Nesameletus staniczeki, a New Species of *Nesameletus* (Ephemeroptera: Nesameletidae) from New Zealand

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A new species of endemic mayfly from the genus *Nesameletus* is described from the South Island of Aotearoa New Zealand. The adult, subimago and larval stages of *Nesameletus staniczeki* sp. nov. are described and a distribution map of known localities is provided. General habitat information of the species and an updated key for *Nesameletus* is provided. Diagnostic characters of the genus are provided with reference to the classification of the Nesameletidae.

Keywords: Aotearoa New Zealand, Ephemeroptera, identification key, *Nesameletus*, taxonomy

Introduction

The family Nesameletidae is of southern hemisphere distribution and includes the following three genera: *Ameletoides* Tillyard, 1933 from Australia, *Metamonius* Eaton, 1885 from South America and *Nesameletus* Tillyard, 1933 from Aotearoa New Zealand. *Nesameletus* was revised by Hitchings and Staniczek (2003) and three new species were described. Five species of *Nesameletus* are presently described and at least one undescribed species is known from Fiordland (see Grainger et al. 2018; Pohe 2019). Canterbury Museum mayfly collection data are published to data aggregators, the Atlas of Living Australia (ALA) and the Global Biodiversity Information Facility (Canterbury Museum 2021). This paper describes another species, *Nesameletus staniczeki* sp. nov., known from inland Canterbury and the West Coast of the South Island.

Materials, Methods and Conventions

Larvae were associated with adults by proximity and by rearing. Specimens, including the type specimens, are stored in 80% ethanol. All material examined is deposited at Canterbury Museum, Christchurch, New Zealand (CMNZ), and provided with an accession number prefixed with CMNZ followed by a tripartite number separated by a period in parentheses.

All body and wing measurements are in millimetres (mm) and presented as a range with means in parentheses. Length ratios of foreleg segments (femur: tibia: tarsomeres 1–5) are based on absolute lengths (mm) of tibia.

Collecting sites follow the abbreviated geographical regional codes of Crosby et al. (1998). Regions referred to in this paper are as follows: MB, Marlborough; KA, Kaikōura; BR, Buller; NC, North Canterbury; MC, Mid Canterbury; SC, South Canterbury; MK, Mackenzie; WD, Westland. The abbreviation APNP refers to Arthur's Pass National Park. Map references are given as latitude and longitude in decimal degrees (Geodetic Datum: WGS84). Altitudes are given in metres (m) above sea level.

Abbreviations of collection sites of material examined are given: Ck – creek; R – river; Stm – stream; Trib – tributary. Abbreviations of collectors: TRH – Tim R Hitchings; SFW – Simon F Watson; RH – Richard Hitchings; TH – Terry Hitchings; GT – Gillie Temm.

Abbreviations for taxonomic features shown in figures are given here: pe – penis; sty – styliger; stp – styliger plate; tf – terminal filament; ce – cerci; spg – subgenital plate; str – sternite; clp – clypeus; lbr – labrum; inc – incisor; prtc – prostheca; mlrsrf – molar surface; galc – galeolacinia; pmx – maxillay palp; gl – glossa; pgl – paraglossa; plb – labial palp; prmt – prementum; pmt – postmentum.

Systematics

Order: Ephemeroptera Hyatt and Arms, 1891
Family: Nesameletidae Kluge et al., 1995
Genus: *Nesameletus* Tillyard, 1933 as diagnosed by Hitchings and Staniczek (2003): 15–18

Keys to *Nesameletus* species at Imago and Larva life stages

Keys to the imago and larva life stages of *Nesameletus* presented here are modified from Hitchings and Staniczeki (2003) to include *Nesameletus staniczeki* sp. nov.

Imago

1 Forewing in its distal ½ with pterostigmatic region without clustering of crossveins between Sc and R_1 ..... **2**
Forewing in its distal ½ with pterostigmatic region showing clustering of crossveins between Sc and R_1 ..... **4**

2 Bullae of forewing surrounded by dark blotches of pigmentation and thus conspicuous **3**
Bullae of forewing without blotches of pigmentation and thus inconspicuous, first femur with a dark band ..... *austrinus*

3 In male, penis separated by a narrow v shaped margin at mid length. Stripe of pigmentation centrally along each penis, first femur without a dark band ..... *vulcanus*
In male, penis separated by wide v shaped notch at mid length. Dark brown pigmentation at lateral and apical margins, first femur with a darkening at mid length ..... *staniczeki*

4 Clustered crossveins in the pterostigmatic region of forewing between R_1 and R_2 thinner than crossveins between Sc and R_1 ..... *ornatus*
Clustered crossveins in the pterostigmatic region of forewing between R_1 and R_2 at least as thick as crossveins between Sc and R_1 ..... **5**

5 Pterostigmatic region of forewing tinted reddish; crossveins between C and Sc in this region reticulated ..... *murihiku*
Pterostigmatic region of forewing neither tinted reddish nor with many reticulated crossveins ..... *flavitinctus*

Late instar larva

1 Abdominal ganglia strongly pigmented and thus well visible through sterna of segments III–VIII ..... *austrinus*
Abdominal ganglia at most pigmented on sterna 5–8 ..... **2**

2 Posterior borders of abdominal terga 8–9 only with transverse row of spines present (small number of spines present on terga 7 sometimes) **3**
Posterior borders of abdominal terga 5–9 at least with well-developed transverse row of spines present **4**

3 Posterior borders of abdominal terga 8 and 9 only with well-developed transverse row of spines. Dorsal abdomen with larger white maculae along midline, giving appearance of a continuous pale line ..... *vulcanus*
Posterior borders of abdominal terga 8 and 9 with irregular transverse row of spines. Dorsal abdomen with smaller white maculae along midline that does not give appearance of a continuous pale line ..... *staniczeki*

4 Without dark patches or longitudinal marks on femur I ..... *murihiku*
With dark patches or longitudinal marks on femur I **5**

5 Caudal filaments with distinct dark medial band; labium with several stout spines on postmentum shoulder ..... *ornatus*
Caudal filaments rarely with distinct dark medial band; labium without stout spines on postmentum shoulder ..... *flavitinctus*

***Nesameletus staniczeki* sp. nov.**

Description: Measurements (mm). Male imago (single specimen): length of body 16.4; forewing 16.1; hindwing 7.2. Female imago (n = 6): body length 14.3–17.4 (15.8); forewing 15.5–16.9 (16.6); hind wing 5.6–7.7 (6.7). Male mature larva (n = 10): body length 12.0–15.0 (13.8). Female mature larva (n = 3): body length 14.6–16.5 (15.4).

Male imago: Head. Pale grey, ocelli whitish, dark brown to blackish at bases, eyes grey, darker below, antennal scape pale grey. Thorax. Pronotum pale yellowish grey with paired paler marks at anterior margin, darker at lateral margins; notum generally greyish white with fine pale longitudinal centreline; distal margin pale grey, extended and with paired dark brown maculae. Pleura yellowish grey with dark brown margins. Thoracic sterna reddish white. Legs. Generally pale yellowish white; first femur slightly darker at mid length; first tibiae and tarsi dark brown; articulation of the femora with tibiae and subsequent tarsal joints darker. Length ratios of the foreleg segments: 1.00: 0.85: 0.27: 0.46: 0.38: 0.35: 0.23. Wings. Forewing (Fig. 1A). Width 0.31 x length. Forewing cells C and Sc translucent, faintly brownish apically, otherwise hyaline. All veins brown with thickening diminishing from costa to dorsum. In the pterostigmatic region each row of crossveins between Sc, R_1 and R_2 similarly spaced; little reticulation between C and Sc only. The Sc and R_2 bullae ampoule-like, with dark brown cell wall and paler brownish clouding within. Third and fourth bullae may be visible on veins R_{4+5} and at the fork of M, approximately in line with the others, but without clearly defined cell walls. Both veins R_{3a} and R_{3b} basally connected. Hindwing (Fig. 1B). Width 0.51 x length and length 0.43 x that of forewing, as described for the genus (Hitchings and Staniczek 2003). Abdomen (Fig. 2). Terga each faintly brownish with a slightly darker longitudinal centre line. A transverse posterior dark brownish band on all segments. Tergum 9 paler. Sterna greyish brown, dark brown abdominal ganglia visible on sternum 8 and sometimes 7. Genitalia (Fig. 3A and 3B). Penes greyish brown, fused, then separated at mid length by a wide v-shaped notch. The apex of each penis further extended laterally, rounded and darkened on lateral and apical margins. Styliger plate with a wide v-shaped emargination and rounded apices. In lateral view each penis tapering to a rounded apex, without appendages and indented slightly at mid length. Caudal filaments yellowish white, each annulation darker distally.

Female imago: As in the male except as follows: Eyes blackish grey, head pale grey. Thorax. As for male. Legs. Tibiae and

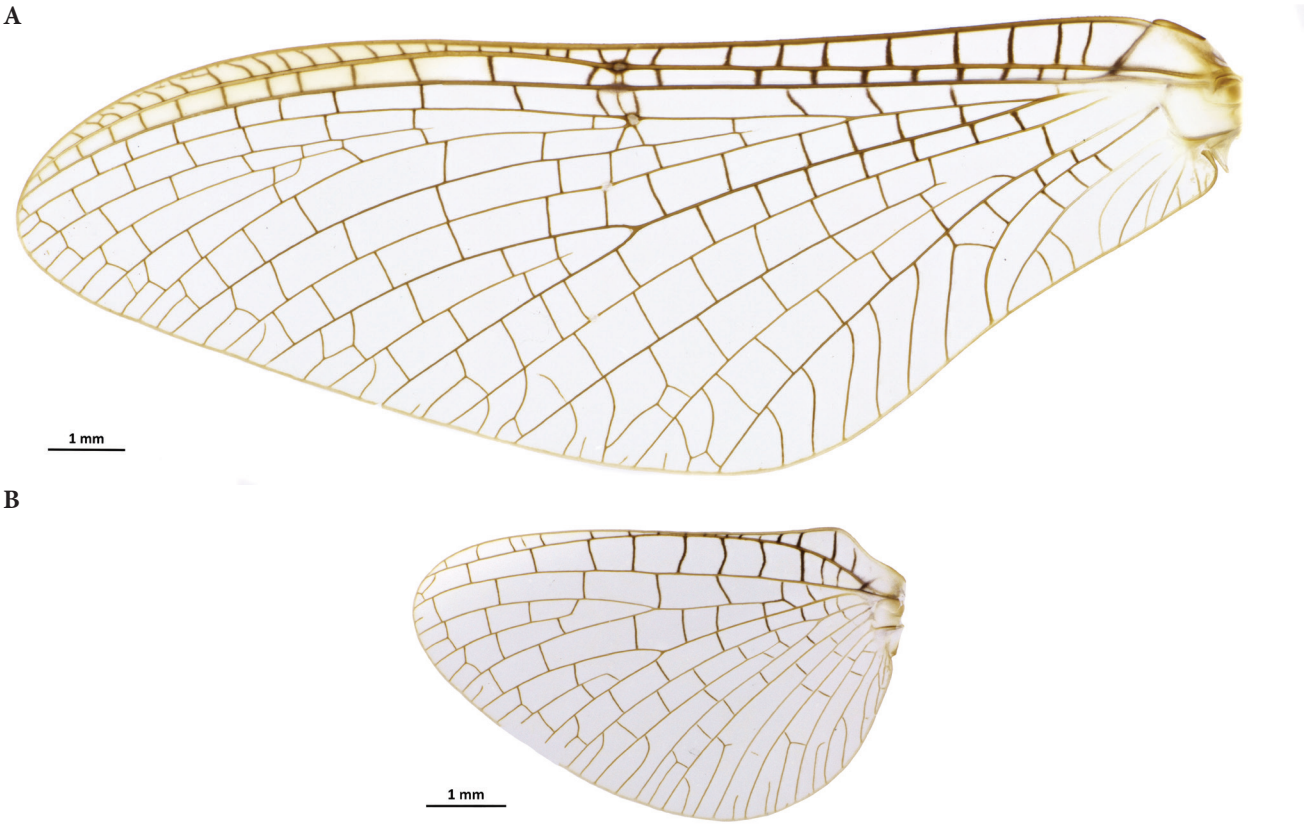

Figure 1. Forewing (**A**) and hindwing (**B**) of male imago

tarsi similar to femora but with each segment darkening distally. Wings. Forewing: Width 0.36 x length. Hindwing: width 0.53 x length and length 0.37 x that of forewing. Forewings brownish apically almost without reticulation in cells C and Sc. Bullae clouded and present on veins Sc, R_1 and R_2 as in the male imago. Abdomen as for male, except: terga with darker longitudinal centreline marked on segments 7–9. Sterna and abdominal maculae as in male. Genitalia (Fig. 4A and 4B). Sternum 7 with triangular subgenital plate extending about one quarter the length of sternum 8. Sternum 9 with v-shaped, basally rounded emargination and rounded apices.

Female subimago: As in the imago except as follows: Eyes of the male and female greyish black. Anterior portion of the lateral scutal suture washed with dark brown. Scutum and scutellum whitish. Pleura and sterna whitish with margins brownish. Posterior extension of metanotum with paired parallel brownish marks. Abdominal terga 1–8 pale brownish, each with dark brown posterior transverse bands. Tergum 9 whitish. Sterna whitish with a macula well marked on sternum 7 but less so on the other segments. Wings. Forewing (Fig. 5A): membranes translucent; longitudinal and crossveins dark brown; faint clouding at crossveins, most noticeable near the bullae. Hindwings (Fig. 5B): membranes also translucent with brownish veins.

Late instar larva (Fig. 6): Head. Dorsal head, thorax and abdomen with an almost uniformly greyish brown background; clypeus whitish, darker brown at basal margin; labrum blackish at lateral margins; antennae yellowish brown, half the length of head. Eyes: greyish black. Mouthparts. Clypeus and labrum (Fig. 7): length: 0.83–0.94 (0.89) x as long as and width 0.72–0.82 (0.77) x as wide as clypeus. Right mandible (Fig. 8A): well-worn; inc surface with about 12 parallel cuticular serrated ridges. Maxilla

Figure 2. Dorsal view of abdomen of male imago

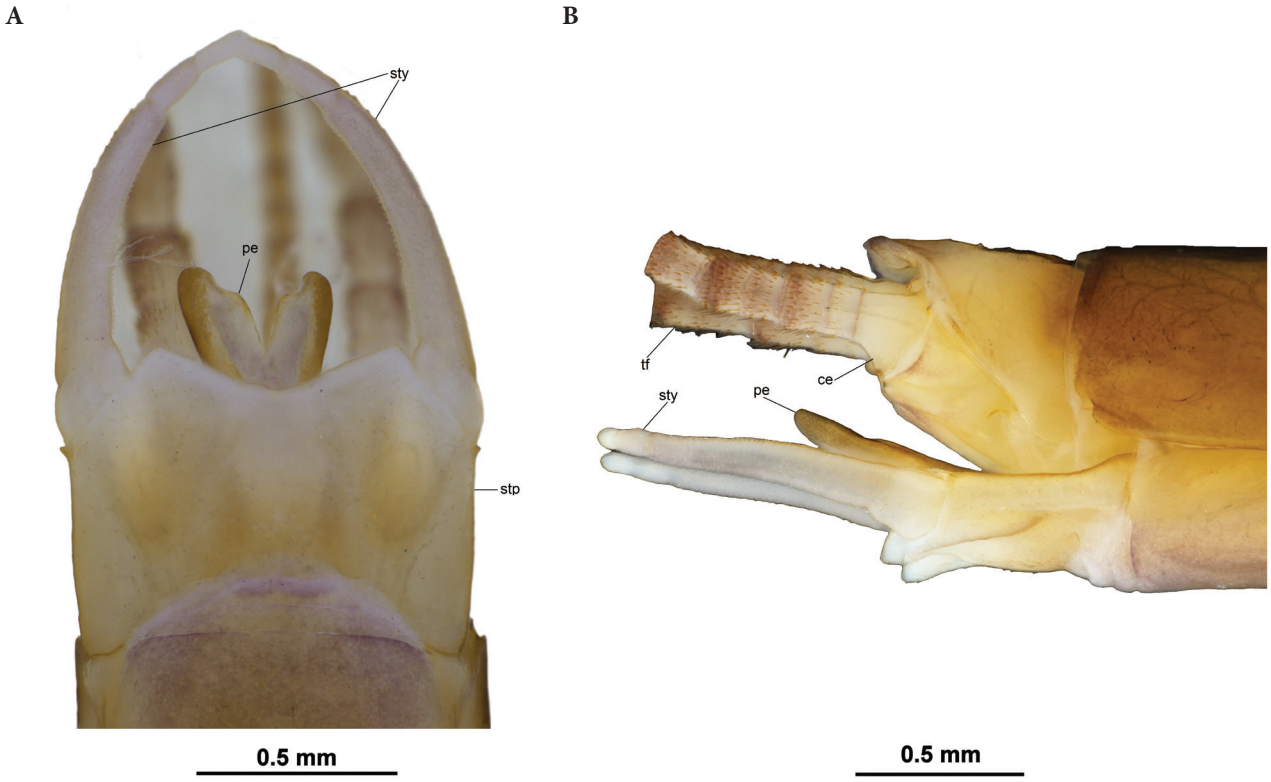

Figure 3. Ventral view (**A**) and lateral view (**B**) of male genitalia

(Fig. 8B): right maxilla lacinia with marginal row of 15 larger spines directed medioventrally; posterior submarginal row of 4 setae and basal row of 5 setae. Palp segment 2, 0.85 x as long as segment 1; segment 3 0.23 x as long as segment 1. Labium (Fig. 9A and 9B): aboral surface of prementum with a paired group of 0–2 thick spines. Palp segment 2, 0.67 x as long as segment 1; segment 3, 0.80 x as long as segment 2. Dorsal thorax: greyish brown, darker at the anterior and lateral margins; mesonotum and metanotum each with a narrow whitish central longitudinal band. Scutellum with paired oval darker brownish marks. Pleura pale brown, darker ventrally. Dorsal abdomen (Fig. 6): greyish white, dark brown at posterior margins. Dorsal abdominal segments 1–9 with paired whitish lateral maculae and smaller oval whitish maculae in the midline; segments 2–9 with paired brownish parasagittal marks, those on segment 8 most strongly contrasted against a whitish background. A few small and irregularly developed posterior spines directed caudally on tergite 9 and occasionally tergite 8. Ventral abdomen (Fig. 6): sterna whitish, each without or with only weakly developed irregular posterior transverse spines directed caudally. Abdominal ganglia usually strongly pigmented on sternum 8, less so on 7. Remaining ganglia variably visible. Posterolateral projections small on segments 2–9 but acuminate only on segments 8–9, as in *N. vulcanus*. Legs: greyish brown, generally without dark maculae at mid length of femur but sometimes with indistinct prolateral darkening, and at the tarsal articulations. Tarsal claws yellowish brown with two rows of 10–12 denticles on inner margins. Gills and legs as described for the genus (Hitchings and Staniczek 2003). Caudal filaments: yellowish and lack a distinct dark medial band, 0.41–0.42 x as long as body.

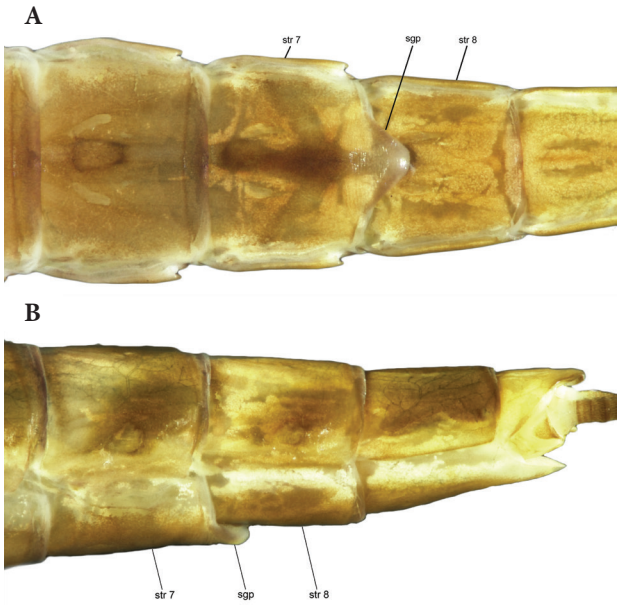

Figure 4. Ventral view (**A**) and lateral view (**B**) of female genitalia

Holotype: Male imago (reared), SC, Rata Stm, Peel Forest, -43.896, 171.229, 416 m, 4 October 2020, TRH (CMNZ 2022.38.1).

Allotype: Female imago (reared), SC, Rata Stm, Peel Forest, -43.896, 171.229, 416 m, 4 October 2020, TRH (CMNZ 2022.38.2).

Paratypes: 2 female imagoes (reared), SC, Rata Stm, Peel Forest, -43.896, 171.229, 416 m, 4 October 2020, TRH (CMNZ 2022.38.3, CMNZ 2022.38.4); 1 female subimago (reared), SC, Rata Stm, Peel Forest, -43.897, 171.22959, 415

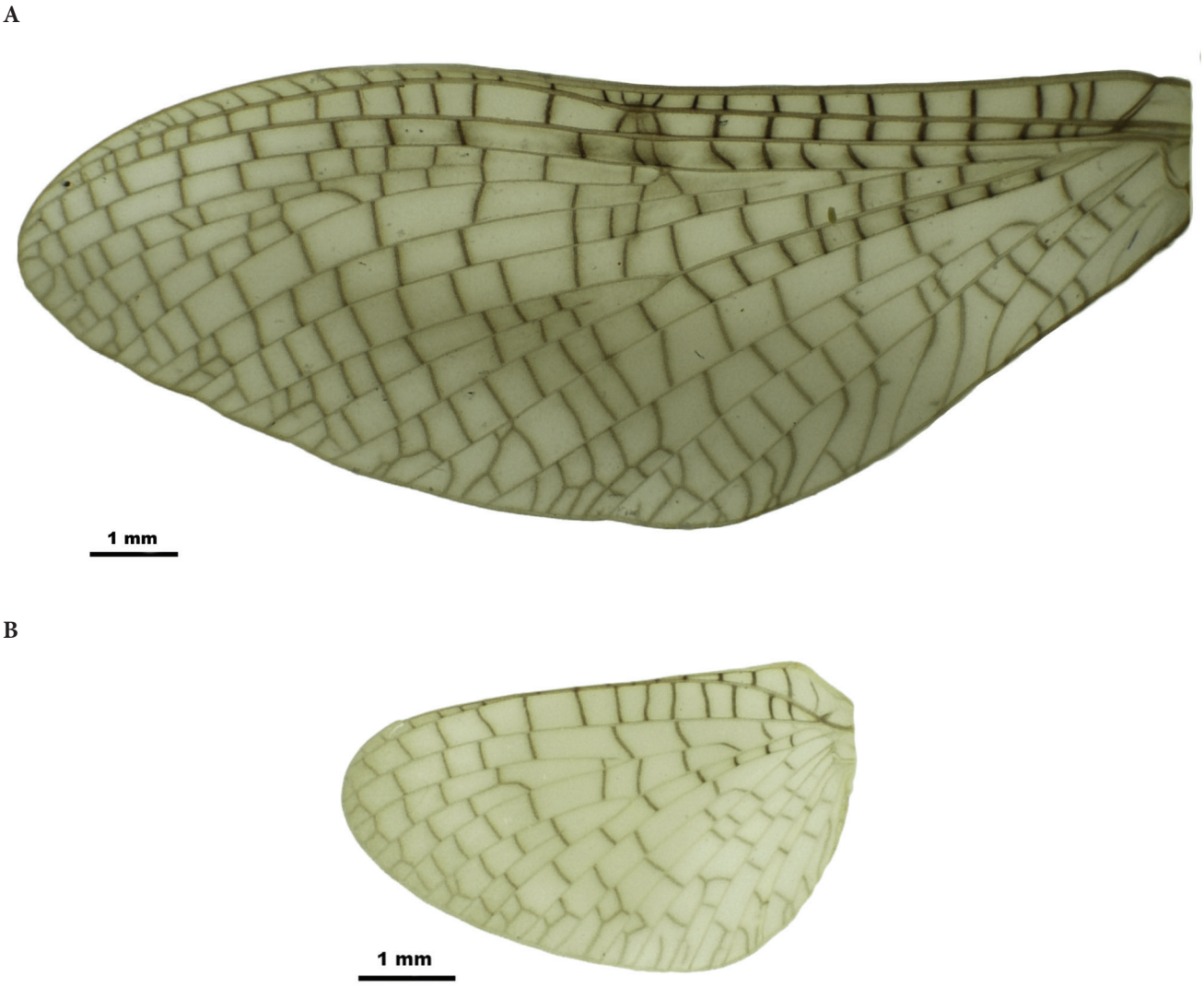

Figure 5. Forewing (**A**) and hindwing (**B**) of female subimago

Figure 6. Dorsal and ventral view of late instar larva (cerci truncated)

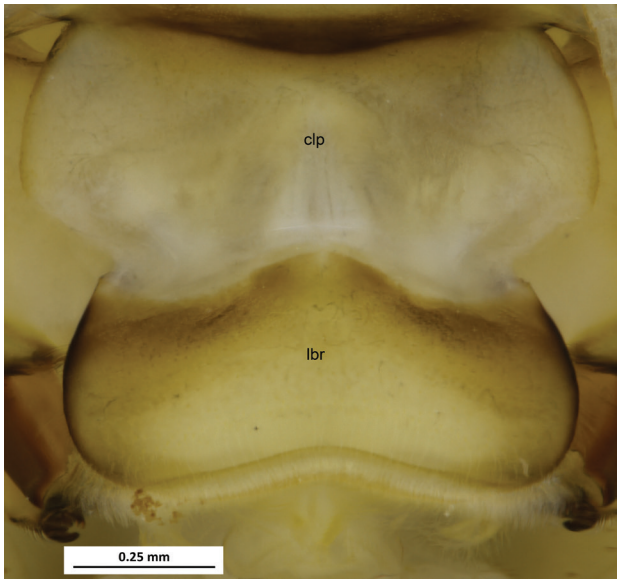

Figure 7. Dorsal view of clypeus and labrum of larva

m, 2 February 2021, TRH (CMNZ 2022.38.5); 1 larva, SC, Rata Stm, -43.897, 171.23, 415 m, 2 February 2021, TRH (CMNZ 2022.38.6); 3 larvae, NC, Tarn Col, Otaheke R, Trib, -42.889, 171.690, 1,370 m, 26 April 2003, SFW (CMNZ 2022.38.7 – CMNZ 2022.38.9); 1 larva, NC, Waimakariri R Trib, -42.917, 171.488, 1283 m, 21 October 2018, TRH and RH (CMNZ 2022.38.10).

Other material examined: 1 larva, MC, Camp Ck, -43.140, 171.702, 1,300 m, 31 December 1997, TH (CMNZ 2022.38.11); 1 larva, Craigieburn -43.1116, 171.7085, 1200 m, 19 February 1999, TH (CMNZ 2022.38.12); 1 larva, MC, Ryton R, Trib, -43.215, 171.607, 1050 m, 26 January 1996, TH (CMNZ 2022.38.13); 1 larva, Ryton R, Trib, -43.197, 171.607, 1470 m, 26 January 1996, TH (CMNZ 2022.38.14); 1 larva, NC, Broken R, -43.132, 171.691, 1113 m, 6 February 2018, TRH (CMNZ 2022.38.15); 1 larva, NC, Bealey R, Trib, -42.914, 171.547, 940 m, 15 January 2006, TH (CMNZ 2022.38.16); 4 larvae, NC, Twin Falls Stm, -42.897, 171.718, 1079 m, 23 November 2012, TRH (CMNZ 2022.38.17–CMNZ 2022.38.20); 3 larvae final instar female, SC, Rata Stm, Peel Forest, -43.896, 171.229, 416 m, 4 October 2020, TRH (CMNZ 2022.38.21–CMNZ 2022.38.23); 2 female imagoes (reared), SC, Rata Stm, -43.896, 171.229, 416 m, 6 February 2021, TRH (CMNZ 2022.38.24, CMNZ 2022.38.25); 1 female imago (reared), SC, Rata Stm, Peel Forest, -43.896, 171.229, 416 m, 4 October 2020, TRH (CMNZ 2022.38.26); 2 larvae, SC, Rata Stm, -43.897, 171.230, 415 m, 2 February 2020, TRH (CMNZ 2022.38.27, CMNZ 2022.38.28); 2 larvae, MC, Twin Ck, headwaters, -42.909, 171.579, 1390 m, 18 February 1999, TH (CMNZ 2022.38.29, CMNZ 2022.38.30); 3 larvae, WD, Hunts Ck, at hut, -42.841, 171.5025, 880 m, 12 November 2005, SFW, GT (CMNZ 2022.38.31–CMNZ 2022.38.33); 1 larva, WD, Otira R, Trib, -42.897, 171.544, 980 m, 14 Jan 2006, TH (CMNZ 2022.38.34); 3 larva, SC, Emily Stm, Peel Forest, -43.897, 171.226, 416 m, 27 October 2019, TRH (CMNZ 2022.38.35–CMNZ 2022.38.37).

Material on slides: NC, Tarn Col, Otehake R, Trib, APNP, -42.889, 171.690, 1370 m, 26 April 2003, SFW, (1) Gills. (2) Labium. (3) Mandibles. (4) Maxillae (four slides from three specimens CMNZ 2022.38.7–CMNZ 2022.38.9); NC, Sudden Valley, APNP, -42.962, 171.686, 1360 m, 20 December 2003, SFW, (1) Labium. (2) Labrum, hypopharynx. (3) Mandibles. (4) Maxillae. (5) Larval gills (five slides from one specimen CMNZ 2014.2.47419).

Distribution and habitat: The distribution of collection sites for *N. staniczeki* covers inland Canterbury and the West Coast of the South Island (Fig. 10). *Nesameletus staniczeki* has a distribution in streams and rivers ranging through the central region of the Southern Alps, including Peel Forest, Rangitata River, Arthur's Pass National Park and Westland. Larvae were collected mostly from the slower flowing areas of steep and unstable forested and open first and second order streams, predominantly above 900 m (range 415–1470 m).

Throughout its range, *N. staniczeki* is sympatric with *N.*

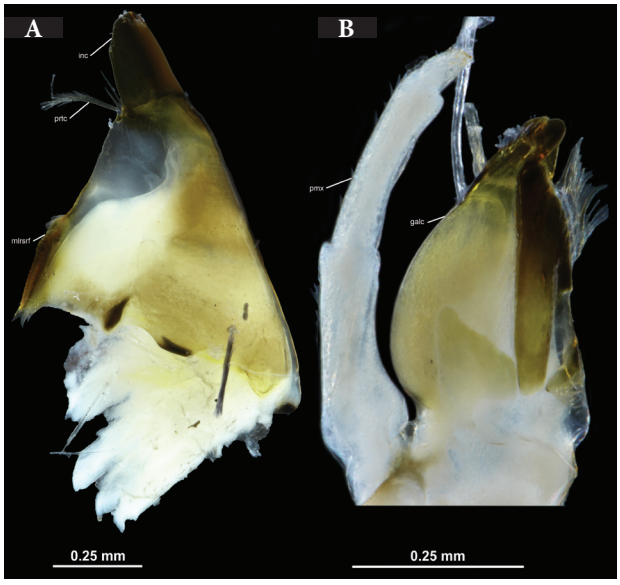

Figure 8. Right mandible (**A**) and right maxilla (**B**) of larva

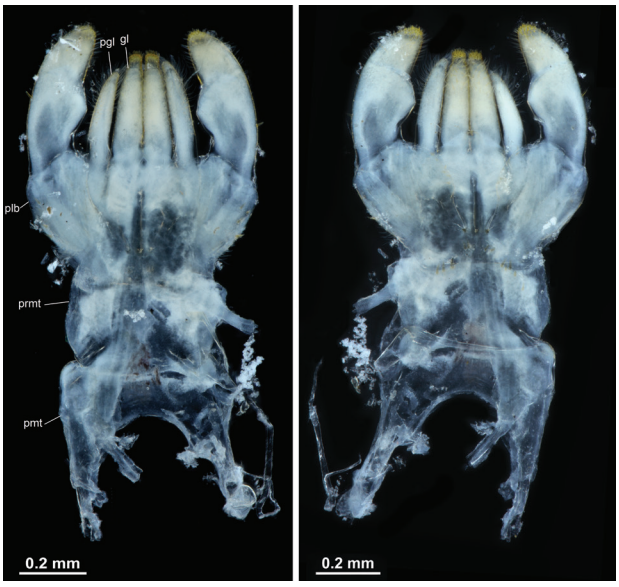

Figure 9. Labium of larva; left = dorsal view, right = ventral view

austrinus, *N. cf. vulcanus*, *N.ornatus* and *N.flavitinctus* (Pohe 2019; GBIF.org 2022). *Nesameletus ornatus* and *N. flavitinctus* are widely distributed and often found locally abundant on both main islands of Aotearoa New Zealand. The remaining species appear to be restricted to the South Island. *Nesameletus austrinus* is widespread in the central mountainous region, *N. murihiku* seems to be confined to the southern South Island and Stewart Island. *Nesameletus vulcanus* is currently known from Banks Peninsula, with recent records of *N. cf vulcanus* collected from the central South Island around the Arthur's Pass area. Populations of *N. staniczeki* appear to be smaller as they are collected less frequently than other congeneric species.

Differential Diagnosis and Discussion

Nesameletus Tillyard, 1933 as diagnosed by Hitchings and Staniczek (2003): 15–18, except that in the male imago the styliger plate may be deeply emarginated, and in the female imago, sternum 7 has a subgenital plate, which may sometimes extend to almost half the length of sternum 9.

In terms of the phylogenetic characters proposed by Hitchings and Staniczek (2003), *Nesameletus staniczeki* appears to have a sister group relationship with *N. austrinus* and *N. vulcanus*. Thus in the forewing there is an absence, or almost complete absence of, a cluster of crossveins between Sc, R_1 and R_2 in the apical half; veins R_{3A} and R_{3B} are basally connected. The crossvein thickening is absent between R_1 and R_2. In the subimago, forewings lack darkened diagonal bands.

In their revision of the genus *Metamonius* Eaton, 1885, Mercado and Elliott (2004) drew attention to diagnostic characters for that genus given in Dominguez et al. (1994). All the characters given by Dominguez et al. (1994) are also shown by *Nesameletus*. Anastomosis of the apical costal region of the forewing is also usually shown by *N. murihiku* and sometimes to a lesser extent by *N. austrinus* and *N. vulcanus*.

Nesameletus staniczeki most resembles *N. vulcanus* and *N. austrinus*. Features that distinguish the three species from each other are summarised in Table 1 (imago) and Table 2 (larva) (p 178). An identification key is provided above. Additional distinctive larval characters of *Nesameletus* species are described and illustrated with drawings and photographs in Hitchings and Staniczeck (2003).

Etymology: This species has been named to recognise the valued contribution to the taxonomy of the Nesameletidae made by Arnold H Staniczek.

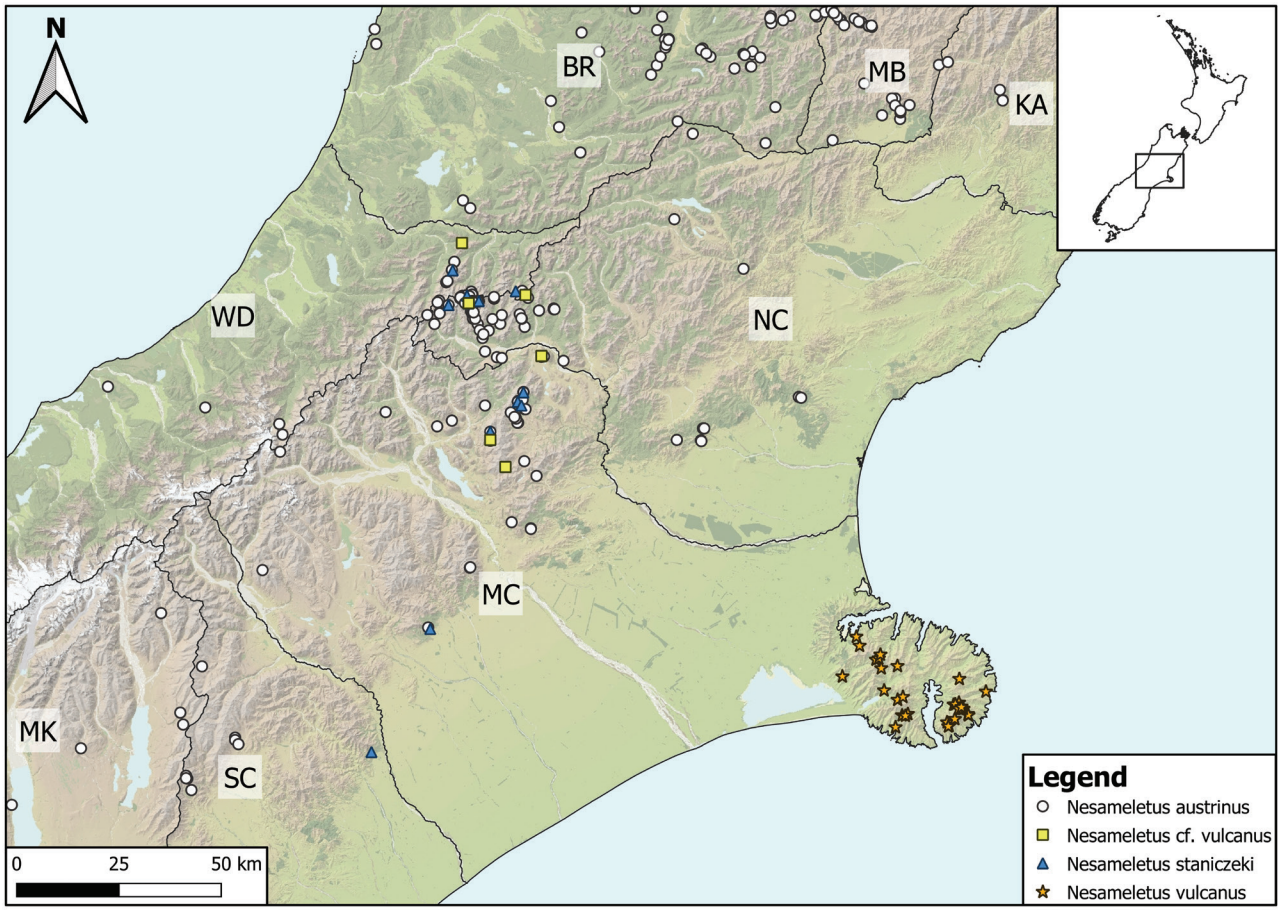

Figure 10. *Nesameletus staniczeki* sp. nov. distribution map. Distribution data for *N. vulcanus*, *N. cf vulcanus* and *N. austrinus* across *N. staniczeki* range also shown (GBIF.org 2022).

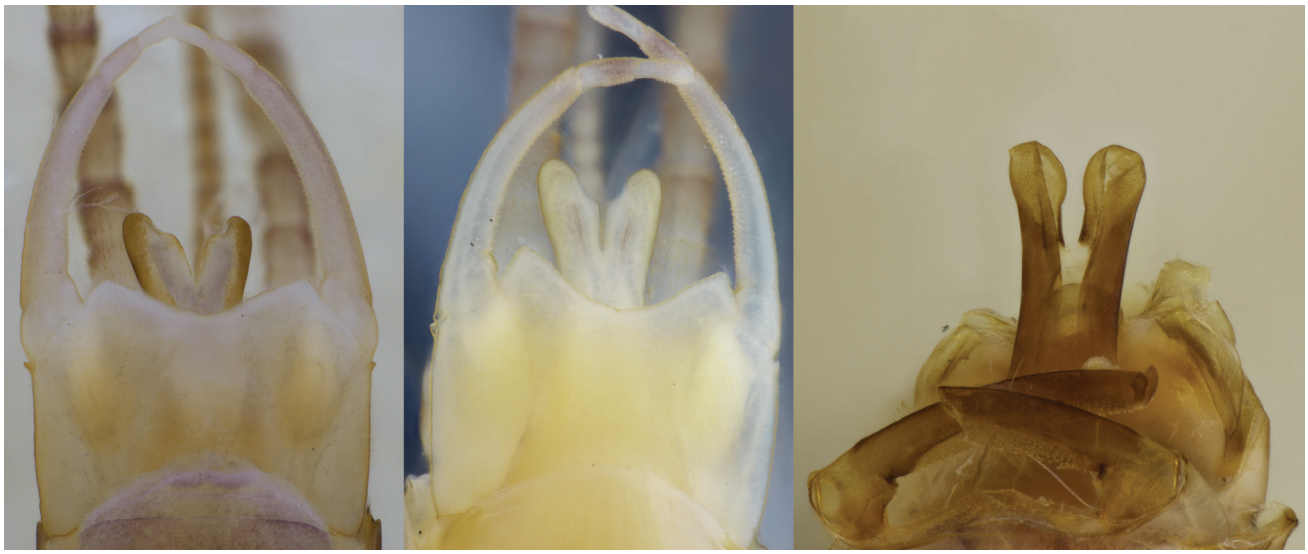

Figure 11. Genitalia (ventral view) comparison between male imagoes of *N. staniczeki*, *N. vulcanus* and *N. austrinus* (Left to Right)

Table 1. Distinguishing features of *N. staniczeki*, *N. austrinus* and *N. vulcanus* imagoes

Imago	***N. staniczeki***	***N. austrinus***	***N. vulcanus***
Markings on femur	Darkening at mid length	Dark band at mid length	No dark band mid length
Forewing crossveins in distal half between Sc and R1	Not evenly spaced	Evenly spaced	Evenly spaced
Forewing bullae	Four bullae on veins Sc, R_1, R_2 and at the fork of vein MA. Clouding at bullae	Inconspicuous bullae without clouding at Sc, R_1 and R_2	Four bullae on veins Sc, R_1, R_2 and at the fork of vein MA. Clouding at bullae
Shape of penes (Fig. 11)	Separated by wide v-shaped notch at mid length. Dark brown pigmentation at lateral and apical margins. Broad and extended laterally, slight indentation in lateral view	Fused to mid length, slightly divergent without v-shaped notch and rounded apically. Not broad and extended laterally, no indentation in lateral view	Separated by a narrow v-shaped margin at mid length. Stripe of pigmentation centrally along each penis
Genital plate in female	Shallowly triangular and extending only about one quarter the length of sternum 8	Spatulate and extending usually whole length of sternum 8, rounded	Apically rounded subgenital extending about one third the length of sternum 8
Clouding around forewing bullae Sc, R1 and R2	Present	Absent	Present

Table 2. Distinguishing features of *N. staniczeki*, *N. austrinus* and *N. vulcanus* larvae

Larva	***N. staniczeki***	***N. austrinus***	***N. vulcanus***
Abdominal ganglia	8 pigmented, 7 less so	Strongly pigmented 3 to 8	8 and 7 also usually well pigmented, other ganglia variably visible and usually faint
Denticles posterior margins abdominal tergites (Fig. 12).	A few small irregular denticles on 9, occasionally on 7 and 8	Well-developed and regular on 4 or 5 to 9	Regular, well developed denticles 8–9, occasionally some denticles on 7
Abdominal segment posterolateral projections	Small, present on sternites 7–9, largest on 7	Present on sternites 4–9, large on 9	Small, present on sternites 8 and 9 only
Dorsal abdominal pattern	Mid length with smaller white maculae, does not give appearance of a continuous pale line	Dorsal segments with median longitudinal biconvex white mark and brownish black paired parasagittal longitudinal marks	Mid length with larger white maculae, gives appearance of a continuous pale line

Figure 12. Tergite denticle comparison between *N. staniczeki* and *N. vulcanus*

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