

***Deleatidium kakahu*, new species of *Deleatidium* (Ephemeroptera: Leptophlebiidae) from New Zealand**

Terry R Hitchings¹ and Tim R Hitchings²

Canterbury Museum, 11 Rolleston Avenue, Christchurch 8013, New Zealand

¹Email: thitchings@internet.co.nz

²Email: trhitchings@canterburymuseum.com

The mayfly, *Deleatidium* (*Deleatidium*) *kakahu* sp. nov. from the central South Island and lower North Island is described. A description of the three principal life stages (nymph, subimago and imago) is included. Notes on ecology and distribution are given. Diagnostic characters of the species are illustrated and compared with similar species.

Keywords: *Deleatidium*, Ephemeroptera, Leptophlebiidae, mayflies

Introduction

The Leptophlebiidae are distributed worldwide and are the largest mayfly family found in New Zealand. The endemic genus *Deleatidium* currently comprises 20 species (Hitchings and Hitchings 2018; Pohe 2018) and was established by Eaton (1899). Further species were described by Phillips (1930) and Towns and Peters (1979, 1996) who also established two subgenera *Deleatidium* (*Deleatidium*) and *D.* (*Penniketellum*) in their latter paper. More recently, additional species have been added by Hitchings (2008, 2009, 2010) and by Hitchings and Hitchings (2016, 2018).

The imago, subimago and larva of a new species of *Deleatidium* from the South Island and lower North Island is described in this paper. Information is included to provide methods of distinguishing the new species from similar species and also habitat information.

Materials, Methods and Conventions

Late instar larvae of the new species were associated with subimagos and imagos by proximity and by rearing in aquaria. Specimens in all life stages are stored in 80% ethanol. Body, fore and hindwing lengths were measured

in millimetres with a microscope eyepiece graticule using an Olympus SZ40 microscope. Mean measurements are given in parentheses. Length ratios of the segments (femur: tibia: tarsomeres 1–5) are based on the length of the tibia. Collecting sites are grouped into regions of New Zealand using the two letter area code of Crosby et al. (1998). Those referred to in this paper are: MB, Marlborough; NN, Nelson; SC, South Canterbury; WN, Wellington; and WA, Wairarapa. Map references are given as latitude and longitude in decimal degrees. Altitudes are given in metres above sea level. All material is held at Canterbury Museum, Christchurch (CMNZ) and the Arthropod Collection, Landcare Research, Auckland (NZAC).

Systematics

Order: Ephemeroptera Hyatt & Arms, 1891

Family: Leptophlebiidae Banks, 1900

Genus: *Deleatidium* Eaton, 1899, as diagnosed by Towns & Peters 1996: 27–29

Subgenus: *Deleatidium* (*Deleatidium*) Towns & Peters, 1996, as diagnosed by Towns and Peters 1996: 30

***Deleatidium (Deleatidium) kakahu* sp. nov.**

Description: Dimensions (mm). Imago male: length of body 7.0–8.0 (7.5); forewings 7.6–10.5 (8.3). Imago female: length of body 6.9–7.9 (7.4); forewings 8.1–9.5 (8.6). Mature larva: length of body 7.6–9.5 (8.0).

Male imago: Head dark brown to whitish, pedicel and antennal scape pale brownish, flagellum white; eyes in contact in the mid-line with their upper portion yellow and lower portions greyish black. Thorax. Pronotum and mesonotum yellowish brown, darker at the margins, the latter with three narrow parallel longitudinal median and submedian marks; metanotum and scutellum yellowish brown; thoracic pleura and sterna pale brown, each with a greyish brown well defined macula; legs yellowish white. Length ratios of male imaginal foreleg segments 1.33: 1.00: 0.039: 0.060: 0.060: 0.070: 0.070. Pretarsal pad without an apical hook. Wings. Forewing (Fig. 1A): membranes hyaline, width 0.34 (0.31–0.36) x length; longitudinal and cross veins uniformly uncoloured; membranes of cells C and Sc pale greyish brown; bullae weakly marked at

midlength in veins Sc, R2, R4+5 but barely visible on R1. Veins C and Sc without crossveins in basal half. Vein ICu connected at base to CuA and CuP. Crossveins of C and Sc absent from basal half of the forewing. Hindwing (Fig. 1B): width 0.51 (0.44–0.60) x length; length 0.27 (0.23–0.31) x that of forewing; vein Sc 0.95–0.96 (0.96) x length of forewing. Abdomen (Figs. 2A and 2B). Dorsal surface without, or almost without a mid-dorsal longitudinal line, darker brown posterolateral margins sharply defined on segments 1–6, less so on 7–9. Submedian paired brownish marks on segments 1–5. Each tergum with brownish lateral margin which includes a short dark brown diagonal stripe. Each tergum darker posteriorly. Sternum 7 with strongly pigmented blackish ganglion. Other ganglia more lightly pigmented. Genitalia (Fig. 3A) in ventral view with paired, almost colourless penes, the apices of which are hemispherical, fused, narrowed sub apically and expanded basally. Paired, asymmetrically tapered appendages project posteriorly at about 45 degrees close to the midpoint of the penes (Fig. 3B) and angled at about 45 degrees posteriorly to the shaft of the penes. Styliiger plate with a shallow median cleavage. Each forceps bears a cluster of

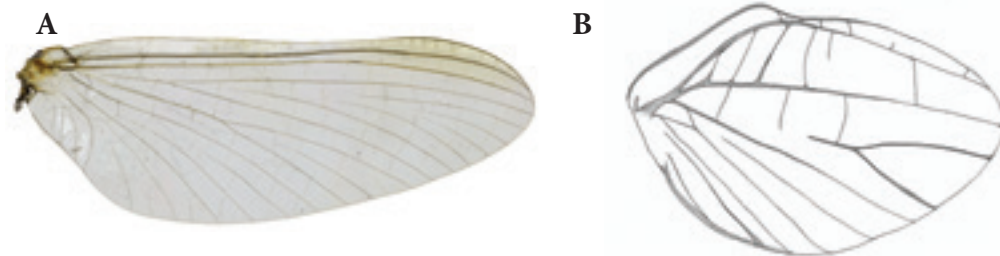


Figure 1. Male imago. A, forewing. B, hindwing

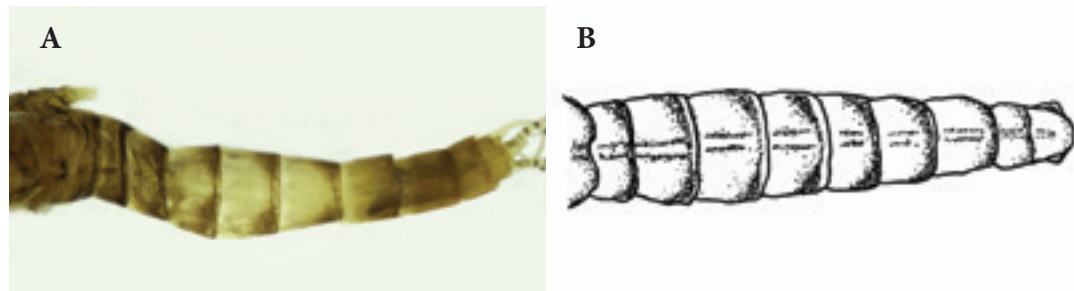


Figure 2. Male imago dorsal surface (distorted). A, photograph. B, drawing (antennae and caudal filaments truncated)

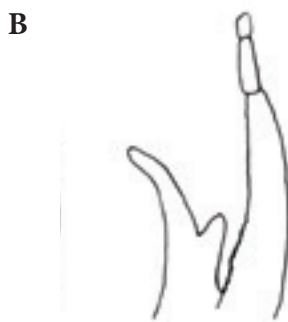
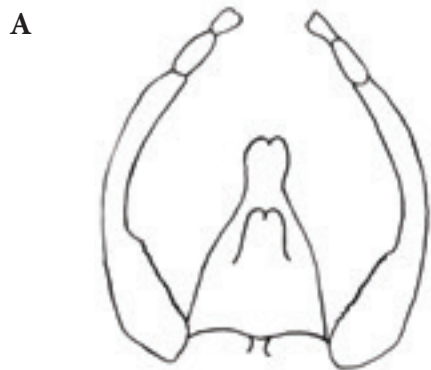


Figure 3. Male genitalia. **A**, lateral view. **B**, ventral view



Figure 4. Female imago forewing venation



Figure 5. Male subimago forewing venation



Figure 6. Mid instar larva: dorsal view

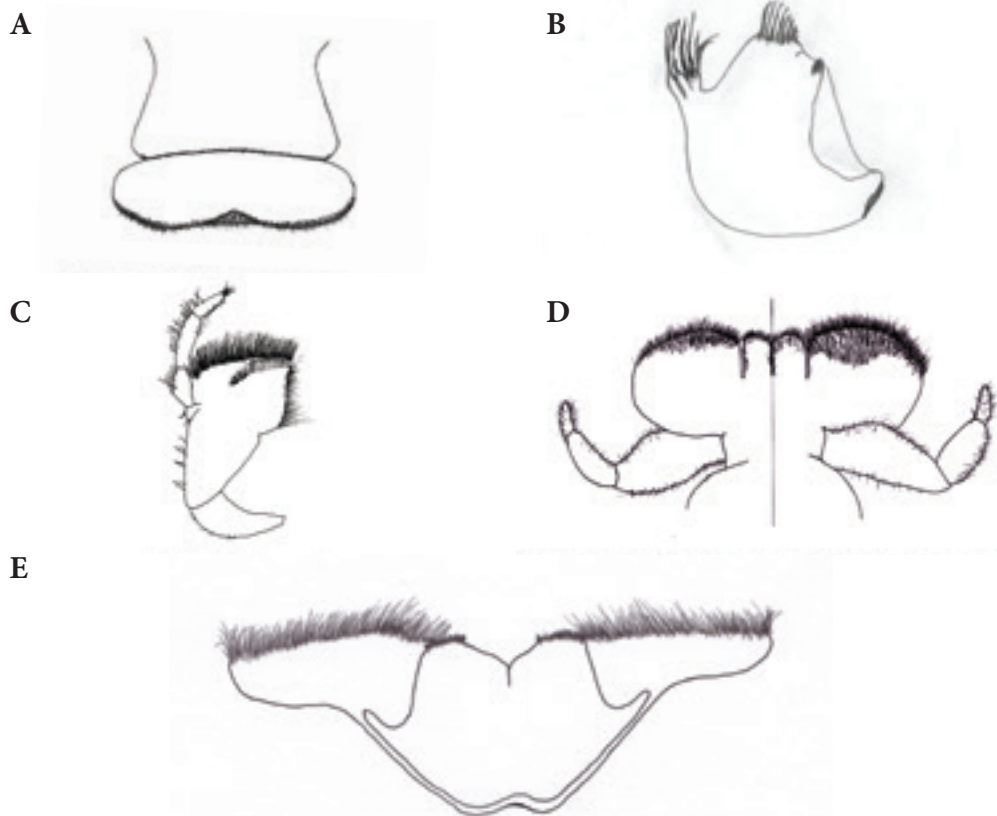


Figure 7. Larval mouthparts. **A**, clypeus and labrum. **B**, left mandible. **C**, right maxilla. **D**, labium in dorsal (left) and ventral (right) views. **E**, hypopharynx

10–15 short basal spines. Caudal filaments 0.94 cm, long, pale grey, of similar length and tending darker at the articulation of the annulations.

Female imago: As in the male, except as follows: eyes black and separated by about twice the width of the eye. Femora pale yellowish white and without markings. Forewing (Fig. 4): width 0.30–0.36 (0.34) x length; membranes of cells C and Sc greyish in apical half. Veins brownish. Hindwing width 0.44–0.65 (0.55) x length and length 0.19–0.23(0.22) x that of the forewing.

Dorsal abdomen with the abdominal longitudinal line more clearly defined line than the male. Sternum 9 with a widened, v-shaped cleft.

Subimago: Male and female as in the imago except as follows: male head whitish between the eyes; upper portion of eyes yellowish white, lower portion black. Female eyes blackish. Pronotum yellowish with paired submedian brown lateral marks; mesonotum with paired median longitudinal marks and paired brownish yellow submedian lateroparapsidal sutures; metanotum whitish, darker laterally. Pleura whitish with brown margins. Ventral thorax and abdomen whitish, darker at the posterolateral margins. Ventral abdominal ganglia brownish, visible on sternum 7, less so on sterna 3–6. Legs whitish. Wing (Fig. 5) membranes brownish grey, veins of cells Sc and R1 darker. Dorsal abdominal segments whitish, with well-defined central longitudinal mark and dark brown



Figure 8. Abdominal gills 1, 4 and 7

posterolateral margins; each segment with a small lateral brownish macula. Male genitalia: penes whitish and fused to rounded apices and with bluntly pointed ventral appendices at midlength; distal portion of each penis angled about 45 degrees posteriorly. Female: sternum 9 emarginated as for female imago.

Larva: Mid instar larva (Fig. 6). Head brown; upper portion of male eyes brownish, darker at the margins, lower portion black; female eyes blackish. Antennae 1.3–2.5 mm long. Mouth parts: Labrum 0.72 x as long as clypeus and 1.09 x as wide (Fig. 7A). Anteromedian emargination with irregular spines. Notum yellowish-brown with borders and lateroparapsidal sutures darker; left mandible (Fig. 7B); right maxilla (Fig. 7C). Galealacinia with sub-apical row of about 20 spines; palp segment 2 1.4 x as long as segment 1; segment 3 0.7 x as long as segment 2; labium in dorsal (left) and ventral (right) views (Fig. 7D); palp

segment 2 0.75–0.86 (0.81) x as long as segment 1; segment 3, 0.50–0.75 (0.63) x as long as segment 2; hypopharynx (Fig. 7E). Thorax. Notum yellowish brown with margins and latero-paracidal sutures darker. Femur 1 with basal whitish macula. Dorsal abdomen without, or with only a faint longitudinal median line; segments uniformly yellowish brown, each with darker transverse posterior marking. Sterna whitish. Ventral abdomen pale yellowish, with ganglion darkened on sternum 7 but less so on preceding sterna. Posterolateral projections present on segments 3–9. Abdominal gills single, translucent, longer than wide and with numerous blackish tracheae; apices pointed. Gill 1 generally ovate with a small ventral lobe and a very small point apically. Gill 7 not folded ventrally. Some gills may have apical points drawn out (Fig. 8).

Holotype: Male imago, SC, Kakahu River, -44.154, 171.097, 110 m, 3 January 2002, JB & GM Ward (CMNZ 2021.33.1).

Allotype: Female imago (reared), SC, Kakahu River, -44.151, 171.000, 96 m, 16 February 2019, Tim R Hitchings, (CMNZ 2021.33.2).

Paratypes: Male imago, MB, Pelorus River, -41.301, 173.569, 30 m, 7 January 2016, C Vink (CMNZ 2021.33.3); 1 male imago, SC, Kakahu River, -44.154, 171.097, 110 m, 3 January 2002, JB & GM Ward (CMNZ 2021.33.4); 1 male imago, SC, Kakahu River, -44.154, 171.097, 110 m, 3 January 2002, JB & GM Ward (CMNZ 2021.33.5); 1 male imago, SC, Kakahu River, -44.154, 171.097, 110 m, 3 January 2002, JB & GM Ward (CMNZ 2021.33.6); 1 male subimago, NN, Anatoki River, One Speck Road, -40.867, 172.798, 15 m, 11 December 2011, JB & GM Ward (CMNZ 2021.33.7); 1 male subimago, MB, Pelorus/Tinline Rivers, -41.315, 173.503, 80 m, 31 January 2004, TR Hitchings (CMNZ 2021.33.8); 1 female subimago (reared), SC, Kakahu River, -44.151, 171.090, 112 m, 28 October 2019, Tim R Hitchings (CMNZ 2021.33.9); 2 larvae, SC, Kakahu River, -44.1537, 171.0947, 110 m, 21 January 2018, TR Hitchings (CMNZ 2021.33.10, CMNZ 2021.33.11); 1 larva, SC, Totara Creek tributary, -44.229, 170.956, 151 m, 16 December 2018, Tim R Hitchings (CMNZ 2021.33.12). Mouth parts on slide.

Other material examined: 3 female subimagos, SC, Kakahu River, -44.154, 171.097, 110 m, 3 January 2002, JB and GM Ward (CMNZ 2021.33.13, CMNZ 2021.33.14, CMNZ 2021.33.15); 2 larval exuviae, SC, Raincliff Stream tributary, -44.140, 170.964, 177 m, 11 December 2018, Tim R Hitchings (CMNZ 2021.33.16, CMNZ 2021.33.17); 1 female subimago plus exuvia, SC, Kakahu River, -44.151, 171.090, 112 m, 28 October 2019, Tim R Hitchings (CMNZ 2021.33.18); 1 larva, WN, Waiohine River, -41.006, 175.402, 140 m, 23 February 2020, MFJ Hitchings (CMNZ 2021.33.19); 2 larvae, WA, Kiriwhakapapa Stream, -40.8085, 175.544, 310 m, 10 April 2003, TR Hitchings (CMNZ 2014.2.24524, CMNZ 2014.2.24525); 1 male subimago plus exuvia (reared), SC, Kakahu River, -44.151, 171.090, 112 m, 11 January 2020, Tim R

Hitchings (CMNZ 2021.33.20); 1 female imago plus exuvia (reared), SC, Kakahu River, -44.151, 171.090, 112 m, 11 January 2020, Tim R Hitchings (CMNZ 2021.33.21).

Diagnosis

The larva of *Deleatidium kakahu* resembles that of *D. autumnale* but the latter has all gills rounded and all ganglia pigmented. Also, *D. autumnale* does not have a dark band across the posterior margin of most abdominal terga. *Deleatidium kakahu* has a small point on gill 1 and the other gills are variably pointed, the proximal abdominal ganglia are hyaline and there is often a dark band across the posterior margin of most terga. In the subimago, the forewings of *D. kakahu* have no darker clouds at the crossveins and each of the abdominal terga 2–7 have a short, dark brown, diagonally sloping lateral mark. In the male imago of *D. kakahu*, the fused penes also have fused ventral appendages, whereas in the female, diagonal lateral tergal marks are present.

Its larva also resembles that of *D. fumosum*, which may be distinguished by posterolateral abdominal projections on segments 4 or 5 to 9, a rounded first gill and pale proximal and distal macules on the first femur. In contrast, *D. kakahu* has posterolateral projections on segments 2 or 3 to 9, a small point on gill 1 and a single proximal macula on the first femur. *Deleatidium fumosum* also has prominent dark maculae on terga 2 to 8 but terga 5, 6 and 7 are more weakly pigmented than the others. *Deleatidium kakahu* has terga without a pigmented pattern except for a dark posterior band.

The larvae of *D. kakahu* can also be distinguished from *D. vernale* by the absence of strongly pigmented maculae and connectives on the thoracic and abdominal ganglia. The dorsal abdomen of the larva of *D. kakahu* is relatively uniform in colouring and lacks a median whitish longitudinal line.

D. kakahu can be distinguished from *D. lillii* by the length of gill 1, which, in *D. lillii*, is greater than its width and also the presence of elongated apical filaments on some of the gills in *D. kakahu*,

where this is not the case in *D. lillii*.

The imagos of *D. kakahu* may be confused with those of *D. branchiola*, but can be distinguished by the following features shown by the imago of *D. branchiola*: in the forewing, yellowish colouration of the longitudinal and crossveins, a bulla at the junction of Sc, R2 and R4+5, and also vein ICu1 being basally connected to CuP as well as ICu. In the male of *D. branchiola* the penes have sharp-pointed ventral appendages but in *D. kakahu* these are rounded.

Distribution

The present known range of *D. kakahu* includes the foothills region of South Canterbury (SC) between Geraldine and the Raincliff River, including the Kakahu Forest. Specimens, identified as the same species, have also been collected from the Pelorus (MB) and Anatoki Rivers (NN) in the northern South Island. In the North Island, specimens have been collected from the Waiohine River on the eastern side of the Tararua Range (WN) west of Masterton and Kiriwhakapapa Stream in the Wairarapa (WA).

Habitat

All presently known collecting sites for *D. kakahu* have been less than 320 metres above sea level. Alpine streams in south and mid Canterbury have, up to the present, not revealed further specimens. It is possible that the species has an isolated distribution, confined largely to low altitude bouldery stretches of strong-flowing water flowing through beech and mixed podocarp forested foothills. The habitats of outlying populations are similar.

Etymology

The species name is derived from the Māori *kākahu*, a cloak or covering, and has been applied to the forested area from which the species was first collected.

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References

- Crosby TK, Dugdale JS, Watt JC. 1998. Area codes for recording specimen localities in the New Zealand subregion. *New Zealand Journal of Zoology* 25: 175–183.
- Eaton AE. 1899. An annotated list of the Ephemeroidea of New Zealand. *Transactions of the Entomological Society of London* 1899: 285–293.
- Hitchings TR. 2008. A new species of *Deleatidium* (*Penniketellum*) and the adult of *D. (P.) cornutum* Towns and Peters (Ephemeroptera: Leptophlebiidae) from New Zealand. *Records of the Canterbury Museum* 22: 31–43.
- Hitchings TR. 2009. Three new species of *Deleatidium* (*Deleatidium*) (Ephemeroptera: Leptophlebiidae) from New Zealand. *Records of the Canterbury Museum* 23: 35–50.
- Hitchings TR. 2010. Two new species of *Deleatidium* (*Deleatidium*) (Ephemeroptera: Leptophlebiidae) from the South Island, New Zealand. *Records of the Canterbury Museum* 24: 27–38.
- Hitchings TR, Hitchings TR. 2016. Two further species of *Deleatidium* (*Deleatidium*) (Ephemeroptera: Leptophlebiidae) from New Zealand. *Records of the Canterbury Museum* 30: 52–64.
- Hitchings TR, Hitchings TR. 2018. Two new species of *Deleatidium* from the central North Island of New Zealand. *Records of the Canterbury Museum* 32: 5–15.
- Phillips JS. 1930. A revision of New Zealand Ephemeroptera. Part 2. *Transactions and Proceedings of the New Zealand Institute* 61: 335–390.
- Pohe SR. 2018. An annotated checklist of New Zealand mayflies (Ephemeroptera), 2018. *New Zealand Natural Sciences* 43: 1–20.
- Towns DR, Peters WL. 1979. New genera and species of Leptophlebiidae (Ephemeroptera) from New Zealand. *New Zealand Journal of Zoology* 6: 439–452.
- Towns DR, Peters WL. 1996. Leptophlebiidae (Insecta, Ephemeroptera). *Fauna of New Zealand* 36: 1–144.