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Kiwisaldula (Hemiptera: Heteroptera: Saldidae) from the South Island of New Zealand: new species and identification key

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Abstract

Kiwisaldula cranshawi new species, *K. januszkiewiczi* new species, *K. ryani* new species, and *K. yangae* new species are described from the South Island of New Zealand. Morphological descriptions are provided together with illustrations emphasising the most important diagnostic features of external morphology and male genitalia. Information is given on synonymy, type specimens, material examined, geographic distribution and biology.

Key words: shore bugs, revision, systematics, biodiversity

Introduction

This is the fourth in a series of papers aiming to revise the taxonomy of New Zealand Saldidae (Hemiptera: Heteroptera) and to provide comprehensive information on their geographic distribution and biology.

Larivière & Larochelle (2015) erected the genus *Zemacrosaldula* (four species) which occurs on both main islands of New Zealand. Larivière & Larochelle (2016) studied the North Island and nearby offshore islands saldids, resulting in the establishment of two new genera (*Aoteasalda*, one species; *Kiwisaldula,* six species); this completed the generic re-assignment of all New Zealand species previously placed in *Saldula* Van Duzee, 1914 (*sensu lato*). Larivière & Larochelle (2017) described two new species of *Kiwisaldula* from the South Island and redescribed *K. butleri* (White, 1878) and *K. laelaps* (White, 1878) in the interest of taxonomic stability.

In the present paper, *Kiwisaldula cranshawi*, *K. januszkiewiczi*, *K. ryani*, and *K. yangae* are described as new, and all South Island *Kiwisaldula* species are keyed. Taken together, this publication and that of Larivière & Larochelle (2017) provide an overview of the South Island *Kiwisaldula* fauna.

Three genera and 17 species of Saldidae (Saldinae: Saldoidini) are now recognised from New Zealand:

Aoteasalda Larivière & Larochelle, 2016
A. maculipennis (Cobben, 1961)
Kiwisaldula Larivière & Larochelle, 2016
K. butleri (White, 1878)
K. cranshawi new species
K. hurunui Larivière & Larochelle, 2017
K. januszkiewiczi new species
K. laelaps (White, 1878)
K. manawatawhi Larivière & Larochelle, 2016
K. parvula (Cobben, 1961)
K. porangahau Larivière & Larochelle, 2016
K. ryani new species
K. stoneri (Drake & Hoberlandt, 1950)
K. waiho Larivière & Larochelle, 2017
K. yangae new species

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Zemacrosaldula Larivière & Larochelle, 2015
Z. australis (White, 1876)
Z. kapekape Larivière & Larochelle, 2015
Z. pangare Larivière & Larochelle, 2015
Z. whakarunga Larivière & Larochelle, 2015

As with previous papers on Saldidae the authors hope that their efforts to clarify the alpha-taxonomy of South Island *Kiwisaldula* species and to publish detailed information on their distribution and biology, address part of the limitations to advancing knowledge on New Zealand and Southern Hemisphere saldids as well as provide a foundation for more detailed systematics and evolutionary studies.

Materials and methods

This study is based on the examination of over 500 specimens (mostly adults) collected in 30 localities on the South Island of New Zealand. Most of this material was collected by the authors and is deposited in the New Zealand Arthropod Collection (NZAC), Auckland.

Other specimens were provided by or are deposited in the following institutions: Canterbury Museum, Christchurch (CMNZ); Entomology Research Museum, Lincoln University, Lincoln (LUNZ).

The NZAC specimens used in this study received unique barcode labels and were databased. Once this paper is published, specimen records will be made available through Manaaki Whenua - Landcare Research's Systematics Collections Database portal
(http://scd.landcareresearch.co.nz/).

Terms particular to Saldidae morphology, including the terminology used to describe the degree of wing development, mostly follow Schuh & Polhemus (2009) except as noted by Larivière & Larochelle (2015, 2016).

The male genitalia of representatives of as many populations as possible were dissected and examined in the manner described by Larivière & Larochelle (2015).

Descriptions are based on adults. Measurements included in the descriptions, were taken as follows: *body length*, in dorsal view, from visible apex of head to apex of hemelytron or abdomen (in species with hemelytron shorter than abdomen); *antennal segment length*, from base to apex of segment; *leg segment length*, from base to apex of segment; *pronotum* or *scutellum length*, along midline, from base to apex. Cells in the membrane of the hemelytron are numbered from 1 to 4, from most anterior cell (near costal margin) to most posterior cell (near apex of clavus).

The eunomy or eunomic series – the range of variation in hemelytral pigmentation arranged in a sequence from light to dark according to a more or less stable gradation pattern for a given species –often is an important taxonomic character used in saldid taxonomy. The eunomic series illustrated in this paper represent the general pattern that best fits the most common variations observed among populations of a species. Larivière & Larochelle (2016: 460) briefly discussed eunomic variability in New Zealand Saldidae and the relative usefulness of this character to diagnose *Kiwisaldula* species.

Facial colour and degree of mouthpart development are characters also commonly used in saldid taxonomy. Facial photos are provided for descriptive purpose although, as discussed by Larivière & Larochelle (2017: 42), facial characters are not considered to be of high diagnostic value in most New Zealand species.

Type data, when provided, are listed in this order: type status followed by sex, acronym of entomological collection or museum serving as repository, and original label data with a forward slash (/) separating data from different labels.

Photographs, other illustrations, and the distribution maps were prepared in the manner described by Larivière & Larochelle (2015).

The two-letter abbreviation codes of Crosby *et al*. (1976; 1998) for areas of New Zealand, were used to record South Island localities: BR, Buller; CO, Central Otago; DN, Dunedin; FD, Fiordland; KA, Kaikoura; MB, Marlborough; MC, Mid Canterbury; MK, Mackenzie; NC, North Canterbury; NN, Nelson; OL, Otago Lakes; SC, South Canterbury; SD, Marlborough Sounds; SL, Southland; WD, Westland. Table 1 provides decimal degrees geographical coordinates for collecting localities.

Biological notes are based on an analysis and synthesis of specimen label data and field observations by the authors.

TABLE 1. Geographical coordinates of localities in decimal degrees.

Locality	Area code	Latitude	Longitude
Aniseed Valley, Roding River near Hacket Creek	NN	-41.3872	173.2132
Barrytown	BR	-42.2333	171.3167
Carrick Range, Watts Rock	CO	-45.1639	169.0767
Dart and Wangapeka Rivers junction	NN	-41.4201	172.6493
Headlong Peak, South Basin	OL	-44.5581	168.6078
Lake Mahinapua	WD	-42.7833	170.9000
Lake Mapourika	WD	-43.3167	170.2164
Lake Mapourika, MacDonalds Creek mouth	WD	-43.2833	170.2167
Lake Moeraki	WD	-43.7167	169.2667
Lake Poerua, Te Kinga Scenic Reserve	BR	-42.7000	171.4833
Mahitahi River and Highway 6 junction	WD	-43.6333	169.5833
Matukituki River, slightly E of Raspberry Creek	OL	-44.5092	168.7488
Mossy Burn, 2 km South of Kohaihai River	NN	-41.1167	172.1000
Mount Aspiring National Park, Arawata River	WD	-44.4064	168.5931
Mount Aspiring National Park, Liverpool Bivouac	OL	-44.4311	168.6653
Nelson Lakes National Park, Lake Rotoiti, West Bay	BR	-41.8000	172.8167
Nelson Lakes National Park, Lake Rotoroa	BR	-41.8000	172.6000
Obelisk Range	CO	-45.3114	169.1942
Ohinetamatea River	WD	-43.4833	169.9000
Okarito	WD	-43.2167	170.1500
Old Man Range	CO	-45.3567	169.2086
Puponga Farm Park, Green Hills Stream mouth	NN	-40.5101	172.6517
Rock and Pillar Range, Stonehenge Track	CO	-45.4028	170.1153
Rotokohu, Inangahua River	BR	-41.9667	171.8667
Snowdon Forest, Boyd Creek Tops track	OL	-45.1500	168.0167
Tahunanui Beach, Back Beach inlet	NN	-41.2831	173.2371
Taramakau River mouth, South Head	BR	-42.5656	171.1236
The Remarkables, Lake Alta	CO	-45.0584	168.8181
The Remarkables, Rastus Burn	CO	-45.0553	168.8139
Woodpecker Bay	BR	-42.0167	171.3833

Taxonomy, geographic distribution, and biology

Kiwisaldula Larivière & Larochelle, 2016

Type species. *Saldula parvula* Cobben, 1961, by original designation.

Remarks. The genus *Kiwisaldula* was described in detail and keyed against *Aoteasalda* and *Zemacrosaldula* by Larivière & Larochelle (2016) who also revised and keyed the North Island species of *Kiwisaldula*.

Key to *Kiwisaldula* species (South Island)

Remark. Additional helpful but not necessarily exclusive characters are provided between brackets.

1 Body length less than 3.2 mm, on average 2.5–2.9 mm. Brachypterous 2
- Body length more than 3.2 mm, on average 3.5 mm or more. Brachypterous to macropterous....4

2 Overall dorsal appearance very dark; hemelytra with restricted pale markings on exocorium (Figs 1, 9). Female venter completely dark, not margined with pale. Male paramere (Fig. 13): processus hamatus moderately long, sinuate. [Body somewhat pear-shaped, length 2.58–3.13 (2.94 mm). Distribution: mostly alpine zones of mountains in Central Otago (CO) and Otago Lakes (OL).] .... ***K. yangae*** new species
- Overall dorsal appearance paler, more mottled in colour; hemelytra with more extensive pale markings on exocorium (Larivière & Larochelle, 2017: Figs 1–2, 13). Female venter narrowly to moderately margined with pale. Male paramere (Larivière & Larochelle, 2017: Figs 16–17): differently shaped; processus hamatus rather short to moderately long, not sinuate....3

3 Lateral margins of pronotum narrowly explanate, narrowly pale whitish yellow (mostly) to yellowish brown or brown (pale area at midlength about as wide or narrower than the width of antennal segment II) (Larivière & Larochelle, 2017: Fig. 1). Male paramere (Larivière & Larochelle, 2017: Fig. 16): processus hamatus rather short, slightly constricted basally, its tip rather broad; main body bulbous. [Body length: 2.25–2.81 (2.50 mm). Distribution: South Island, central west coast (WD).].... .... ***K. waiho*** Larivière & Larochelle
- Lateral margins of pronotum more broadly explanate, more broadly pale whitish yellow (pale area at midlength about 1.5x the width of antennal segment II) (Larivière & Larochelle, 2017: Fig. 2). Male paramere (Larivière & Larochelle, 2017: Fig. 17): processus hamatus moderately long, not constricted basally, its tip narrow; main body slender, not bulbous. [Body length: 2.28–2.82 (2.57 mm). Distribution: South Island, northeastern areas (KA, NC).] .... ***K. hurunui*** Larivière & Larochelle

4 Body nearly pear-shaped or subelliptical. Dorsum (Larivière & Larochelle, 2017: Figs 4, 15) very dark, with highly reduced pale markings and ill-defined, barely visible eyespot on hemelytra. Lateral margins of pronotum completely dark dorsally and ventrally, or dorsally with short yellowish patch near posterolateral angles. Brachypterous. Male paramere (Larivière & Larochelle, 2017: Fig. 19): main body and shaft of similar width; processus hamatus moderately long, rather straight. [Body length: 3.58–3.93 (3.71 mm). Distribution: South Island, Carrick Range, Watts Rock (CO).].... ***K. laelaps*** (White)
- Body short-ovate to elongate-ovate. Dorsum not as dark, with more developed pale markings and more visible eyespot on hemelytra. Lateral margins of pronotum pale dorsally and ventrally for most of length. Not brachypterous. Male paramere differently shaped....5

5 Hemelytra (Figs 2, 10) very dark, nearly immaculate, with prominent steely grey pruinose areas and reduced pale markings; colour strongly contrasting against pale lateral margins of pronotum. Male paramere (Fig. 14): processus hamatus elongate, slightly constricted at base, its tip very narrow, acuminate. [Mostly submacropterous. Body length: 3.30–4.27 (3.72 mm). Distribution: South Island, alpine zone of mountains in Central Otago (CO) and Otago Lakes (OL).] .... ***K. cranshawi*** new species
- Hemelytra paler, mottled in appearance, with less noticeable pruinose areas and more extensive, often coalesced pale markings; colour not strongly contrasting against pale lateral margins of pronotum. Male paramere differently shaped: processus hamatus shorter....6

6 Lateral margins of pronotum (Fig. 3) rather narrowly pale, subrectilinear (sometimes barely convex or slightly sinuate). Hemelytral eyespot more or less distinct, reduced (Figs 3, 11). Male paramere (Fig. 15) slender: processus hamatus short, almost pointing straight. [Submacropterous to macropterous (especially females). Costal margin of hemelytra lined with somewhat narrow, uninterrupted or interrupted pale band. Body length 3.32–4.35 (3.75 mm). Distribution: South Island, northwestern areas (BR, NN, SD).].... ***K. ryani*** new species

- Lateral margins of pronotum more broadly pale and more convex. Hemelytral eyespot distinct, not reduced. Male paramere more thickly shaped; processus hamatus shorter, differently shaped. [Costal margin of hemelytra lined with broader, uninterrupted pale band.] 7

7 Subbrachypterous to submacropterous. Body (Fig. 4) short-ovate to subelongate-ovate; female often nearly pear-shaped; dorsal colour dark with overall brownish hue. Male paramere (Fig. 16): processus hamatus somewhat narrow, not constricted at base; main body above shaft broadly arcuate. [Body length: 3.38–4.15 (3.64 mm). South Island, mostly areas west of the Southern Alps (BR, WD).] ..... ***K. januszkiewiczi*** new species

- Macropterous. Body (Larivière & Larochelle, 2017: Fig. 3) always elongate-ovate, nearly elliptical; dorsal colour dark with overall blackish hue. Male paramere (Larivière & Larochelle, 2017: Fig. 18a–b): processus hamatus somewhat broad, slightly to strongly constricted at base; main body above shaft not broadly arcuate. [Body length: 3.62–4.65 (3.97 mm). Distribution: South Island, eastern lowlands to lower montane areas from North to South (KA–SL/FD).] ..... ***K. butleri*** (White)

Kiwisaldula yangae new species

Kiwisaldula yangae Larivière and Larochelle, new species. Holotype: Male (LUNZ) labelled "NEW ZEALAND CO Obelisk Ra. [=Range] 1680m 7.ii.1986 J.W. Early / alpine bog / HOLOTYPE [male symbol] *Kiwisaldula yangae* Larivière & Larochelle, 2018 (red label)." Paratypes 2 males (1 LUNZ, 1 NZAC), 5 females (3 LUNZ, 2 NZAC) with same data as holotype, except for 2 female paratypes (collected by S.P. Worner / sweeping), bearing blue paratype labels.

Description (Brachypterous adult). Body length 2.58–3.13 (2.94 mm); short-ovate or subelliptical, somewhat pear-shaped (Fig. 1). Dorsal colour largely dark, usually with contrastingly pale although restricted markings on exocorium of hemelytra and very narrowly pale lateral margins of pronotum. Facial colour (Fig. 5) slightly to strongly contrasted. Head, pronotum, and scutellum moderately shiny against mostly dull hemelytra. Dorsal pubescence short to moderately long, mostly reclined, usually more densely distributed, thicker and more golden brown on pronotum, clavus, and endocorium. Hemelytra with reduced cells in membrane; hindwings highly reduced (not fully formed), reaching about half of corium length or shorter. **Head** (Fig. 5, facial view). Preocellar spots whitish yellow to yellowish brown (indistinct in very dark individuals). Preocular spots whitish yellow to yellowish brown (indistinct in very dark individuals). Transverse swelling slightly to strongly developed; lateral portions contiguous (mostly) or separated by a narrow gap; whitish yellow to dark yellowish brown, darker near facial midline. Mandibular plates moderately to strongly developed (sometimes slightly developed), concolorous with transverse swelling. Maxillary plates strongly developed (sometimes less developed), concolorous with or paler than transverse swelling. Rostrum yellowish brown to brown, reaching hind coxae. ***Antennae*** about 3.9x longer than pronotum + collar medially; segment I whitish yellow to yellowish brown, with ventral and dorsal sides at least partially dark (striped or not), sometimes infumate or completely brown; segment II yellowish brown to pale brown (mostly) or darker brown (in very dark individuals), about 2.1 x longer than segment I; segments III–IV dark brown to nearly black. **Thorax**. Lateral margins of pronotum subrectilinear (mostly) to barely convex, narrowly explanate, narrowly pale whitish yellow to yellowish brown over most of length or over basal quarter to half (pale area at midlength narrower than or about as wide as antennal segment II), more rarely completely or partially very thinly lined with pale or completely dark (in very dark individuals). Scutellum about 1.5x longer than pronotum + collar medially. Thoracic underside black, with slightly to moderately contrasting acetabula (acetabulum I broadly pale, acetabulum II narrowly pale (mostly) or completely dark, acetabulum III narrowly pale or completely dark), and broadly (mostly) or more narrowly pale (about half of length) lateral margins. ***Legs*** marginally pale; fore, mid, and hind femora almost completely dark brown to black (darkly coloured sides coalesced or nearly so into a long annulus), usually paler near base and apex, sometimes largely pale with more discontinuous dark markings on fore and mid femora; fore tibiae pale or slightly infumate dorsally (sometimes darkly striped over most of length); hind tibiae about 2.4x longer than tarsal segments II+III combined. ***Hemelytra***: corium (Figs 1, 9) largely dark brown to nearly black, with reduced pale markings on endocorium and more extensive pale markings (whitish) on exocorium (larger and more coalesced from basal quarter to basal half) – markings less extensive than in *K. waiho* and *K. hurunui*; endocorium with distinct, sometimes reduced, brown eyespot subbasally near R vein; eyespot often surrounded by prominent, pale, oblong to sublinear marking; costal margin lined with narrow pale band in basal half or mostly dark (pale band rarely covering most of costal length); colour pattern in female consistent with that in male; pruinose areas well developed, distributed on

FIGURES 1–4. Dorsal views of *Kiwisaldula* species (males; legs and antennae omitted). Scale bar = 1 mm. (1) *K. yangae*, (2) *K. cranshawi*, (3) *K. ryani*, (4) *K. januszkiewiczi*.

most of clavus and corium, and on membrane near apex of clavus (usually patchy on middle of corium or less prominent on exocorium); basal pruinose area of clavus usually broad and short, covering less than one-third of clavus length; basal pale spot of clavus present (sometimes very small) or absent; subapical pale spot of clavus present (often very small, nearly indistinct); membrane with four, sometime three, reduced cells; cell 1 the shortest, distinctly shorter than cells 2 and 3, oval to subtriangular; cells 2 and 3 subrectangular, subequal in length and width; cell 4, when present, the narrowest, slender, subequal to distinctly shorter than cell 3, ending apically well before tip of cell 3. **Abdomen**. Venter: male, dark brown to blackish, with or without hind margin of segments very narrowly pale; female, colouration as in male, not margined with pale as in most *Kiwisaldula* species. ***Male parandria*** (Fig. 17) elongate, narrowly subtriangular, acutely rounded and strongly narrowed at tip; inner margins slightly convex in basal two-thirds, concave in apical third; medial membrane with blunt inward projection on each side; basal margin rather straight to slightly sinuate. ***Male paramere*** (Fig. 13) with distinct, slightly developed processus sensualis bearing less than ten setae (processus sensualis sometimes evanescent); processus hamatus moderately long and sinuate, not constricted basally, its tip somewhat broad, acutely rounded. *Other characters as in generic description (Larivière & Larochelle, 2016: 459).*

Geographic distribution (Fig. 21). South Island, subalpine and alpine zones of mountains in Central Otago (CO) and Otago Lakes (OL).

Material examined. A total of 36 specimens including types, from the following localities: **South Island CO**–Carrick Range, Watts Rock (LUNZ); Obelisk Range (LUNZ, NZAC); Old Man Range (NZAC); The Remarkables, Rastus Burn (LUNZ, NZAC). **OL**–Headlong Peak, South Basin (NZAC); Mount Aspiring National Park (Liverpool Bivouac (LUNZ); Matukituki River, slightly East of Raspberry Creek (NZAC)). **WD**–Mount Aspiring National Park, Arawata River (LUNZ).

Biology. **Altitudinal range**. Subalpine to alpine; collected mostly around 1050 to1700 m (lower elevation at Matukituki River, OL). **Habitat**. Collected on alpine vegetation and mossy waterlogged ground around bogs, in tussock grasslands and herbfields; also in subalpine meadow near a river, on *Juncus*-carpet over sandy-silty soil, 2 m from water (Matukituki River, OL). **Seasonality**. Adults and tenerals (newly emerged adults) collected in February and March, but tenerals mostly found in March. **Food**. Predator or scavenger. **Behaviour**. Undocumented.

Remarks. This species is named after Yun-Tai (Rita) Yang (New Zealand-Taiwan), a special acquaintance and highly skilled health specialist, and someone who handles challenges with grace.

At first glance *K. yangae* may superficially resemble *K. waiho* and *K. hurunui*. It is however darker in overall colour than both species, has less developed coalesced pale markings on hemelytra, a completely darker venter in the female, and differently shaped male genitalia.

Kiwisaldula yangae is known to co-occur with *K. laelaps* on Carrick Range where more strongly pear-shaped individuals can be reminiscent of that species. *Kiwisaldula yangae* is, however, much smaller than *K. laelaps* – the largest males being smaller than the smallest males of *K. laelaps* – has more extensive pale hemelytral markings, paler lateral margins of pronotum (dorsally and ventrally), and differently shaped male parameres and parandria.

Specimens examined from Mount Aspiring National Park (OL, WD) are mostly tenerals and although paramere configuration and body shape appear somewhat distorted compared to fully mature adults from other populations, these specimens appear to be conspecific with *K. yangae*.

Kiwisaldula cranshawi new species

Kiwisaldula cranshawi Larivière and Larochelle, new species. Holotype: Male (LUNZ) labelled "NEW ZEALAND CO The Remarkables Rastus Burn 1680m 6.ii.1986 R.R. Scott / hillside seepages / HOLOTYPE [male symbol] *Kiwisaldula cranshawi* Larivière & Larochelle, 2018 (red label)." Paratypes 5 males (3 LUNZ, 2 NZAC), 5 females (3 LUNZ, 2 NZAC) with same data as holotype, except for 1 female paratype (collected by J.W. Early), bearing blue paratype labels.

Description (Submacropterous adult). Body length 3.30–4.27 (3.72 mm); short-ovate (mostly) to elongate-ovate (Fig. 2); female generally more broadly shaped. Dorsal colour largely dark, with moderately pale lateral margins of pronotum contrasting against dark hemelytra with reduced, mostly individual (rarely coalesced) pale markings and strongly developed steely grey pruinose areas. Facial colour (Fig. 6) moderately contrasted. Head, pronotum, and scutellum moderately shiny against mostly dull hemelytra. Dorsal pubescence short to moderately long, mostly reclined, mostly golden brown, often more densely distributed on pronotum, clavus, and endocorium. Hemelytra

fully developed or with some cell reduction; hindwings reaching from about tip of corium to half of membrane. **Head** (Fig. 6, facial view). Preocellar spots whitish yellow to yellowish brown. Preocular spots yellowish to yellowish brown (sometimes nearly indistinct). Transverse swelling slightly to moderately (mostly) developed; lateral portions contiguous; whitish yellow (mostly) to yellowish brown, darker near facial midline. Mandibular plates slightly to moderately developed, concolorous with or darker than transverse swelling. Maxillary plates moderately to strongly (mostly) developed, concolorous with or paler than transverse swelling. Rostrum brown, reaching hind coxae. ***Antennae*** about 4.1x longer than pronotum + collar medially; segment I whitish yellow to yellowish brown (sometimes pale brown), ventral and dorsal sides dark throughout or nearly so (striped), ventral side usually more heavily marked than dorsal side; segment II yellowish brown to brown throughout, about 2.2x longer than segment I; segments III–IV dark brown to nearly black. **Thorax**. Lateral margins of pronotum subrectilinear to slightly convex, distinctly explanate, moderately pale whitish yellow to yellowish brown (pale area at midlength about 1.5x the width of antennal segment II, sometimes narrower). Scutellum about 1.8 x longer than pronotum + collar medially. Thoracic underside black, with slightly to moderately contrasting acetabula (acetabulum I narrowly to broadly pale, more broadly so in male; acetabulum II very narrowly pale; acetabulum III very narrowly pale or completely dark), and broadly pale lateral margins. ***Legs*** largely pale; fore and mid femora with ventral side dark brown to nearly black over most of length (distinctly striped); hind femora without ventral and dorsal sides dark brown to black, coalesced into an annulus; fore tibiae pale (mostly) or slightly infumate dorsally near base (not striped throughout); hind tibiae about 2.7x longer than tarsal segments II+III combined. ***Hemelytra***: corium (Figs 2, 10) largely blackish, with highly reduced or evanescent pale markings on endocorium and usually slightly more extensive pale markings (whitish yellow) on exocorium; endocorium with distinct or sometimes ill-defined dark brown to black eyespot subbasally near R vein; costal margin usually dark throughout; colour pattern in female sometimes with slightly more extended pale markings on exocorium but mostly consistent with that in male; pruinose areas strongly developed, bearing a distinctive steely grey tinge, distributed on base and apex of clavus, most of corium (sometimes evanescent on exocorium), and on membrane near apex of clavus; basal pruinose area of clavus narrow and short, covering less than one-third of clavus length; basal pale spot of clavus absent; subapical pale spot of clavus present (mostly) or absent; membrane with four fully formed cells or with some cell reduction; cell 1 the shortest, distinctly shorter than cells 2 and 3, subtriangular; cells 2 and 3 subrectangular, subequal in length and width (cell 3 sometimes narrower); cell 4 the narrowest, slender, subequal in length or distinctly longer than cell 3**,** ending apically nearly in line with tip of cell 3 (sometimes well before tip of cell 3). **Abdomen**. Venter: male, completely blackish (rarely with margin of some segments narrowly pale); female, blackish medially with hind margin of segments narrowly pale and moderately to broadly margined with yellowish ivory. ***Male parandria*** (Fig. 18) elongate, broadly subtriangular with outer margins almost straight in basal half, obtusely rounded and somewhat broad at tip; inner margins almost straight or barely convex in basal half, moderately concave in apical half; medial membrane with acute inward projection on each side; basal margin slightly sinuate. ***Male paramere*** (Fig. 14) without distinct processus sensualis, instead with slightly uneven cuticular surface bearing less than ten setae; processus hamatus elongate (sometimes shorter than illustrated), slightly constricted at base, its tip very narrow, acuminate. *Other characters as in generic description (Larivière & Larochelle, 2016: 459).*

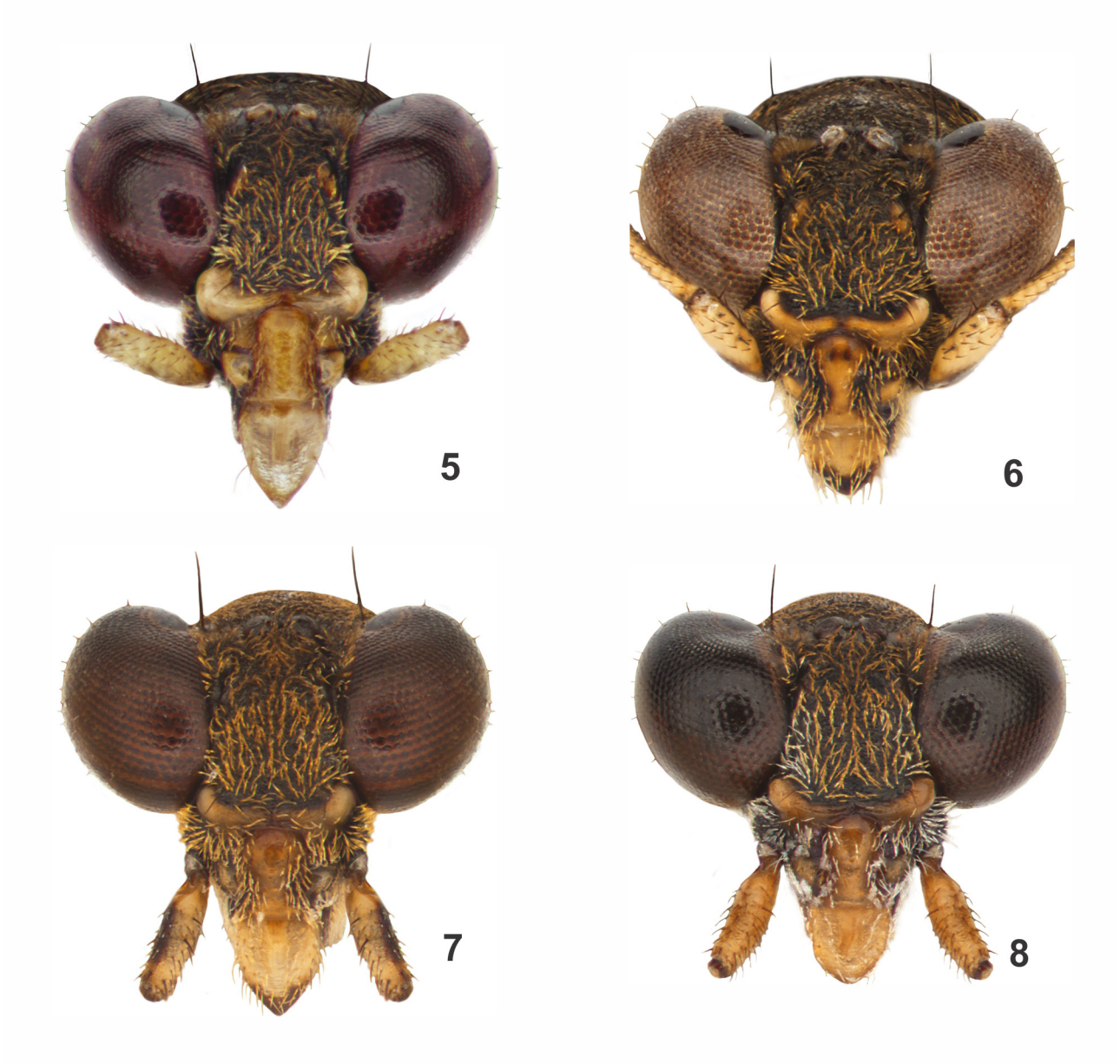
Geographic distribution (Fig. 21). South Island, alpine zone of mountains in Central Otago (CO) and Otago Lakes (OL).

Material examined. A total of 86 specimens including types, from the following localities. **South Island**. **CO**–Old Man Range (NZAC); Rock and Pillar Range, Stonehenge Track (LUNZ); The Remarkables (Lake Alta Track (NZAC); Rastus Burn (LUNZ, NZAC)). Snowdon Forest, Boyd Creek Tops track, alpine tops (NZAC).

Biology. **Altitudinal range**. Alpine; collected around 1200 to 1800 m. **Habitat**. Collected in numbers on dense carpet of alpine vegetation (e.g., moss-*Juncus*-cushion plants) of waterlogged bog in scree and tussock grasslands; also on hillside seepages, on sphagnum moss by tarn, in alpine bog, tarn or swamp. **Seasonality**. Adults and tenerals (newly emerged adults) collected in February and March, but tenerals mostly found in March. **Food**. Predator or scavenger. **Behaviour**. Undocumented.

Remarks. This species is named after Ian Cranshaw (Auckland), a special acquaintance and highly skilled health specialist, and someone who likes to climb mountains.

Kiwisaldula cranshawi is a distinctive small to medium-size species with pale lateral margins of pronotum strongly contrasting against dark, highly pruinose hemelytra with reduced pale markings, and processus hamatus of male paramere elongate, acuminate.



FIGURES 5–8. Facial views of *Kiwisaldula* species; males. (5) *K. yangae*, (6) *K. cranshawi*, (7) *K. ryani*, (8) *K. januszkiewiczi*.

This is mostly a submacropterous species but the Old Man Range population is subbrachypterous (with highly reduced hindwings). The odd macropterous individuals may also be encountered.

Specimens examined from Snowdon Forest, Boyd Creek Tops track (OL) are mostly tenerals and rather small for *K. cranshawi* but paramere configuration, body shape and overall colour suggests that they may belong to this species.

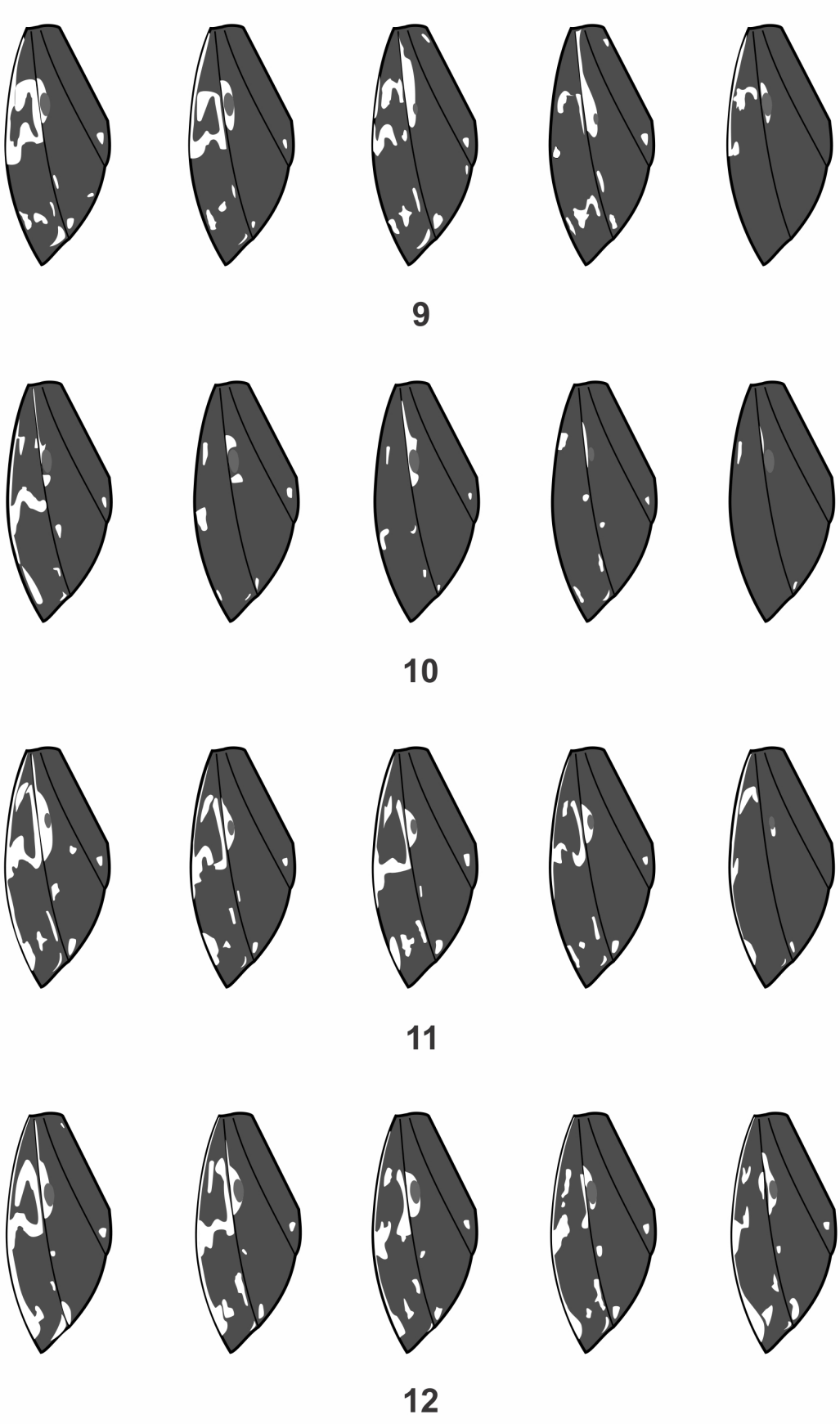
***Kiwisaldula ryani* new species**

Kiwisaldula ryani Larivière and Larochelle, new species. Holotype: Male (NZAC) labelled "NEW ZEALAND NN Aniseed Valley, Roding River nr [=near] Hacket Creek 22.II.2014 100m -41.3872 173.2132 Larivière, Larochelle / Boggy edge of mountain stream nr [=near] forest: among flattened vegetation near waterline. In sun. / HOLOTYPE [male symbol] *Kiwisaldula ryani* Larivière & Larochelle, 2018 (red label)." Paratypes 5 males (2 LUNZ, 3 NZAC), 2 females (1 LUNZ, 1 NZAC) with same data as holotype; 1 male and 1 female NZAC paratypes mounted on same pin.

Description (Submacropterous to macropterous adult). Body length 3.32–4.35 (3.75 mm); short-ovate to elongate-ovate (Fig. 3); female generally more broadly shaped. Dorsal colour largely dark, blackish, with narrowly to moderately pale lateral margins of pronotum and slightly to moderately well developed, sometimes coalesced pale markings on hemelytra. Facial colour (Fig. 7) slightly to moderately contrasted. Head, pronotum, and scutellum slightly to moderately shiny against mostly dull hemelytra. Dorsal pubescence moderately long, mostly reclined, mostly golden brown, usually more densely distributed on pronotum, clavus, and endocorium. Hemelytra with some slight cell reduction in membrane or fully developed; hindwings reaching basal quarter to half of membrane or fully developed. **Head** (Fig. 7, facial view). Preocellar spots whitish yellow to whitish brown. Preocular spots dark brown (nearly indistinct). Transverse swelling slightly to moderately developed; lateral portions contiguous; whitish yellow to yellowish brown, darker near facial midline. Mandibular plates slightly to moderately developed, concolorous with or darker than transverse swelling. Maxillary plates slightly to moderately developed, concolorous with or darker than transverse swelling, sometimes dark brown. Rostrum mostly yellowish brown or partly darker brown to nearly black, reaching hind coxae. ***Antennae*** about 3.9x longer than pronotum + collar medially; segment I whitish yellow to yellowish brown or brown (in very dark specimens), ventral and dorsal sides dark in part or throughout (usually striped), ventral side often more heavily marked than dorsal side; segment II whitish yellow to yellowish brown, often darker along one side or two sides, sometimes brownish throughout, about 2.2x longer than segment I; segments III–IV dark brown to nearly black. **Thorax**. Lateral margins of pronotum subrectilinear, sometimes barely convex or slightly sinuate, distinctly explanate, slightly to moderately pale whitish yellow to yellowish brown, sometimes infumate (pale area at midlength 1–1.5x the width of antennal segment II). Scutellum about 1.7x longer than pronotum + collar medially. Thoracic underside black, with slightly contrasting acetabula (acetabulum I narrowly (female) or broadly (male) pale; acetabulum II narrowly pale (mostly) or completely dark; acetabulum III very narrowly pale or completely dark), and broadly pale lateral margins. ***Legs*** largely pale, sometimes infumate; fore and mid femora with ventral side dark brown to nearly black over most of length (distinctly striped); hind femora without ventral and dorsal sides dark brown to black, coalesced into an annulus; fore tibiae pale or infumate dorsally (not striped throughout); hind tibiae about 2.6x longer than tarsal segments II+III combined. ***Hemelytra***: corium (Figs 3, 11) largely blackish, with reduced pale markings on endocorium and more extensive pale markings (whitish yellow to yellowish brown, often infumate) on exocorium; endocorium with more or less distinct, mostly reduced, pale to dark brown eyespot subbasally near R vein; costal margin lined with narrow to moderately wide, uninterrupted or interrupted pale band; colour pattern in female often with more extended pale markings but mostly consistent with that of male; pruinose areas strongly developed, distributed on base and apex of clavus and most of corium, and usually on membrane near apex of clavus; basal pruinose area of clavus broad and short, covering less than one-third of clavus length; basal pale spot of clavus absent; subapical pale spot of clavus present or absent (rarely); membrane with four nearly fully formed or fully formed cells; cell 1 the shortest, distinctly shorter than cells 2 and 3, subtriangular; cells 2 and 3 subrectangular, subequal in length and width; cell 4 as wide or narrower than cell 3, subequal in length (mostly) or distinctly longer or shorter**,** ending apically well before or nearly in line with tip of cell 3. **Abdomen**. Venter: male, blackish with or without (mostly) hind margin of segments very narrowly pale; female, blackish medially with hind margin of segments narrowly pale and narrowly to moderately margined with yellowish ivory to pale yellowish brown (pale margin sometimes infumate or obscured in darker individuals). ***Male parandria*** (Fig. 19) elongate, broadly subtriangular, acutely rounded and moderately narrowed at tip; inner margins almost straight or barely convex in basal half, moderately concave in apical half; medial membrane with truncate inward projection on each side; basal margin straight. ***Male paramere*** (Fig. 15) somewhat variable, especially length of processus hamatus (shorter or slightly longer than illustrated) and width of main body (very slender at times); with barely distinct processus sensualis (mostly) or with nearly flat cuticular surface, bearing less than ten setae; processus hamatus very short and almost pointing straight (as opposed to *K. butleri* and *K. januszkiewiczi*), slightly constricted at base, its tip very narrow, acutely rounded. *Other characters as in generic description (Larivière & Larochelle, 2016: 459).*

Geographic distribution (Fig. 21). South Island, northwestern areas (BR, NN, SD).

Material examined. A total of 197 specimens including types, from the following localities. **South Island**. **BR**–Nelson Lakes National Park (Lake Rotoiti, West Bay (NZAC); Lake Rotoroa (NZAC)); Rotokohu, Inangahua River (NZAC). **NN–**Aniseed Valley, Roding River near Hacket Creek (NZAC); Junction Dart and Wangapeka Rivers (NZAC); Kotinga, Long Point Road (NZAC); Mossy Burn, 2 km South of Kohaihai River (NZAC); Puponga Farm Park (Green Hills Stream mouth (NZAC); Whahariki Stream Mouth (NZAC)); Tahunanui Beach, Back Beach inlet (NZAC). **SD**–Junction Opouri River and Tunakino Valley Road (NZAC).



FIGURES 9–12. Eunomy (left corium), most frequently observed pigmentation patterns. (9) *Kiwisaldula yangae*, (10) *K. cranshawi*, (11) *K. ryani,* (12) *K. januszkiewiczi*.

Biology. **Altitudinal range**. Lowland to montane; collected from sea level to around 800 m. **Habitat**. Occurs in open habitats, mostly on moist to wet, bare or sparsely vegetated, sometimes silty sand along or near sand bars, the banks or side-channels of gravelly or sandy streams and rivers, lakes and ponds; in small moss clumps between sparse stones, on ground surface between sparse *Juncus*-tufts, in plant debris, on flood-flattened vegetation, along boggy banks; usually near water (from the water line to within a few meters). Also collected near water in coastal situations; on bare to sparsely vegetated, wet sand flats in estuary streams and lagoons, on moist sand patches of intertidal flats with sparse to dense *Salicornia*-cover, on bare wet, silt cakes over sand on the banks of coastal streams. **Seasonality**. Adults and tenerals (newly emerged adults) collected from February to March, but tenerals mostly found in March; nymphs collected in February and March; mating pair observed in February. **Food**. Predator or scavenger. **Behaviour**. Undocumented.

Remarks. This species is named after Grant Ryan (Auckland), a highly skilled health specialist.

Kiwisaldula ryani is expected to be more widely distributed in northernmost areas of the South Island than might be surmised from the list of currently known localities, and to possibly be found in the Kaikoura region (KA) which remains undersurveyed for saldids.

This new species is morphologically highly variable, small to moderate in size, with an overall blackish appearance, subrectilinear to sometimes slightly convex or sinuate, somewhat narrowly pale lateral margins of pronotum, extensive pale markings and a more or less distinct, mostly reduced eyespot on hemelytra, and distinctive male genitalia. *K.* ryani does not appear to be strictly sexually dimorphic for body shape and wing development. Generally speaking, however, males appear to predominantly have a short-ovate body and to be submacropterous while females seem to be more regularly elongate-ovate and macropterous.

Kiwisaldula ryani is on average smaller than *K. butleri* but larger, longer-winged, paler individuals, although slenderer in appearance, can be difficult to diagnose from *K. butleri*; dissection of male genitalia may be necessary. Material examined so far suggests that the two species are allopatric in distribution although the authors' field experience does not preclude the possibility of westward penetrations by *K. butleri* via river valleys and mountain passes and the prospect of parapatry with *K. ryani*.

At the limit of their distribution *K. ryani* and *K. januszkiewiczi* can also be difficult to distinguish based on external morphology, especially paler submacropterous or macropterous individuals; these species may also prove to be parapatric in distribution. Available field data suggest that *K. ryani* favours less muddy, more oligotrophic habitats than *K. januszkiewiczi*.

The Nelson Lakes (BR) populations include specimens that superficially resemble all three species and identification could only be confirmed using male genitalia.

Kiwisaldula januszkiewiczi new species

Kiwisaldula januszkiewiczi Larivière and Larochelle, new species. Holotype: Male (NZAC) labelled "NEW ZEALAND WD Lake Moeraki 4343S 16916E 20.III.2003 Larivière, Larochelle / Lakeshore: bare, coarse, wet gravel; near water / HOLOTYPE [male symbol] *Kiwisaldula januszkiewiczi* Larivière & Larochelle, 2018 (red label)." Paratypes 1 male (LUNZ), 1 female (NZAC) with same data as holotype, 4 males (1 CMNZ, 1 LUNZ, 2 NZAC), 3 females (1 CMNZ, 1 LUNZ, 1 NZAC) with same data as holotype except habitat label (Lakeshore: seepages and mossy stones), bearing blue paratype labels.

Description (Subbrachypterous to submacropterous adult). Body length 3.38–4.15 (3.64 mm); short-ovate (mostly) to subelongate-ovate (Fig. 4); female often elongate and dorsally broad behind midlength of hemelytra (as opposed to more regularly elongate-ovate in *K. ryani* and *K. butleri*). Dorsal colour largely dark, blackish, often with overall brownish hue including antennal segments I–II (as opposed to more regularly blackish hue and paler antennal segments I–II in *K. ryani*), moderately to broadly pale lateral margins of pronotum and slightly to moderately well developed, sometimes coalesced pale markings on hemelytra. Facial colour (Fig. 8) slightly to moderately contrasted. Head, pronotum, and scutellum slightly to moderately shiny against mostly dull hemelytra. Dorsal pubescence moderately long, mostly reclined, mostly golden brown, usually more densely distributed on pronotum, clavus, and endocorium. Hemelytra with some cell reduction in membrane; hindwings not surpassing tip of corium (mostly) or reaching middle of membrane. **Head** (Fig. 8, facial view). Preocellar spots yellowish brown to brown. Preocular spots brownish (often nearly indistinct). Transverse swelling slightly to moderately developed; lateral portions con-

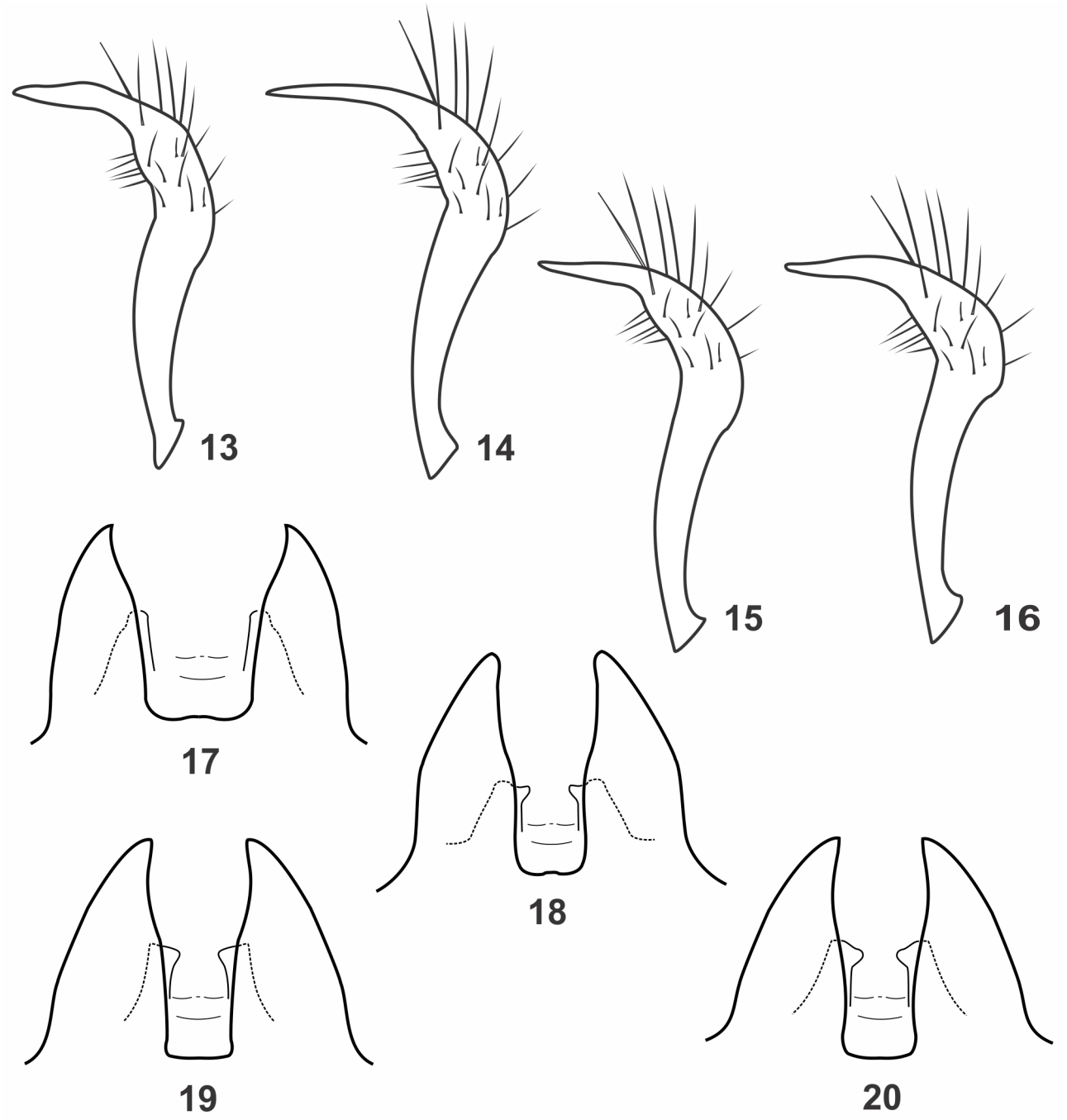
tiguous; whitish yellow to brownish, darker near facial midline. Mandibular plates slightly to moderately developed, concolorous with or darker than transverse swelling. Maxillary plates slightly to moderately developed, concolorous with or darker than transverse swelling, sometimes dark brown. Rostrum mostly brown, reaching hind coxae. ***Antennae*** about 4.0x longer than pronotum + collar medially; segment I yellowish brown to brown, ventral and dorsal sides often dark in part or throughout (striped or not), ventral side usually more heavily marked than dorsal side; segment II yellowish brown to brown throughout, about 2.1x longer than segment I; segments III–IV dark brown to nearly black. **Thorax**. Lateral margins of pronotum subrectilinear to moderately convex, rarely slightly sinuate, distinctly explanate, moderately to broadly pale whitish yellow to yellowish brown, often infumate (pale area at midlength 1.5–2x the width of antennal segment II). Scutellum about 1.8x longer than pronotum + collar medially. Thoracic underside black, with slightly contrasting acetabula (acetabulum I narrowly (female) or broadly (male) pale; acetabulum II narrowly pale (mostly) or completely dark; acetabulum III very narrowly pale or completely dark), and broadly pale lateral margins. ***Legs*** largely pale, often infumate; fore and mid femora with ventral side dark brown to nearly black over most of length (distinctly striped); hind femora without ventral and dorsal sides dark brown to black, coalesced into an annulus; fore tibiae pale or infumate dorsally (not striped throughout); hind tibiae about 2.8x longer than tarsal segments II+III combined. ***Hemelytra***: corium (Figs 4, 12) largely dark brown to nearly blackish, with reduced pale markings on endocorium and more extensive pale markings (whitish yellow to yellowish brown, often infumate) on exocorium; endocorium with distinct dark brown to black eyespot subbasally near R vein; costal margin lined with narrow to moderately wide, mostly uninterrupted pale band; colour pattern in female often with less extended pale markings and darker overall brownish hue but generally consistent with that of male; pruinose areas strongly developed, distributed on base and apex of clavus and most of corium, and usually on membrane near apex of clavus; basal pruinose area of clavus broad and short, covering less than one-third of clavus length; basal pale spot of clavus present or absent (mostly); subapical pale spot of clavus present; membrane with four nearly fully formed cells; cell 1 the shortest, distinctly shorter than cells 2 and 3, subtriangular; cells 2 and 3 subrectangular, subequal in length and width; cell 4 the narrowest, slender, subequal in length (mostly) or distinctly longer or shorter than cell 3**,** ending apically well before or nearly in line with tip of cell 3. **Abdomen**. Venter: male, blackish with or without hind margin of segments very narrowly pale; female, blackish medially with hind margin of segments narrowly pale and moderately to broadly margined with, often infumate, yellowish ivory to pale yellowish brown. ***Male parandria*** (Fig. 20) elongate, broadly subtriangular, acutely rounded and moderately narrowed at tip; inner margins slightly convex in basal half, slightly concave in apical half; medial membrane with acute inward projection on each side; basal margin barely concave. ***Male paramere*** (Fig. 16) somewhat variable, especially width of main body above shaft (more arcuate and broader than *K. butleri* and *K. ryani*; at times narrower than illustrated); without distinct processus sensualis, instead with slightly wavy cuticular surface bearing less than ten setae; processus hamatus moderately long, not constricted at base, its tip rather narrow, acutely rounded. *Other characters as in generic description (Larivière & Larochelle, 2016: 459).*

Geographic distribution (Fig. 21). South Island, mostly areas west of the Southern Alps (BR, WD).

Material examined. A total of 198 specimens including types, from the following localities. **South Island**. **BR**–Barrytown (NZAC); Lake Poerua, Te Kinga Scenic Reserve (NZAC); Taramakau River mouth, South Head (NZAC); Woodpecker Bay (NZAC). **WD**–Junction Mahitahi River and Highway 6 (NZAC); Lake Mahinapua (NZAC); Lake Mapourika, MacDonalds Creek mouth (NZAC); Lake Moeraki (NZAC); Ohinetamatea River (NZAC); Okarito (NZAC).

Biology. **Altitudinal range**. Lowland to lower montane; collected from sea level to about 500 m. **Habitat**. Occurs in open habitats mostly on wet, bare to moderately vegetated, sandy or gravelly banks or side-channels of sandy-gravelly streams and rivers, lakes, and ponds; on bare, coarse, wet gravelly lakeshore, on bare sand or sand with moderate *Juncus*-cover along calm recesses or pools of sandy-gravelly rivers, on bare, wet, sandy lakeshore, on sparsely mossy and moderately vegetated banks of sandy streams entering lakes, among seepages and mossy stones on lakeshores; usually near the water line but also found at a certain distance from it (5–10 m). Also collected usually near water in coastal situations; on muddy-stony stream banks, on wet mudflats with sparse *Juncus* near streams, along canals on wet, silty-sandy sand flats covered by dead algae; also in a muddy grass field with sparse *Juncus* near a lagoon. **Seasonality**. Adults and tenerals (newly emerged adults) collected in March when tenerals appeared more abundant than fully mature adults. **Food**. Predator or scavenger. **Behaviour**. Undocumented.

Remarks. This species is named after Janek Januszkiewicz (Auckland), a highly skilled health specialist.



FIGURES 13–20. Schematic view of male genitalia (13–16) Paramere, ventral view. (13) *Kiwisaldula yangae*, (14) *K. cranshawi*, (15) *K. ryani*, (16) *K. januszkiewiczi*. (17–20) Parandria, posterior view. (17) *K. yangae*, (18) *K. cranshawi*, (19) *K. ryani*, (20) *K. januszkiewiczi*.

Kiwisaldula januszkiewiczi is expected to be more widely distributed in western areas of the South Island than might be surmised from the list of material examined.

This new species is morphologically highly variable, small to moderate in size, with an overall dark brownish, often infumate appearance, subrectilinear to moderately convex, somewhat broadly pale lateral margins of pronotum, hemelytra with extensive pale markings, a usually uninterrupted pale costal band, and a distinct eyespot, and distinctive male genitalia. Generally speaking, *K. januszkiewiczi* has a short-ovate to subelongate-ovate body shape but females often appear dorsally broad behind hemelytral midlength, and can look almost pear-shaped.

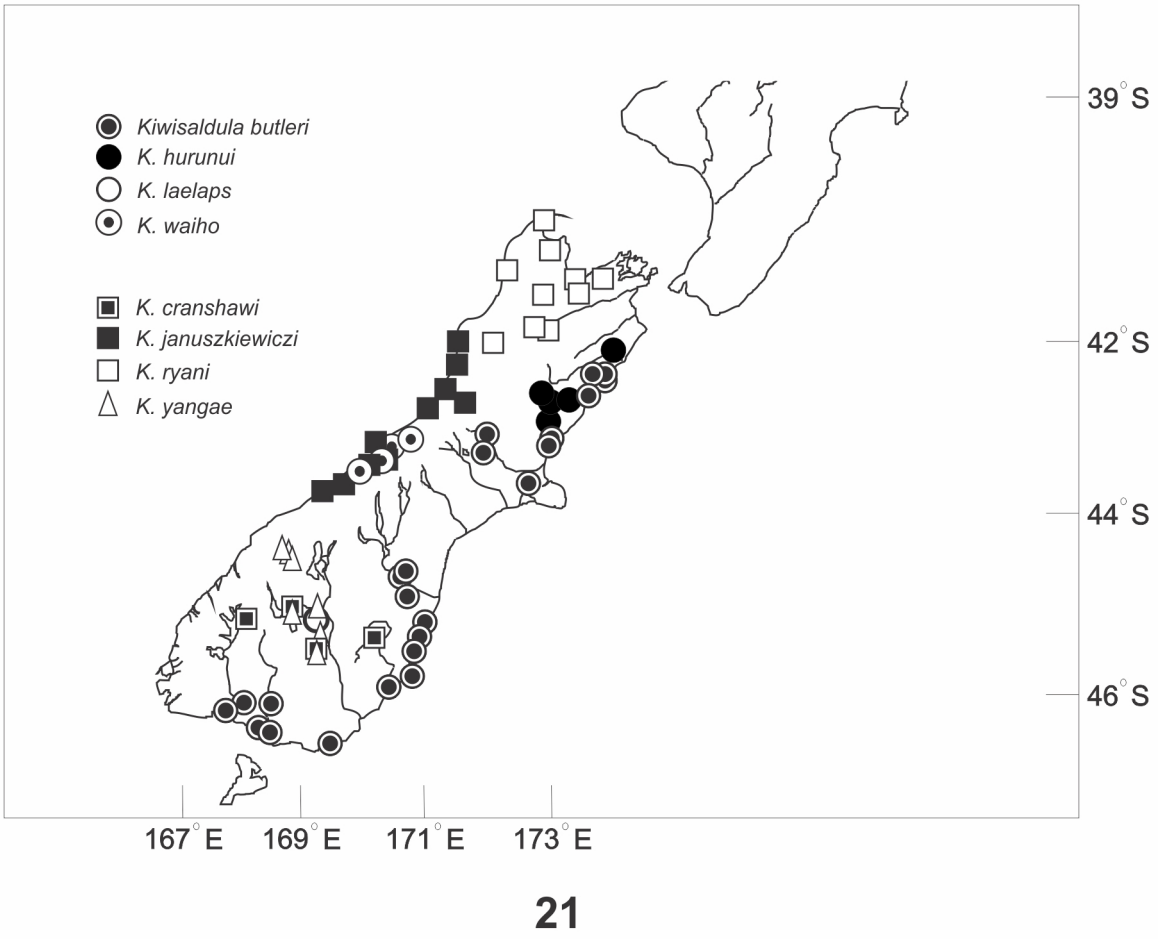


FIGURE 21. Collecting localities of *Kiwisaldula* species, South Island, New Zealand; updated from Larivière & Larochelle (2017).

Kiwisaldula januszkiewiczi is on average smaller than *K. butleri* but larger, longer-winged, paler individuals can be very difficult to distinguish from *K. butleri* based on external morphology although as it stands the two species are allopatric in their distribution. Available field data suggest that *K. januszkiewiczi* favours muddier, more eutrophic habitats than *K. ryani*. See also **Remarks** under *K. ryani*.

Specimens from Barrytown (BR) and other localities nearing the northern limit of *K. januszkiewiczi*'s distribution show great morphological variability within and between populations; identification could only be confirmed using male parameres.

Notes on species variability

The populations so far confidently identified as belonging to *K. butleri, K. ryani,* or *K. januszkiewiczi*—three morphologically close species—are allopatric. The authors have, however, also seen populations at the edge of species distributions in the northern Buller area (BR) and southern as well as eastern Northwest Nelson (NN) and Marlborough (MB) areas, that display highly variable and unbalanced phenotype and male genitalic characters. Further study using tools of molecular genetics could ascertain the status of edge-of-range populations that cannot be identified with certainty using conventional means.

Similar difficulties were encountered with populations of what could potentially be *K. butleri* or *K. cranshawi* at the western limit of these species ranges, especially along the foothills and lower mountain slopes on the eastern side of the Southern Alps and in Fiordland National Park (FD) in the southwestern corner of the South Island. Unfortunately the authors could not get a firm grasp of the *Kiwisaldula* fauna of the Fiordland (FD) for lack of suitable study material. It is hoped that further surveying of this World Heritage area will occur in the future.

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