeroptera, Leptophlebiidae, mayfly, *Nousia*, taxonomy.

INTRODUCTION

The taxonomy of Australian mayflies is, at present, poorly known, with at least as many species to be described as are already documented (Dean & Suter 1996; Hubbard & Campbell 1996). This is despite a proliferation of recent publications defining new taxa (Dean 1987, 1988, 1997; Campbell & Peters 1993; Dean *et al*. 1999). The endemic Australian subgenus *Australonousia* (Campbell & Suter 1988) requires significant revision as it presently includes only three described species (Hubbard & Campbell 1996), although it is considered that there may be at least 16 (Dean 1999).

The present contribution documents a new species of *Nousia* Navás (1918) from south-eastern Australia. The nymph has been known for some time and has been variously referred to as *Atalophlebioides* sp. E (Murray Darling Freshwater Research Centre; MDFRC), *Atalonella* sp. 5 (Museum Victoria; MV) and *Nousia* sp. 4 (Monitoring River Health Initiative; MRHI). In the latest guide, however, it is referred to as *Nousia* AV4 (Dean 1999). It is a commonly encountered species in macroinvertebrate survey work, being found in the mid to high altitudes of mountainous regions of eastern Victoria and southern New South Wales, where it generally prefers fast-flowing, unpolluted streams. Formal description of this species is important to prevent further confusion in future publications. This species is presented here in advance of a full revision of the genus. Examination of all life stages has confirmed the new species status of this taxon and its agreement with the generic diagnosis (Pescador & Peters 1985).

MATERIALS AND METHODS

In the field, nymphs were brushed directly from rocks and wood using a paintbrush and either preserved with 70% ethanol or kept alive. Live nymphs were stored in a bottle of stream water and placed on ice for transportation to the laboratory for rearing. In the laboratory, final-instar nymphs were placed individually in specially designed rearing chambers in a controlled-temperature environment. Resultant subimagos and imagos were associated with the nymphal exuviae.

Whole specimens were examined with the aid of a dissecting microscope, while body parts were mounted in Canada balsam and examined by using a compound microscope. Illustrations were made with the aid of a drawing tube or a microprojector.

Wing venation terminology follows that of Edmunds *et al*. (1976). Leg and palpi segment ratios were calculated using the method of Suter (1986), where each segment is compared to the length of the femur, or first segment, and expressed as a ratio. The absolute length of the femur/first segment is given in parentheses. The labia figures follow the method of Peters and Edmunds (1964), where the dorsal surface is illustrated on the left and the ventral surface on the right.

Material for the scanning electron microscope was prepared by transfer from 70% ethanol to 100% ethanol through a series of washes. The genitalia were dissected and eggs removed without exposing them to air. The eggs were ultrasonicated for 5 min. All material was critical-point dried to minimise distortion. The dried eggs were placed on metal stubs using adhesive and genitalia were mounted on cardboard attached to a metal stub, allowing for maximum rotation so that the dorsal, ventral and lateral sides could be viewed.

Specimens that I collected are referenced by an eight digit code with, where necessary, identification of individuals by two further digits. Other material is referenced by a MV code ('EPH' plus four digits). For material not collected by the author, MDFRC or MRHI, initials are as follows: DC, David Cartwright; JD, John Dean. Specimens are denoted by N (nymph), S (subimago) or I (imago). Multiple combinations of these letters indicate exuviae retained from

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rearing. All type material is lodged in the MV, other material remains in the author's personal collection.

TAXONOMY

Order Ephemeroptera, family Leptophlebiidae, subfamily Atalophlebiinae

Nousia wiltkorringae sp. n.

Types. ***Victoria.*** Holotype male NI, Cement Creek, Mount Donna Buang Road, outside Warburton, 670 m a.s.l., 145°42′20″E, 37°42′48″S, 5.iii.1998, 98030501.15. Paratypes same locality, 1.xii.1976: EPH1602, one female SI (JD); EPH1587, one male I (JD); EPH1588, one male NI (JD); 23.xi.1978: EPH1589, one female NI reared (JD); EPH1590, one male NSI (JD); EPH1591, one male NS (JD); EPH1592, one female NS (JD); EPH1594, one female NI (JD); EPH1596, one female NI (JD); EPH1597, one female NS (JD); EPH1598, one female NS (JD); EPH1599, one male NS, 1(NS (JD); 3.iii.1980: EPH1593, one female NS (JD); 5.iii.1998: 98030503.01, one female SI; 98030503.05, one male N; 29.xi.1998: 98112901.03, one male NSI reared; 23.i.1999: 99012301, two male N, one female N; 20.iii.1999: 99032004, one female N; 23.xi.1978: EPH1599, one male NS, one female, NS (JD).

Other material examined. ***Victoria.*** Acheron River, Marysville Rd, 560 m a.s.l., 145°43″E, 37°38′S, 5.xi.1997, three N (MRHI); Badger Creek, 5 km south-east of Healesville, 300 m a.s.l., 145°34′04″E, 37°41′17″S, 18.i.1980: EPH1605, one male N, one female N (JD); same locality 20.iii.1980, EPH1606, one male N, one female N (JD); Buller Creek**,** Mirimbah, 670 m a.s.l., 146°24″E, 37°06′S, 2.xi.1981, EPH1761, 1 female N (JD); Charity Creek**,** Mount Baw Baw, 700 m a.s.l., 146°13′49″E, 37°50′57″S, 12.xi.1997, three N (MRHI); Charity Creek tributary**,** Mount Baw Baw Tourist Road, 1180 m a.s.l., 146°15′15″E, 37°50′47″S, 16.ii.1999, 99021602, three male N, seven female N; Deep Creek, 0.5 km north of Uplands, 620 m a.s.l., 147°42′E, 36°49′S, 15.ii.1999, 99021501, one female N; Erinundra River**,** Erinundra, 320 m a.s.l., 148°53′E, 37°22′S, 15.xi.1994, three N; 05.xi.1996, one N (MRHI); Eurobin Creek**,** Mount Buffalo Road, 440 m a.s.l., 146°50′29″E, 36°43′10″S, 7.xi.1996, 96110702, one male N; Growlers Creek, Wandiligong, 380 m a.s.l., 146°59′10″E, 36°45′54″S, 8.xi.1996, 96110801, one male N; Kiewa River, 5 km north-east of Mount Hotham, 1180 m a.s.l., 147°10′44″E, 36°55′46″S, 7.xi.1997, 97110703, one female N; King Parrot Creek, 15 km south-west of Flowerdale, 350 m a.s.l., 147°14′56″E, 37°25′50″S, 3.v.1988, 98030501, one female N, one female NI, one male NSI; La Trobe River**,** 5 km east of Powelltown, 320 m a.s.l., 145°50′10″E, 37°52′35″S, 10.x.1996, 96101002, one female NSI; Learmonth Creek**,** Powelltown, 180 m a.s.l., 145°44′33″E, 37°51′43″S, 10.x.1996, 96101001.04, three female N; Mountain Creek**,** 7 km east of Tawonga South, 510 m a.s.l., 147°14′E, 36 °42′S, 3.xi.1990, EPH1723, one male N, two female N (DC); Myrtle Gully, 3 km east of Toolangi, 620 m a.s.l., 145°31′04″E, 37°31′44″S, 29.xi.1996, 96112901, one female N; O'Shannassy River, 580 m a.s.l., 145°49′E, 37°36′S, 14.xi.1975, EPH1603, one male N, two female N (JD); 4.i.1980, EPH1604, one male NS (JD); 5.xii.1994, two N (MRHI); Rodger River, Deddick, 560 m a.s.l., 148°27′E, 37°17′S, 23.xi.1990, one female N (MRHI); Snowy River**,** Wanton Bridge, location unknown, 17.iii.1974, EPH1647, one female N (collector unknown); Steavensons River**,** 12 km south-east of Buxton, 460 m a.s.l., 146°50′29″E, 36°43′10″S, 15.ii.1998, 98021504.06, one male NSI; Taggerty River**,** Marysville, 400 m a.s.l., 145°46′28″E, 37°30′20″S, 17.x.1998, 981201704, one male N; Thomson River**,** 12 km north-northwest of Walhalla, 290 m a.s.l., 146°24′E, 37°52′S, 12.xi.1977, one N (MDFRC); West Ovens River, Harrietville, 540 m a.s.l., 147°04′15″E, 36°54′13″S, 12.xi.1990, two female N (MRHI); Whitelaw Creek, Whitelaw Portal, 470 m a.s.l., 146°16′E 37°43′S, 2.xi.1977, one N (MDFRC). ***New South Wales.*** No. 1 Creek, near Thredbo, 1260 m a.s.l., 148°23′E, 36°28′S, 14.xii.1978, two female N (JD); Thredbo River, Thredbo, 1380 m a.s.l., 148°18′E, 36°30′S, 14.xii.1978, EPH1655, one male N, two female N (JD).

Diagnostic features. ***Male imago (Figs 1–8,25–27).*** In ethanol. Body length 7.0–8.9 mm (mean = 8.1 mm, $n = 8$); forewing length 8.6–9.6 mm (mean = 9.0 mm, $n = 6$); hindwing length 1.4–1.6 mm (mean = 1.5 mm, $n = 6$). General body colour ranging from golden brown to orange-brown with darker brown markings. Head brown. Antennae yellow. Ocelli black with white inserts, lateral ocelli larger than medial. Eyes: upper lobes orange, just meeting on meson of head; lower lobes grey black. Thorax and abdomen golden to orange brown with darker brown markings. Abdominal terga golden to orange-brown with distinct dark brown markings forming a W-shaped pattern that becomes more apparent on the posterior segments (Fig. 1). Abdominal sterna with lighter brown markings. Wings: forewing with membrane hyaline (Fig. 2); longitudinal and crossveins brown except for anal veins, which are lighter and yellow coloured; costal and subcostal cells hyaline but slightly darker. Three bullae present on veins Sc, R_2 and R_{4+5} at approximately one-half to one-third the distance from base to wing margin. In the costal region 6–7 cross veins prebulla, 11–14 postbulla; in the subcostal region 5–7 crossveins prebulla, 9–14 postbulla ($n = 8$). Rs forked at approximately one-third of the distance from wing base to wing margin; vein MA symmetrically forked at approximately one-half the distance from base to wing margin; IMP joins MP_1, sometimes recurved but not always; MP_2 recurved to join MP_1 at one-quarter to one-fifth the length of MP_1 from base to wing margin; MP_2 joined by crossvein to CuA; ICu_1 joins CuA, sometimes recurved; ICu_2 recurved to join ICu_1, both attached at base to CuA; CuA and CuP linked by crossvein, CuP strongly curved and linked by crossvein to A_1. Hindwing hyaline (Fig. 3); costal margin slightly convex at midlength followed by shallow concavity, subcosta four-fifths maximum length of wing. Costal space with no crossveins in proximal half, 4–5 crossveins in distal half ($n = 5$). Subcostal space with 4–5 crossveins ($n = 5$).

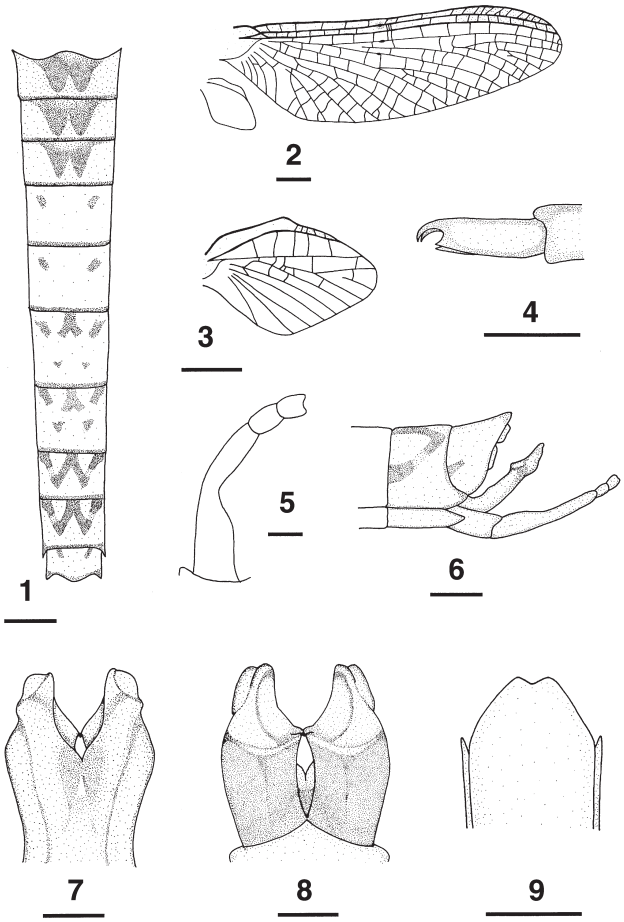


Fig. 1–9. *Nousia wiltkorringae.* **(1–8)** male imago: **(1)** Abdominal segments, dorsal patterning; **(2)** forewing with hindwing comparatively sized; **(3)** hindwing; **(4)** tarsal claws; **(5)** forceps; **(6)** genitalia, lateral; **(7)** genitalia, ventral; **(8)** genitalia, dorsal. **(9)** Female imago, ninth sternum, ventral. Scale bars: Fig. 1, 0.5 mm; Fig. 2, 1 mm; Fig. 3, 0.5 mm; Fig. 4, 0.1 mm; Fig. 5–6, 0.2 mm; Fig. 7–8, 0.1 mm; Fig. 9, 0.5 mm.

Legs golden brown with no markings except for the forelegs where apex of each segment washed with brown. Forelegs with seven segments; mean length ratios 1.00 : 1.37 : 0.10 : 0.43 : 0.36 : 0.30 : 0.16 (1.99 mm, *n* = 5). Tarsal claws of a pair similar, each apically hooked with an opposing smaller hook (Fig. 4). Male genitalia: forceps three-segmented (Fig. 5); yellow, third segment globose and slightly indented at apex. Penes yellow, laterally quite large with penes extending to approximately half the length of forceps (Fig. 6). Ventral surface of penes (Figs 7,25,26) fused in basal third, remainder divided, divergent; dorsal surface (Figs 8,27) separate with two laterally expanded lobes meeting at two-thirds length and two small triangular processes projecting from inner surface. Caudal filaments three, yellow with dark brown at proximal edge of each segment giving a banded appearance. Terminal filament longer than cerci. ***Female imago (Fig. 9).*** In ethanol. Body length 7.8–9.7 mm (mean = 8.9 mm, *n* = 10); forewing length 9.8–10.9 mm (mean = 10.3 mm, *n* = 10); hindwing length 1.5–2.0 mm (mean = 1.6 mm, *n* = 12).

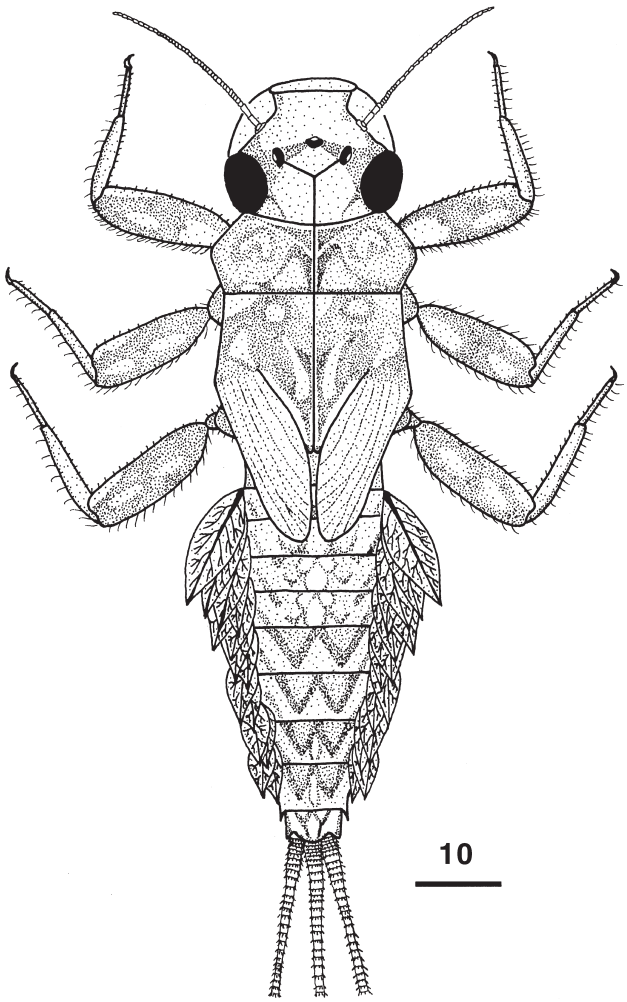
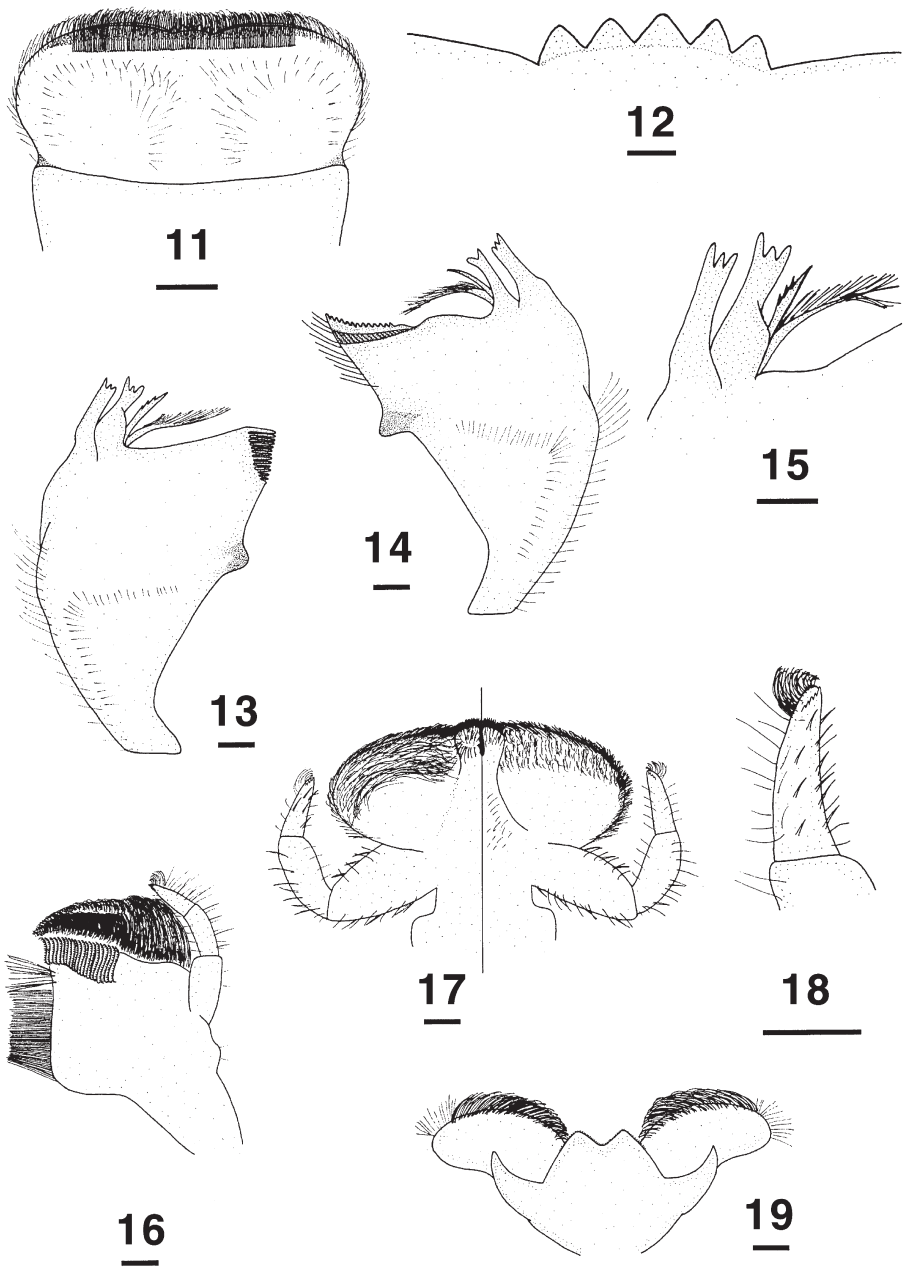


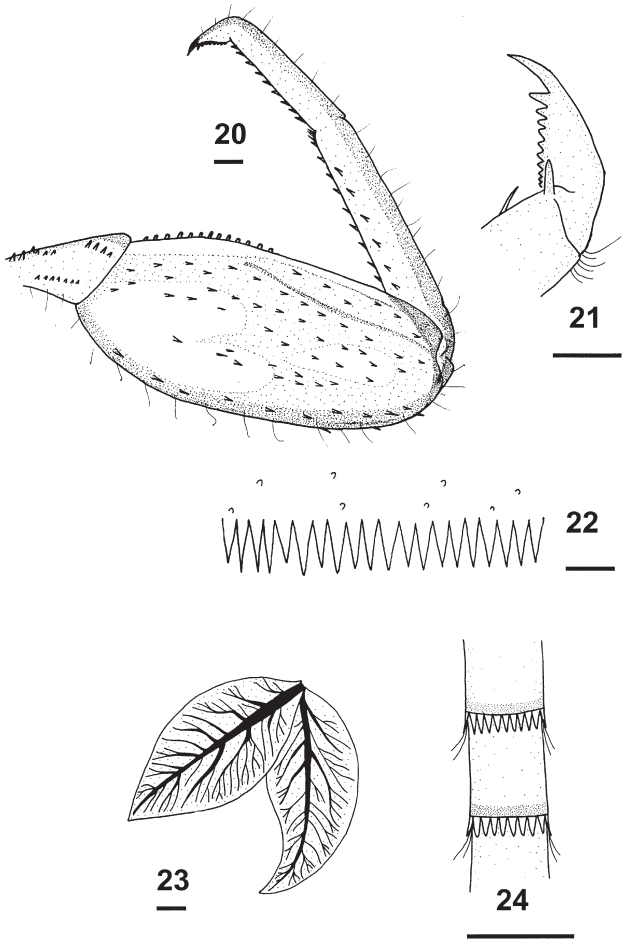
Fig. 10. *Nousia wiltkorringae* mature nymph. Scale bar: 1 mm.

Colour and markings as in male. Forewings with generally more crossveins in costal and subcostal spaces; costal region with 6–9 crossveins prebulla, 13–16 post bulla; subcostal region with 6–8 crossveins prebulla, 11–16 postbulla (*n* = 9). Hindwings: costal space with no crossveins in proximal half, 5–6 crossveins in distal half, subcostal space with 5–6 crossveins (*n* = 7). Eyes of grey-black, separated on meson of head by a distance of four times maximum width of eye. Total leg length shorter than male. Forelegs with six segments; mean leg length ratios 1.00 : 1.35 : 0.24 : 0.21 : 0.17 : 0.17 (1.85 mm, *n* = 7). Sternum 9 with very shallow apical cleft (Fig. 9). ***Egg (Fig. 28).*** Ovoid, polar cap absent, chorion with evenly spaced flower-shaped protuberances. ***Male and female subimago.*** In ethanol. Colour and markings similar to imago although not as apparent. Wings uniformly greyish-yellow, opaque. Forelegs not elongated. Genitalia not fully developed. ***Mature nymph (Figs 10–24).*** In ethanol. Body length: male 6.2–9.8 mm (mean = 8.3 mm, *n* = 18), female 7.9–11.4 mm (mean = 9.5 mm, *n* = 16). General colour golden to tan brown with dark brown markings. Head prognathous, width 1.6–2.2 mm (mean = 1.7 mm, *n* = 15). Head colour predominantly golden brown with dark brown wash between



Figs 11–19. *Nousia wiltkorringae* mature nymph: **(11)** labrum; **(12)** labrum, anterior margin enlarged showing arrangement of denticles; **(13)** left mandible, dorsal; **(14)** right mandible, dorsal; **(15)** left mandible incisors, enlarged; **(16)** left maxillae, ventral; **(17)** labium, dorsal (left of midline) and ventral (right of midline); **(18)** terminal segment of labial palp, dorsal; **(19)** hypopharynx. Scale bars: Figs 11,13–19, 0.1 mm; Fig. 12, 0.01 mm.

ocelli and on anterior margin of eyes. Ocelli black. Antennae golden brown. Antennae length 1.7–2.3 mm (mean = 1.9 mm, $n = 6$), slightly longer than head width; ratio of antennae length to head width 1.0–1.2 (mean = 1.1, $n = 6$). Upper lobes of male eyes tan, lower lobes grey-black. Eyes of female grey-black. Mouthparts (Figs 11–19): clypeus (Fig. 11) with lateral margins very slightly diverging to anterior; lateral margin of labrum slightly wider than clypeus, width of labrum 2.05–2.46 times the length along the median line (mean = 2.29, $n = 10$); anterior margin slightly concave with medial convex 'hump', which is 0.08–0.15 times the width of labrum (mean = 0.12, $n = 10$) and bearing four (or more usually five) small, prominent rounded denticles (Fig. 12). Frontal setae arranged as a broad band, subapical hair fringe clearly separated from frontal band and 0.54–0.73 times the width of the labrum (mean = 0.61, $n = 10$). Mandibles (Figs 13–15) with outer margin slightly curved, a small indentation at lateral midpoint with sparse tuft of long spine-like setae and shorter setae along margin between tuft and base. Both mandibles with dark coloured nodule at midpoint on inner margin and row of setae in an inverted L-shape on lower mandible body. Left mandible with robust incisors (Fig. 15) each with three apical teeth; inner incisor very robust with wide base and prostheca wide, serrated. Right mandible with incisors also large; outer incisor with three apical teeth, inner incisor with two teeth and prostheca simple, slender; 12–15 spine-like setae on inner mesal surface. Maxillae (Fig. 16) with galea-lacinae expanded medially with subapical row of approximately 20 pectinate setae; palpi three-segmented, mean palp segment ratios 1.00 : 0.74 : 0.65 (0.23 mm, $n = 10$); terminal segment has small triangular processes on apex. Labium (Fig. 17) with glossae not turned under ventrally and

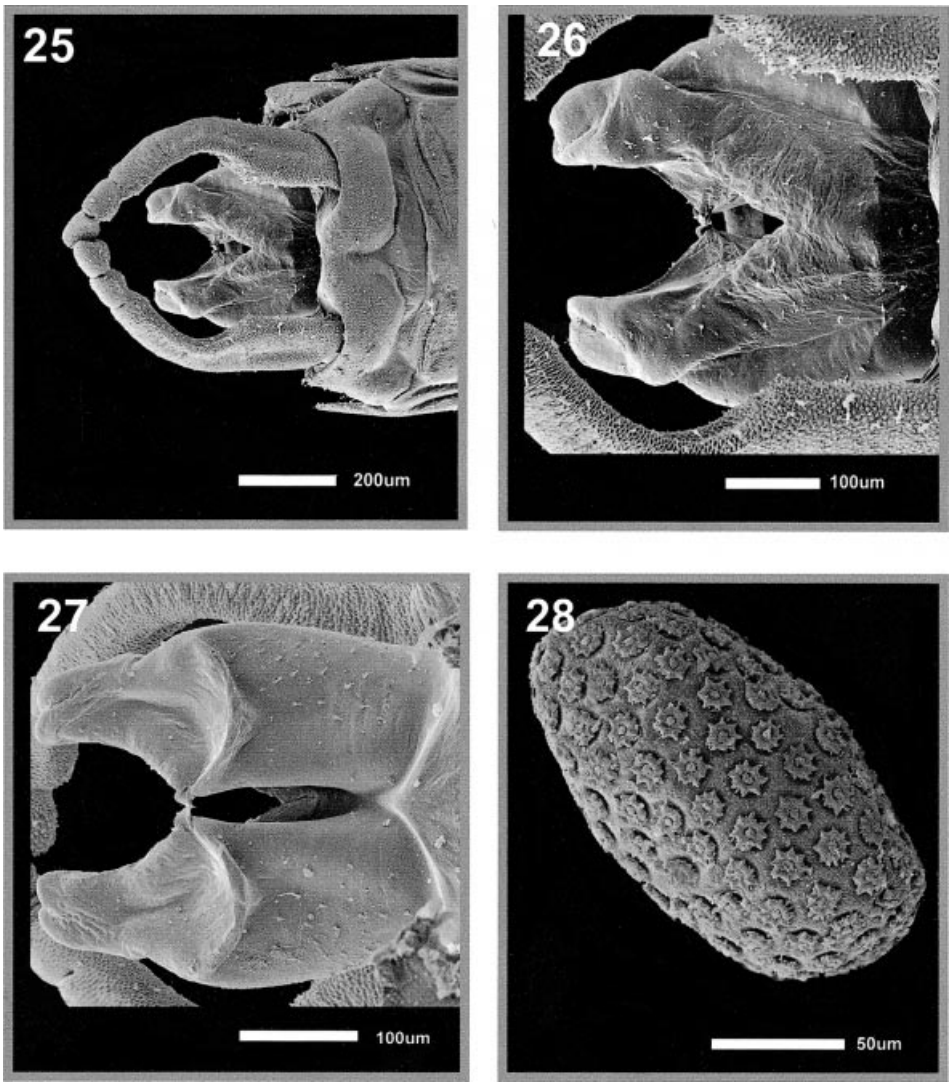


Figs 20–24. *Nousia wiltkorringae* mature nymph: **(20)** foreleg; **(21)** fore-tarsal claw; **(22)** posterior spines of abdominal terga five; **(23)** gills from abdominals segment five; **(24)** cercus at one-third length. Scale bars: Figs 20,21,23,24, 0.1 mm; Fig. 22, 0.01 mm.

lying in same plane as paraglossae; with series of blunted spines apically. Submentum with sparse robust spines. Palpi three-segmented; first segment with stout spines both anteriorly and posteriorly, terminal segment with line of triangular processes almost circling apex (Fig. 18). Labium mean palp segment ratios: 1.00 : 0.81 : 0.61 (0.36 mm, n = 10). Hypopharynx (Fig. 19) with relatively well-developed lateral processes, anterior margin of lingua moderately but noticeably cleft and lined with short setae, superlingua with thick tufts of setae on anterior margins. Thorax: tan brown with darker brown markings. Pronotum width 1.8–2.4 mm (mean = 2.1 mm, n = 15); wider than head (see above). Ratio of pronotum width to head width ranges from 1.06 to 1.25 (mean = 1.30, n = 15). Legs: colour golden to orange brown washed with slightly darker brown at outer lateral margins; femora apex of each leg dark brown; distinct white patches are present on fore-, mid- and hindleg. Fore-femora short and squat, 2.0–2.7 times longer than wide (mean = 2.3, n = 11) with short blunt spines on inner lateral margin for approximately one-half the total length of femur (Fig. 20). Mean leg-length ratios: foreleg 1.00 : 0.77 : 0.36 (1.38 mm, n = 10), middle leg 1.00 : 0.76 : 0.36 (1.35 mm, n = 10), hindleg 1.00 : 0.80 : 0.32 (1.58 mm, n = 10). Tarsal claws (Fig. 21) with approximately eight ventral teeth, progressively larger apically although apical denticle much larger. Abdominal terga colour golden to tan brown with distinct dark brown markings forming a W-shape especially clear on posterior segments; each tergum with a continuous row of spines along posterior margin (Fig. 22). Posterolateral spines present on segments 2–9, progressively larger apically. Gills (Fig. 23) pale coloured, sometimes slightly tinged pink or yellow; present on segments 1–7, becoming somewhat progressively smaller towards posterior although not significantly so. Gills double with upper and lower lamellae equally developed, each lamella broadly lanceolate. Lateral tracheae strongly developed with main trunk quite thick. Caudal filaments three, golden with darker coloration at segment join giving a slightly banded appearance. Each segment bearing apical whorl of short triangular denticles (Fig. 24). Terminal filament longer than cerci.

Etymology. The species name is derived from the language of the Wurundjeri Woiwurrung, the Aboriginal people who inhabit the area of the type locality. The word *wiltkorring* means wide and refers to the shape of the gills.

Remarks. This new species, although quite distinct, conforms to the genus diagnosis of Pescador and Peters (1985). It can be distinguished from all other species of *Nousia* by the following combination of characters. In the imago: (i) MA symmetrically forked at slightly more than half the distance from base to wing margin; (ii) subcosta of hindwing is four-fifths the maximum length of wing; (iii) ventral surface of penes fused in basal third, remainder divided, divergent; (iv) dorsal surface of penes separate with two laterally expanded lobes meeting at two-thirds length; two small triangular processes hook together at this point; (v) terminal segment of forceps globular, indented at apex; (vi) male eyes meeting on meson of head; (vii) distinct abdominal colouring in a W-shaped pattern; and (viii) female sternum nine with very shallow apical cleft. In the nymph: (i) pronotum wider than head; (ii) clypeus width is slightly narrower than labrum width, the lateral margins very slightly diverging to anterior; (iii) width of labrum approximately 2.0–2.5 times the length along the median line; (iv) anterior margin of labrum slightly concave with medial convex ‘hump’ bearing 4–5 small, rounded denticles; (v) frontal setae of labrum arranged as a broad band with subapical hair fringe clearly separated; (vi) inner incisor of left mandible very robust with wide base; (vii) prostheca of left mandible serrated; (viii) labium with glossae not turned under ventrally and with a series of blunted spines apically; (ix) hypopharynx moderately but noticeably cleft; (x) fore-femora short and squat, twofold longer than wide with short blunt spines on inner lateral margin for about half the total length of femur; (xi) abdomen patterning distinct; (xii) terga with continuous row of minute spines along posterior margin; (xiii) posterolateral spines present on segments 2–9, progressively larger apically; and (xiv) gills large, wide and lanceolate, becoming progressively smaller posteriorly.



Figs 25–28. Scanning electron micrographs. Male genitalia and egg of *Nousia wiltkorringae*: **(25)** ventral view of genitalia; **(26)** ventral view of penes, enlarged; **(27)** dorsal view of penes, enlarged. **(28)** Egg.

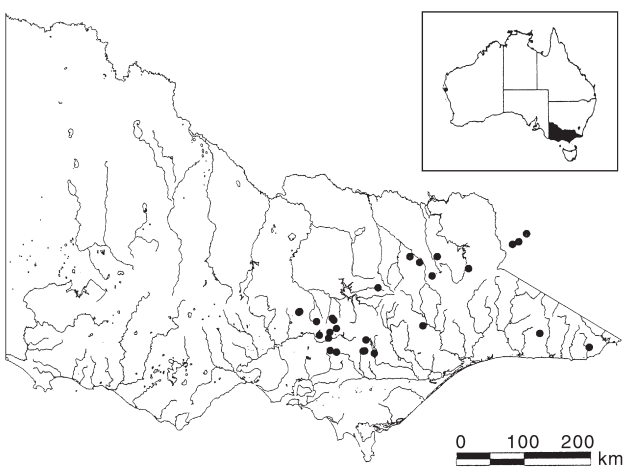


Fig. 29. Distribution of *Nousia wiltkorringae* in Victoria and southern New South Wales.

Habitat. This species has been found exclusively in mountainous areas of the eastern part of Victoria and southern New South Wales (Fig. 29). Animals have been collected at altitudes ranging from 180 to 1380 m a.s.l., but the majority are found between altitudes of 400 and 700 m a.s.l. Nymphs inhabit cold, fast-flowing, undisturbed upland streams (7–15°C) that are heavily shaded with native vegetation. They are generally found clinging to cobbles, large rocks, logs and within leaf litter, generally in association with shallow riffles. It is reasonable to assume that this species is present in other similar areas in neighbouring states. However, MRHI data collected from New South Wales and Tasmania have been identified to family level only, so it is unknown whether this species occurs there.

ACKNOWLEDGEMENTS

I am supported by a PhD studentship jointly funded by the Cooperative Research Centre for Freshwater Ecology and the Land and Water Resources Research and Development Corporation. Many thanks go to Bill Nicholson of the Wurundjeri Tribal Council who suggested the species name and gave permission for the use of it. Thanks to Dr Ken Walker, the Curator of Entomology at the Museum Victoria, for making available the material held in the MV collections. Richard Marchant and John Dean are acknowledged for helpful comments and

advice. I am also grateful to Fred Govedich, Faye Wescott, Anne Duguay, Edward Tsyrlin and most especially Nigel Ainsworth for all their help with collecting material from the field. Thank you also to Gunta Jaudzems and Joan Clark for their help and advice in preparing the SEM specimens.

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Accepted for publication 4 February 2000.