

## Key to the mature nymphs of *Coloburiscoides* (Lestage) (Ephemeroptera: Coloburiscidae)

PHILLIP SUTER<sup>1,2</sup>, JEFF WEBB<sup>1,2</sup> AND DARRYL ROWE<sup>1,2</sup>

<sup>1</sup>Department of Environmental Management and Ecology, La Trobe University, Albury-Wodonga Campus, Wodonga Victoria, 3690.

<sup>2</sup>Taxonomy Research and Information Network (TRIN), <http://www.taxonomy.org.au/>  
(corresponding author Phillip Suter: [p.suter@latrobe.edu.au](mailto:p.suter@latrobe.edu.au))

### Abstract

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Six species of *Coloburiscoides* (Ephemeroptera : Coloburiscidae) are recognized based on nymphal material. Of these six species, three are undescribed but can be recognized using molecular and morphological characteristics. A detailed and illustrated morphology of the nymphs is presented showing useful morphological characters and an illustrated key enabling identification of the six species is provided. Distribution maps are provided for all species.

### Keywords

*Coloburiscoides*, Ephemeroptera, Mayflies, Australia

### Introduction

The Family Coloburiscidae includes three genera restricted to the southern hemisphere. They are *Murphyella* Lestage from South America, *Coloburiscus* Eaton from New Zealand and *Coloburiscoides* Lestage from the Australian mainland.

The Australian genus *Coloburiscoides* has very distinctive nymphs which filter organic material from fast flowing streams in the Australian Alps in the south east of the Australian mainland. Although the nymphs are very distinctive, the three described species *C. haleuticus* (Eaton), *C. giganteus* (Tillyard), and *C. munionga* (Tillyard) are distinguished only in the adult stage with no characteristics recognized which are useful in distinguishing the nymphs. The larger species tend to be recorded at high altitudes in the Australian Alps whereas the smaller species occur in the foothills of the mountains of south eastern Australia. However, two species can be found in close proximity or at the same location.

*Coloburiscoides haleuticus* was originally described in the genus *Coloburus* by Eaton (1871) but he subsequently (Eaton 1883-1888) recognized that this generic name was occupied and established a new genus *Coloburiscus*. This species is only known from a single pinned adult male from the type location of “Melbourne?” No nymphs have been associated with this specimen. Tillyard (1933) described the nymphs, subimagos and adults of *Coloburiscus giganteus* and the

subimagos and adults of *Coloburiscus munionga* from Mt Kosciuszko. Tillyard (1933) noted that the nymphs of *C. munionga* were immature and “generally are of a much paler brown colour, somewhat less robust build, with slightly narrower thorax and more cylindrical abdomen, the legs and gills less spiny. Mouthparts closely resembling those of previous species” (*C. giganteus*). Subsequently Lestage (1935) used adult and nymphal characters to describe a new genus *Coloburiscoides* for the Australian species *C. giganteus* and *C. munionga*. The generic characters that Lestage (1935) recognized to distinguish *Coloburiscoides* from *Coloburiscus* in the nymphs were the presence of fibrillar tufts on the gills of *Coloburiscoides* and the relatively short terminal filaments. Riek (1955) recognized that *C. haleuticus* belonged in *Coloburiscoides* with *C. giganteus* and *C. munionga*, on the basis of the characteristics of the adult male penes. Campbell (1983) in an unpublished thesis recognized 5 species of *Coloburiscoides* adults, but was unable to reliably distinguish between the nymphs. This inability to identify the nymphs has limited the value of biological monitoring, conservation and distribution data as only a generic designation could be made (Suter and McGuffie 2007).

The key presented here recognizes 6 species of *Coloburiscoides* and provides characteristics which enable the determination of the nymphs for these species. The nymph of *C. haleuticus* remains unknown, and it is likely that the only specimen of this species will remain the type.

## Structure and terminology used in the key to *Coloburiscoides* nymphs.

### Sex.

The males and females can only be distinguished in mature specimens by the structure of the eyes (Figs 1 & 2). In males the eyes occupy more than 60% of the head width and in the female less than 50% of the head width. In most species the concavity between the posterior spines of the 9<sup>th</sup> abdominal sternite is angular in males (Fig. 3) and curved in females (Fig. 4), but this can be a difficult character in some species. Within each species the females are larger in body length and body width.



Figures 1-2. Dorsal view of eyes of *Coloburiscoides* nymphs. 1, male; 2, female.

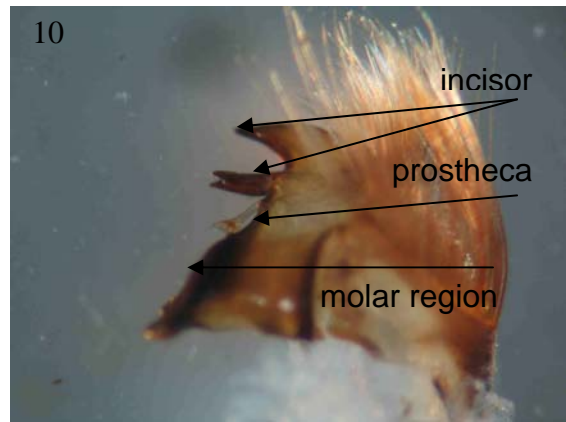


Figures 3, 4. Ventral view of 9<sup>th</sup> abdominal sternite. 3, male; 4, female. Concavity indicated by arrow.

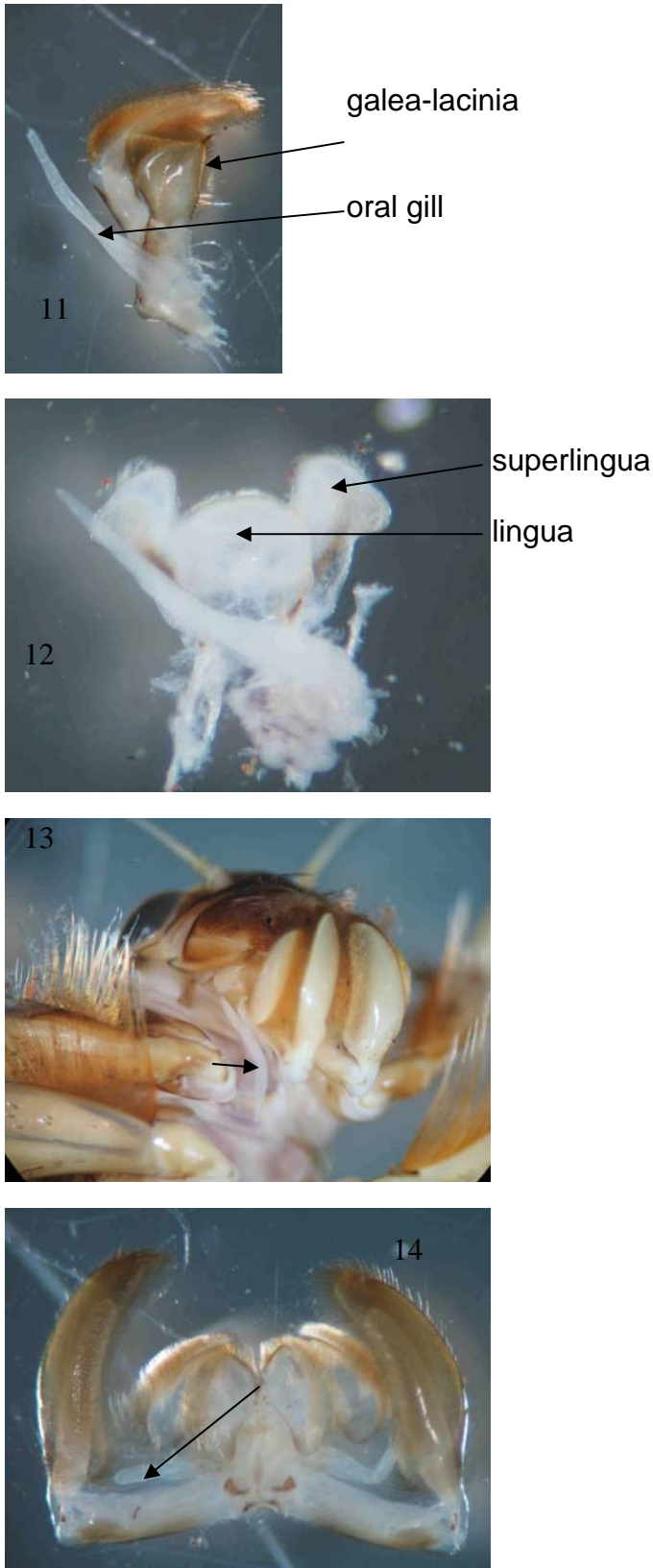
### Head and Mouthparts.

The head is hypognathous (Fig. 5) with large eyes (Figs 1-2). **Labrum** hairy, rectangular, width approximately twice length (Fig. 6). **Mandibles** paired, robust with 2 prominent, separate **incisors** and well developed **molar** region; **protheca** well developed, divided (forked) apex and a tuft of hairs in fork, dorsal surface with a curved row of long filtering setae, lateral margin with a tuft at base of outer incisors (figs. 7-10). Posterior to the mandibles are a pair of **maxillae**, each with

the **galea-lacinia** rectangular, slightly broader apically with a two segmented **palp** and a single soft process (**oral gill**) at base of palp (Fig. 11). Between the maxillae is the **hypopharynx** which is simple, with a rounded **lingua** and knob-like **superlingua** all lined with fine hairs (Fig. 12). The **labium** is the most posterior structure and is held in a vertical orientation (Fig. 13) and consists of a pair of **glossae** and **paraglossae** and a 2-segmented **palp**, each with the distal segment covered in long hairs. Attached ventrally to the base of the palps are a single pair of **oral gills** (Fig. 14).



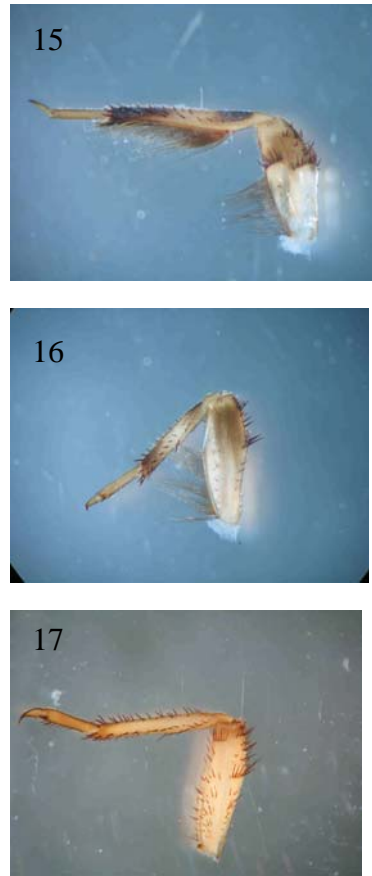
Figures 5-10. Mouthparts of *Coloburiscoides* nymph. 5, lateral view of nymph; 6, labrum; 7, left mandible ventral view; 8, left mandible dorsal view; 9, right mandible ventral view; 10, right mandible dorsal view.



Figures 11-14. Mouthparts of *Coloburiscoides* nymph. 11, maxilla; 12, hypopharynx; 13, ventral view of head showing orientation of labium and arrows show the oral gills; 14, labium.

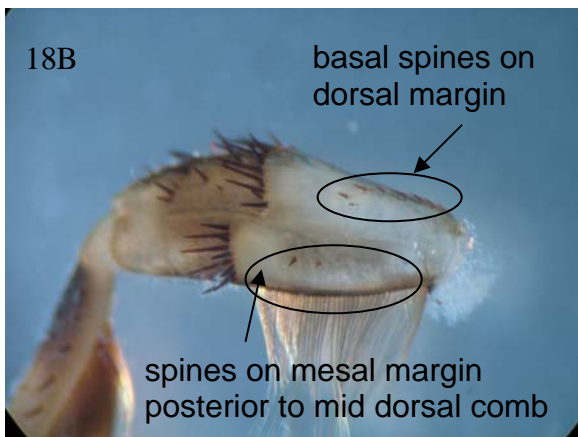
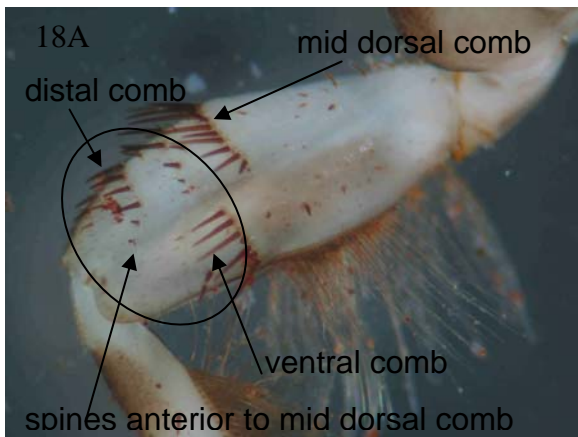
### Legs

The three pairs of legs are structurally distinct (Figs 15-18) with long filtering hairs present on the fore and mid femora, and fore tibiae. The hind leg lacks filtering hairs. All legs are covered with robust spines.



Figures 15-17. Legs of *Coloburiscoides* nymphs. 15, fore leg; 16, mid leg; 17, hind leg.

**The fore, mid and hind femora** (Fig. 18) have two or three distinct rows of spines forming comb-like structures on the anterior (outer) face of the segment. The most apical and dorsal comb is called the **distal comb**, the dorsal comb near the centre of the femur is the **mid dorsal comb**, and the **ventral comb** is situated between the two dorsal combs. The distal comb may be absent in some species. The number of spines between the mid dorsal comb and the apex of the femur are a good taxonomic character, and includes all **spines anterior of the mid dorsal comb** including the spines of the distal and ventral combs. Posterior to the mid dorsal comb are a two sets of spines which are taxonomically important. From the base of the femur on the dorsal margin is a row of sharp spines termed the **basal spines on the dorsal margin**, and on the anterior face is randomly placed spines. These latter spines can be large or small, but the number is taxonomically important, and are referred to as spines on the **mesal margin posterior to the mid dorsal comb**.



Figures 18A, B. Fore femur of *Coloburiscoides* showing spine characters.

The **fore tibiae** (Fig. 19) have two main rows of spines, one on the **dorsal margin** and one on the outer face of the segment termed the **inner row** of spines. There are also numerous apical spines, but they are not useful as taxonomic characters.

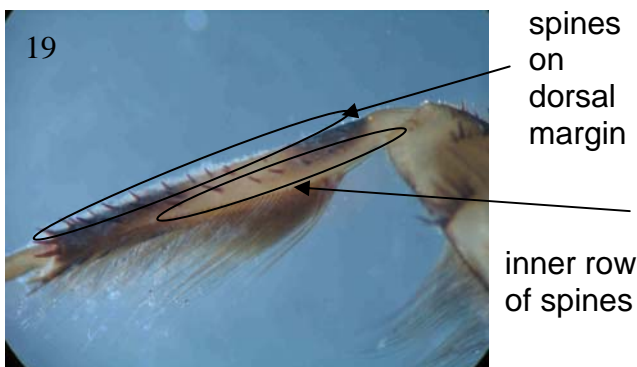
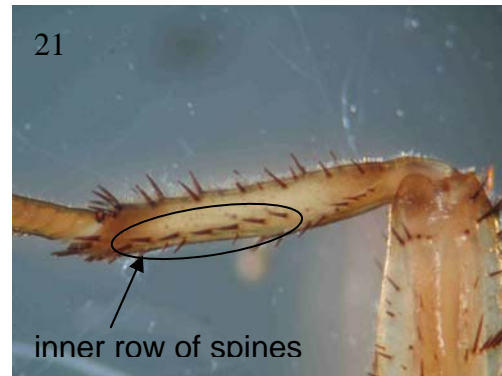
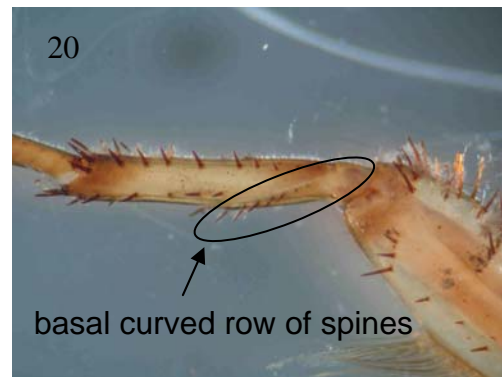


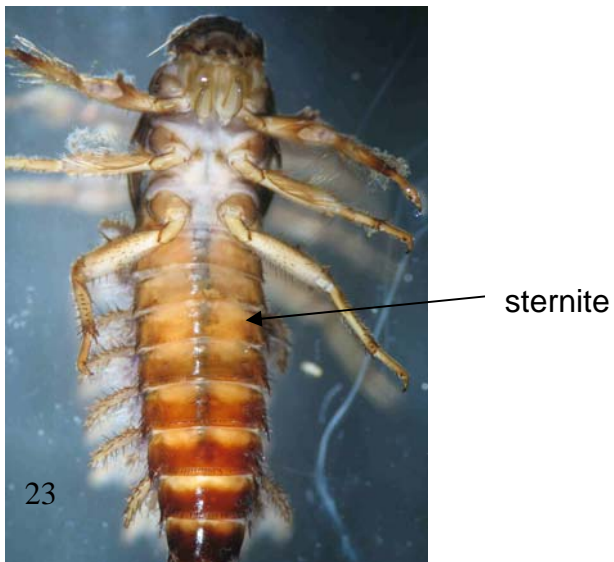
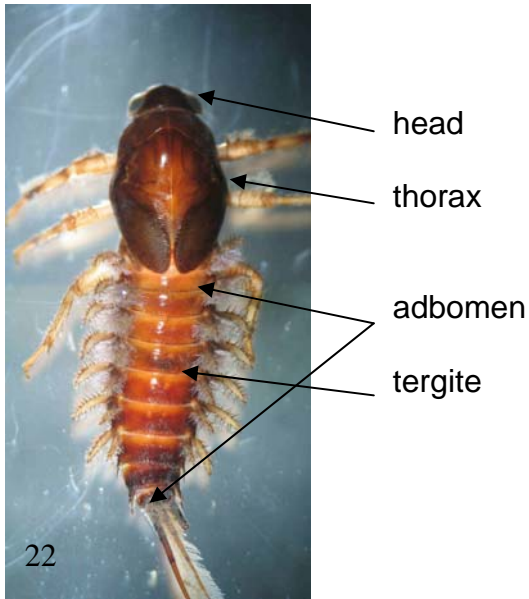
Figure 19. Fore tibia of *Coloburiscoides* nymph showing spine characters.

The **mid** and **hind tibiae** differ from the fore tarsi in having a third row of spines near the base of the tibia which curves to join the mid ventral margin of the tibia, termed the **basal curved row** (Figs 20-21).



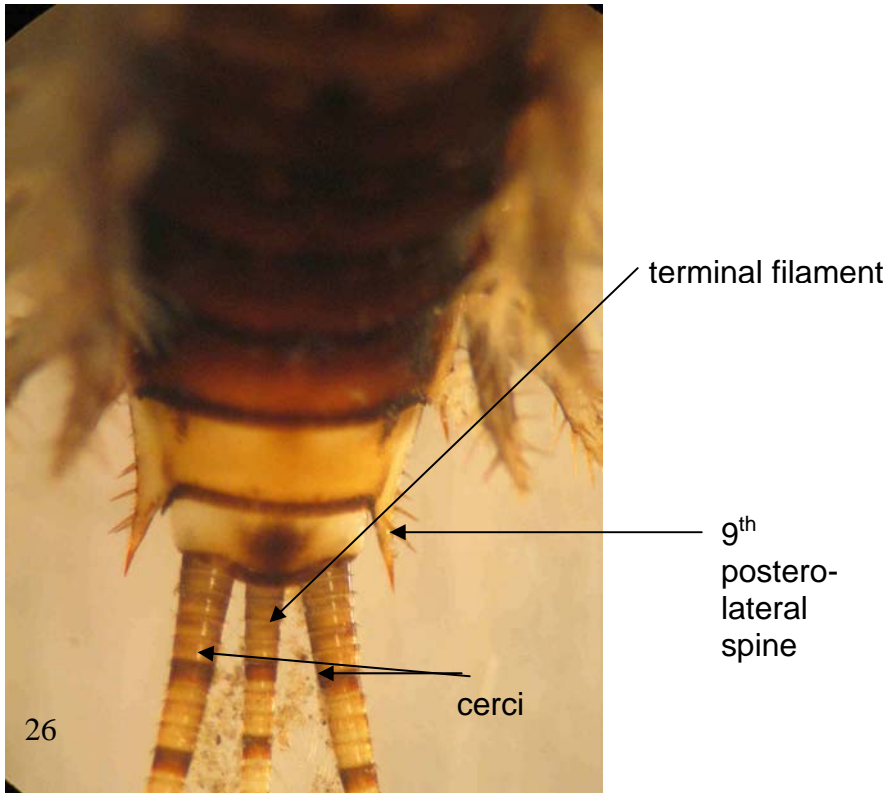
Figures 20-21. Mid and hind tibiae of *Coloburiscoides* nymph showing spine characters. 20, mid tibia; 21, hind tibia.

The **abdomen** consists of ten segments, each with a dorsal **tergite** and a ventral **sternite** (Figs 22 and 23) and the spination of these sections are important in distinguishing the species of *Coloburiscoides* nymphs. The abdominal tergites have a row of spines on the posterior margin and the number of spines is a useful character (Fig 24). Similarly the abdominal sternites have a posterior row of spines and the number is also a useful character (Fig 25). Abdominal segment 9 has very long postero-lateral spines which extending beyond segment 10. The **gills** of *Coloburiscoides* are on abdominal segments 1 to 7 and are distinctive fleshy bifid structures with numerous spines and a basal tuft of branched fibrils which occur on gills 1-6 or 1-7. Generally they are not used for distinguishing species, but in fresh or live material the colour of the fibrils can be useful. The medial **terminal filament** has a fringe of swimming hairs on the lateral margins and the lateral **cerci** have a fringe of swimming hairs on the inner margin. The terminal filaments are multi-segmented and banded in all species with a dark brown segment every 8-10 segments.



Figures 22-23. *Coloburiscoides giganteus*. 22, dorsal view; 23 ventral view.

Figures 24-25. Spines on the abdomen of *Coloburiscoides* nymphs. 24, tergites of *Coloburiscoides giganteus*; 25, sternites of *Coloburiscoides* sp C.



Figures 26-27. Terminal appendages and gill of *Coloburiscoides* nymphs. 26, dorsal view of terminal filaments of *Coloburiscoides* sp A; 27, gill of *Coloburiscoides* sp C.

**Key to mature *Coloburiscoides* nymphs**

1. Abdominal segments with contrasting dark and light (white and brown) segments or colour pattern distinct (Figs 28, 29), thorax with wing pads lighter than scutellum. .... 2
- All abdominal segments uniform brown, black or graded shades of brown, wing pads brown or black but similar colour to scutellum (figs 30-31). .... 3



Figures 28-31. Dorsal colour patterns of *Coloburiscoides* nymphs. 28, *Coloburiscoides* sp A; 29, *Coloburiscoides* sp B; 30, *Coloburiscoides giganteus*; 31, *Coloburiscoides* sp C.





Figures 32-33. Dorsal colour patterns of *Coloburiscoides* nymphs. 32, *Coloburiscoides munionga*; 33, *Coloburiscoides* sp D.

2. Abdominal tergites brown but with segment 9 white and clearly contrasting the other dark brown (Fig. 34) but may not be obvious (Fig. 35), abdominal sternites lacking distinct striped colour pattern (Fig. 37). Tibiae of legs with dark apex and base (figs. 39 and 41). Mid femora with mid dorsal comb with 7-9 spines, ventral comb with 1-3 spines, distal comb with 2-4 spines, apical half with 10-13 spines (Fig. 43). Posterior margins of abdominal sternites 7 and 8 with <28 spines (Fig. 45). Distribution Inland New South Wales restricted to the Murrumbidgee River system. ....*Coloburiscoides* sp A (Gundagai sp)

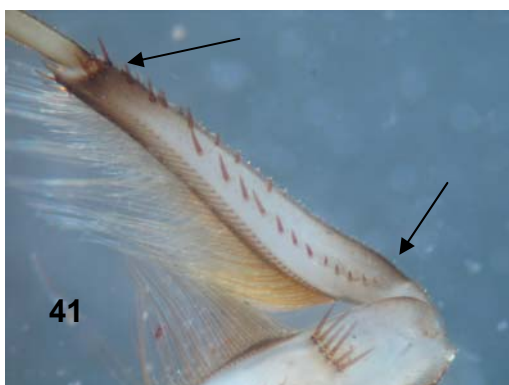
Abdominal tergites with white central stripe and tergite 8 brown (Fig. 36), abdominal sternites white with three dark patches giving a three-striped appearance (Fig.38). Tibia of legs lacking dark markings on apex and base (figs. 40 and 42). Mid femora with mid dorsal comb with 14 spines, ventral comb with 7 spines, distal comb with 7 spines, apical half with 28 spines (Fig. 44). Posterior margins of abdominal sternites 7 and 8 with >30 spines (Fig. 46). Distribution - North-eastern New South Wales, Hastings River system. ....*Coloburiscoides* sp B (Hastings)



Figures 34-36. Dorsal colour patterns of *Coloburiscoides* nymphs. 34, female *Coloburiscoides* sp A; 35, male *Coloburiscoides* sp A; 36, *Coloburiscoides* sp B.



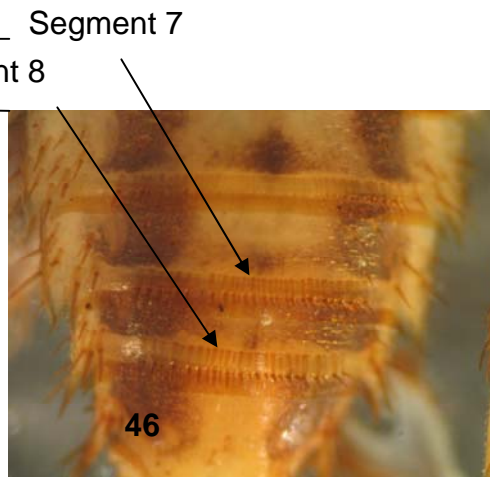
Figures 37-38 Ventral abdominal colour patterns of *Coloburiscoides* nymphs. 37, *Coloburiscoides* sp A; 38, *Coloburiscoides* sp B.



Figures 39-42. Forelegs of *Coloburiscoides* nymphs. 39, *Coloburiscoides* sp A; 40, *Coloburiscoides* sp B; 41, tibia of *Coloburiscoides* sp A; 42, tibia of *Coloburiscoides* sp B. Arrows indicate markings on apex and base of tibia.



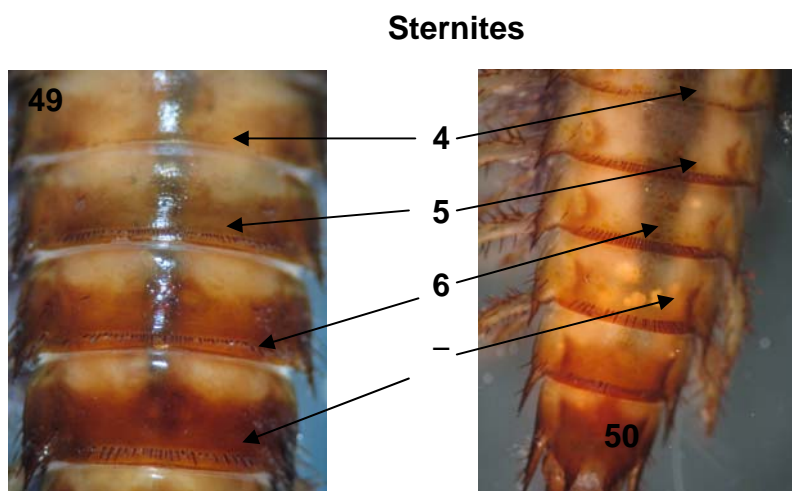
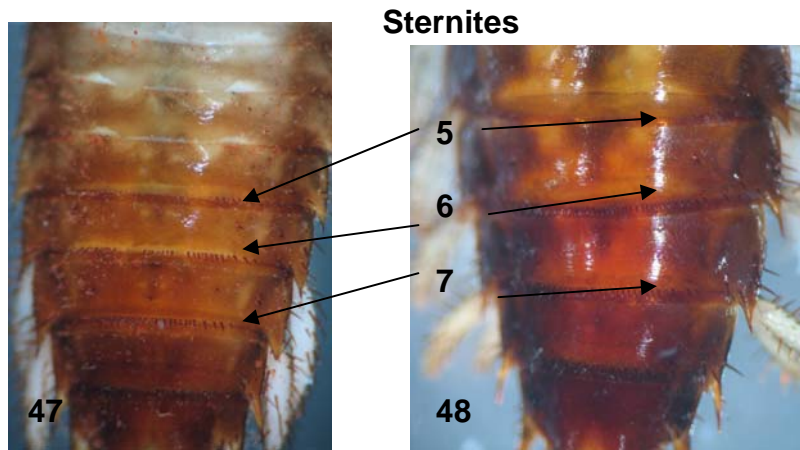
Figures 43-44. Mid femora of *Coloburiscoides* nymphs. 43, *Coloburiscoides* sp A; 44, *Coloburiscoides* sp B.



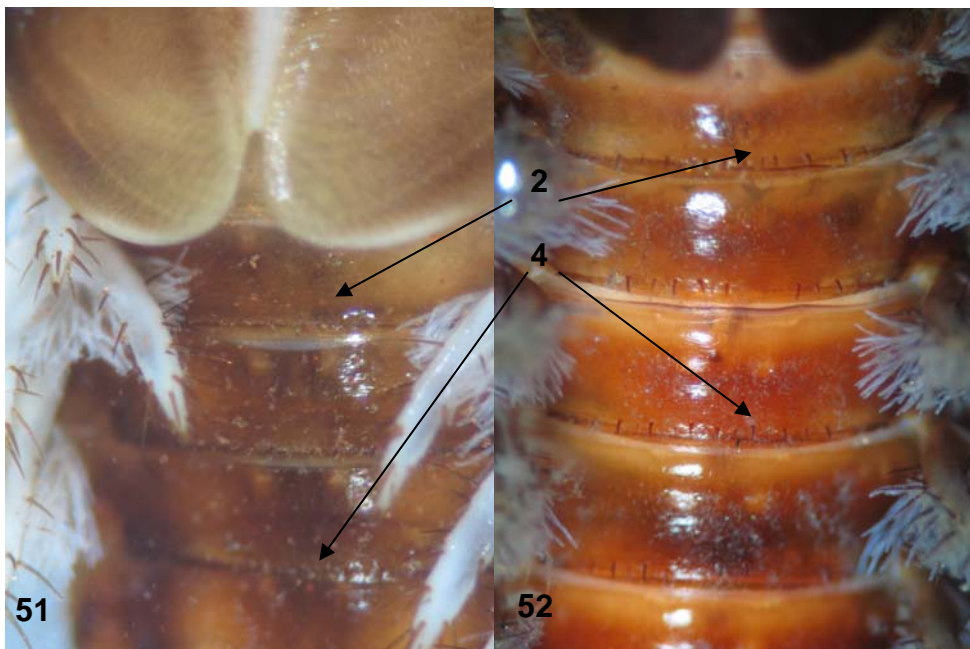
Figures 45-46. Spines on the posterior margins of abdominal sternites 7 and 8 of *Coloburiscoides* nymphs. 45, *Coloburiscoides* sp A; 46, *Coloburiscoides* sp B.

3. Mature nymph <17mm body length (max. length 16.5mm). Abdominal sternite 5 with <50 spines and sternite 6 with <45 spines (Figs 47-48). Abdominal tergites 2 and 3 with >20 spines on posterior margin (Fig. 51). Fore femora with 6-12 basal spines on dorsal margin, distal comb with 2-7 spines, ventral comb with 6-8 spines (Figs 53-54); fore tibiae with inner spine row with 9-14 spines (Figs 57-58); fore tarsi with 2-6 ventral spines. Mid femora with 13-37 spines in apical half between mid dorsal comb and distal margin (Figs 61-62). Hind femora with mid dorsal comb with 5-11 spines (Figs 65-66) .....4

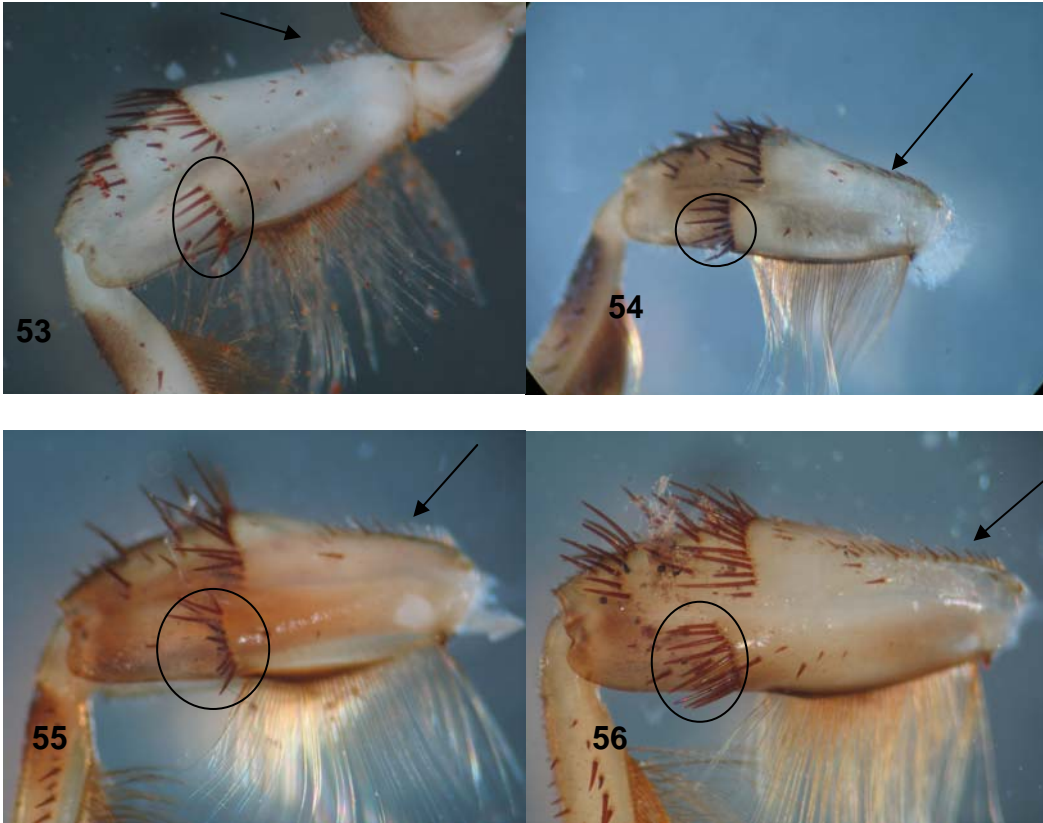
Mature nymph >18mm body length (max. length 22mm). Abdominal sternite 5 with >50 spines and sternite 6 with >40 spines (Figs 49-50). Abdominal tergites 2 and 3 with <15 spines on posterior margin (Fig. 52). Fore femora with 13-15 basal spines on dorsal margin, distal comb with 6-7 spines, ventral comb with 9-12 spines (Figs 55-56); fore tibiae with inner spine row with 13-22 spines (Figs 59-60); fore tarsi with 4-10 ventral spines. Mid femora with 27-35 spines in apical half between mid dorsal comb and distal margin (Figs 63-64). Hind femora with mid dorsal comb with 8-10 spines (Figs 67-68) ..... 5



Figures 47-50. Abdominal sternites of *Coloburiscoides* nymphs. 47, *Coloburiscoides munionga*; 48, *Coloburiscoides* sp D; 49, *Coloburiscoides giganteus*; 50, *Coloburiscoides* sp C.



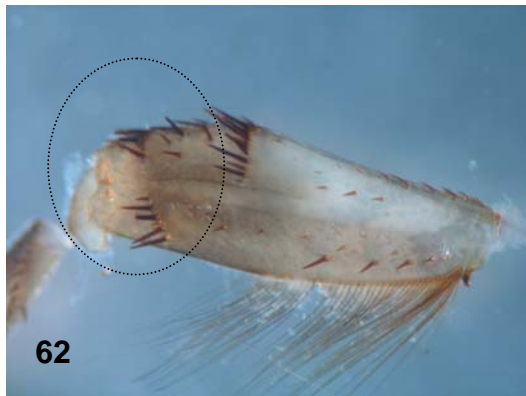
Figures 51-52. Abdominal tergites 2-4 of *Coloburiscoides* nymphs. 51, *Coloburiscoides munionga*; 52, *Coloburiscoides giganteus*.



Figures 53-56. Fore femora of *Coloburiscoides* nymphs. 53, *Coloburiscoides munionga*; 54, *Coloburiscoides* sp D; 55, *Coloburiscoides giganteus*; 56, *Coloburiscoides* sp C. Ventral comb circled, basal spines indicated by arrow.



Figures 57-60. Fore tibia of *Coloburiscoides* nymphs. 57, *Coloburiscoides munionga*; 58, *Coloburiscoides* sp D; 59, *Coloburiscoides giganteus*; 60, *Coloburiscoides* sp C. Inner spine row circled.



Figures 61-64. Mid femora of *Coloburiscoides* nymphs. 61, *Coloburiscoides munionga*; 62, *Coloburiscoides* sp D; 63, *Coloburiscoides giganteus*; 64, *Coloburiscoides* sp C. Apical spines circled.



Figures 65-68. Hind femora of *Coloburiscoides* nymphs. 65, *Coloburiscoides munionga*; 66, *Coloburiscoides* sp D; 67, *Coloburiscoides giganteus*; 68, *Coloburiscoides* sp C. Mid dorsal comb spines circled.



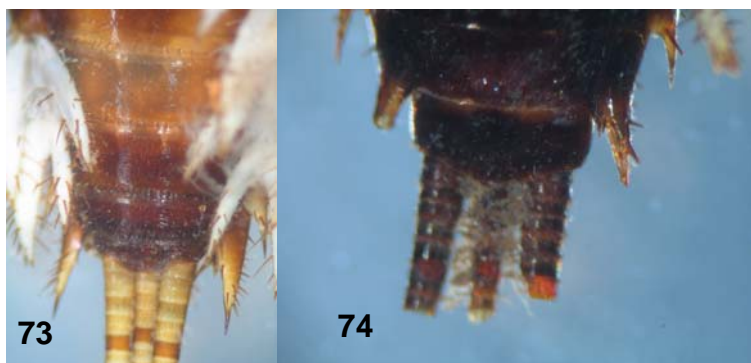
## Key to the mature nymphs of *Coloburiscoides*

4. Body dark brown with indistinct central stripe and lacking lateral markings on thorax; tergites of abdomen brown, may have lateral light patches (Fig. 69); sternites 1-2 white with lateral brown patches, segments 3-9 red brown with darker lateral margins (Fig. 71). Lateral projections of abdominal segment 9 1.3-2.0x segment 10 length (Fig. 73), segment 10 lacking spines on tergite. Tibiae of all legs banded with dark brown at apex and base (Fig. 75). Mesal margin of fore femora with 12-15 spines (Fig. 77); mesal margin of middle femora with 27-35 spines (Fig. 79). Posterior margin of abdominal tergites 6-8 with <20 spines (range 5-19) (Fig. 81). Distribution: South-eastern and inland NSW and Victoria. ....*Coloburiscoides munionga*

Body dark black/brown with distinct white central stripe and lateral markings around scutellum; tergites of abdomen black without light patches (Fig. 70); sternites 2-6 dark brown with 2 large light medial patches and 2 small postero-medial patches, sternites 7-9 dark red brown (Fig. 72). Lateral projections of abdominal segment 9 1.6-2.6x segment 10 length (Fig. 74), segment 10 with 2 medial spines on tergite. Tibiae of all legs banded with black at apex and base (Fig. 76). Mesal margin of fore femora with 2-3 spines (Fig. 78); mesal margin of middle femora with 13-14 spines (Fig. 80). Posterior margin of abdominal tergites 6-8 usually with >20 spines (range 8-44) (Fig. 82). Distribution – small forested streams/tributaries in the Goulburn and Yarra Catchments .....*Coloburiscoides* sp D



Figures 69-72. Colour patterns on the body of *Coloburiscoides* nymphs. 69, *Coloburiscoides munionga*, dorsal; 70, *Coloburiscoides* sp D, dorsal; 71, *Coloburiscoides munionga*, ventral abdomen; 72, *Coloburiscoides* sp D, ventral.



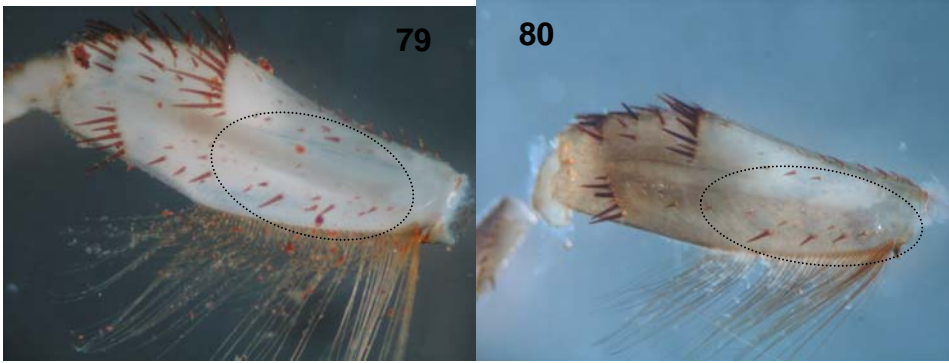
Figures 73-74. Abdominal tergites 9 and 10 showing postero-lateral projections on segment 9. 73, *Coloburiscoides munionga*; 74, *Coloburiscoides* sp D.



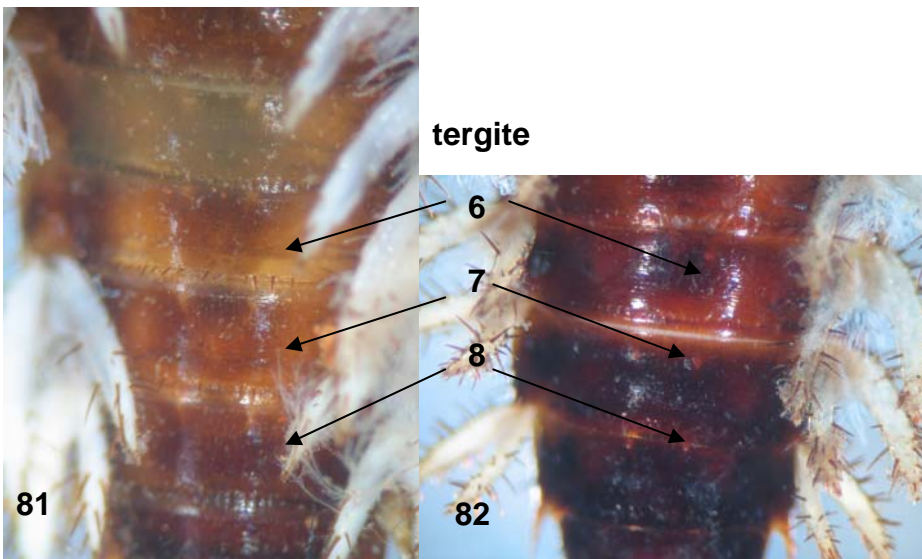
Figures 75-76. Fore tibiae of *Coloburiscoides* nymphs. 75, *Coloburiscoides munionga*; 76, *Coloburiscoides* sp D.



Figures 77-78. Fore femora of *Coloburiscoides* nymphs. 77, *Coloburiscoides munionga*; 78, *Coloburiscoides* sp D.



Figures 79-80. Mid femora of *Coloburiscoides* nymphs. 79, *Coloburiscoides munionga*; 80, *Coloburiscoides* sp D. Mesal margin spines circled.



Figures 81-82. Abdominal tergites 6-8 of *Coloburiscoides* nymphs. 81, *Coloburiscoides munionga*; 82, *Coloburiscoides* sp D.

5. Thorax lacking distinct markings, tergites of abdomen red-brown with posterior half darker than anterior half (Fig. 83). Abdominal sternite 4 with 5-8 posterior spines, sternite 6 with >45 posterior spines, sternite 8 with 15-21 posterior spines (Fig. 85). 9<sup>th</sup> abdominal tergite with 6-8 posterior spines, no dorsal-lateral spines on the 1<sup>st</sup> abdominal tergite (Fig. 87). Fore femora with 35-38 spines forward of mid comb (including distal and ventral combs) (Fig. 89). Mid femora length 2.4-2.8x width, 7-14 basal spines on dorsal margin, ventral comb with 5-6 spines, distal comb with 4-7 spines (Fig. 91); mid tibiae with 7-12 spines on outer margin (Fig. 93). Hind femora with 35-45 spines in front of mid comb, posterior dorsal margin with 14-16 spines, mesal margin with 60-63 spines (Fig. 95), hind leg ratio of 1.00 : 0.77 : 0.33. Distribution - Kosciuszko National Park .....  
.....*Coloburiscoides giganteus*

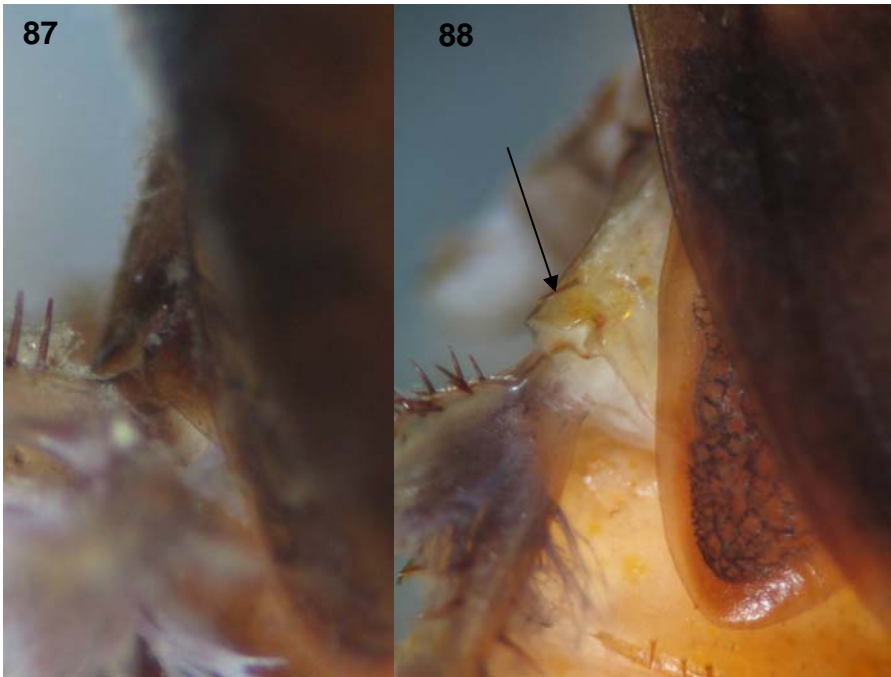
Thorax usually with a light circle around scutellum; tergites of abdomen with medial light patches on segments 2-7; darker red-brown on segments 8-10; sternites 1-6 bicoloured, light anteriorly, dark brown posteriorly, segments 7-9 dark brown (Fig. 84). Abdominal sternite 4 with >18 posterior spines, sternite 6 with approx. 40 posterior spines, sternite 8 with <10 posterior spines (Fig. 86). 9<sup>th</sup> abdominal tergite with 4-5 posterior spines, dorso-lateral spines present on 1<sup>st</sup> abdominal tergite (Fig. 88). Fore femora with 25-32 spines in front of mid comb (including distal and ventral combs) (Fig. 90). Mid femora length 2.8-3.0x width, 12-17 basal spines on dorsal margin, ventral comb with 3-4 spines, distal comb with 7-9 spines (Fig. 92); mid tibiae with 13-17 spines on outer margin (Fig. 94). Hind femora with 40-70 spines in front of mid comb, posterior dorsal margin with 9-12 spines, mesal margin with 36-42 spines (Fig. 96), hind leg ratio of 1.00 : 0.97 : 0.44. Distribution - Victorian Alps .....  
.....*Coloburiscoides* sp C



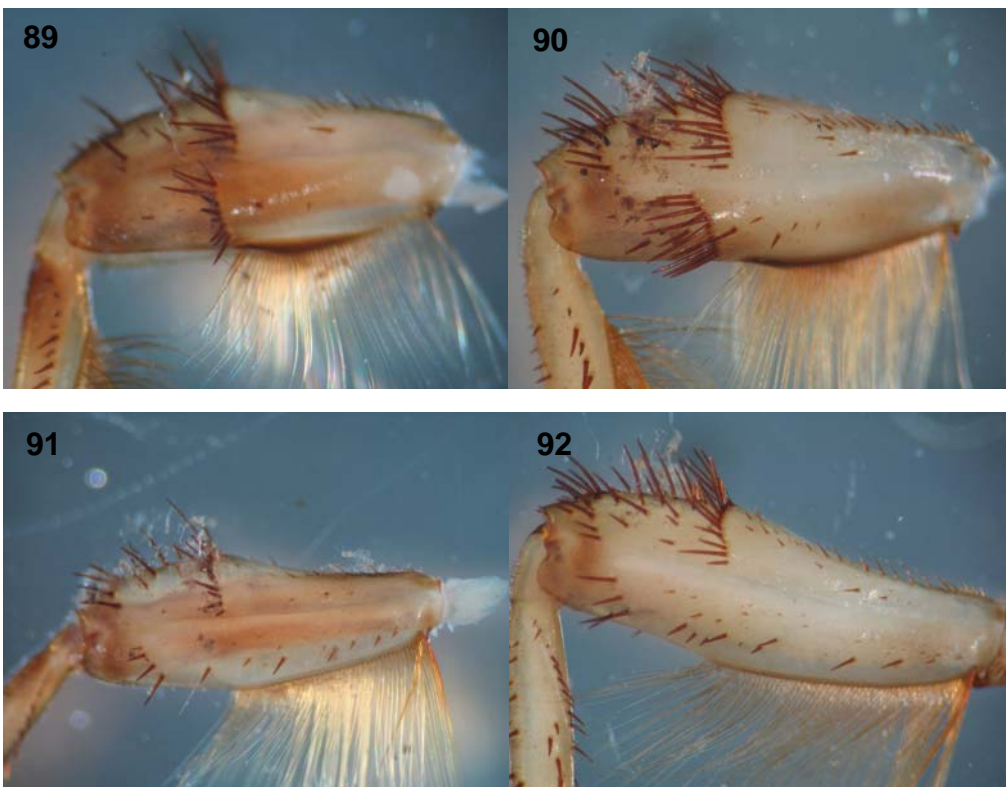
Figures 83-84. Dorsal view of *Coloburiscoides* nymphs. 83, *Coloburiscoides giganteus*; 84, *Coloburiscoides* sp C.



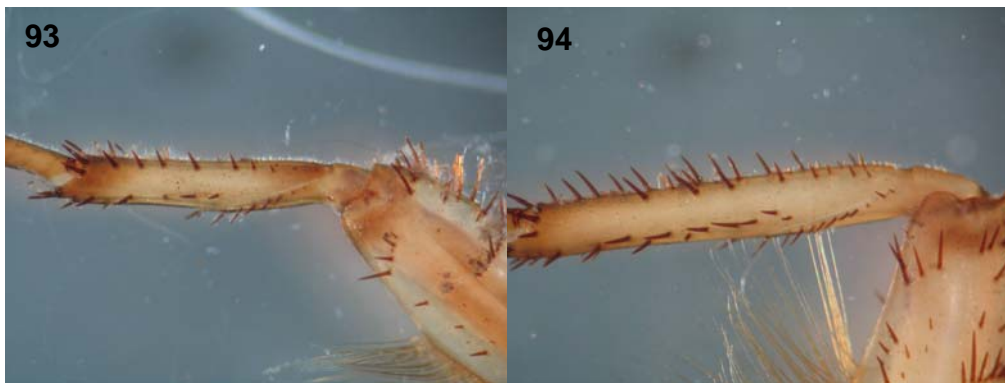
Figures 85-86. Ventral view of abdominal sternites of *Coloburiscoides* nymphs. 85, posterior spines on sternites 4-8 of *Coloburiscoides giganteus*; 86, posterior spines on sternites 4-8 of *Coloburiscoides* sp C.



Figures 87-88. Lateral margin of abdominal tergite 1 of *Coloburiscoides* nymphs. 87, *Coloburiscoides giganteus*; 88, *Coloburiscoides* sp C. Arrow indicates spine.



Figures 89-92. Fore and mid femora of *Coloburiscoides* nymphs. 89, Fore femur of *Coloburiscoides giganteus*; 90, Fore femur of *Coloburiscoides* sp C; 91, mid femur of *Coloburiscoides giganteus*; 92, mid femur of *Coloburiscoides* sp C.



Figures 93-94. Mid tibiae of *Coloburiscoides* nymphs. 93, *Coloburiscoides giganteus*; 94, *Coloburiscoides* sp C.



Figures 95-96. Hind femora of *Coloburiscoides* nymphs. 95, *Coloburiscoides giganteus*; 96, *Coloburiscoides* sp C.

## Distribution

*Coloburiscoides* nymphs have been recorded from streams draining the Australian Alps in Victoria and New South Wales and on Wilsons Promontory and Otway Ranges in Victoria. The number of sites shown in Figure 97 is greater than shown in the maps for individual species as many of the samples only contained juvenile nymphs which could not be identified. In addition, there are many samples from the Victorian EPA which we haven't examined using the current key.

Maps for the individual species that have limited records are provided for New South Wales (Fig. 98) and Victoria (Fig. 99) but the widespread *Coloburiscoides munionga* (Fig. 100) is provided separately.

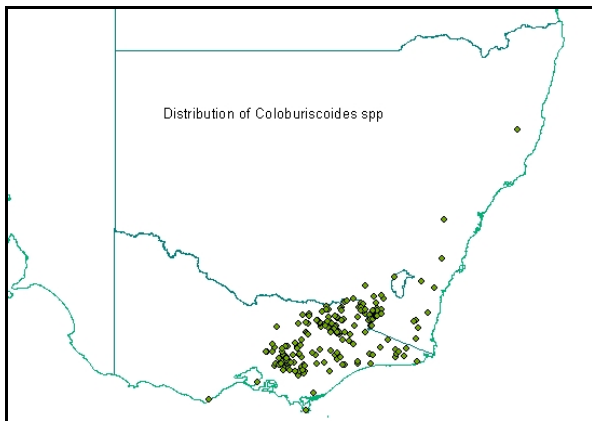


Figure 97. Location of sites from which *Coloburiscoides* nymphs have been recorded (Auslig 2001).

### New South Wales

#### *Coloburiscoides* sp A.

This species is the smallest species of *Coloburiscoides* and has only been found in the Murrumbidgee River downstream of Burrinjuck Dam at altitudes less than 300m. Nymphs have been recorded from gravel beds at Gundagai and in drift nets at Narrandera (Fig. 98). During irrigation releases from Blowering Dam this species can be found co-existing with *C. munionga*.

#### *Coloburiscoides* sp B.

This species was only recorded from a single collection from the Hastings River system in New South Wales at an altitude of 700m (Fig.98). This is the most northerly record of *Coloburiscoides*.

#### *Coloburiscoides giganteus*

This large species is almost restricted to streams in the Mt Kosciuszko National Park at high altitude (above 1000m) (Fig. 98). It may co-exist with *C. munionga*.

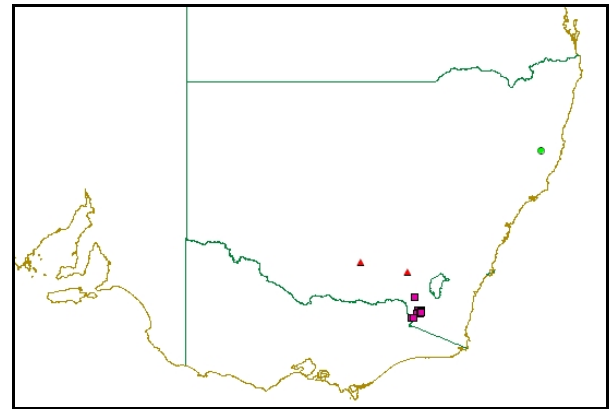


Figure 98. Location of sites where nymphs of *Coloburiscoides giganteus* (■), *Coloburiscoides* sp A (▲) and *Coloburiscoides* sp B (●) have been recorded (Auslig 2001).

### Victoria

#### *Coloburiscoides* sp C.

This species currently has been found at high altitude (above 675m) in streams on the Bogong High Plains and Mt Buller in the Victorian Alps (Fig. 99). *Coloburiscoides* sp C resembles *Coloburiscoides giganteus* in being generally greater than 18mm in body length. It occurs in streams from above the tree line to forested rivers draining the Alps, and often is associated with cobbles to boulder size substrate.

#### *Coloburiscoides* sp D.

This species is very distinctive being predominantly black. It has only been found in small forested streams that are tributaries of larger rivers eg Yarra and Acheron (Fig.99). In the main river channel immediately below the junction of such small tributaries it may be found co-existing with *Coloburiscoides munionga*.

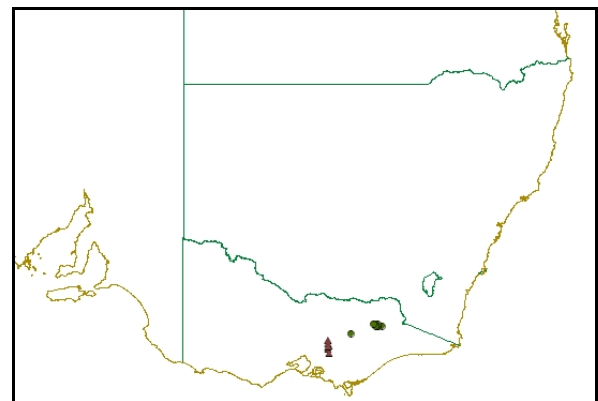


Figure 99. Location of sites in Victoria where nymphs of *Coloburiscoides* sp C (●), *Coloburiscoides* sp D (▲) have been recorded (Auslig 2001).

#### *Coloburiscoides munionga*

This species is the most widespread of all *Coloburiscoides* species. It generally is found in foothill streams at altitudes below 700m but also occurs at high altitude in the Kosciuszko National Park (Fig. 100).

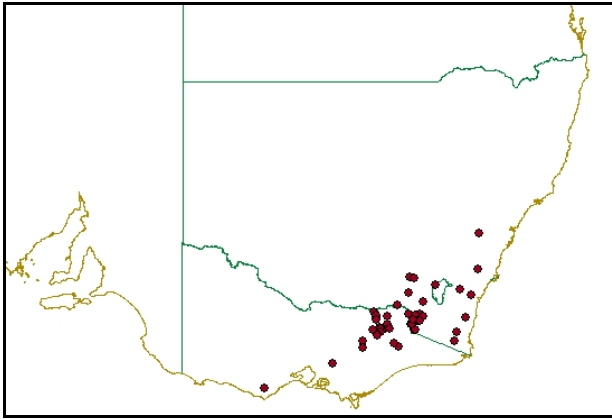


Figure 100. Location of sites where nymphs of *Coloburiscoides munionga* have been recorded (Auslig 2001).

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