

*et al.* 2012). No insertions/deletions were detected and sequences were translated to confirm that there were no stop codons or frame shifts that would indicate the presence of nuclear paralogs. We examined the relationships of putative *Miotopus* mtDNA COI haplotypes with respect to *Pleioplectron* and other representatives of the New Zealand cave w t (*Allegrucci et al.* 2010) using phylogenetic



several locations on North Island are consistent with Hutton's description of *Miotopus diversus*, but most specimens from South Island represent an undescribed species.

In the OR our phylogenetic analysis of a 1435 bp alignment of mtDNA COI, *Miotopus diversus* did not cluster with







**Type material****Holotype**

NEW ZEALAND: 1 ♂, from Upper Wanganui (as *Pleiopectron diversum*) in Canterbury Museum (Hutton 1897).

**Other material**

NEW ZEALAND: 1 ♂ from Makaretu, Hawkes Bay (as *Miotopus diversus*) (Hutton 1898).

**Material examined**

See Table 2.

**Description**

**HEAD.** Mostly brown with vertical pale stripes, covered in fine setae, palps light brown with fine setae, fastigium brown with pale spots on the sides, eyes black and ovoid, antennae long and dark brown. Male antennae are notably thick, densely clothed in setae and abruptly tapering to a thin thread at the end, whereas female antennae are narrow and almost uniformly thin from end to end, scape and peduncle pale (Fig. 5).

**THORAX.** Pronotum with anterior and posterior margins convex, and sides rounded with a slight outward 'lip', dark brown–red brown with occasional pale markings (Fig. 6A–B).

**LEGS.** Moderately long, hind femora shorter than tibiae, coxae and trochanters cream, femora and tibiae dark brown with cream bands. Fore femora compressed with one prolateral apical spine and one retrolateral apical spine present, short dark setae present. Fore tibiae with two prolateral and three or four retrolateral long, pale to transparent, linear spines positioned in the mid to distal portion of the tibiae. Fore tibiae with two superior apical spines (one prolateral and one retrolateral), pale with dark tip, almost hidden amongst the setae, two inferior apical spines (one prolateral and one retrolateral), inferior apical spines longer than superior spines, articulate, pale with dark tip, longer and thicker than the surrounding setae. Mid femora compressed with one long articulated prolateral apical spine, one long articulated retrolateral apical spine. Mid tibiae with three or four prolateral and two or three retrolateral long, linear spines positioned in the mid to distal portion of the tibiae, prolateral linear spines longer than the retrolateral spines. Mid tibiae with two superior apical spines (one prolateral and one retrolateral), pale with dark tip, two inferior apical spines (one prolateral and one retrolateral), inferior spines longer than superior spines, pale with dark tip. Hind femora with one retrolateral apical spine (sometimes very small), slightly pigmented. Hind tibiae longer than femora with small brown alternate spines along superior surface (Fig. 9). Hind tibiae with two superior subapical spines (one prolateral and one retrolateral), two superior apical spines (one prolateral and one retrolateral), spines twice as long as superior subapical spines, two inferior apical spines (one prolateral and one retrolateral) length of superior apical spines above, two inferior subapical spines. Tarsi with four segments, 1<sup>st</sup> and 2<sup>nd</sup> segment with a pair of spines on distal end, 1<sup>st</sup> segment has eight small spines up from the end in alternate fashion; on the underside of the 1<sup>st</sup> segment minute brown spinules run up the length of the segment either side of the tarsal pad. The 2<sup>nd</sup> segment has three minute spines above, 4<sup>th</sup> segment half the length of the 1<sup>st</sup> segment.

**ABDOMEN.** Glossy, brown tones. Short setae covering both tergites and sternites; sternum light brown colour.

**TERMINALIA MALE** (Fig. 7A–B). Cerci long, round, brown in colour, clothed in setae, styli short, not extending beyond the end of the subgenital plate. Subgenital plate is a finger-like protrusion.

**Table 2** (continued on next pages). Material of *Miotopus diversus* (Hutton, 1896) examined. All specimens collected in New Zealand. Collector abbreviations: DH = Danilo Hegg; GB = Gareth Hegg; GB = Gareth Hegg; ML = Mike Lusk; MMR = Mary Morgan-Richards; RG = Ron Goudswaard; ST = Steve Trewick.

Entomological Region	Material	Locality	Coordinates	Elevation m a.s.l.	Micro-habitat	Collecting method	Date	Collector	Institution code	Specimen code
TK (Taranaki)	3 , 3 , 4 nymphs	Egmont National Park, Kaitake Range, Lucy's Gully	-39.14931, 173.94167	200	Under log in forest	Day search	25 Sep. 2006	ST & MMR	MPN	CW459–CW465
TK (Taranaki)	1	Egmont National Park, Oakura River	-39.19482, 173.99864	400		Night search	1 Apr. 2007	ST & MMR	MPN	CW783
TK (Taranaki)	1 , 3	Lake Rotokare	-39.45409, 174.40923	200		Pitfall trap			LCR	LR-L3-A LR-W19-A, B LR-L59-B
WN (Wellington)	1	Palmerston North, Turitea Rd	-40.41566, 175.66390	100			21 Aug. 2004	MMR	MPN	CW133
WN (Wellington)	1	Palmerston North, Turitea Rd	-40.41566, 175.66390	100		Night search	15 Mar. 2005	ST	MPN	CW336
WN (Wellington)	1	Palmerston North, Turitea Reserve	-40.43045, 175.67273	200	Near boat shed	Night search	15 Aug. 2010	ST	MPN	CW1439
WN (Wellington)	4 , 1	Palmerston North, Turitea Reserve	-40.43045, 175.67273	200		Night search	19 Nov. 2010	ST	MPN	CW1452, CW1459, CW1467–CW1469
WN (Wellington)	1	Palmerston North, Turitea Reserve	-40.43045, 175.67273	200		Pitfall trap				TD19(1)-b
WN (Wellington)	1	Palmerston North, Kahuterawa Stream	-40.47068, 175.61204	150	Stream bed		1 Jul. 2009		MPN	CW1327
WN (Wellington)	1	Wellington, Karori Sanctuary	-41.302893, 174.703689	250			21 Jul. 2004	RG	MPN	CW117

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**Table 2** (continued).

Entomological Region	Material	Locality	Coordinates	Elevation m a.s.l.	Micro-habitat	Collecting method	Date	Collector	Institution code	Specimen code
MB (Marlborough)	1	Pelorus Bridge, Circle Loop Track	-41.29802, 173.57333	30		Night search		ST & MMR	MPN	CW533A
MB (Marlborough)	2 , 1 nymph	Pelorus Bridge	-41.29655, 173.5744	30	In roots of fallen tree	Night search + insect net	6 Oct. 2017	DH	MPN	CW3598, CW3599, CW3790
MB (Marlborough)	1									

TERMINALIA FEMALE (Fig. 8A–C). Subgenital plate with three points, the outer two slightly longer than the middle one. Apex rounded and blunt. Ovipositor reddish-brown with 7–8 teeth on the ventral edge near at the tip.

*Miotopus richardsi* sp. nov.

[urn:lsid:zoobank.org:act:BFDCEBC5-E058-4362-B5B4-42E3D9FAAD8F](https://zoobank.org/act/BFDCEBC5-E058-4362-B5B4-42E3D9FAAD8F)

Figs 4, 5C, 6C–D, 7C–F, 8D–F, 9, 10C–F

### Diagnosis

A medium sized cave w t found in forested areas of the South Island, New Zealand with a variegated colour pattern. Similar to *Miotopus diversus* based on apical spines with the exception of the presence on hind femora of both pro lateral and retrolateral apical spines (n.b. this trait was formerly considered diagnostic of *Pachyrhanna*, see Cook *et al.* 2010). It is easily identified by the very long legs and the

presence of three pairs of prominent, socketed superior spines on the hind tibiae. Female with subgenital plate similar to *M. diversus*, but differs in male genital terminalia. Notably long ovipositor, as long as or longer than body length (Fig. 10C–F).

### **Etymology**

Named for Aola Richards who studied New Zealand cave w t and published many important systematic papers from 1954 until 1972.

### **Type material**

#### **Holotype**

NEW ZEALAND: , adult, Fiordland (FD), Gulliver River, -44.704477, 167.97031, 60 m a.s.l., under large river boulders in native forest, by hand during night search, Jan. 2014, Tony Jewell leg. (MPN CW2619; NMNZ AI.035053).

#### **Paratype**

NEW ZEALAND: , adult, Brunner (BR), Lewis Pass, Cannibal Gorge, -42.333962, 172.424113, 820 m a.s.l., on rotting tree stump in native forest, with insect net during night search, 24 Apr. 2017, Danilo Hegg leg. (MPN CW3429; NMNZ AI.035054).

#### **Additional material examined**

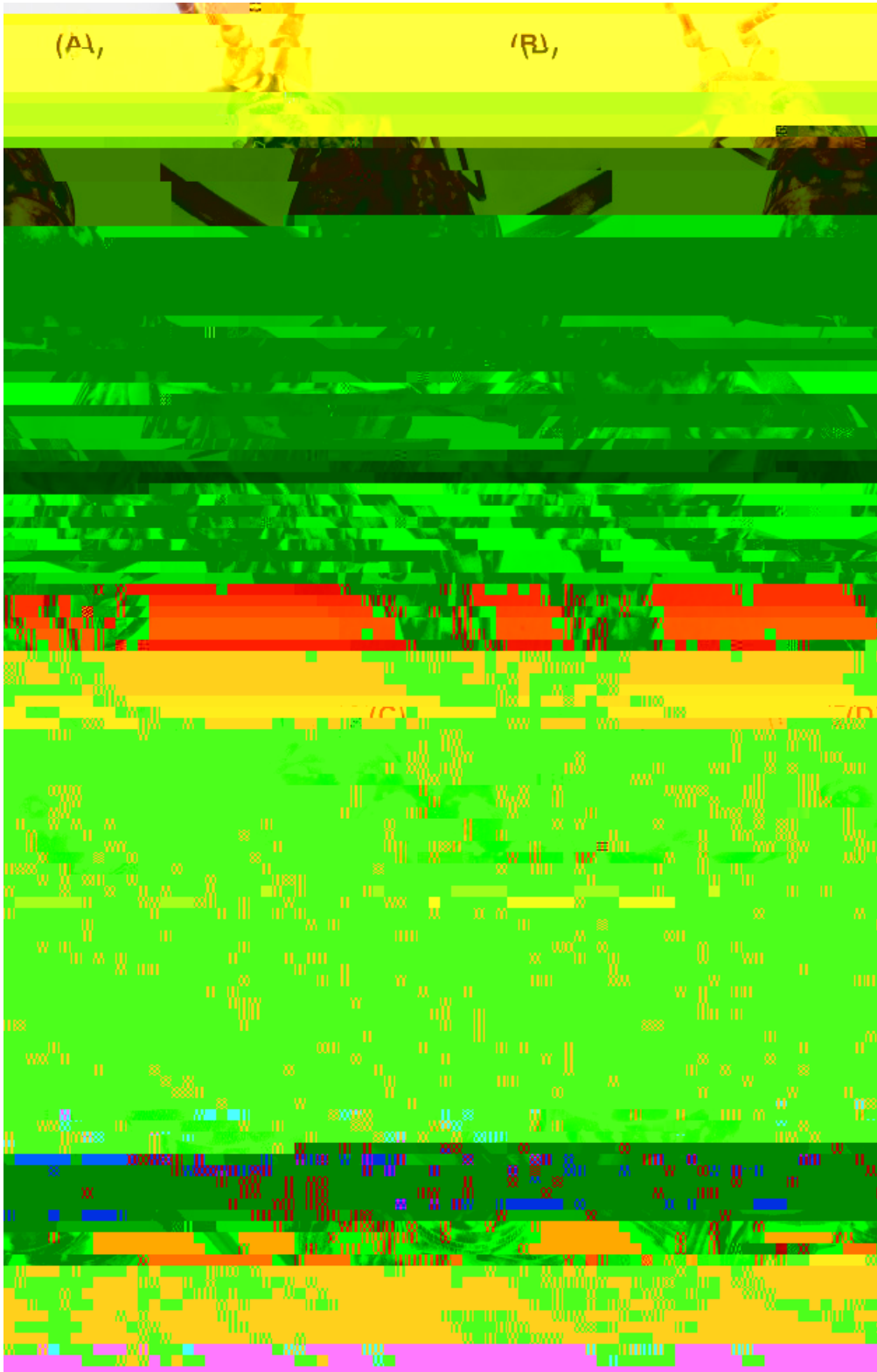
See Table 3.

### **Description**

MEASUREMENTS. See Table 1.

HEAD. Head slightly variegated colouring with a medium brown and golden light brown; covered in fine setae; palps are light golden brown and covered with fine setae; fastigium medium brown with minor golden light brown, with pale spots on the sides; eyes black; antennae long and medium brown with setae; scape and peduncle light golden brown (Fig. 5C–D).

THORAX



**Fig. 6.** Dorsal views of cave w t in the genus *Miotopus* Hutton, 1898. **A–B.** *Miotopus diversus* (Hutton, 1896). **A.** Adult ♂, Resolution Bay, Queen Charlotte Sound (MPN CW3601). **B.** Adult ♀, Camp Bay, Queen Charlotte Sound (MPN CW3596). **C–D.** *Miotopus richardsi* sp. nov. **C.** Adult ♂, Lewis Pass (MPN CW3609). **D.** Adult ♀, Borland Road, Fiordland NP (MPN CW3811). Scale bar = 5 mm.

**Table 3** (continued on next pages). Material of *Miotopus richardsi* sp. nov. examined. All specimens collected in New Zealand. <sup>H</sup> = Holotype, <sup>P</sup> = Paratype. Collector abbreviations: DC = Deborah Carden; DH = Danilo Hegg; MMR = Mary Morgan-Richards; ST = Steve Trewick; TJ = Tony Jewell.

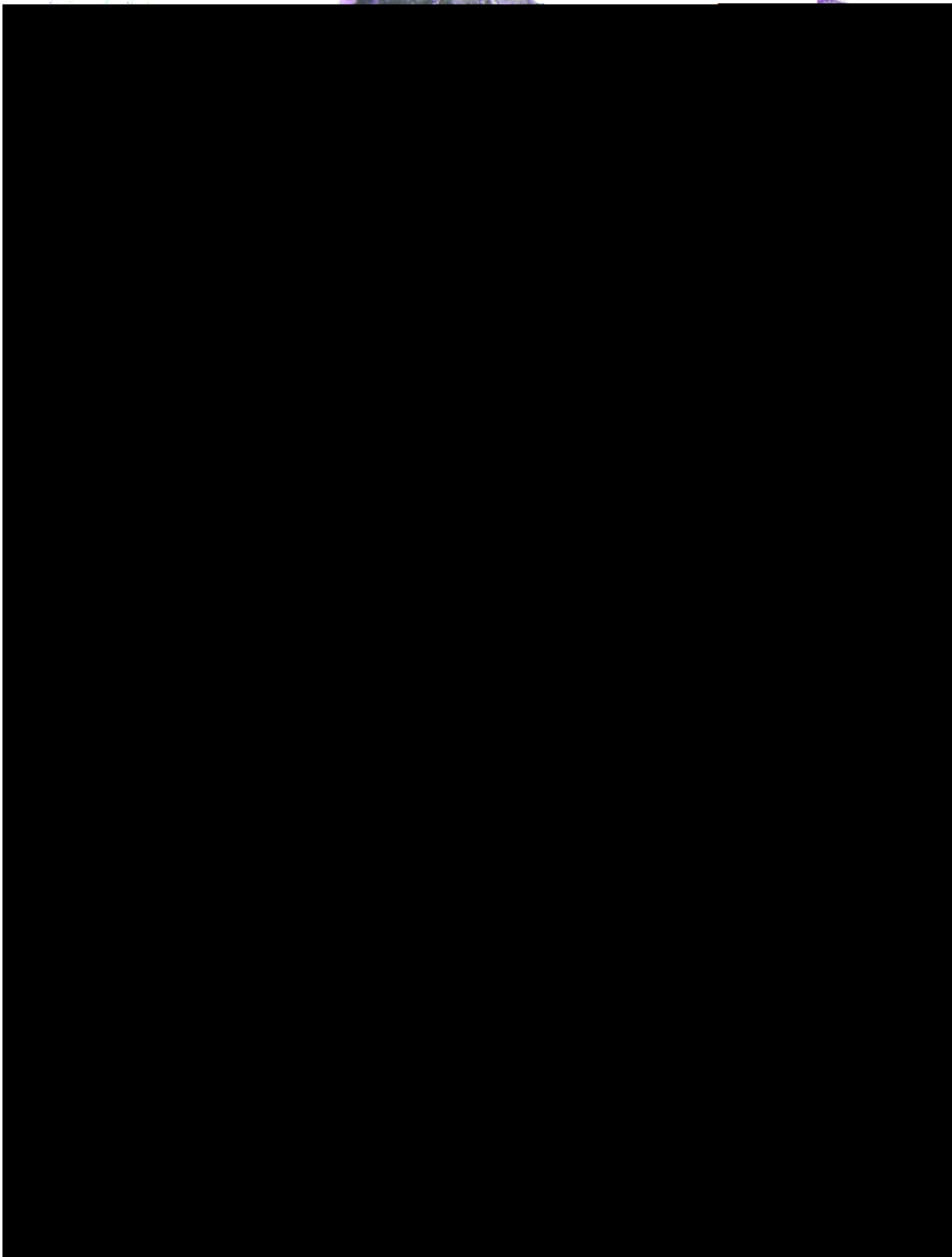
Entomological Region	Material	Locality	Coordinates	Elevation m a.s.l.	Micro-habitat	Collecting method	Date	Collector	Institution code	Specimen code
SI (Stewart Island)	2	Port Pegasus, South Pegasus Hut	-47.199964, 167.638315	0	Under tree arch	Caught by hand at night	17 Jan. 2018	DH	MPN	CW3640, CW3641
SI (Stewart Island)	1	Oban, Horseshoe Point	-46.880401, 168.148586	0	On tree	Night search	20 Apr. 2017	ST & MMR	MPN	CW3481
SI (Stewart Island)	1	Oban,								



Entomological Region	Material	Locality	Coordinates	Elevation m a.s.l.	Micro-habitat	Collecting method	Date	Collector	Institution code	Specimen code
FD (Fiordland)	1 1	Gulliver River		60	Under dry boulder overhang in forest	Night search	Jan. 2014	TJ	MPN	CW2619 <sup>H</sup> , CW2620
FD (Fiordland)	1 , 1	Lake Rakatu	-45.62037, 167.59631	190	On tree trunk in native forest	Caught by hand at night	10 Sep. 2016	DH	MPN	CW3810, CW3523
FD (Fiordland)	1 1	Borland Rd	-45.74031, 167.42700	700	Dry rock overhang in road cutting	Night search + insect net	3 Mar. 2017	DH	MPN	CW3542, CW3811
FD (Fiordland)	1	Eglinton Valley, Knobs Flat	-44.97774, 168.00520	350	In cavity at base of tree trunk	Photograph only	13 Jan. 2009	DH	iNaturalist	3101320
FD (Fiordland)	1	Eglinton Valley, Lake Gunn	-44.87218, 168.08828	480	In shrubs	Night search + insect net	11 Mar. 2017	DH	MPN	CW3543
OL (Otago Lakes)	1 , 1	West Matukituki River, Raspberry Flat	-44.50037, 168.75445	450	Under rock overhang in bluffs	Caught by hand at night	21 Feb. 2016	DH	MPN	

Entomological Region	Material	Locality	Coordinates	Elevation m a.s.l.	Micro-habitat	Collecting method	Date	Collector	Institution code	Specimen code
BR (Brunner)	1	Lewis Pass, Nina Valley	-42.459738, 172.364717	600	Under large rock in forest	Night search + insect net	26 Jan. 2018	DH	MPN	CW3762
NN (Nelson)	1	Oparara, Box Canyon Cave	-41.13481, 172.19008	250	In cave		Feb. 2005	DC	MPN	CW345
NN (Nelson)	1	Takaka, Sky Farm	-40.92435, 172.sect n282							

~~Miotopus diversus~~ *Miotopus diversus*



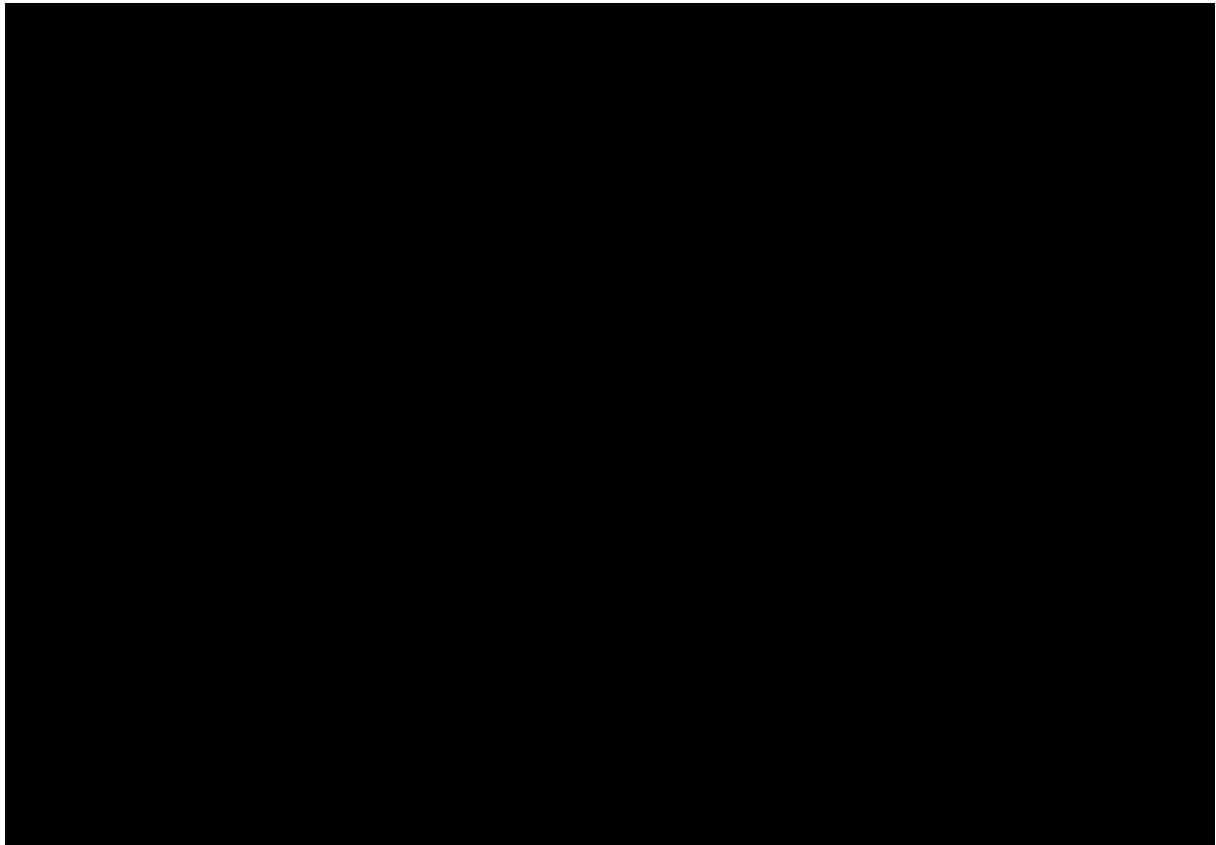
**Fig. 7.** Male terminalia of *Miotopus* Hutton, 1898 cave w t . **A–B.** *Miotopus diversus* (Hutton, 1896) (MPN CW3601). **A.** Lateral. **B.** Ventral. **C–F.** *Miotopus richardsi* sp. nov. (MPN CW3542). **C.** Lateral. **D.** Ventral. **E.** Close dorsal. **F.** Ventral views of named structures. Scale bars = 2 mm.

and one retrolateral), twice as long as superior subapical spines, two inferior apical spines (one prolateral and one retrolateral) the length of superior apical spines above, two inferior subapical spines. Hind tarsi with 4 segments, 1<sup>st</sup> and 2<sup>nd</sup> segment with a pair of spines on distal end. 1<sup>st</sup> segment has 4–11 small dorsal, alternate spines, and minute brown spinules along the underside of either side of the tarsal pad. The 2<sup>nd</sup> segment occasionally has one or two small spines above, 4<sup>th</sup> segment half the length of the 1<sup>st</sup> segment.

ABDOMEN. Shiny, brown coloured. Short setae covering both tergites and sternites; sternum pale brown colour.

TERMINALIA MALE. Cerci long, round, brown in colour, clothed in setae. Styli reduced, not extending beyond the end of the subgenital plate. Subgenital plate short and bulbous, usually with median groove on ventral surface. Paraprocts adjacent to subgenital plate each bearing a prominent, sharp spine (Fig. 7C–D).

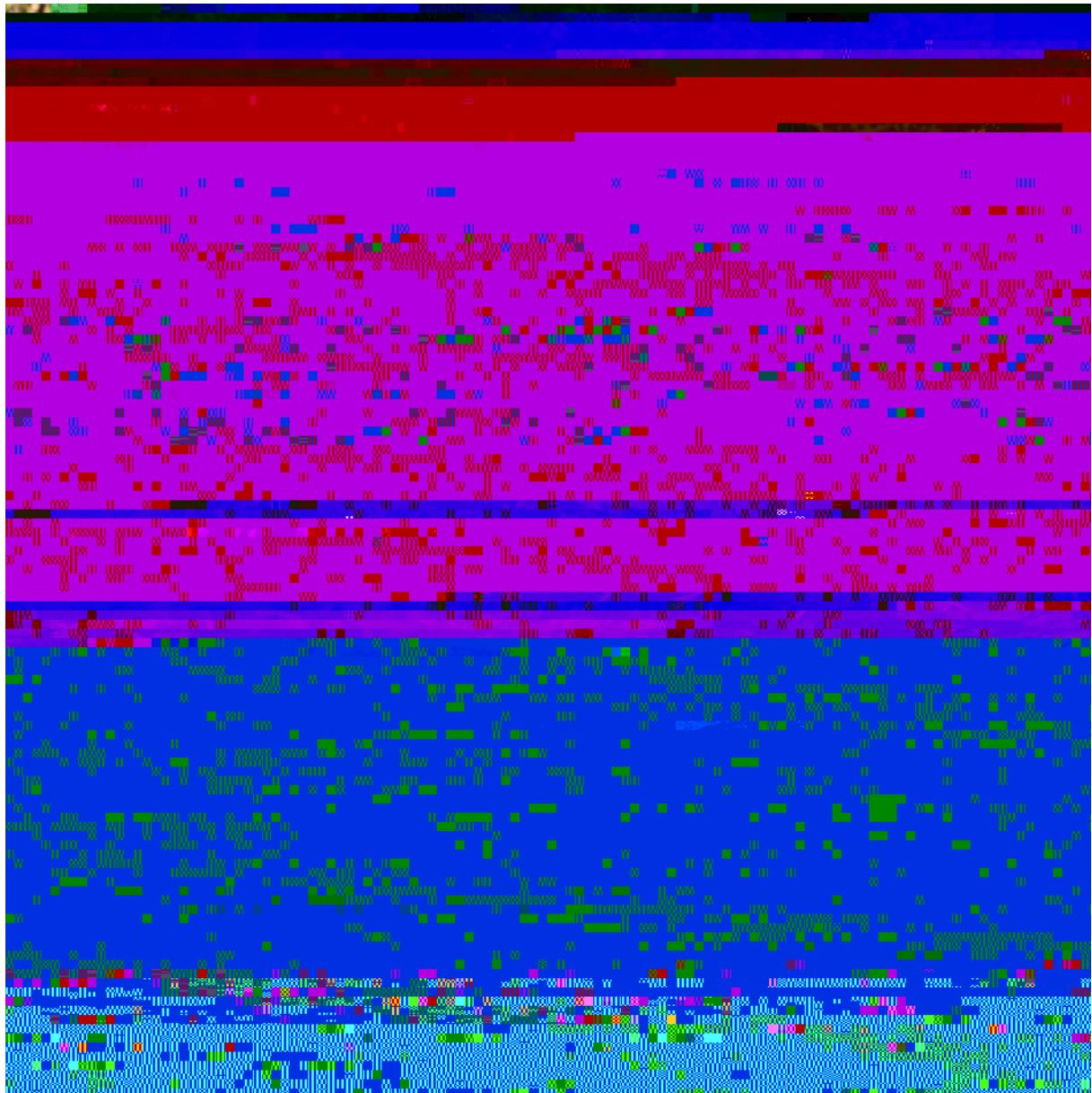
TERMINALIA FEMALE. Subgenital plate simple. Appears as either truncated or sinuous with middle portion of posterior margin slightly indented. Ovipositor very long, as long as or longer than the body length, reddish-brown with 18–30 small teeth on ventral edge near the tip (Fig. 8D–F).



**Fig. 8.** Female terminalia of *Miotopus* Hutton, 1898 cave w t . **A–C.** *Miotopus diversus* (Hutton, 1896) (MPN CW3596). **A.** Ventral. **B–C.** Lateral views. **D–F.** *Miotopus richardsi* sp. nov. (MPN CW3543). **D.** Ventral. **E–F.** lateral views. Scale bars = 3 mm.



feeding on lichen and leafy liverworts (*Plagiochila* spp.) on tree trunks, and on fungal fruiting bodies on the forest floor. It was also observed feeding on a beech strawberry fungus *Cyttaria gunnii* Berk., a meal it was sharing with a darkling beetle *Zeadelium intricatum* (Broun, 1880). We have also documented an adult *Miotopus* apparently obtaining moisture or slime from the head of a leaf-veined slug (*Pseudaneitea* spp.), while straddling it with its long legs (Fig. 10F), and have seen this behaviour in several other species of cave wētā.



**Fig. 10.** Living *Miotopus* Hutton, 1898 in their natural environment. **A–B.** *Miotopus diversus* (Hutton, 1896), adult . **A.** Resolution Bay, Queen Charlotte Sound. **B.** Turitea Reserve, Palmerston North. **C–F.** *Miotopus richardsi* sp. nov. **C.** Adult , Brewster Hut Track, Haast Pass. **D.** Female nymph, Goulund Downs Caves, Kahurangi NP. **E.** , laying eggs in rotting wood, Brewster Hut Track, Haast Pass. **F.** , 'licking' the slime off a native leaf-veined slug (*Pseudaneitea* spp.), Raspberry Flat, Matukituki River West Branch.

## **Acknowledgements**

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