



## ADDITIONS TO *ZELANDOBIUS* (PLECOPTERA: GRIPOPTERYGIDAE ANTARCTOPERLINAE) FROM NEW ZEALAND

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### ABSTRACT

The generic diagnosis of *Zelandobius* and the diagnosis for the *Furcillatus* Species Group are given. The male and nymph of *Zelandobius alatus* are described and the female redescribed. *Z. crawfordi* and *Z. edwardsi* new species are described. The male of *Z. kuscheli* is described and the female redescribed.

**Keywords:** Systematics; Antarctoperlinae; *Zelandobius*; generic diagnosis; additions; new species

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### INTRODUCTION

*Zelandobius* contains more species than any other genus of New Zealand stoneflies. This account will bring the number of described species to 29. The species involved in this paper all belong to the *Confusus* Group which is by far the largest species group containing 23 species against six in the *Furcillatus* Group.

Most speciation in *Zelandobius* appears to be recent probably through the Pleistocene (McLellan 2006). In most cases the species look superficially the same but there are decided differences mainly in male and female genitalia. The larvae can be identified to species group but so far most in each group are difficult to tell apart. In the *Confusus* Group only the larva of *Z. illiesi* McLellan is distinctive enough to separate from the rest. In the *Furcillatus* Group *Z. pilosus* Death stands out because of its hairiness but there is a similar undescribed species just as hairy. This presupposes that these distinctive species have an older history than the others.

The names of the repositories for type material are in brackets at the end of each entry.

The abbreviation NZAC is an acronym of the initials of New Zealand Arthropod Collection (Landcare

Research, Auckland, New Zealand).

The area codes of Crosby et al. (1998) are used to categorise collection data (i.e. NZCO = New Zealand Central Otago; NZSL = New Zealand Southland; NZFD = New Zealand Fiordland).

### Genus *Zelandobius* Tillyard 1921

Tillyard, 1921, *Canadian Entomologist* 53:35-43.

McLellan, 1965, *Transactions of the Royal Society of New Zealand* 6 (22):229-234.

McLellan, 1966, *Transactions of the Royal Society of New Zealand, zoology* 8 (2):5-22.

McLellan, 1967, *Transactions of the Royal Society of New Zealand, zoology* 9 (1):1-15.

McLellan, 1969, *Transactions of the Royal Society of New Zealand* 11 (3):25-41.

McLellan, 1977, *New Zealand Journal of Zoology* 4:119-147.

McLellan, 1993, *Fauna of New Zealand Number* 27:1-70.

Type species *Leptoperla confusa* Hare, 1909.

### DIAGNOSIS

**Adult.** Small to medium-sized stoneflies with or without wings. Ocelli present. Distal segment of

maxillary palp about twice as long as penultimate segment. Rs with a terminal fork in all wings. Hind wing with fusion of M and Cu incomplete distally. Thoracic spiracles not on cones. Lateral tergal ridge evident on abdomen. Cerci short, usually comprising no more than 15 segments.

**Male genitalia.** Epiproct hastate in plan, with a ventral hook and usually with a pair of teeth on each margin; sides normally sloping up from midline; ventrally, at base of epiproct, a dark, usually globular sclerotised mass. Paraprocts broadening distally before tapering abruptly to either a terminal spine or a rounded blade. Tergite 10 divided into 2 anterolateral sclerites with a medial sclerite behind them, followed by a membranous cone, then terminating in a dark, sclerotised knob. Penis membranous, 3 to 5 lobed, evaginated from beneath subgenital plate in mated specimens.

**Female genitalia.** Posterior of subgenital plate with a pair of short lateral lobes with a medial concavity between them.

**Larva.** No hairy fringe on legs. Maxillary palp with distal segment about twice as long as penultimate segment. Segment 10 of abdomen usually long, sometimes bulged basally. Subanal lobes tongue-shaped. Anal gill rosette well developed but incapable of pulsation. Cerci sturdy or thread-like, less than half as long as body.

## CONFUSUS GROUP

Distal crossveins in forewing surrounded by dark ovals which usually are coalesced, forming 3 or 4 irregular dark bands across wing.

**Male genitalia.** Cercus with basal segments extending directly in line with its basal sclerite, which is tapered towards its lowest point.

**Female genitalia.** Subgenital plate covering most of ventral surface of segment, with laterosternal ridges not prominent in ventral aspect; hind margin of plate with a pair of distinct lateral lobes. Subanal lobes broadly tongue-shaped, lamelliform. Tergite 10 completely sclerotised, clothed with short, pale hairs; hind margin broadly rounded.

**Larva.** With hind margin of mesonotum and metanotum deeply re-entrant, in the form of a shallow V. Femora and tibiae wide, flat. Tergite 10 not bulged basally. Cerci sturdy.

## *Zelandobius alatus* McLellan 1993

(Figs. 1–9)

*Zelandobius alatus* McLellan, 1993, 1-70 (initial description of female only).

Here the male and nymph are described for the first time but with more material and better technology I thought it better to redescribe the female.

**Material examined.** Holotype ♀, NZCO, Old Man Range, 1554 m, in pool, 19 Feb 1974, J. S. Dugdale (NZAC); 2 paratype ♀, short-winged, NZCO, Rock and Pillar Range, 1280 m, 5 Dec 1991, B. H. Patrick (NZAC); 3 ♀, NZCO, Old Man Range, 1450 m, 1 Jan 1992, B. H. Patrick; 1 ♀, short-winged, NZCO, South end Old man Range, 1335-1365 m, 11 Jan 1992, B. H. Patrick; 2 ♀, NZCO, Old Man Range, 1450 m, 11 Jan 1992, B. H. Patrick; 1 ♀, NZOL, Rob Roy Valley, 850 m, West Matukituki, 6 Dec 1992, B. H. Patrick; 1 ♀, NZCO, Rock and Pillar Range, W of McPhee's Rock, 1100-1200 m, 26 Feb 1993, B. H. Patrick; 1 ♀, NZCO, Rock and Pillar Range, 1220 m, 17 Dec 1994, B. H. Patrick; 1 ♀, NZSL, Blue Mountains, 980 m, 15 Dec 1995, B & H. Patrick; 4 ♂, 2 ♀, NZCO, Old Woman Range, 1600 m, 1 Jan 1996, B. H. Patrick; 4 ♂, 2 ♀, 3 larvae, 2 exuvia, , NZCO, Old Woman Range, 1680-1720 m, 1 Jan 1996, B. H. Patrick; 1 ♂, 2 ♀, 11 larvae, NZCO, Old Woman Range, 1600 m, 4 Feb 1996, B. H. Patrick; 1 ♀, NZCO, Coal Ck, 1350 m, Old Man Range, 22145, 55327, 30 Jan 1997, E. Edwards, R. Logan, S. J. Morris; 2 ♀, NZCO, Old Man Range, 1600 m, stream edge, 6 Feb 1997, B. H. Patrick.

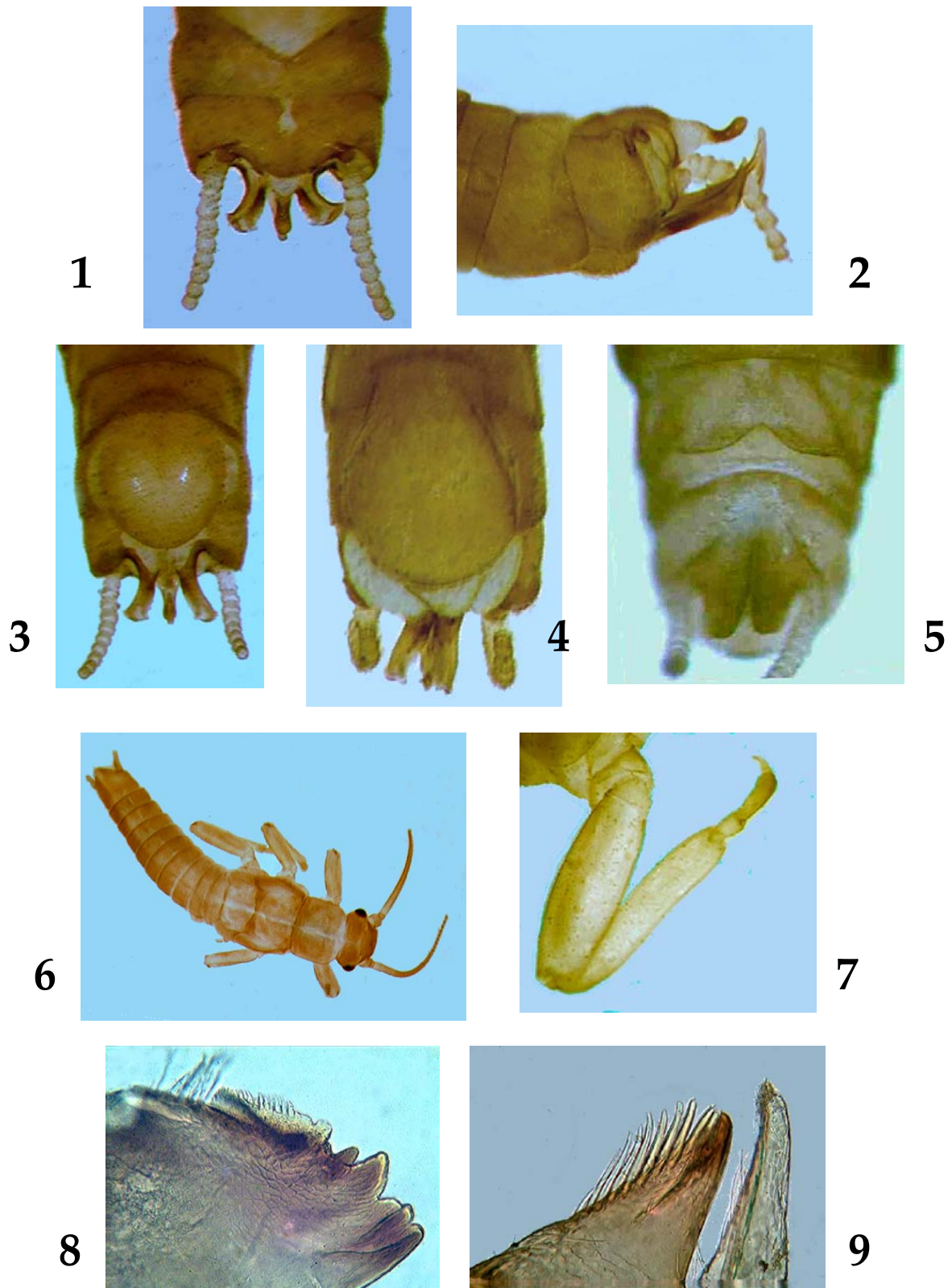
### Dimensions.

Male: Body length 5.5-8 mm; antenna 3.5-4 mm; wing 1.5 mm; hind leg 5 mm; pronotum length 0.8 mm, width 1.12 mm.

Female: Body length 6-7.5 mm; antenna 4.5-6 mm; forewing 1.87-7 mm; hind leg 5-5.8 mm; pronotum length 0.96 mm, width 1.28 mm.

Larva: Body length 6.5–8 mm; antenna 2.5 mm; cercus broken but would be about 2 mm.

**Adult.** Head with a brown mask between prominent ocelli. Antennal flagellum with 1st segment shorter than scape. Pronotum wider posteriorly. Wings variable in length from full wing to short wing terminating on tergite 2. Forewing with Rs fork variable in length, from 0.17x as long as Rs, and sometimes containing a crossvein, to 0.28x as long as



Figs. 1-9. *Zelandobius alatus*. 1. Male genitalia, dorsal, 2. Male genitalia, lateral, 3. Male genitalia, ventral, 4. Male genitalia, ventral with penis, 5. Female genitalia, ventral, 6. Larva, habitus, 7. Larva, hindleg, 8. Larva, right mandible, 9. Larva, right lacinia tip.

Rs. Distal half of forewing with 3 dark bars across the wing surrounding very pale, expanded distal crossveins. Legs brown with tibiae paler than femora. Abdominal tergites and sternites sclerotised,

**Male genitalia.** (Figs. 1-4). Posterior margin of central sclerite much rounded; membranous cone long and curved down distally to a long dark upcurved posterior sclerite. Epiproct with 2 pairs of marginal teeth, one pair sub-apically and the other pair about mid length; tip long, tapered and slightly curved with rounded apex. Paraproct with dorsal and posterior margins curved up to a sharp slightly curved apical spine. Subgenital plate much rounded but extended when 3 lobed penis is everted. Cerci each with about 11 segments and downcurved.

**Female genitalia.** (Fig. 5). Subgenital plate with an almost W-shaped dark patch, the apices of its arms extending into the lobes. Medial emargination and lobes with narrow, heavily sclerotised margins. Subgenital plate and sternite 9 with prominent lateral sternotergal ridges. Cercus each 12-segmented.

**Larva.** (Figs. 6-9). Much like the type species but thickset with broad shorter legs and larger claws. Anal gill rosette prominent. Preserved specimens brown. The mouthparts are unremarkable. Mandible with a row of about 6 short teeth and prostheca with a row of short bristles. Lacinia with two apical teeth with rounded tips and a comb of 10-12 bristles.

*Zelandobius crawfordi* sp. n.  
(Figs. 10-13)

**Material examined.** Holotype ♂, NZCO, Pigroot Ck, 520 m, 8 Sept 1993, B. H. Patrick (NZAC); paratype ♀, NZCO, Pigroot Ck, 500 m, 12 Oct 1994, B. H. Patrick (NZAC); 2 paratype ♂, NZCO, Pigroot Ck, 520 m, 8 Sept 1993, B. H. Patrick (Central Stories Museum & Art Gallery, Alexandra, New Zealand); 1♂, NZCO, Shag River headwaters, 570 m, 10 Sept 1993, B. H. Patrick; 2♂, NZCO, Umbrella Mts, 360 m,

trib Pomahaka River, 23 Sept 1993, H. Patrick; 1♂, NZCO, West Eweburn, Ida Range, 1100-1250 m, 25 Sept 1996, B. H. Patrick.

**Dimensions.**

Male: Body length 7-7.5 mm; antenna 6 mm; forewing 7-7.5 mm; hind leg 5.5 mm; pronotum length 0.8 mm, width 1.09 mm.

Female: Body length 7.5 mm; antenna 5 mm; forewing 8 mm; hind leg 5.5 mm; pronotum length 0.96 mm, width 1.28 mm.

Larva: Unknown.

**Adult.** Head uniform medium brown apart from a darker patch at base of antennae; ocelli prominent. Antennae long with first segment of flagellum as long as scape. Pronotum uniform medium brown, rectangular and slightly wider than long. Forewing (Fig. 10) with most distal crossveins white; 4 grey to brown bars across wing distally; areas between bars in middle of wing white; tip of wing brown. Rs fork 0.33 x length of Rs.

**Male genitalia.** (Figs. 11, 12). Posterior margin of central sclerite concave. Membranous cone covered with dark spots and with sides tapered. Posterior sclerite long, dark and bulged at tip. Epiproct with tip curved and bulged and 2 pairs of teeth on epiproct margins. Paraproct with prominent bulge on dorsal margin below base of spine which is sturdy and slightly curved. Cerci each with about 12 segments and extended straight posteriorly.

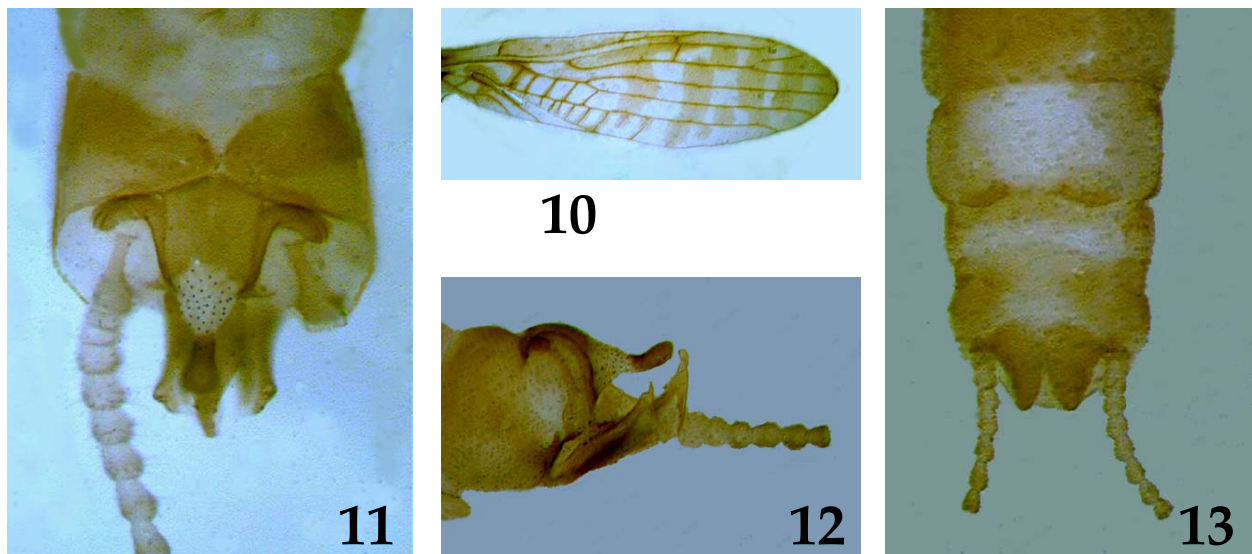
**Female genitalia.** (Fig. 13). Subgenital plate brown with medial third pale and with prominent lateral lobes of posterior margin dark brown. Subanal lobes dark brown.

**Remarks.** This species appears closely related to *Z. patricki* (Figs. 14, 15). The male genitalia are similar and both have the cerci of about 12 segments which extend posteriorly. The differences in genital structures are shown for males in Figs. 12 and 14 and Table 1. Differences in female genital patterns are shown in Figs. 13 and 15.

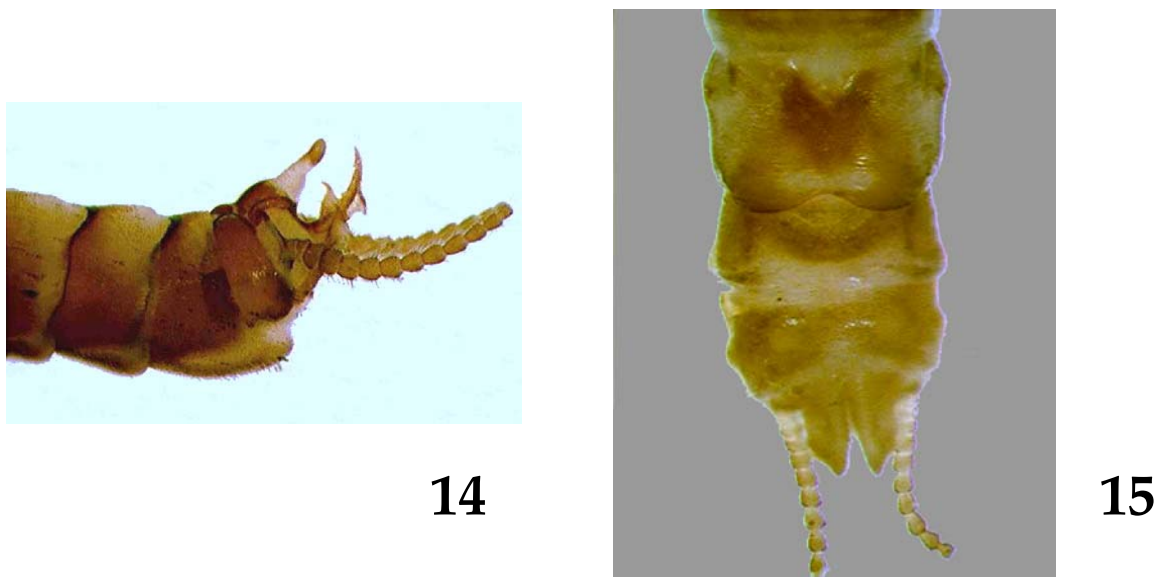
Species	Epiproct	Paraproct	Posterior Sclerite
<i>Zelandobius crawfordi</i>	Bulged tip; long ventral hook	Dorsal bulge at base of short curved apical spine	As long as lateral length of membranous cone
<i>Zelandobius patricki</i>	Long curved tip with short apex; Short ventral hook	Long curved apical spine without basal bulge	Half lateral length of membranous cone

Table 1. Comparison of male genitalia of *Zelandobius crawfordi* and *Z. patricki*





Figs. 10-13. *Zelandobius crawfordi*. 10. Forewing, 11. Male genitalia, dorsal, 12. Male genitalia, lateral, 13. Female genitalia, ventral.



Figs. 14–15. *Zelandobius patricki*. 14. Male genitalia, lateral, 15. Female genitalia, ventral.

**Etymology.** This species is dedicated to aquatic insect photographer W. J. Crawford (a.k.a. Mayfly Bill) of Taupo, New Zealand for the great effort he has made in collecting aquatic insects for me.

*Zelandobius edwardsi* sp. n.  
(Figs. 16-19)

**Material examined.** Holotype ♂, paratype ♀, NZCO, Hector Mts, Ben Nevis area, 1750-1800 m, 21 Feb 1994 B.H Patrick, NZAC03000777 (NZAC); paratype ♂ and ♀, NZCO, Mt Bengier, Timber Creek, 1050 m, 16 Sept 1999, E. Edwards, NZAC03000776 (NZAC); paratype ♂ and ♀, NZCO, Hector Mts, Ben Nevis area, 1650-1800 m, 23 Feb 1994, B.H. Patrick (Central

Stories Museum & Art Gallery, Alexandra, New Zealand); 8♂, 4♀, 5 exuvia, NZCO, Hector Mts, Ben Nevis area, 1650-1800 m, 23 Feb 1994, B.H. Patrick, NZAC03000776.

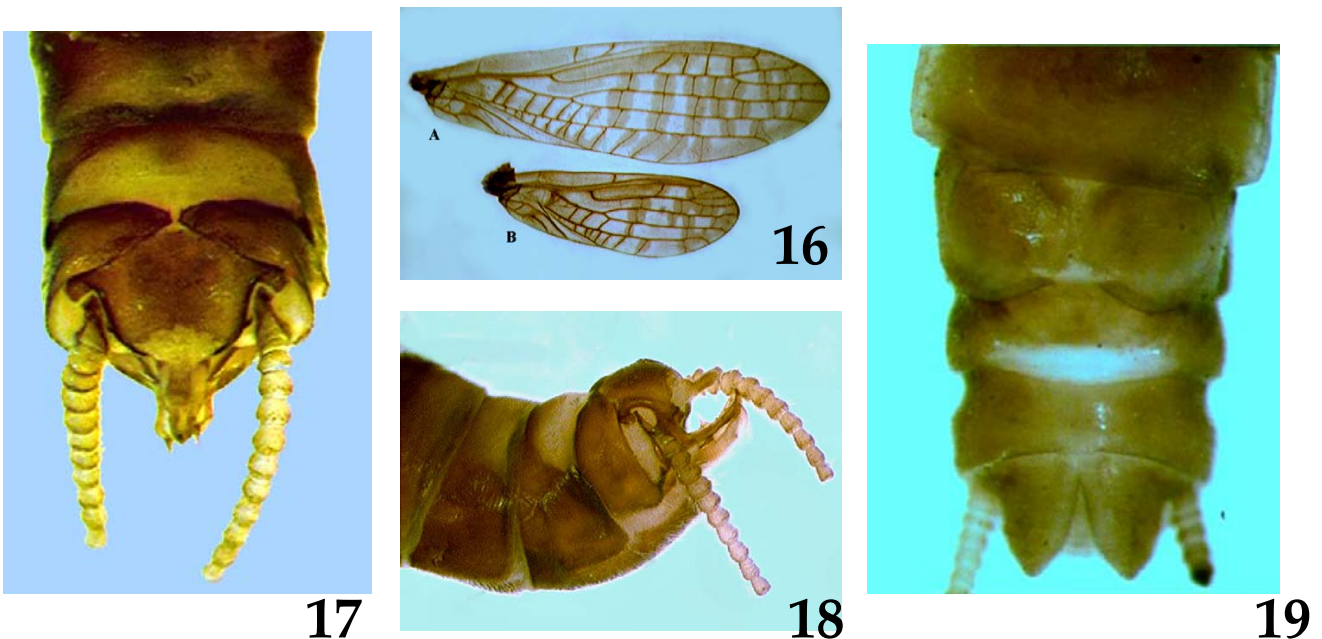
**Dimensions.**

Male: Body length 6-10 mm ; antenna 6.5-10 mm; forewing 3.5-11 mm; hindleg 3.5-8.5 mm; pronotum length 0.88-1.2 mm, width 1.6-2.18 mm.

Female: Body length 9.512 mm; antenna 7-8 mm; forewing 4.75-12 mm; hindleg 6.75-7.5 mm; pronotum length 0.96-1.76 mm; width 1.6-2 mm.

**Adult.** Head with dark brown. Epicranium and frons

almost black; ocelli prominent with a pair of tubercles directly in front of the medial ocellus. Antenna with first segment of flagellum longer than scape. Pronotum brown, slightly wider than long with angles not produced. Legs almost uniform brown. Wings vary in populations from full length (Fig. 16A) to about half body length (Fig. 16B). In forewings each distal crossvein is surrounded by a brown to light brown patch which usually coalesces with surrounding patches to form bars. In full winged specimens Rs fork 0.35x length of Rs and short winged 0.29x.



Figs. 16-19. *Zelandobius edwardsi*. 16. Forewings for A) fully winged, and B) brachypterous individuals, 17. Male genitalia, dorsal, 18. Male genitalia, lateral, 19. Female genitalia, ventral.

**Male genitalia.** (Figs. 17, 18). Posterior margin of central sclerite concave. Membranous cone very short with almost straight sides. Posterior sclerite long, almost straight and slightly bulged at tip. Epiproct with tip short curved and pointed; 3 pairs of teeth on epiproct margins, the anterior 2 pairs minute, the posterior pair large. Paraproct with short curved apical spine without basal bulge. Cerci each with about 11 segments and downcurved.

**Female genitalia.** (Fig. 19). Subgenital plate brown with broad lateral lobes. Medially from the medial emargination and as wide as it, a pale triangle

extends a short distance anteriorly. Another pale triangle extends posteriorly from the middle of the plate's anterior margin. Medially on the posterior margin of sternite 9 a pale membranous patch about two thirds as wide as the posterior margin extends forward for about a quarter of the sternites's length.

**Remarks.** This species appears closely related to *Z. mariae*. McLellan The male genitalia are similar but have decided differences. *Z. mariae* McLellan has a short bulged posterior sclerite; the epiproct has a longer sharper tip and the anterior teeth are not minute. In this as in other species the length of

forewing determines the number of distal crossveins. In this species there are about 8 between Rs and  $M_{1+2}$  in full winged specimens and about half that number in short winged specimens. The Rs fork is also affected by wing reduction and its relative length is shorter.

**Etymology.** This species is dedicated to Eric Edwards (Department of Conservation Invercargill, New Zealand). He has collected stoneflies extensively throughout the South Island adding greatly to the knowledge of this order.

*Zelandobius kuscheli* McLellan 1993  
(Figs. 20-24)

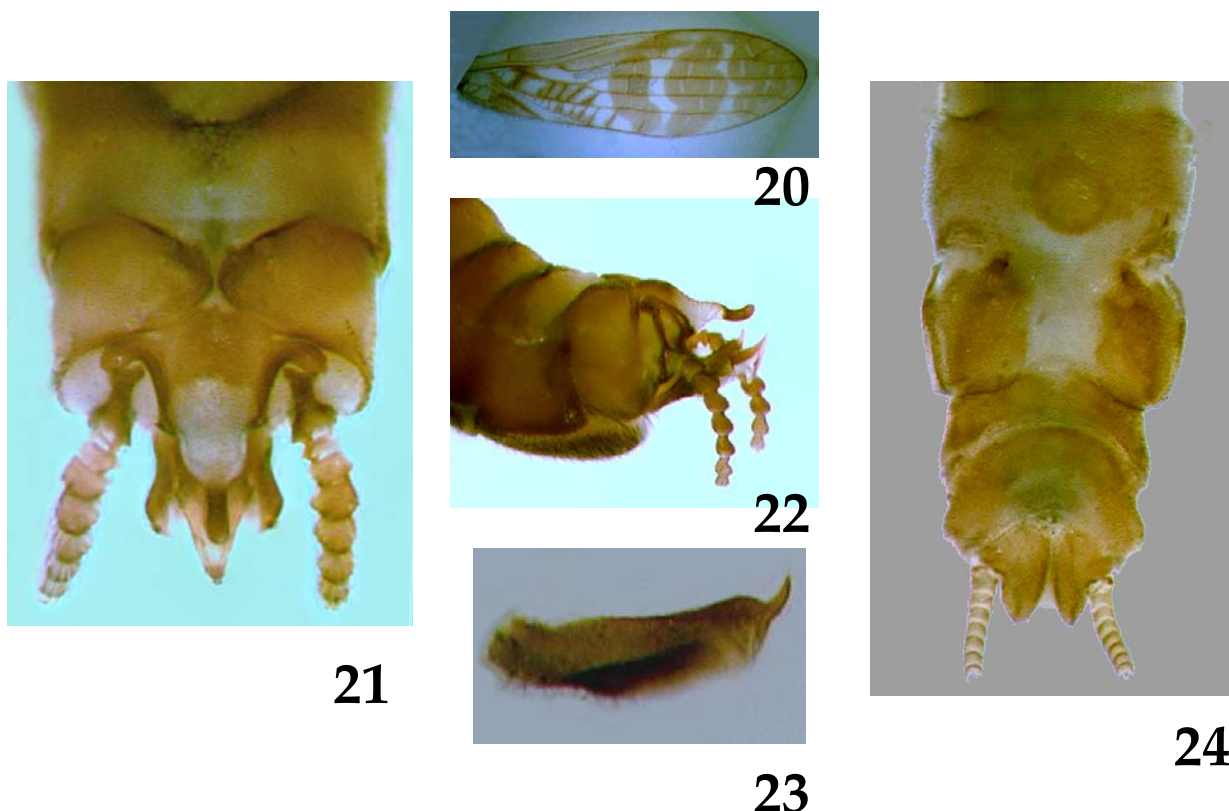
**Material examined.** Holotype ♀ and paratype ♀: NZFD, Manapouri, Wolfe Flat, 1000 m, 16 January 1970, G. Kuschel; 4♂, 5♀, NZFD, Murchison Mts., E McKenzie Burn, 1020 m, 6 July 1980, R. Emberson,

beaten *Hebe* scrub; 1♂, NZFD, Murchison Mts., E McKenzie Burn, 1020 m, 6 Dec 1980, R. Emberson, C. A. Muir; 2♂, NZSL, Blue Lake Huts, 260 m, F43 926 176, North Garvie Mts., 25 Oct 1997, E. Edwards, A. McIntosh; 2♂, NZSL, Blue Lake edge, 1300 m, 260 m, F43 717 176, North Garvie Mts., 26 Oct 1997, E. Edwards, A. McIntosh; 1♂, NZFD, Wolfe Flat, 1000 m, Turret Range, Exp Jan 1970, W. G. Kuschel; 2♀ (one with spermatophore), NZFD, Murchison Mts., E McKenzie Burn, 6 Dec 1980, R. Emberson, beaten *Hebe* scrub.

**Dimensions.**

Male: Body length 8 mm; antenna 6 mm; forewing 7.5 mm; hind leg 5.5 mm; pronotum length 0.77 mm, width 1.02 mm.

Female: Body length 9 mm; antenna 4.5 mm; forewing 7.3 mm; hind leg 4.6-5.0 mm; ; pronotum length 1.04 mm, width 1.04 mm.



Figs. 20-24. *Zelandobius kuscheli*. 20. Forewing, 21. Male genitalia, dorsal, 22. Male genitalia, lateral, 23. Male right paraproct, lateral, 24. Female genitalia, ventral.



**Adult.** Head uniform medium to dark brown; ocelli prominent. Antennae long with first segment of flagellum almost twice as long as scape. Pronotum uniform medium brown, rectangular (slightly wider than long) to square. Forewing (Fig. 20) with most distal crossveins white; 3 brown bars across wing distally; areas between bars in middle of wing white; tip of wing brown. Rs fork 0.17 x length of Rs. Legs of male darker with a pale bar on femora. Legs of female light brown and without a pale bar on femora.

**Male genitalia.** (Figs. 21-23). Posterior margin of central sclerite concave. Membranous cone with sides in distal half much convexly tapered. Posterior sclerite long, dark with slightly upturned tip. Epiproct curved to a short sharp tip; ventral hook of medium length with rounded tip. Paraproct with a large curved spine on tip and without basal bulge to spine. Cerci each with about 9 segments and downcurved.

**Female genitalia.** (Fig. 24). Subgenital plate with short lateral lobes. Medially from the medial emargination and as wide as it, a white patch extends the length of the plate and onto the rear of sternite 7. Lateral to the patch most of the plate surface is brown to dark brown, rugulose, and covered with minute dark rings (bristle basal rings without the bristles). These modified lateral areas taper anteriorly and terminate in the dark bases of plate apodemes. An almost circular to triangular similarly modified raised patch is present posteromedially on sternite 7. Sternite 9 is similarly modified posteromedially and bulged into the medial emargination closing the genital opening. Cerci of about 10 segments.

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I wish to acknowledge the debt I owe the collectors of the material examined. Particularly Brian Patrick (Director Central Stories Museum and Art Gallery, Alexandra, New Zealand) and Eric Edwards ((Department of Conservation Invercargill, New Zealand) who have both added greatly to collections over the last few years. J. S. Dugdale and G. Kuschel (Landcare Research) who collected originally as members of Landcare's forerunner, Entomology Division, DSIR, Nelson, New Zealand and during the 1970's amassed the first decent collection of stoneflies from the southern half of the South Island. My thanks to Brian Patrick and Terry Hitchings (Canterbury Museum, Christchurch New Zealand) for reviewing the manuscript.

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