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A revision of the New Zealand weevil genus *Irenimus* Pascoe, 1876 (Coleoptera: Curculionidae: Entiminae)

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Abstract

The taxonomy of the New Zealand weevil genus *Irenimus* Pascoe, 1876 is revised, resulting in a narrower concept of the genus than has been considered in recent decades. In total, the genus now contains only seven species. In addition to the type species, *I. parilis* Pascoe, 1876, the genus contains *I. duplex* (Broun, 1904) and five newly described species: *I. aniptus* **new species** (type locality, Oamaru, DN), *I. crinitus* **new species** (type locality, Hakataramea Valley, SC), *I. minimus* **new species** (type locality, Alexandra, CO), *I. stichus* **new species** (type locality, Tekapo, MK) and *I. thoracicus* **new species** (type locality, Oamaru, DN). The genus *Chalepistes* **new genus** is established to contain the majority of species previously described in the genus *Catoptes* Schönherr, 1842, but also including species described in *Brachyolus* White, 1846; *Irenimus* Pascoe, 1876; *Inophloeus* Pascoe, 1875; and *Nicaeana* Pascoe, 1877. A total of 27 valid described species are **new combinations** with *Chalepistes*: *C. aequalis* (Broun, 1895) (from *Irenimus*), *C. albosparsus* (Broun, 1917) (from *Irenimus*), *C. apicalis* (Broun, 1923) (from *Catoptes*), *C. asperatus* (Broun, 1914) (from *Brachyolus*), *C. compressus* (Broun, 1880) (from *Irenimus*), *C. costifer* (Broun, 1886) (from *Inophloeus*), *C. curvus* (Barratt & Kuschel, 1996) (from *Irenimus*), *C. dehiscens* (Broun, 1917) (from *Catoptes*), *C. dugdalei* (Barratt & Kuschel, 1996) (from *Irenimus*), *C. egens* (Broun, 1904) (from *Irenimus*), *C. inaequalis* (Sharp, 1886) (from *Brachyolus*), *C. instabilis* (Marshall, 1931) (from *Catoptes*), *C. latipennis* (Broun, 1893) (from *Catoptes*), *C. limbatus* (Broun, 1909) (from *Catoptes*), *C. lobatus* (Broun, 1921) (from *Catoptes*), *C. patricki* (Barratt & Kuschel, 1996) (from *Irenimus*), *C. pensus* (Broun, 1914) (from *Inophloeus*), *C. placidus* (Broun, 1914) (from *Nicaeana*), *C. posticalis* (Broun, 1893) (from *Irenimus*), *C. rhesus* (Pascoe, 1875) (from *Inophloeus*), *C. rubidus* (Broun, 1881) (from *Inophloeus*), *C. similis* (Barratt & Kuschel, 1996) (from *Irenimus*), *C. spectabilis* (Broun, 1914) (from *Catoptes*), *C. spermophilus* (Broun, 1895), **revised status** (from *Irenimus*), *C. stolidus* (Broun, 1886) (from

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Irenimus), *C. tenebricus* (Broun, 1893) (from *Catoptes*), *C. vastator* (Broun, 1893) (from *Irenimus*). Numerous **new synonyms** with species of *Chalepistes* are also proposed: *Brachyolus fuscipictus* Broun, 1914 and *Brachyolus terricola* Broun, 1917 are junior subjective synonyms of *Chalepistes asperatus* (Broun); *Brachyolus cervalis* Broun, 1903 and *Brachyolus sylvaticus* Broun, 1910 are junior subjective synonyms of *Chalepistes costifer* (Broun); *Inophloeus tricostatus* Broun, 1915 is a junior subjective synonym of *Chalepistes pensus* (Broun); *Catoptes pallidipes* Broun, 1917, *Catoptes flaviventris* Broun, 1917 and *Catoptes nigricans* Broun, 1917 are junior subjective synonyms of *Chalepistes placidus* (Broun); *Inophloeus longicornis* Broun, 1904, *Inophloeus medius* Broun, 1893, *Inophloeus sulcicollis* Broun, 1914 and *Inophloeus suturalis* Broun, 1893 are junior subjective synonyms of *Chalepistes rhesus* (Pascoe); *Inophloeus albonotata* Broun, 1893, *Catoptes asperellus* Broun, 1893, *Irenimus bicostatus* Broun, 1886, *Catoptes caliginosus* Broun, 1893, *Catoptes chalmeri* Broun, 1893, *Catoptes decorus* Broun, 1893, *Inophloeus discrepans* Broun, 1904, *Catoptes fumosus* Broun, 1914, *Catoptes furvus* Broun, 1893, *Catoptes humeralis* Broun, 1893, *Catoptes longulus* Sharp, 1886, *Inophloeus nigellus* Broun, 1881, *Irenimus pilosellus* Broun, 1886 and *Catoptes scutellaris* Sharp, 1886 are junior subjective synonyms of *Chalepistes rubidus* (Broun); *Catoptes subnitidus* Broun, 1914 and *Catoptes curvatus* Broun, 1914 are junior subjective synonyms of *Chalepistes spermophilus* (Broun); *Catoptes brevicornis* Sharp, 1886 and *Catoptes vexator* Broun, 1904 are junior subjective synonyms of *Chalepistes stolidus* (Broun); and *Catoptes aemulator* Broun, 1893 and *Catoptes argentalis* Broun, 1914 are junior subjective synonyms of *Chalepistes tenebricus* (Broun). Additional **new combinations** include *Inophloeus robustus* (Broun, 1917) (from *Catoptes*) and *Nicaeana fraudator* (Marshall, 1931) (from *Catoptes*), while *Catoptes postrectus* Marshall, 1931 is a **new synonym** of *Protolobus obscurus* Sharp, 1886.

Introduction

Anthropogenic modification of habitats usually results in decreased species richness, particularly of indigenous elements of the system (Harris & Burns, 2000; Murphy & Romanuk, 2014). The lowland environments in New Zealand have undergone dramatic changes since human settlement, especially in the 200 years since European colonisation (Ewers *et al.*, 2006). Much of the New Zealand lowlands has been converted into agricultural pasture based on a simplified flora of exotic fodder crops (Leathwick *et al.*, 2003; Goldson *et al.*, 2014). The persistence of endemic New Zealand faunal elements in these highly modified environments is therefore of interest.

Broad-nosed weevils in the genus *Irenimus* Pascoe, 1876 and related genera are examples of New Zealand endemics that have survived in agricultural environments. As a result, they have been the subject of much research into their ecology, due to some species achieving minor pest status (Baker, 1980; Scott, 1984; Stewart, 1981) and because of concern over the effects of non-target parasitism by braconid wasps introduced to control adventive pest weevils (Barratt, 2004; Barratt *et al.*, 2000). The taxonomy and systematics of the group has, however, received little attention since the pioneering work of Thomas Broun, resulting in confusion regarding nomenclature and the limits of species and genera (Bremner, 1988; Barratt & Kuschel, 1996; Macfarlane *et al.*, 2011).

Irenimus was described by Pascoe (1876) as a monotypic genus containing *I. parilis* Pascoe, 1876. Subsequently, Broun (1886) described four species in *Irenimus*, before Sharp (1886) synonymised the genus with *Catoptes* Schönherr, 1842. This synonymy was accepted by Broun (1910). Kuschel (1969), having discovered that *Catoptes* had been misapplied by Broun, reinstated *Irenimus* Pascoe and placed *Catoptes aequalis* Broun, 1895 and *Catoptes compressus* Broun, 1880 into *Irenimus*. He also recommended that, until a comprehensive revision could be undertaken, all species described by Broun, Sharp and Marshall under *Catoptes* should provisionally be placed in *Irenimus*. Kuschel's (1969) concept of *Catoptes* Schönherr, with generic synonyms of *Asaphia* Broun, 1881, *Empaeotes* Pascoe, 1876, *Exonastus* Broun, 1921, *Getopsephus* Broun, 1913, *Platyomida* White, 1846, *Protophormus* Sharp, 1886 and *Tigones* Broun, 1886 is followed in this paper. With the restricted definition of *Irenimus* presented here, the new genus *Chalepistes* is made available to accommodate a number of species that would otherwise be unplaced to genus. A monograph of *Chalepistes* is in preparation, which will include keys to species, type details and descriptions of new species. In the interim, a list of species placed in *Chalepistes* is provided, with synonyms.

Methods

Field-collected specimens were killed in 100% ethanol or placed directly into a freezer at a temperature of -20°C. Ethanol-preserved specimens were used preferentially for DNA extraction and sequencing.

Genitalia were examined by softening specimens for a short time in warm water before removing the abdomen by inserting fine forceps between the metaventrite and ventrite 1. The abdomen was cleared by digestion for c. 36 hours in a porcine pancreatin solution (Álvarez Padilla & Hormiga, 2008). The lysate from this digest was then used for DNA extraction. If specimens were unsuitable for DNA extraction, or had not cleared satisfactorily at the end of this time, abdomens were digested in cold 10% KOH for up to two hours.

After clearing, the abdomen was flayed by cutting down through the right margin of the membranous tergites with spring scissors. Male genitalia were removed by severing the strong ligaments connecting sternite 8 to tergite 8, then cutting through the pretegminal membrane between the phallobase and the anus. Female genitalia were stained briefly by immersion in a 1% w/v solution of Chlorazol Black dissolved in 70% ethanol, then removed by cutting through the membranes connecting tergites 7 and 8. Sternite 8 and tergite 8 were separated from the gonocoxites by cutting through their connecting membranes. Genitalia were photographed, then mounted on a card using dimethyl hydantoin formaldehyde (DMHF) (Liberti, 2005), which was then pinned below the specimen.

Terminology follows Oberprieler *et al.* (2014), Lawrence *et al.* (2010) and Arzanov (2003). Body length was measured in lateral view, from the anterior margin of the eyes to the elytral declivity. Rostrum width was measured across the antennal insertions. Legs are described in their idealised laterally extended position, thereby having dorsal, ventral, anterior and posterior surfaces. The term 'pappolepida' is coined (after the Greek *pappos*, 'downy', Brown 1956) to describe a distinctive type of appressed scale found in abundance on the venter of several species. Pappolepida are multiply divided, giving them a feathery or velvety appearance (Figure 38).

Descriptions of colour follow the terminology provided by the National Bureau of Standards (Kelly & Judd, 1976). The NBS centroid colours are a dictionary of 267 colours, with natural-language descriptions. Digital representations of these colours have been provided by Jaffer (2011).

Specimens were loaned from and deposited in the following collections:

AMNZ	Auckland War Memorial Museum, Auckland, New Zealand
ANIC	Australian National Insect Collection, CSIRO, Canberra, Australia
CMNZ	Canterbury Museum, Christchurch, New Zealand
BMNH	Natural History Museum, London, United Kingdom
FRNZ	National Forest Insect Collection, Scion, Christchurch, New Zealand
IACC	Invermay Agricultural Centre Collection, Mosgiel, New Zealand
LUNZ	Lincoln University Entomology Research Collection, Lincoln, Canterbury, New Zealand
MONZ	Te Papa Tongarewa, National Museum of New Zealand, Wellington, New Zealand
NZAC	New Zealand Arthropod Collection, Manaaki Whenua Landcare Research, Tamaki, Auckland, New Zealand
OMNZ	Otago Museum, Dunedin, New Zealand
USNM	Smithsonian Institution National Museum of Natural History, Washington D.C., United States of America

DNA sequencing and analysis. Only freshly collected specimens were used for sequencing. Genomic DNA was extracted from pancreatin lysate (see above) using the Zymo Quick g-DNA Miniprep Kit (Zymo Research Corporation, Irvine, CA, U. S. A.), following the manufacturer's instructions for a proteinase k extraction. Four gene regions were sequenced: the cytochrome *c* oxidase subunit I (COI) mitochondrial gene, the D2-D3 region of the 28S ribosomal RNA gene, the nuclear protein-coding gene arginine kinase (ArgK) and the nuclear protein-coding carbamoyl-phosphate synthetase 2-aspartate transcarbamylase-dihydroorotase (CAD) gene (Table 1).

DNA was amplified using a 25 µl polymerase chain reaction (PCR) consisting of 1.25 U iStar Taq (iNtRON Biotechnology, Seongnam, South Korea), 0.4 mM dNTP, 1.5 mM $MgCl_2$ and 0.2 µM of forward and reverse primers. The COI primer combination LCO1490-JJ/TL2-N-3014 was used preferentially, in order to amplify the whole gene, which was then sequenced using all four primers. If amplification using this combination was not successful, C1-J-2183/TL2-N-3014 was used. Reactions were run on a C1000 Touch thermal cycler (Bio-Rad

Laboratories Inc., Hercules, CA, USA) or a MJ Mini thermal cycler (Bio-Rad Laboratories Inc.) with an initial denature of 94°C for 2 min, followed by 40 cycles of denaturing 94°C (20 s), variable annealing temperature (20 s) and extension 72°C (60 s), with a final extension at 72°C for 5 min. Annealing temperatures were 45°C for COI and 52°C for 28S reactions. ArgK and CAD reactions were amplified using a touchdown protocol, with annealing temperatures starting at 50°C, decreasing by 1°C per cycle for 5 cycles followed by 35 cycles at 45°C. Purified PCR products were sequenced by Macrogen (Seoul, Korea) using ABI BigDye 3.1 technology on an ABI3730XL platform (Applied Biosystems).

TABLE 1. Markers and PCR primer combinations used in this research.

Marker	Primer name	Direction	Primer sequence	Reference
COI	C1-J-2183	Forward	5′-CAA CAT TTA TTT TGA TTT TTT GG-3′	Simon *et al.* 1994
	LCO1490-JJ	Forward	5′-CHA CWA AYC ATA AAG ATA TYG G-3′	Astrin & Stüben 2008
	HCO2198-JJ	Reverse	5′-AWA CTT CVG GRT GVC CAA ARA ATC A-3′	Astrin & Stüben 2008
	TL2-N-3014	Reverse	5′-TCC AAT GCA CTA ATC TGC CAT ATT A-3′	Simon *et al.* 1994
28S	S3660	Forward	5′-GAG AGT TMA ASA GTA CGT GAA AC-3′	Sequeira *et al.* 2000
	28S-Ff	Reverse	5′-TTA CAC ACT CCT TAG CGG AT-3′	Gómez-Zurita *et al.* 2005
ArgK	ArgKforB4	Forward	5′-GAY CCC ATC ATC GAR GAC TAC C-3′	McKenna *et al.* 2009
	ArgKrevB1	Reverse	5′-TCN GTR AGR CCC ATW CGT CTC-3′	McKenna *et al.* 2009
CAD	CADfor4	Forward	5′-TGG AAR GAR GTB GAR TAC GAR GTG GTY CG-3′	Jordal *et al.* 2011
	CADrev1mod	Reverse	5′-GCC ATY RCY TCB CCY ACR CTY TTC AT-3′	Jordal *et al.* 2011

Sequences were aligned by eye in SEAVIEW (Guoy *et al.*, 2010), trimmed to minimise missing data, and analysed in R (R Development Core Team, 2010). Uncorrected genetic distances (*p*-distances) were calculated using APE (Paradis *et al.*, 2004), which were then decomposed into interspecific and intraspecific components using SPIDER (Brown *et al.*, 2012). Diagnostic nucleotides (Sarkar *et al.*, 2008) for each species were identified using SPIDER.

Illustrations. Line drawings were made with a Zeiss Stemi SV6 stereo microscope fitted with a camera lucida. The drawings were scanned and inked digitally and saved in vector graphic format using INKSCAPE (v. 0.91, Inkscape Team, 2004-2017). Genitalia illustrations were prepared from photographs.

Habitus photographs were created using focus stacking, as implemented in the software Nikon NIS ELEMENTS (v. 4.10). The image stack was prepared using a Nikon AZ100M stereomicroscope fitted with a Nikon DS-Ri 1 digital camera and mechanical z-stepper. The top and bottom planes of the specimen was specified in NIS ELEMENTS, which then took multiple photographs and combined them into a single image with a large depth of field.

Specimen data. Label data from holotypes are transcribed using the following conventions. Data from individual labels are enclosed using quotes (‘…’), lines are indicated with a solidus (/) and metadata is given in square brackets ([…]).

Two-letter regional codes (DN, SC, CO, etc) follow those proposed by Crosby *et al.* (1998). Coordinates given after the locality names are in the WGS84 datum. Coordinates tagged “R” (Recorded) were obtained from coordinates on the label when given, or from consultation with the collector. Coordinates tagged “A” (Approximate) were determined by using available gazetteers, primarily the New Zealand Gazetteer of Place Names (Land Information New Zealand, 2016). These georeferenced data were used to extract estimated altitudes from 25 m resolution digital elevation models of New Zealand provided by Landcare Research (Landcare Research, 2010a, 2010b).

Species and taxonomic concepts. In common with usage throughout history, a generative conception of species is used here (Wilkins, 2009). In this paper, I infer the extent of a species by the formation of diagnosable entities as revealed by morphological traits. Genetic data provide extra evidence that the species described herein represent separate lineages. These taxa are proposed in order to investigate the evolutionary processes leading to their existence and the ecological functions that they fulfil (Wilkins, 2010).

Alignments between changing historical taxonomic concepts of species and genera were created using the EULER/X toolkit (Chen *et al.*, 2014; Jansen & Franz, 2015; Franz *et al.*, 2015). This software evaluates logical consistency between two taxonomies, given a list of the region connection calculus (RCC-5) relations (Li & Ying, 2003; Franz *et al.*, 2015) between the two.

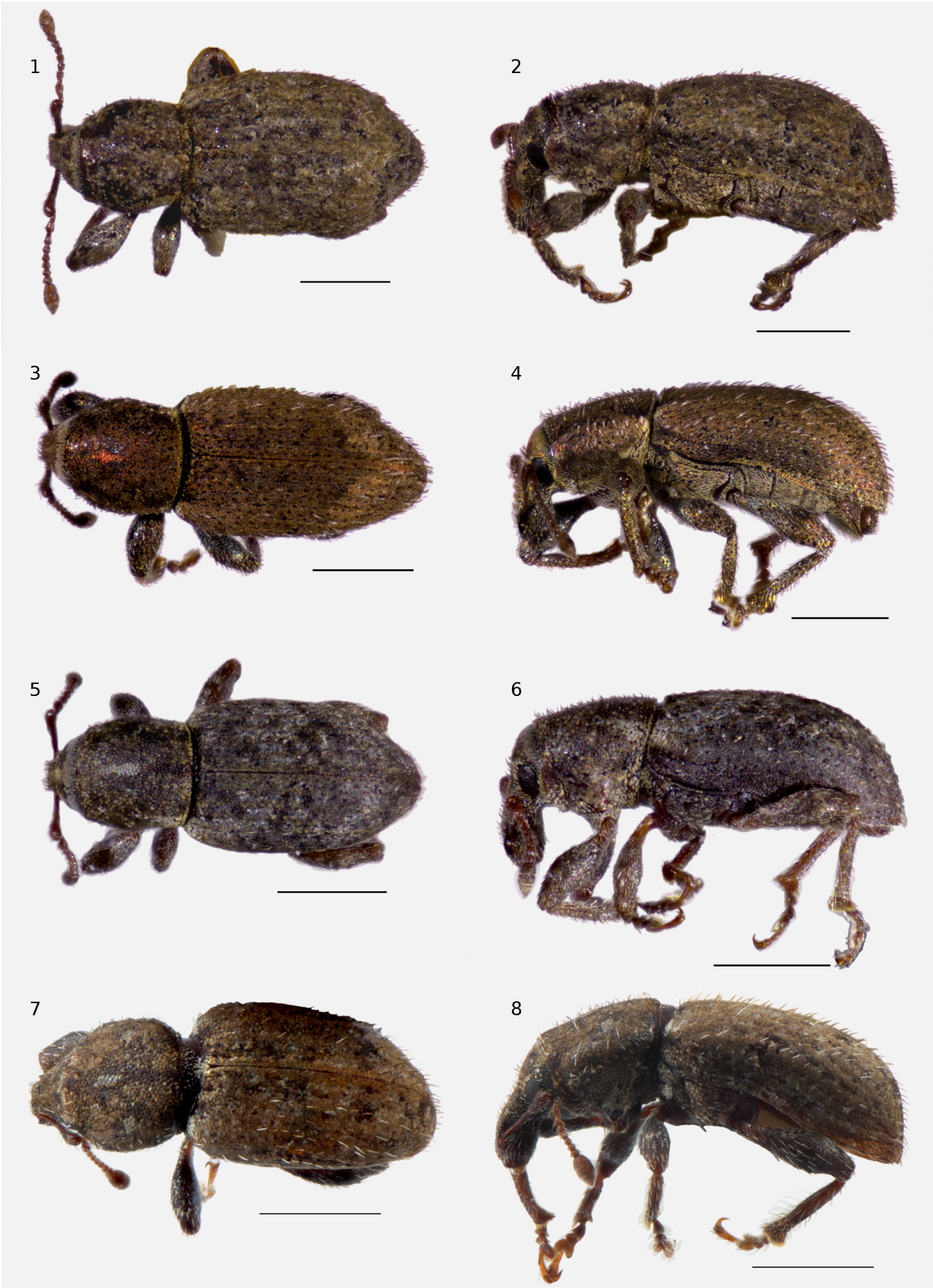
Irenimus Pascoe, 1876

Irenimus Pascoe, 1876:54. Synonymised with *Catoptes* Schönherr by Sharp, 1886:422. Reinstated by Kuschel, 1969:799. Type species: *Irenimus parilis* Pascoe, 1876:54, by monotypy. Gender: masculine.

Diagnosis. Integument densely covered with round or oval appressed scales. Rostrum short and stout, around 1.5 times longer than wide; subparallel proximally. Epistome indistinctly differentiated from frons. Scrobes lateral. Ventral curvature of head angulate. Elytra without tubercles or protuberances. Metanepisternum narrow, suture complete. Metafemora without sharp demarcation between scaled and unscaled regions on posterior surface. Metatibiae with a narrow to wide corbel and a distinctively shaped, angulate apical comb (Figures 29–33). Penis with a sclerotised dorsal membrane.

Differential diagnosis. Species of *Irenimus* can be distinguished from other New Zealand weevils by the combination of characters given above. The indistinct epistome and angulate ventral head curvature distinguishes them from *Catoptes*, which have a distinctly demarked epistome and a rounded ventral head curvature, with the angle between head and rostrum approximately 140°. The complete metanepisternal suture and the form of the metatibial apex distinguish *Irenimus* from *Chalepistes*, which has the metanepisternal suture invisible, a simple metatibial apex, and a sharply demarked bare area on the posterior surface of the metafemora. The convex elytral disc and lack of elytral tubercles or prominences distringuish *Irenimus* from *Inophloeus villaris* Pascoe and allied species which have a flat elytral disc, formed by a subcarinate interstriae 7, and strong protuberances on interstriae 5 above the declivity. The wide, readily visible metanepisternum and the discrete appressed scales on the elytra distinguish *Irenimus* from *Protolobus*, which has a very narrow metanepisternum that is often obscured by the lateral margin of the elytra and has dull, strongly overlapping, inseparable appressed scales on the elytra. The proximally subparallel rostrum and laterally situated scrobes distinguish *Irenimus* from *Haplolobus* and *Nicaeana*, both of which have proximally expanding rostra and dorsally situated scrobes.

Description. Body length ranging from 3.2 mm to 6.9 mm. Densely covered with scales on all surfaces. **Rostrum**. Subparallel proximally, abruptly widened at antennal insertions. Epistome plurisetose, slightly raised above frons but indistinctly differentiated. Epifrons with longitudinal medial carina, lacking sulci; continuous with occiput, without distinct dorsal separation between head and rostrum. **Antennae**. Sockets dorsolateral, sited in apical 1/3 of rostrum. Scape clavate, reaching to or exceeding the middle of the eye. Funicular segments clavate, subspherical or oblately spheroid, moderately to loosely articulated, segment 7 almost as wide as club. Club two times longer than wide, tapering apically. **Head**. Width of vertex between eyes greater than width of rostrum. Eyes large, lateral, flat, ovate to subcircular with long axis vertical, parallel with sagittal axis. Ventral curvature of head and rostrum angulate, approximately 90°. **Pronotum**. Disc smooth, evenly convex. Postocular lobes poorly to well developed, vibrissae present. **Elytra**. Approximately parallel-sided in anterior 2/3. Elongate scales arising from interstriae. Elytral declivity rounded. No interstriae formed into tubercles, at most a slight swelling on interstria 3 above the elytral declivity. Ventral margin sinuous, highest point around level of metacoxae. **Thorax**. Procoxae contiguous. Prosternum visible behind procoxae as a raised tubercle ("prosternellum"). Metaventrite with medial suture visible only as a small, circular fovea posteriorly. **Abdomen**. Ventrites 1 and 2 fused, ventrites 3 to 5 free. Ventrite 1 and 2 subequal in length at midpoint; ventrites 3 and 4 subequal in length, approximately 0.5 times length of ventrites 1 and 2; ventrite 5 approximately equal in length to ventrites 1 and 2. Suture separating ventrites 1 and 2 curved anteriorly at midpoint, other sutures straight. **Wings**. Absent. **Legs**. Uniformly and densely covered with appressed scales and setae, except for the posterior surface of the metafemora. Femora unarmed, maximum depth around distal 1/4. Tibiae with indistinct denticles along ventral margin of protibiae and mesotibiae; mucrones present on protibiae and mesotibiae; protibiae wider in distal 1/3 than proximal 1/3, incurved at apex; metatibiae with subparallel dorsoventral margins; apical comb angulate with pale setae; corbel present, narrow to wide, bare. Tarsi with long, coarse setae on dorsal surface, without appressed scales; underside with short, dense setae forming pads. Claws simple, separate, diverging. **Male genitalia**. Hemisternite 8 divided, with a paired membranous lobe on the anterior margin of the membrane joining the two halves. Penis tubular, strongly curved; lateral lobes



FIGURES 1–8. Habitus photographs of *Irenimus* males. 1, 2: *I. aniptus*. 3, 4: *I. crinitus*. 5, 6: *I. stichus*, holotype. 7, 8: *I. minimus*. Scale bars = 1 mm.

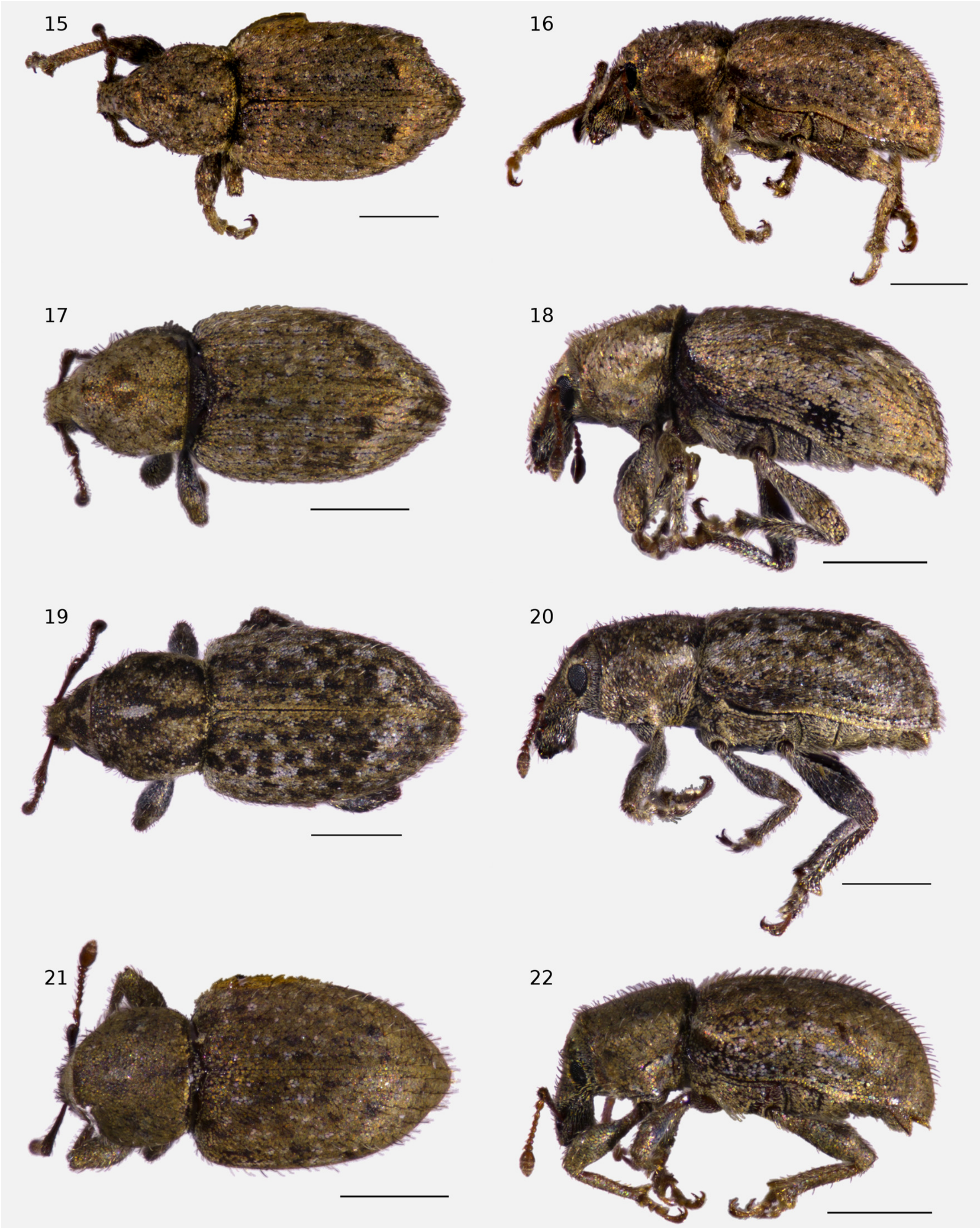
FIGURES 9–14. Habitus photographs of *Irenimus* males. 9, 10: *I. duplex*. 11, 12: *I. parilis*. 13, 14: *I. thoracicus*, holotype. Scale bars = 1 mm.

separated dorsally by sclerotised dorsal membrane extending from ostium to anterior margin (Figure 41, dm); temones longer than penis. Endophallus moderate in length, usually reaching anterior 1/3 of temones when in repose; armed with large aggonoporial sclerite, other sclerites variably present. Tegmen with ring complete; parameroid lobes well-developed; manubrium shorter than temones. **Female genitalia**. Sternite 8 with spiculum ventrale over 2.5 times as long as blade. Gonocoxite divided into two parts; proximal gonocoxite around 2.6 times longer than distal gonocoxite, largely unsclerotised except for strongly sclerotised rod; distal gonocoxite lightly sclerotised. Bursal sclerites present or absent, numbering 2 if present.

Distribution. All species found in Canterbury and Otago, South Island, New Zealand, with a disjunct population of *I. parilis* in the central North Island.

Etymology. Pascoe (1876) did not explain how the name was derived. It may have come from the Greek *eirene*, meaning 'peace', and the Latin suffix *-imus* meaning 'having the quality of'.

Remarks. The extensive dorsally sclerotised membrane of the penis is a strong apomorphy for *Irenimus*. However, all external characters that distinguish the genus are considered plesiomorphic.



FIGURES 15–22. Habitus photographs of *Irenimus* females. 15, 16: *I. aniptus*. 17, 18: *I. crinitus*. 19, 20: *I. stichus*. 21, 22: *I. minimus*. Scale bars = 1 mm.

Key to species of *Irenimus*

1	Scape clothed with setae only	2
-	Scape clothed with appressed scales as well as setae	4
2 (1)	Ventral margin of metatibial apex with a strong, conspicuous emargination. Elytra with elongate scales mostly decumbent. Abdominal ventrite 1 with few pappolepida, clothed primarily with appressed scales	*I. stichus* **n. sp.**
-	Ventral margin of metatibial apex entire or with an inconspicuous emargination. Elytra with elongate scales semi-erect to erect. Vestiture of abdominal ventrite 1 dominated by numerous pappolepida	3
3 (2)	Elongate scales of pronotum of equal length. Dorsal appressed scales with coarse ridges, resulting in a dull appearance.	

Metaventrite with appressed scales laterally. . . . . *I. aniptus* **n. sp.**

- Elongate scales of pronotum longer towards anterior margin. Dorsal appressed scales with fine ridges, resulting in a glossy appearance. Metaventrite with pappolepida laterally (Figure 38). . . . . *I. crinitus* **n. sp.**

4 (1) Larger species, body length longer than 4 mm 5

- Smaller species, body length shorter than 4 mm. . . . . *I. minimus* **n. sp.**

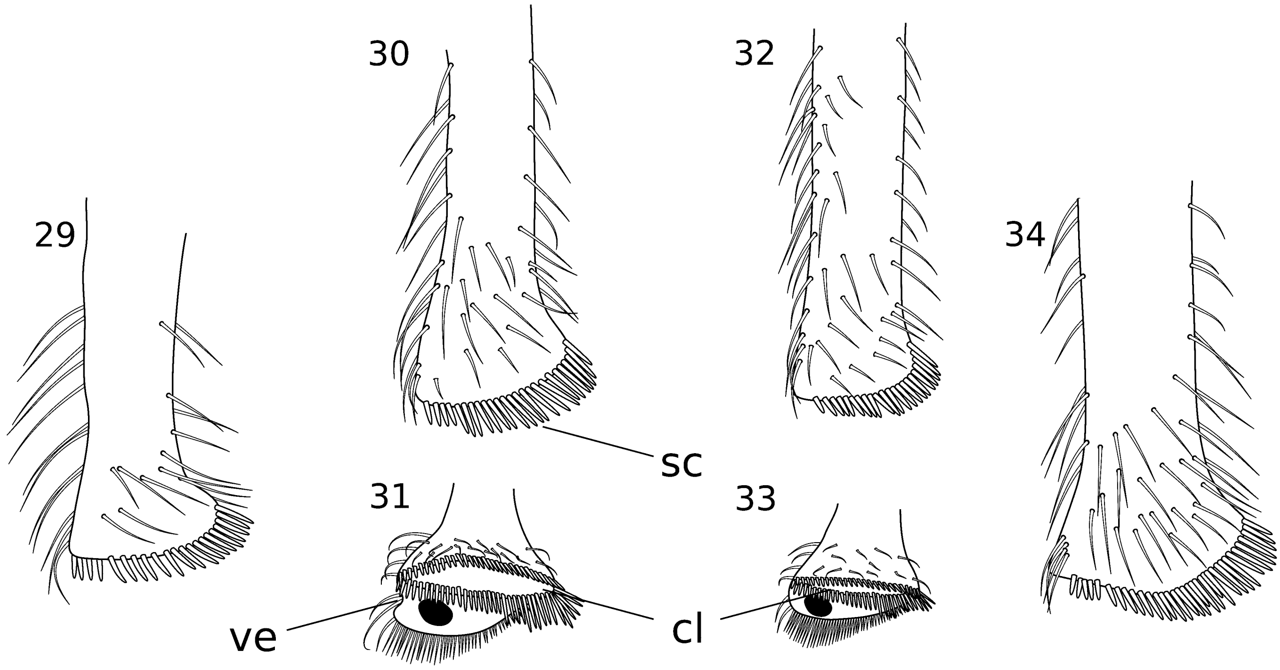
5 (4) Metatibiae with broad corbel (Figure 31). Ventral margin of metatibial apex emarginate (Figure 31). Pronotum with appressed scales flat, resulting in a smooth appearance . . . . *I. parilis* Pascoe

- Metatibiae with narrow corbel (Figure 33). Ventral margin of metatibial apex entire (Figure 33). Pronotum with appressed scales domed, resulting in a bumpy appearance 6

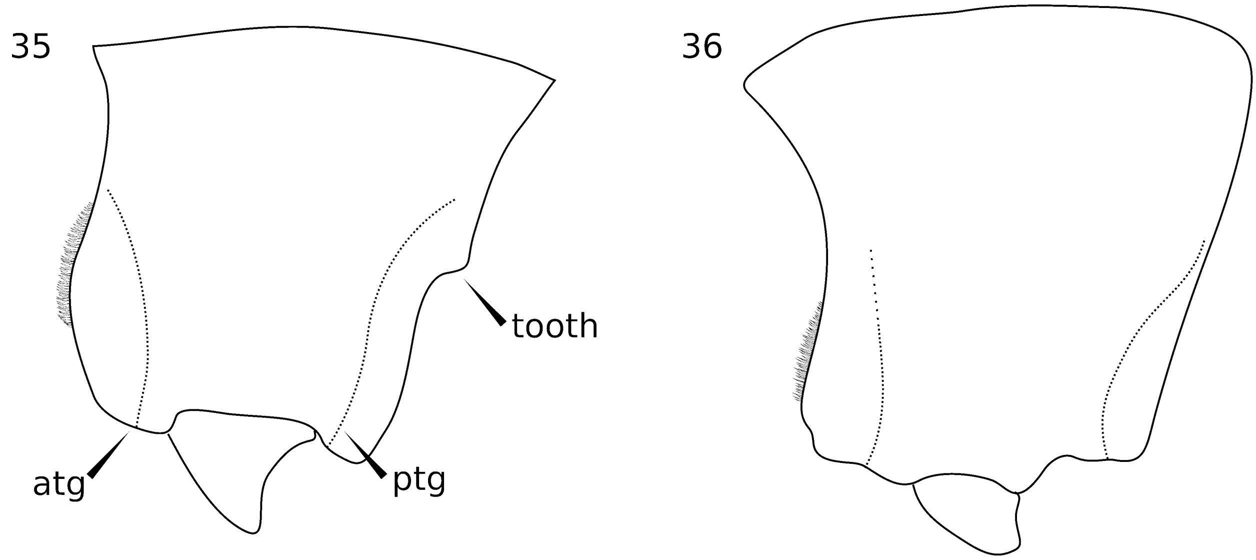
6 (5) Lateral margins of pronotum evenly curved along length (Figure 39) . . . . *I. duplex* (Broun)

- Lateral margins of pronotum strongly curved in anterior 2/3; subparallel in posterior 1/3 (Figure 40) . . . . *I. thoracicus* **n. sp.**

FIGURES 23–28. Habitus photographs of *Irenimus* females. 23, 24: *I. duplex*. 25, 26: *I. parilis*. 27, 28: *I. thoracicus*. Scale bars = 1 mm.



FIGURES 29–34. Left metatibia, anterior view. 29, *Irenimus minimus*; 30, *Irenimus parilis*; 31, *Irenimus parilis*, apical view; 32, *Irenimus duplex*; 33, *Irenimus duplex*, apical view; 34, *Chalepistes compressus*. Abbreviations: cl–corbel; sc—setal comb; ve—ventral emargination. Drawings not to scale.



FIGURES 35–36. Pronotum, left lateral view. 35, *Irenimus crinitus*; 36, *Irenimus stichus*. Abbreviations: atg—anterior transverse groove; ptg—posterior transverse groove; tooth—pronotal tooth.

1. *Irenimus aniptus* Brown, new species
Figures 1, 2, 15, 16, 41, 42, 43, 44, 45, 46, 85

Diagnosis. Medium-sized species; oval; grey, often with encrustation of soil. Scape without appressed scales. Metaventrite laterally with appressed scales. Elytra with inconspicuous swelling on interstriae 3.

Appressed scales with coarse ridges, resulting in a duller appearance than *I. crinitus* **n. sp.**

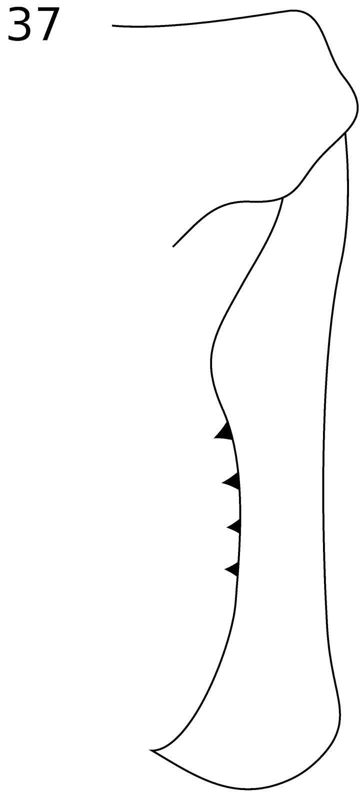


FIGURE 37. Left mesotibia of *Irenimus parilis* male, showing blunt tooth in proximal 1/3.

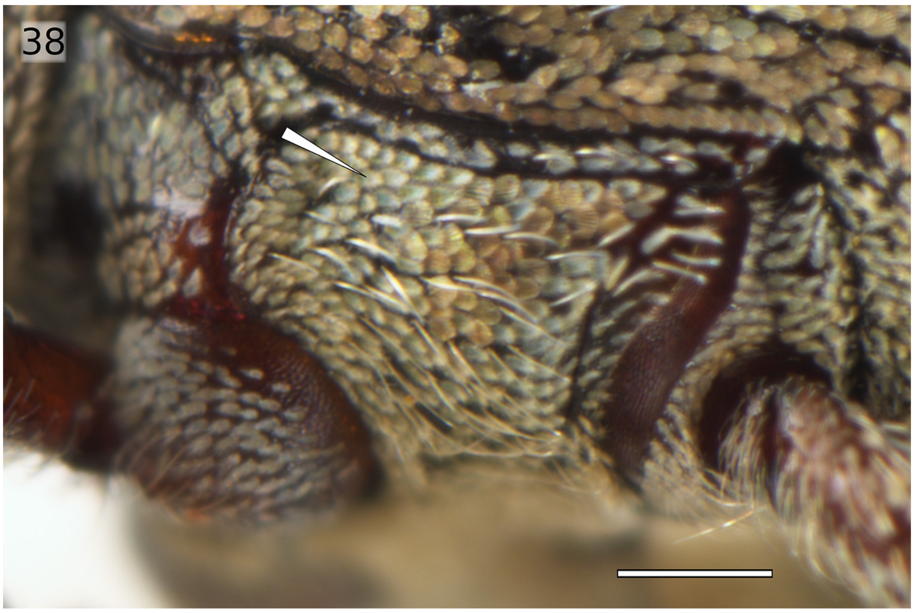
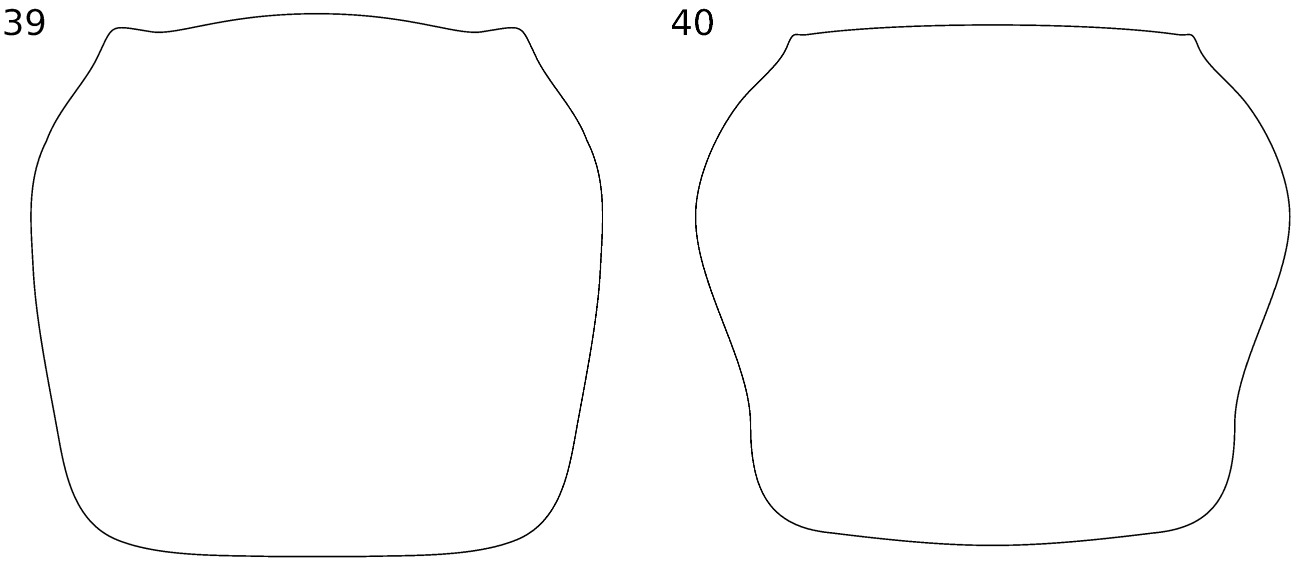


FIGURE 38. Metaventrite of *Irenimus crinitus*, left lateral view, showing pappolepida (white dart). Scale bar = 0.2 mm.



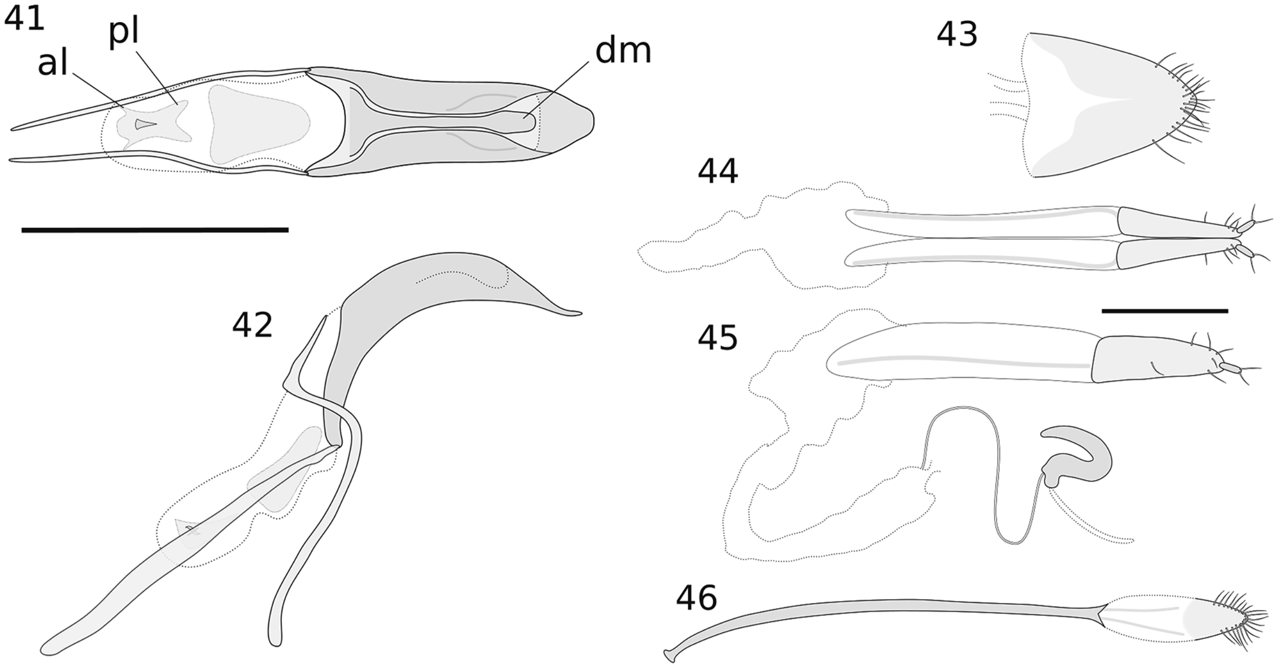
FIGURES 39–40. Pronotum, dorsal view with head to top of image. 39, *Irenimus duplex*; 40, *Irenimus thoracicus*.

Description. Body length 4.07 mm to 4.75 mm ($\bar{X}$ = 4.34 mm, s = 0.25, n = 5). Integument dark red to black. Dorsum densely covered with light greyish yellowish brown appressed scales with metallic reflections; elytral disc with small, scattered darker spots; inconspicuously paler on elytral declivity. Femora with proximal 2/3 dark greyish yellow, distal 1/3 and tibiae greyish yellow. Tarsi with integument strong orange yellow. Frequently with soil affixed to surface, obscuring vestiture. **Rostrum**. Length 0.88 mm to 0.96 mm ($\bar{X}$ = 0.93 mm, s = 0.04, n = 5), width 0.56 mm to 0.58 mm ($\bar{X}$ = 0.57 mm, s = 0.01, n = 5), length/width ratio 1.52 to 1.71 ($\bar{X}$ = 1.63, s = 0.08, n = 5). Epifrons with appressed scales overlapping; elongate scales setiform, semi-erect, dark; medial and lateral carinae barely evident. Dorsal carina arched over antennal insertions. Lateral area ventrally of antennal insertions with fine setae, without appressed scales. **Antennae**. Scape when in repose reaching hind margin of eye; covered exclusively with setae. Funicular segments loosely articulated; segment 1 clavate, around 1.3 times longer than segment 2; segments 2 to 5 clavate, getting progressively shorter; segment 6 subspherical; segment 7 oblately spheroid. **Head**. Eyes ovate. **Pronotum**. Length 1.25 mm to 1.45 mm ($\bar{X}$ = 1.36 mm, s = 0.09, n = 5), width 1.40 mm to 1.65 mm ($\bar{X}$ = 1.48 mm, s = 0.10, n = 5), length/width ratio 0.86 to 1.04 ($\bar{X}$ = 0.92, s = 0.08, n = 5); widest in anterior 1/3, lateral margins anteriorly abruptly curved to widest point, evenly curved behind. Anterior margin entire, posterior margin evenly curved. Disc topography evenly convex; appressed scales tessellate; elongate scales claviform, erect, mixture of pale and dark. Postocular lobes moderately developed. Anterior transverse groove weak beyond level with midpoint of eyes. Posterior transverse groove well-developed. Lateral posterior margin with inflection around 1/4 distance from top. **Elytra**. Length 2.60 mm to 3.20 mm ($\bar{X}$ = 2.83 mm, s = 0.24, n = 5), width 1.88 mm to 2.35 mm ($\bar{X}$ = 2.07 mm, s = 0.18, n = 5), length/width ratio 1.27 to 1.46 ($\bar{X}$ = 1.37, s = 0.07, n = 5). Anterior margin strongly curved posteriad, with humeral angles narrowly rounded. Appressed scales overlapping. Elongate scales setiform, semi-erect, dark on disc, pale laterally and posteriorly. Striae shallowly impressed; interstriae flat. **Thoracic ventrites**. Mesoventral process rounded. Metaventrite densely covered with overlapping appressed scales. **Abdomen**. Ventrites with inner vestiture composed almost exclusively of appressed scales, ventrites 1 and 2 densely clothed, ventrite 3 to 5 with posterior margins sparsely clothed. Apex broadly rounded. Males with ventrite 1 slightly depressed medially, ventrite 5 convex. Females with ventrite 1 flat; ventrite 5 convex, stronger than in male. **Legs**. Metatibiae with corbel present, narrow, bare; ventral margin of tibial apex slightly emarginate. **Male genitalia**. Figures 41, 42. Penis with apex broadly rounded; dorsal plate not narrowed medially. Endophallus with large, lightly sclerotised plate proximal to aggonoporium; aggonoporial sclerite with short anterior lobes and broad posterior lobes. **Female genitalia**. Figures 43–46. Sternite 8 with blade elongate. Styli elongate. Vagina not sclerotised. Bursa copulatrix long, sclerites absent. Spermatheca thick; ramus slightly produced, divergent from corpus. **DNA Sequences: COI**. KX191305, KX191438. **28S**. KX191875, KX192015. **ArgK**. KX191588, KX191722. **CAD**. KX191047, KX191167.

Type material examined. Holotype. Male (NZAC). Specimen mounted on card teardrop; abdomen removed, dissected and mounted in DMHF on white card below specimen; otherwise entire. Labelled 'NEW ZEALAND DN / Ardgowan Rd / Oamaru / 16 Sep 2012 / SDJ Brown' [printed, cream card], 'Blower vac sample from / road verge / 45.0398°S 170.97968°E / SDJBcoll00011' [printed, cream card], '*Irenimus* taxonomy / and systematics / SDJ Brown / PhD Thesis 2012–2015 / IRE4881' [printed, cream card], 'HOLOTYPE / *Irenimus aniptus* / Brown 2016' [printed, red card]. Genomic DNA extract from enzyme digestion of abdomen: E306 (NZAC). CAD sequence KX191167; COI sequence KX191438; ArgK sequence KX191722; 28S sequence KX192015.

Paratypes. A total of 21 specimens (9 males, 7 females, 5 of undetermined gender) designated as paratypes, bearing blue paratype label. Paratype specimens deposited in BMNH, LUNZ, NZAC.

DN: Airedale [-45.0025, 170.9226, A], 2 Feb 1967, French RA, Soil (NZAC: 1); Ardgowan Road [-45.0398, 170.9797, R], 16 Sep 2012, Brown SDJ, Blower vac sample from road verge (LUNZ: 2); Ngapara [-44.9516, 170.7544, A], 25 Jan 1967, French RA, Soil (NZAC: 1); Oamaru [-45.0888, 170.9808, A], 11 Jan 1967, Ridell RJ, Ex bulk harvested grain (BMNH: 1, LUNZ: 1, NZAC: 1); Oamaru [-45.0888, 170.9808, A], 2 Dec 1964, Richards GJ, ex swede seedlings (NZAC: 2); Oamaru [-45.0888, 170.9808, A], 3 Dec 1964, Macann RJ, ex swede seedlings (BMNH: 1, LUNZ: 1, NZAC: 6); Oamaru [-45.0888, 170.9808, A], 5 Jan 1967, French RA, Soil/swedes (NZAC: 3); Weston [-45.0819, 170.9077, A], 19 Jan 1967, French RA, Soil (NZAC: 1).



FIGURES 41–46. Genitalia of *Irenimus aniptus*. 41, penis, dorsal view, al—anterior lobe of aggonoporial sclerite, dm—sclerotised dorsal membrane, pl—posterior lobe of aggonoporial sclerite; 42, aedeagus, lateral view; 43, tergite 8, dorsal view; 44, ovipositor, dorsal view; 45, ovipositor and spermatheca, lateral view; 46, sternite 8, ventral view. Scale bars = 0.5 mm; 41, 42 at same scale; 43–46 at same scale.

Distribution. South Island:—/ DN /—(Figure 85).

DN: Ngapara; Oamaru.

Elevational range. Label data: no elevation data recorded. Georeferenced data: 7 m to 169 m ($\bar{X}$ = 39 m, s = 55, n = 22).

Etymology. Derived from the Greek *aniptos* meaning 'unwashed', referring to the frequent encrustation of dirt.

Biology. Many specimens were collected from swede (*Brassica napus napobrassica*) seedlings, but several were also found in soil, in harvested grain and through vacuum sampling of roadsides in farmland.

2. *Irenimus crinitus* Brown, new species

Figures 3, 4, 17, 18, 35, 38, 47, 48, 49, 50, 51, 52, 85

Diagnosis. Medium sized species, oval; grey to dark brown, variably patterned with darker scales. Scape without appressed scales. Elongate scales on the pronotum longer toward anterior margin. Lateral metaventrite with dense pappolepida. Elytra with inconspicuous swelling on interstriae 3. Males with ventrite 1 strongly depressed. Females with ventrites simple, ventrite 5 swollen medially.

Appressed scales with fine ridges, resulting in an overall appearance of a more glossy species than *I. aniptus* **n. sp.**.

Description. Body length 3.20 mm to 4.10 mm ($\bar{X}$ = 3.70 mm, s = 0.30, n = 8). Integument black. Dorsum densely covered with appressed scales. Elytra with scales on disc variable in colour, predominant colour ranging from greyish yellow, through light yellowish brown to dark greyish brown; often with mottling of a darker or paler colour; usually with pale V on elytral declivity. Pronotum with similar colours to elytra, often with medial, pale macula. Femora unicolorous, same colour as lateral elytra. Tarsi integument strong red to brownish orange, metatarsi often darker. **Rostrum**. Length 0.68 mm to 0.86 mm ($\bar{X}$ = 0.78 mm, s = 0.06, n = 8), width 0.46 mm to 0.58 mm ($\bar{X}$ = 0.52 mm, s = 0.04, n = 8), length/width ratio 1.33 to 1.64 ($\bar{X}$ = 1.50, s = 0.09, n = 8). Epifrons with appressed scales tessellate; elongate scales setiform, erect, dark; medial and lateral carinae not evident. Dorsal carina not arched over antennal insertions. Lateral area ventrally of antennal insertions with fine setae, without appressed scales. **Antennae**. Scape when in repose reaching to middle of eye; covered with setae only. Funicular segments loosely articulated; segment 1 clavate, 1.7 times longer than segment 2. Segments 2 to 4 clavate, getting progressively shorter; segments 5 to 7 subspherical, subequal in length, gradually increasing in width. **Head**. Eyes ovate. **Pronotum**. Length 1.15 mm to 1.28 mm ($\bar{X}$ = 1.21 mm, s = 0.05, n = 6), width 1.44 mm to 1.92 mm ($\bar{X}$ = 1.62 mm, s = 0.18, n = 6), length/width ratio 0.91 to 1.07 ($\bar{X}$ = 1.00, s = 0.08, n = 6); widest in anterior 1/4, lateral margins evenly curved. Anterior margin entire, posterior margin evenly curved. Disc topography evenly convex; appressed scales tessellate; elongate scales setiform, erect, mixture of pale and dark, longer anteriorly. Postocular lobes poorly developed. Anterior transverse groove well developed to level with dorsal margin of eye (Figure 35). Posterior transverse groove well-developed. Lateral posterior margin with obtuse inflection around 1/3 of way down (Figure 35). **Elytra**. Length 2.24 mm to 2.91 mm ($\bar{X}$ = 2.47 mm, s = 0.23, n = 6), width 1.44 mm to 1.92 mm ($\bar{X}$ = 1.62 mm, s = 0.18, n = 6), length/width ratio 1.39 to 1.69 ($\bar{X}$ = 1.53, s = 0.10, n = 6). Anterior margin moderately to strongly curved posteriad, humeral angles narrowly rounded. Appressed scales overlapping. Elongate scales claviform, long, semi-erect, dark on disc, pale laterally and posteriorly. Striae moderately impressed; interstriae flat. **Thoracic ventrites**. Mesoventral process rounded in males, broadly rounded in females. Metaventrite densely covered with pappolepida (Figure 38). **Abdomen**. Ventrites with inner vestiture composed almost exclusively of pappolepida, ventrites 1 and 2 moderately densely clothed, ventrites 3 to 5 increasingly sparse. Apex narrowly rounded. Males with ventrite 1 depressed medially, ventrite 5 shallowly concave. Females with ventrite 1 flat, ventrite 5 swollen medially. **Legs**. Males with profemora enlarged, relative to females. Metatibiae with corbel present, narrow, bare; ventral margin of apex shallowly emarginate. **Male genitalia**. Figures 47, 48. Penis with apex narrowly rounded; dorsal plate not narrowed medially. Endophallus possessing four large, toothed sclerites close to ostium and six smaller teeth positioned distally, though still within penis when in repose; aggonoporial sclerite with long anterior lobes and long posterior lobes. **Female genitalia**. Figures 49–52. Sternite 8 with blade elongate. Styli elongate. Vagina not sclerotised. Bursa copulatrix moderate, sclerites absent. Spermatheca thick. **DNA Sequences: COI**. KX191242, KX191295, KX191296. **28S**. KX191804, KX191865, KX191866. **ArgK**. KX191528, KX191578, KX191579. **CAD**. KX190997, KX191038, KX191039.

Type material examined. Holotype. Male (NZAC). Specimen mounted on card teardrop; abdomen removed, dissected and mounted in genitalia vial below specimen; left hind leg broken off at coxa, still with specimen; right tibia and tarsus missing. Labelled 'NEW ZEALAND SC / Belfield / Hakataramea Valley / 4 Nov 2012 / SDJ Brown' [printed, off-white card], 'Blower vac sample from / road verge / 44.67452° S / 170.5663° E / SDJBcoll00111' [printed, off-white card], '*Irenimus* taxonomy / and systematics / SDJ Brown / PhD Thesis 2012–2015 / IRE1748' [printed, off-white card], 'HOLOTYPE / *Irenimus* / *crinitus* / Brown 2016' [printed, red card]. Genomic DNA extract from enzyme digestion of abdomen: E065 (NZAC). CAD sequence KX190997; COI sequence KX191242; ArgK sequence KX191528; 28S sequence KX191804.

Paratypes. A total of 34 specimens (10 males, 20 females, 4 of undetermined gender) designated as paratypes, bearing blue paratype label. Paratype specimens deposited in AMNZ, ANIC, BMNH, CMNZ, LUNZ, MONZ, NZAC, OMNZ, USNM.

SC: Belfield [-44.6745, 170.5663, R], 4 Nov 2012, Brown SDJ, Blower vac sample from road verge (AMNZ: 2, ANIC: 2, BMNH: 4, CMNZ: 2, LUNZ: 11, MONZ: 2, NZAC: 3, OMNZ: 2, USNM: 2); Timaru [-44.4001, 171.2551, A], 9 Sep 1969, Damaging asparagus (NZAC: 4).

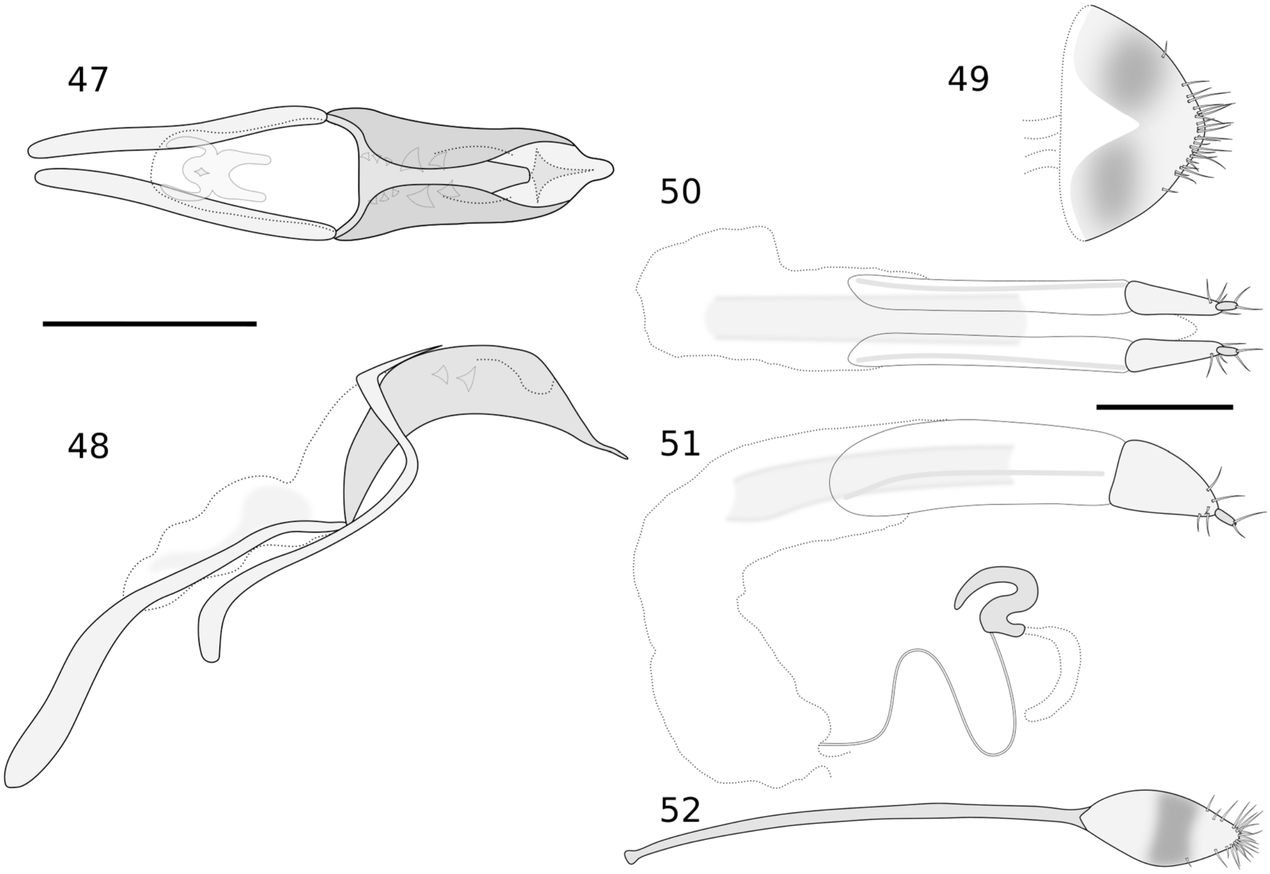
Distribution. South Island:—/ SC /—(Figure 85).

SC: Hakataramea Valley; Timaru.

Elevational range. Label data: no elevation data recorded. Georeferenced data: 12 m to 253 m ($\bar{X}$ = 226 m, s = 78, n = 35).

Etymology. Derived from the Latin *crinitus* meaning 'long-haired', in reference to the long elongate scales at the anterior of the pronotum.

Biology. Most specimens were collected by vacuum sampling in agricultural areas. It has also been recorded as damaging asparagus (*Asparagus officinalis* L.). *Microctonus aethiopoides* Loan (Hymenoptera: Braconidae) was reared from this species, with a parasitism rate of 45% (n = 20) (Shields, 2013).



FIGURES 47–52. Genitalia of *Irenimus crinitus*. 47, penis, dorsal view; 48, aedeagus, lateral view; 49, tergite 8, dorsal view; 50, ovipositor, dorsal view; 51, ovipositor and spermatheca, lateral view; 52, sternite 8, ventral view. Scale bars = 0.5 mm; 47, 48 at same scale; 49–52 at same scale.

3. *Irenimus duplex* (Broun, 1904)

Figures 9, 10, 23, 24, 32, 33, 39, 53, 54, 55, 56, 57, 58, 86

Catoptes duplex Broun, 1904:110
Irenimus duplex (Broun); May, 1977:226, Barratt *et al.*, 1998:57

Diagnosis. Medium to large species; lens shaped to ovate; grey. Scape with appressed scales. Elytra with interstriae slightly swollen, almost tuberculate in some females. Metafemora with posterior face densely scaled, without bare area lacking scales. Males with ventrite 1 depressed; trichia on venter and distal half of metatibiae long and silky. Females with ventrites simple.

Description. Body length 4.46 mm to 6.87 mm ($\bar{X}$ = 5.68 mm, s = 0.85, n = 7). Integument black. Dorsum densely covered with greyish brown to greyish yellowish brown or light greyish brown appressed scales; often with paler V on elytral declivity, rarely extending beyond interstriae 3. Femora unicolorous, same colour as lateral elytra. Tarsi integument moderate reddish brown. **Rostrum**. Length 0.98 mm to 1.46 mm ($\bar{X}$ = 1.19 mm, s = 0.15, n = 8), width 0.64 mm to 0.94 mm ($\bar{X}$ = 0.78 mm, s = 0.10, n = 8), length/width ratio 1.45 to 1.57 ($\bar{X}$ = 1.52, s = 0.05, n = 8). Epifrons with appressed scales overlapping; elongate scales claviform, erect, dark; medial and lateral carinae evident. Dorsal carina moderately arched over antennal insertions. Lateral area ventrally of antennal insertions with fine setae and with appressed scales. **Antennae**. Scape when in repose reaching hind margin of eye; covered with appressed scales and setae. Funicular segments loosely articulated; segments 1 and 2 clavate, subequal, around two times longer than segment 3; segments 3 to 7 clavate, subequal. **Head**. Eyes ovate. **Pronotum**. Length 1.46 mm to 1.84 mm ($\bar{X}$ = 1.69 mm, s = 0.16, n = 4), width 1.55 mm to 2.00 mm ($\bar{X}$ = 1.79 mm, s = 0.23, n = 4), length/width ratio 0.90 to 1.04 ($\bar{X}$ = 0.95, s = 0.06, n = 4); widest in anterior 1/3, lateral margins evenly curved (Figure 39). Anterior margin entire, posterior margin straight. Disc topography evenly convex; appressed scales closely tessellate, domed, thereby forming a bumpy surface; elongate scales claviform, erect, dark. Postocular lobes moderately developed. Anterior transverse groove weak beyond midpoint of eye. Posterior transverse groove well-developed. Lateral posterior margin evenly curved. **Elytra**. Length 3.00 mm to 4.20 mm ($\bar{X}$ = 3.50 mm, s = 0.50, n = 4), width 2.00 mm to 2.75 mm ($\bar{X}$ = 2.22 mm, s = 0.35, n = 4), length/width ratio 1.50 to 1.66 ($\bar{X}$ = 1.58, s = 0.08, n = 4). Anterior margin curved posteriad, humeral angles rounded. Appressed scales closely tessellate to narrowly overlapping. Elongate scales claviform, semi-erect, dark on disc, pale laterally and posteriorly. Striae moderately impressed; interstriae flat. **Thoracic ventrites**. Mesoventral process rounded. Metaventrite densely covered with tessellate appressed scales. **Abdomen**. Ventrites with inner vestiture composed almost exclusively of appressed scales, ventrites 1 to 5 densely clothed. Apex narrowly rounded. Males with ventrite 1 depressed medially, ventrite 5 flat. Females with ventrite 1 flat, ventrite 5 with a medial groove and slightly explanate apical margin. **Legs**. Metafemora with posterior face entirely scaled. Metatibiae with corbel present, narrow, bare; ventral margin of apex not emarginate. **Male genitalia**. Figures 53, 54. Penis with apex truncate; dorsal plate narrowed medially. Endophallus moderate in length; possessing numerous large toothed proximal sclerites sited in the penis when in repose; aggonoporial sclerite with short anterior lobes and broad posterior lobes. **Female genitalia**. Figures 55–58. Sternite 8 with blade elongate. Styli elongate. Vagina not sclerotised. Bursa copulatrix short, two oval sclerites present. Spermatheca thick; collum slightly produced; ramus produced, divergent with corpus.

DNA Sequences: COI. KX191364, KX191440, KX191441. **28S**. KX191935, KX192017, KX192018. **ArgK**. KX191646, KX191724, KX191725. **CAD**. KX191169.

Type material examined. Lectotype, here designated. Male (BMNH). Glued to card mount; claws on right metatarsus missing, otherwise entire. Labelled: 'SYN- / TYPE' [printed white disk with blue margin], '2879' [handwritten, Broun's hand], 'New Zealand / Broun Coll. / Brit. Mus. / 1922-482.' [printed, off-white rectangular label, red rule below first line], 'Ida Valley / Otago -' [handwritten], 'Catoptes / duplex' [handwritten, Broun's hand], 'LECTOTYPE / G.K. 1995' [pink card with Lectotype printed, otherwise handwritten, Kuschel's hand], 'Catoptes / duplex' [handwritten], 'BMNH(E) / 1237362' [printed, white rectangular label], 'LECTOTYPE / Catoptes / duplex / Broun 1904 / Designated SDJ Brown 2016' [printed, red rectangular label].

Broun (1904) states that 5 specimens formed the type series. Four specimens are in the Broun collection, BMNH, two under the drawer label 'Inophloeus duplex' and two under the drawer label 'Catoptes duplex'; it is from the latter series that the lectotype was selected. The fifth specimen is in NZAC, bearing a Kuschel paralectotype label. Kuschel never published this lectotype designation, and to ensure nomenclatural stability, a lectotype is here designated.

Non-type material examined. A total of 131 specimens examined (14 males, 8 females, 109 of undetermined gender).

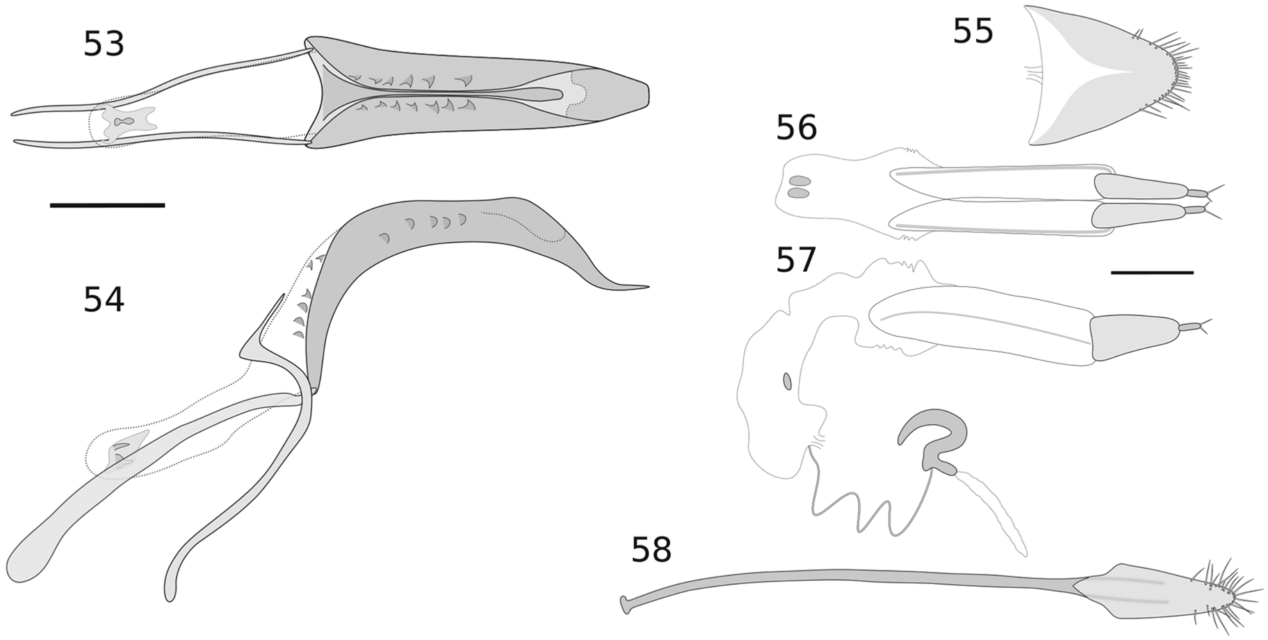
SC: Little Roderick [-44.7721, 170.5818, A], 7 Feb 1978, Johns PM (CMNZ: 1). **MK**: Benmore [-44.4424, 169.9939, A], 18 Jan 1966, Ramsay GW, 2500 feet, Beaten from *Rubus* and *Muehlenbeckia* (NZAC: 3); Benmore Dam [-44.565, 170.1986, A], 19 Feb 1958, Cranfield RS (NZAC: 1); Black Forest Stream [-44.4371, 170.2883, A], 6 Dec 1962, Johns PM, Scree (NZAC: 1); Haldon Spurs [-44.4093, 170.3141, R], 16 Feb 1996, White EG, 720 m, Light trap (LUNZ: 1); Hydro Road, 18 Jan 1966, Townsend JI, 2000-3000 feet, On *Raoulia* (NZAC: 1); Hydro Road, 18 Jan 1966, Townsend JI, 2000-3000 feet, *Raoulia* (NZAC: 1); Hydro Road, 18 Jan 1966, Townsend JI, 2200 feet, Lawyer and *Muehlenbeckia* (NZAC: 7); Lake Tekapo [-44.0044, 170.4839, A], 14 Dec 1992, Vink CJ (LUNZ: 1); Lindis Pass [-44.5914, 169.6418, A], Hutton (NZAC: 1); Moffatt Stream [-44.35423, 170.4697, R], 28 Nov 2006, Emberson RM, Syrett P, 1055 m, Under rocks on rocky top (LUNZ: 1); Otematata [-44.6091, 170.1782, A], 19 Jan 1994, Roberts GM (IACC: 1); Quailburn Road [-44.3607, 169.8265, R], 21 Apr 2014, Phillips CB, Pasture (LUNZ: 1); Stony River [-44.36385, 170.3868, R], 30 Nov 2006, Emberson RM, Syrett P, 600 m, Under log (LUNZ: 1); The Wolds Station [-44.05582, 170.4306, R], 19 Dec 2003, Emberson RM, Syrett P, 630 m, Swept from grassland (LUNZ: 1); The Wolds Station [-44.05582, 170.4306, R], 19 Dec 2003, Emberson RM, Syrett P, 665 m, Under dry rocks on gravel river terrace (LUNZ: 5); The Wolds Station [-44.13933, 170.2401, R], 17 Dec 2003, Emberson RM, Syrett P, 665 m, Under dry rocks on gravel river terrace (LUNZ: 1). **CO**: Alexandra [-45.2557, 169.3755, A], 1–31 Oct 1947, Simpson LO, Damaging apricot trees (NZAC: 15); Alexandra [-45.2557, 169.3755, A], 14 Oct 1947, Simpson LO, Damaging apricot trees (NZAC: 6); Alexandra [-45.2557, 169.3755, A], 20 Dec 1974, Stewart KH, Pitfall trap (NZAC: 1); Alexandra [-45.2557, 169.3755, A] (NZAC: 1); Beattie Road [-44.939, 169.764, R], 12 Dec 2013, Brown SDJ, 430 m, Blower vac sample from road verge (LUNZ: 1); Central Otago, Lewis (NZAC: 2); Crawford Hills Rd [-45.2142, 169.5845, A], 29 Oct 1979, Emberson RM, 548 m, Under rocks (LUNZ: 1); Cromwell [-45.0422, 169.2028, A], 21 Nov 1974, Dugdale JS, Riverside boulder and sand beach (NZAC: 1); Cromwell [-45.0422, 169.2028, A], 21 Nov 1974, Watt JC, Litter (NZAC: 3); Cromwell Chafer Beetle Reserve [-45.06202, 169.17978, A], 14 Dec 1999, Johns PM, Burnt pine logs (CMNZ: 3); Cromwell Chafer Reserve [-45.06202, 169.17978, A], 13 Mar 1979, Watt JC, Litter and debris (NZAC: 1); Cromwell Chafer Reserve [-45.06202, 169.17978, A], 17 Nov 1977, Watt JC (NZAC: 1); Cromwell Gorge [-45.1122, 169.3088, A], 21–27 Nov 1974, Watt JC, Pitfall trap (NZAC: 1); Cromwell Gorge [-45.1122, 169.3088, A], 21 Nov 1974, Watt JC, Litter (NZAC: 10); Cromwell Gorge [-45.1122, 169.3088, A], 21 Nov 1974, Watt JC, Litter under grass on sand (NZAC: 1); Earnscleugh [-45.2159, 169.3149, A], 8 Oct 1948, Hawkins JE (NZAC: 1); Flat Top Hill [-45.3363, 169.3282, A], 21 Sep 1996, Patrick BH, Patrick H (OMNZ: 1); Hyde [-45.2979, 170.2507, A], 28 Sep 1966, French RA (NZAC: 1); Hyde Rock [-45.3893, 169.1974, A], 22 Feb 1974, Watt JC, 1585 m, Under stones (NZAC: 1); Lindis Pass [-44.5914, 169.6418, A], 28 Oct 1964, Johns PM, 2100 feet, *Muehlenbeckia* and *Discaria* scree (NZAC: 1); Lookout, Old Man Range, 20 Feb 1974, Dugdale JS, Sweeping shrubs (NZAC: 1); Lower Manor Burn Dam [-45.2424, 169.4457, A], 8 Mar 1979, Watt JC, Under stones (NZAC: 5); Manorburn [-45.3841, 169.6175, A], 26 Oct 1981, Watt JC, 300 m, Under *Raoulia australis* (NZAC: 3); Manorburn [-45.3841, 169.6175, A], 26 Oct 1981, Watt JC, 300 m, Under stones (NZAC: 1); Mt Grandview [-44.638, 169.342, R], 24 Apr 2014, Phillips CB, Under rock (LUNZ: 1); Omakau, 11–16 Feb 1988, Bowie MH, Yellow pan trap in shoreline *Coprosma repens* (LUNZ: 1); Ophir [-45.1112, 169.609, A], 1 Jan–31 Dec 1902, Lewis JH (NZAC: 2); Ophir [-45.1112, 169.609, A], 24 Aug 1901, Lewis JH (NZAC: 2); Ophir Saddle, 14 Apr 1968, Johns PM, Scree (CMNZ: 1); Queensberry Dam Site [-44.84505, 169.34015, A], 26 Oct 1979, Emberson RM, Under stones (LUNZ: 1); Raggedy Range [-45.155, 169.6279, A], 10 Nov 1968, Townsend JI (NZAC: 2); Roaring Meg [-44.9559, 169.046, A], 17 Nov 1977, Watt JC, Litter (NZAC: 1); Roaring Meg [-44.9559, 169.046, A], 18 May 1975, May BM, Beaten at night from *Poa* (NZAC: 3); Roaring Meg [-44.9559, 169.046, A], 25 Nov 1974, Watt JC, Beaten from shrubs at night (NZAC: 7); Roaring Meg [-44.9559, 169.046, A], 25 Oct 1981, Watt JC, Tussock litter (NZAC: 1); Sandflat Rd [-45.0633, 169.1641, A], 19–28 Nov 1974, Watt JC, Pitfall trap (NZAC: 1); Tiroiti [-45.2585, 170.2645, A], 1–31 Jan 1897, Lewis JH, Under stones (NZAC: 10); Tiroiti [-45.2585, 170.2645, A], Lewis JH (NZAC: 2); Wedderburn [-45.0342, 170.0144, A], 1–31 Jan 1899, Lewis JH (NZAC: 2).

Distribution. South Island:—/ SC, MK, CO /—(Figure 86).

SC: Kurow. **MK**: Lake Benmore; Lake Tekapo; Lindis Pass; Omarama; Otematata. **CO**: Alexandra; Becks; Central Otago; Clyde; Cromwell; Hyde; Kawarau Gorge; Lake Hawea; Lindis Pass; Manorburn; Old Man Range; Omakau; Ophir; Raggedy Range; Tarras; Tiroiti; Wedderburn.

Elevational range. Label data: 300 m to 1585 m ($\bar{X}$ = 663 m, s = 239, n = 30). Georeferenced data: 143 m to 1665 m ($\bar{X}$ = 433 m, s = 314, n = 116).

Biology. *Irenimus duplex* inhabits rough grassland and shrubland in Central Otago and the Mackenzie Country. Specimens were frequently collected from under stones or logs, or beaten from shrubs and vines including matagouri (*Discaria toumatou* Raoul, 1844), *Muehlenbeckia complexa* (A. Cunn.) Meissn., and lawyer (*Rubus* *schmidelioides* A. Cunn., 1839). Several specimens were collected in 1947 damaging apricot trees (*Prunus armeniaca* L., 1753), however, no recent records exist and this species is not considered to be of economic importance.



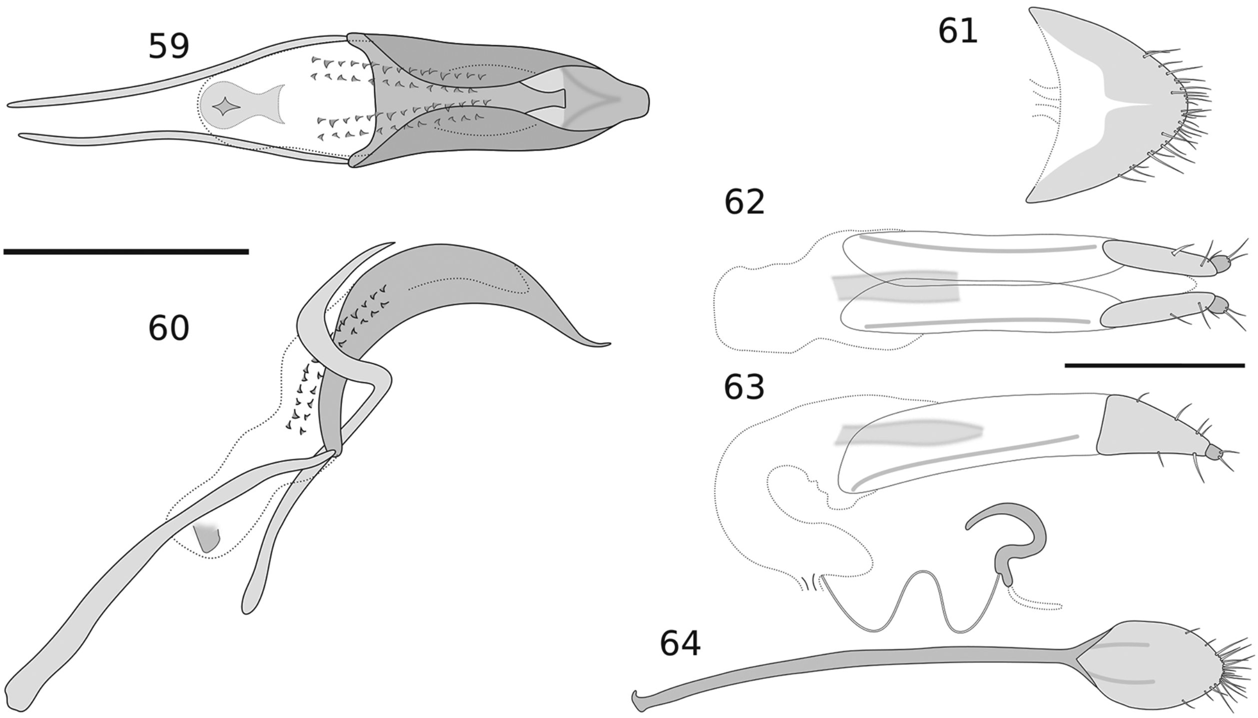
FIGURES 53–58. Genitalia of *Irenimus duplex*. 53, penis, dorsal view; 54, aedeagus, lateral view; 55, tergite 8, dorsal view; 56, ovipositor, dorsal view; 57, ovipositor and spermatheca, lateral view; 58, sternite 8, ventral view. Scale bars = 0.5 mm; 53, 54 at same scale; 55–58 at same scale.

4. *Irenimus minimus* Brown, new species
Figures 7, 8, 21, 22, 29, 59, 60, 61, 62, 63, 64, 85

Diagnosis. Small species, oval, grey to dark brown. Scape with appressed scales. Pronotum broadly subquadrate, lateral margins subparallel medially. Elytra with elongate scales setiform, erect; appressed scales tessellate. Females with ventrites simple, ventrite 5 swollen medially. Posterior face of metafemora covered with metallic scales.

Description. Body length 3.16 mm to 3.56 mm ($\bar{X}$ = 3.33 mm, *s* = 0.20, *n* = 4). Integument black. Dorsum densely covered with light reddish brown appressed scales, with scattering of pale scales on disc of elytra; inconspicuous darker maculae on interstriae 3 at top of elytral declivity. Femora with distal 1/4 paler than proximal 3/4. Tarsi integument deep orange. **Rostrum**. Length 0.64 mm to 0.67 mm ($\bar{X}$ = 0.66 mm, *s* = 0.01, *n* = 4), width 0.43 mm to 0.47 mm ($\bar{X}$ = 0.45 mm, *s* = 0.02, *n* = 4), length/width ratio 1.40 to 1.56 ($\bar{X}$ = 1.46, *s* = 0.07, *n* = 4). Epifrons with appressed scales tessellate; elongate scales setiform, erect, neutral; medial and lateral carinae not evident. Dorsal carina not arched over antennal insertions. Lateral area ventrally of antennal insertions with fine setae, without appressed scales. **Antennae**. Scape when in repose reaching hind margin of eye; covered with appressed scales and setae. Funicular segments moderately articulated; segment 1 clavate, 1.3 times longer than segment 2; segment 2 clavate, around 2 times longer than segment 3; segments 3 to 4 clavate, subequal; segments 5 to 7 subspherical, subequal. **Head**. Eyes subcircular. **Pronotum**. Length 1.05 mm to 1.16 mm ($\bar{X}$ = 1.12 mm, *s* = 0.05, *n* = 4), width 1.10 mm to 1.32 mm ($\bar{X}$ = 1.22 mm, *s* = 0.10, *n* = 4), length/width ratio 0.88 to 0.95 ($\bar{X}$ = 0.92, *s* = 0.04, *n* = 4); widest in middle, lateral margins abruptly broadening to anterior 1/4, subparallel until posterior 1/4, abruptly constricting to base. Anterior margin entire, posterior margin evenly curved. Disc topography evenly convex; appressed scales tessellate, dull, domed; elongate scales setiform, erect, neutral. Postocular lobes poorly developed. Anterior transverse groove weak beyond level with ventral margin of eye. Posterior transverse groove weak. Lateral posterior margin evenly curved. **Elytra**. Length 2.05 mm to 2.36 mm ($\bar{X}$ = 2.21 mm, *s* = 0.15, *n* = 4), width 1.40 mm to 1.78 mm ($\bar{X}$ = 1.62 mm, *s* = 0.17, *n* = 4), length/width ratio 1.28 to 1.50 ($\bar{X}$ = 1.36, *s* = 0.10, *n* =

4). Anterior margin strongly curved posteriad, with humeral angles rounded. Disc with appressed scales tessellate; elongate scales setiform, erect, dark on disc, pale laterally and posteriorly. Striae shallowly impressed; interstriae flat. **Thoracic ventrites**. Mesoventral process rounded in male, acutely rounded in female. Metaventrite densely covered with pappolepida medially, appressed scales laterally. **Abdomen**. Ventrites with inner vestiture composed roughly equally of pappolepida and appressed scales, pappolepida predominant medially, appressed scales predominant laterally; ventrites 1 and 2 sparsely clothed, ventrites 3 to 5 increasingly sparse. Males with ventrite 1 depressed medially, ventrite 5 shallowly concave. Females with ventrite 1 flat, ventrite 5 flat. Apex of abdomen rounded. **Legs**. Metafemora with posterior face entirely scaled. Metatibiae with corbel present, narrow, bare; ventral margin of apex slightly emarginate. **Male genitalia**. Figures 59, 60. Penis with apex truncate; dorsal plate not narrowed medially. Endophallus possessing numerous small toothed proximal sclerites sited in the penis when in repose; aggonoporial sclerite lacking anterior lobes, posterior lobe fused. **Female genitalia**. Figures 61–64. Sternite 8 with blade broad. Styli stout. Vagina sclerotised. Bursa copulatrix short, sclerites absent. Spermatheca slender. **DNA Sequences: COI**. KX191228, KX191248, KX191422. **28S**. KX191784, KX191813, KX191996. **ArgK**. KX191512, KX191534, KX191703. **CAD**. KX191152.



FIGURES 59–64. Genitalia of *Irenimus minimus*. 59, penis, dorsal view; 60, aedeagus, lateral view; 61, tergite 8, dorsal view; 62, ovipositor, dorsal view; 63, ovipositor and spermatheca, lateral view; 64, sternite 8, ventral view. Scale bars = 0.5 mm; 59, 60 at same scale; 61–64 at same scale.

Type material examined. Holotype. Female (NZAC). Specimen mounted on card teardrop; abdomen removed, dissected and mounted in DMHF on white card below specimen. Labelled 'NEW ZEALAND CO / Aldinga Cons. Area / Alexandra / 1 Nov 2012 / SDJ Brown' [printed, off-white card], 'Blower vac sample from / grassland / 45.286°S 169.314°E' [printed, off-white card], '*Irenimus* taxonomy / and systematics / SDJ Brown / PhD Thesis 2012–2015 / IRE4861' [printed, off-white card], 'HOLOTYPE / *Irenimus* / *minimus* / Brown 2016' [printed, red card]. Genomic DNA extract from enzyme digestion of abdomen E286 (NZAC). CAD sequence KX191152; COI sequence KX191422; ArgK sequence KX191703; 28S sequence KX191996.

Paratypes. A total of 3 specimens (1 males, 2 females) designated as paratypes, bearing blue paratype label. Paratype specimens deposited in BMNH, LUNZ.

CO: Clyde Lookout [-45.1942, 169.3044, R], 3 Nov 2012, Brown SDJ, Blower vac sample from herbfield (BMNH: 1, LUNZ: 1); Conroys Rd [-45.2789, 169.3347, R], 1–4 Nov 2012, Brown SDJ, Pitfall trap (LUNZ: 1).

Distribution. South Island:—/ CO /—(Figure 85).

CO: Alexandra; Clyde.

Elevational range. Label data: no elevation data recorded. Georeferenced data: 293 m to 323 m ($\bar{X}$ = 312 m, s = 13, n = 4).

Etymology. From the Latin *minimus*, 'least', in reference to is small size, being the smallest known species of *Irenimus*.

Biology. Specimens were collected from short grassland, *Raoulia* cushionfield, and herbfield dominated by thyme (*Thymus vulgaris* L., 1753).

Remarks. This species can be distinguished from other similarly sized entimine weevils in the same locality by the combination of the complete metanepisternal suture, setiform elongate scales on the elytra and pronotum, the dull, domed, appressed scales on the pronotum and the subquadrate shape of the pronotum.

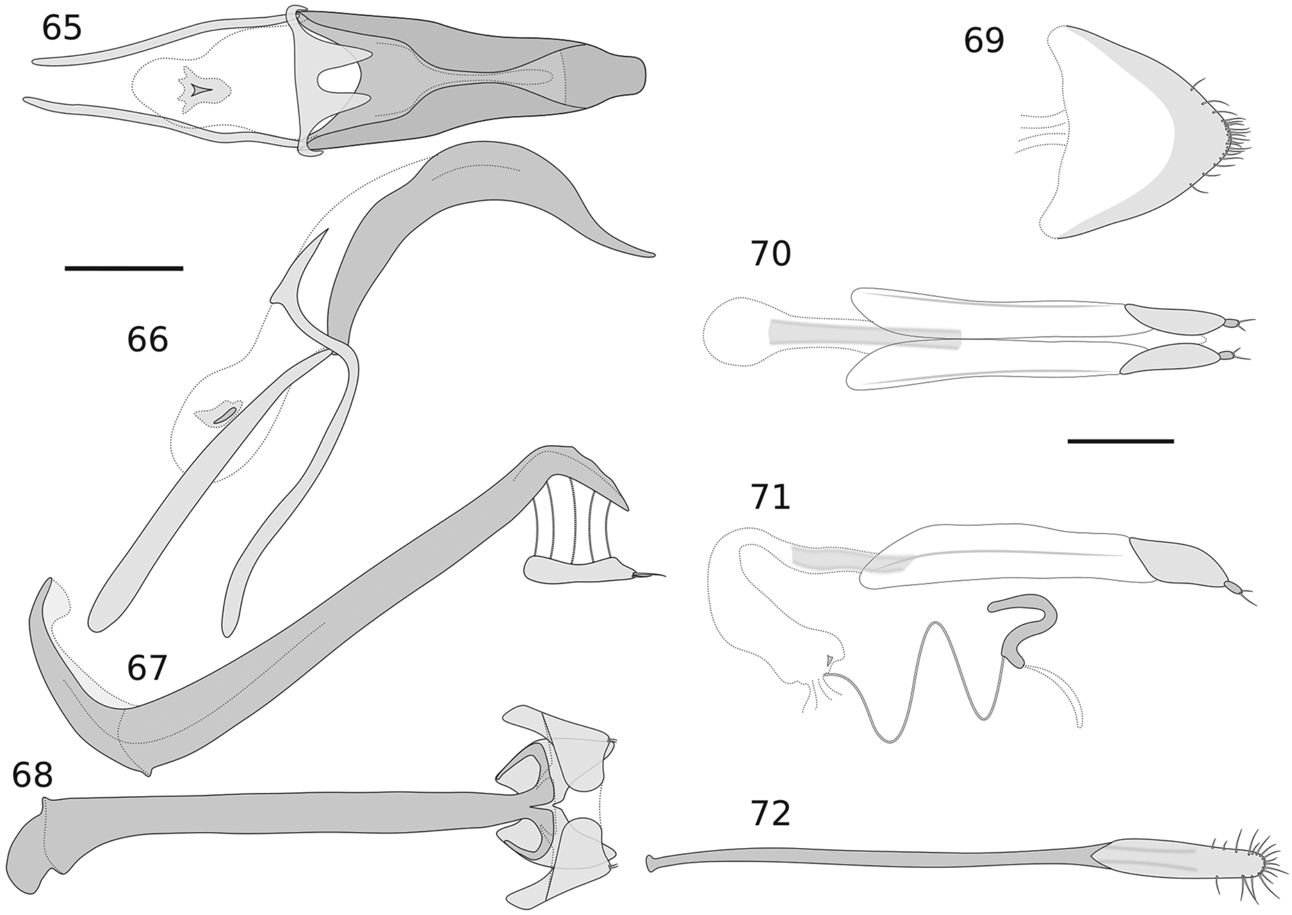
5. *Irenimus parilis* Pascoe, 1876

Figures 11, 12, 25, 26, 30, 31, 37, 65, 66, 67, 68, 69, 70, 71, 72, 86

Irenimus parilis Pascoe, 1876:54

Diagnosis. Medium to large species; ovate, grey. Scape with appressed scales. Elytra with a slight swelling on interstriae 3. Males with ventrite 1 depressed. Female with ventrites simple. Metatibial apex with a broad corbel; strongly emarginate ventrally.

Description. Body length 4.41 mm to 6.95 mm ($\bar{X}$ = 5.75 mm, s = 1.03, n = 7) Integument black. Dorsum densely covered with light brownish grey to dark greyish brown appressed scales, pale V on elytral declivity of varying conspicuousness, pronotum occasionally with an elongate pale medial macula. Profemora and mesofemora unicolorous; metafemora with band of pale scales in distal 1/4, often obscure. Tarsi integument deep orange to strong red. **Rostrum**. Length 1.04 mm to 1.71 mm ($\bar{X}$ = 1.29 mm, s = 0.23, n = 7), width 0.60 mm to 0.92 mm ($\bar{X}$ = 0.77 mm, s = 0.11, n = 7), length/width ratio 1.54 to 1.86 ($\bar{X}$ = 1.67, s = 0.14, n = 7). Epifrons with appressed scales overlapping; elongate scales claviform, semi-erect to decumbent, mixed dark and pale; medial and lateral carinae evident. Dorsal carina strongly arched over antennal insertions. Lateral area ventrally of antennal insertions with coarse setae, but without appressed scales. **Antennae**. Scape when in repose reaching beyond hind margin of eye; covered with appressed scales and setae. Funicular segments loosely articulated; segment 1 clavate, 1.7 times longer than 2; segment 2 clavate, 1.3 times longer than segment 3; segments 3 to 7 clavate, subequal in length. **Head**. Eyes ovate. **Pronotum**. Length 1.32 mm to 1.96 mm ($\bar{X}$ = 1.55 mm, s = 0.22, n = 7), width 1.41 mm to 2.13 mm ($\bar{X}$ = 1.79 mm, s = 0.24, n = 7), length/width ratio 0.81 to 0.94 ($\bar{X}$ = 0.87, s = 0.05, n = 7); widest in anterior 1/3, lateral margins evenly curved. Anterior margin entire, posterior margin curved. Disc topography evenly convex; appressed scales appressed to overlapping; elongate scales claviform, semi-erect, mostly dark. Postocular lobes moderately developed. Anterior transverse groove weak beyond level with ventral margin of eye. Posterior transverse groove weak. Lateral posterior margin with inflection 1/3 of way from top. **Elytra**. Length 2.62 mm to 4.56 mm ($\bar{X}$ = 3.77 mm, s = 0.68, n = 7), width 1.98 mm to 2.95 mm ($\bar{X}$ = 2.58 mm, s = 0.36, n = 7), length/width ratio 1.04 to 1.64 ($\bar{X}$ = 1.47, s = 0.20, n = 7). Anterior margin curved posteriad, humeral angles rounded. Appressed scales overlapping. Elongate scales claviform, semi-erect, dark on disc, mostly dark laterally and posteriorly. Striae moderately impressed, interstriae slightly convex. **Thoracic ventrites**. Mesoventral process truncate. Metaventrite densely covered with appressed scales. **Abdomen**. Ventrites densely clothed with inner vestiture almost exclusively of appressed scales. Apex rounded. Males with ventrite 1 depressed medially, ventrite 5 shallowly concave. Females with ventrite 1 flat, ventrite 5 flat. **Legs**. Males with ventral margin of mesotibiae forming a blunt tooth at the proximal 1/3 (Figure 37). Females with mesotibiae wider in proximal 1/3 than distal 1/3, but without obvious tooth. Metatibiae with corbel present, broad, bare; ventral margin of apex strongly emarginate. **Male genitalia**. Figures 65–68. Penis with apex broadly truncate; lateral margins constricted medially; dorsal plate narrowed medially. Endophallus without proximal sclerites; aggonoporial sclerite with anterior lobes very short, posterior lobe fused. **Female genitalia**. Figures 69–72. Sternite 8 with blade elongate. Styli elongate. Vagina sclerotised. Bursa copulatrix long, two small triangular sclerites present close to opening of oviduct. Spermatheca slender. **DNA Sequences: COI**. KX191336, KX191346. **28S**. KX191805, KX191906, KX191916. **ArgK**. KX191529, KX191618, KX191628. **CAD**. KX191077, KX191087.



FIGURES 65–72. Genitalia of *Irenimus parilis*. 65, penis, dorsal view; 66, aedeagus, lateral view; 67, male hemisternite 8 and spiculum gastrale, lateral view (muscles between hemisternite 8 and basal plate indicated); 68, male hemisternite 8 and spiculum gastrale with basal plate, ventral view; 69, tergite 8, dorsal view; 70, ovipositor, dorsal view; 71, ovipositor and spermatheca, lateral view; 72, sternite 8, ventral view. Scale bars = 0.5 mm; 65–68 at same scale; 69–72 at same scale.

Type material examined. Holotype. Male (BMNH). Glued to card point; abdomen removed for dissection, specimen otherwise with hole in right elytron where formerly pinned, right protarsus missing segments 3–5 and right antenna missing club and funicle segment 7. Dissected material in genitalia vial pinned below labels. Labelled 'Type' [printed, round label with red border], 'NZ / Christchurch' [handwritten, Pascoe's hand; off-white oval label], 'Irenimus / parilis / Type Pasc' [handwritten, Pascoe's hand; small off-white rectangular label], 'Irenimus / parilis Pasc' [handwritten, Pascoe's hand; off-white rectangular label with black border], 'BMNH(E) / 1237417' [printed, white rectangular label], 'HOLOTYPE / Irenimus / parilis / Pascoe 1876 / Confirmed SDJ Brown 2013' [printed, red rectangular label].

Although Pascoe (1876) does not explicitly state how many specimens made up the type series, it consisting of only a single specimen can be inferred by his not stating a size range in the description. Only a single Pascoe specimen is found in BMNH, with a label stating that it is a 'Type' in Pascoe's hand. In the absence of other known type material, this is here regarded as the holotype.

Non-type material examined. A total of 115 specimens examined (6 males, 11 females, 98 of undetermined gender).

TO: Chateau Tongariro [-39.1996, 175.5393, A], 1–31 Dec 1948, Forster RR (NZAC: 1). **RI**: Totara Reserve, Pohangina Valley [-40.1371, 175.8442, A], 18 Dec 1948, Brookes AE (NZAC: 2); Vinegar Hill [-39.9262, 175.6233, A], 18 Oct 1965, Johns PM, Podocarp (CMNZ: 2). **WI**: Ashhurst [-40.294, 175.7581, A], 17 Jan 1959, Townsend JI (NZAC: 1). **NC**: Waikuku [-43.2976, 172.6861, R], 13 Dec 2012, Shields MW, Beaten from tall weeds in waste area (LUNZ: 1); Waikuku [-43.2976, 172.6862, R], 13 Dec 2012, Shields MW, Brown SDJ, Beaten from tall mallows in weedy waste area (LUNZ: 2); Weka Pass [-42.9802, 172.6712, A], 27 Oct 1996, Patrick BH, 250 m (OMNZ: 1). **MC**: Christchurch [-43.5326, 172.6362, A], 30 Oct 1961, Mckenzie R (NZAC: 1); Halkett Rd

[-43.501, 172.3202, A], 14 Oct 1979, Waller J, Ex Blackcurrants (NZAC: 4); Halkett Rd [-43.501, 172.3202, A], 14 Sep 1979, Waller JB, ex Blackcurrants (LUNZ: 6); Halkett Rd [-43.501, 172.3202, A], 15 Dec 1976, Waller JB (NZAC: 2); Harewood [-43.4811, 172.5461, A], 5 Dec 1973, Trott NI (NZAC: 1); Harewood [-43.4811, 172.5461, A], 5 Dec 1973, Trott NI, In raspberry garden (NZAC: 1); Lincoln [-43.642, 172.4899, A], 1–31 Oct 1962, Ex pasture (NZAC: 32); Lincoln [-43.642, 172.4899, A], 14 Nov 1967, Jessop CT (NZAC: 2); Port Hills [-43.6086, 172.6443, A], 1–31 Dec 1916, Lindsay (NZAC: 1); Templeton Research Farm, 9 Sep 1981, Rhodas P, Goldson S (NZAC: 1); Waimakariri Rd [-43.4753, 172.5661, A], 14 Aug 1984, Moody D (NZAC: 1); West Melton [-43.5268, 172.3721, A], 1–31 Oct 1993, Waller JB, In house (LUNZ: 1); West Melton [-43.5268, 172.3721, A], 2 Oct 1990, Waller JB, ex grapes (LUNZ: 29, USNM: 2); West Melton [-43.5268, 172.3721, A], 3 Oct 1972, Smale PE (NZAC: 3); West Melton [-43.5268, 172.3721, A], 3 Oct 1972, Smale PE, Damaging current bushes (NZAC: 3); West Melton [-43.5268, 172.3721, A], 6 Dec 1976, Waller JB, Ex lemon tree (Lisbon) (LUNZ: 7).

Distribution. North Island, South Island: TO, RI, WI / NC, MC /—(Figure 86).

TO: Ruapehu. **RI**: Hunterville; Pohangina Valley. **WI**: Ashhurst. **NC**: Waikuku; Weka Pass. **MC**: Christchurch; Harewood; Lincoln; Port Hills; Templeton; West Melton.

Elevational range. Label data: 250 m (n = 1). Georeferenced data: 7 m to 1122 m ($\bar{X}$ = 80 m, s = 120, n = 106).

Biology. This species has been collected in large numbers on fruit trees and shrubs, including blackcurrants (*Ribes nigrum* L., 1753), grapes (*Vitis vinifera* L., 1753) and lemons (*Citrus* × *limon* (L.) Burman f. cv. 'Lisbon'). It has also been collected from agricultural pasture and from tall weeds, including mallows (*Malva sylvestris* L., 1753).

Remarks. The disjunct distribution of this species is intriguing. Inspection of male genitalia of specimens from Ruapehu and the Pohangina Valley confirm that the North Island populations are conspecific with specimens from Christchurch. It is hypothesised here that the North Island populations are a human-assisted introduction from a South Island source population.

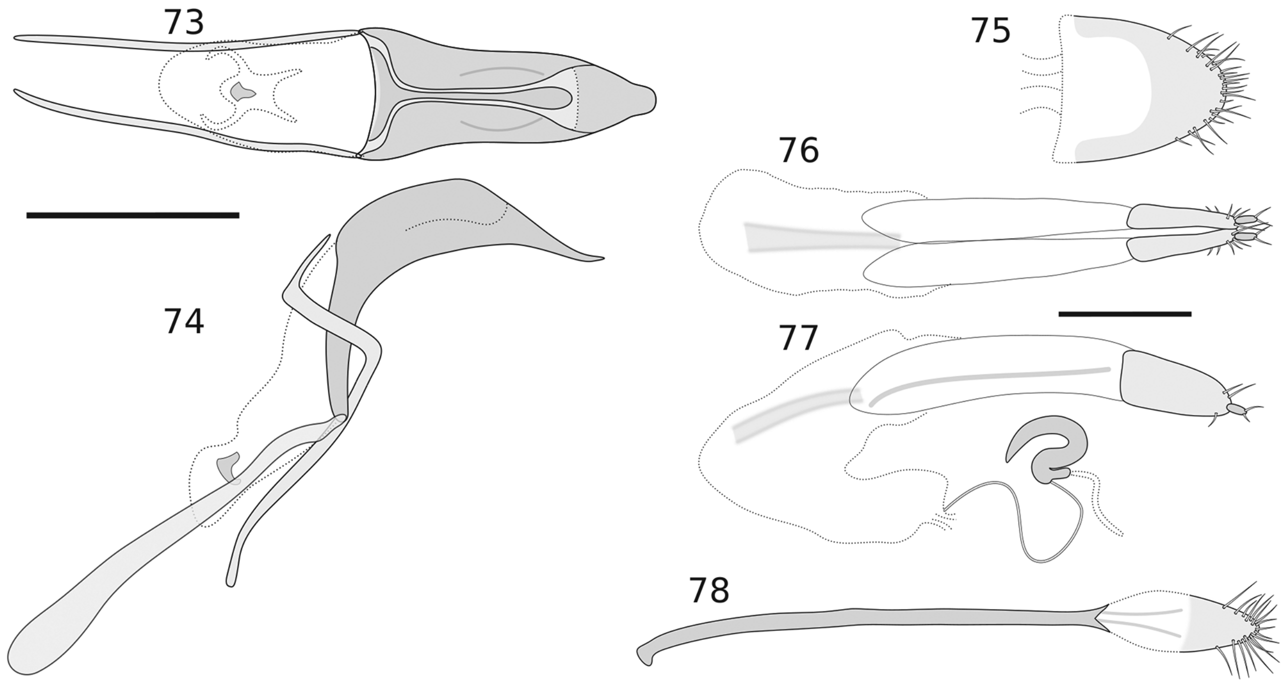
6. *Irenimus stichus* Brown, new species

Figures 5, 6, 19, 20, 36, 73, 74, 75, 76, 77, 78, 85

Diagnosis. Small to medium sized species; oval; dark grey to light grey, with mottling on the dorsum. Pronotum with lateral margins evenly curved. Scape without appressed scales. Elytra without interstriae 3 flat, elongate scales decumbent. Abdominal ventrites dominated by glossy, appressed scales and with few pappolepida. Males with ventrite 1 flat. Females with ventrites simple. Metatibiae more slender than in other species.

Description. Body length 3.12 mm to 4.80 mm ($\bar{X}$ = 3.88 mm, s = 0.61, n = 8). Integument black. Dorsum densely covered with appressed scales, colour variable, base colour ranging from light greyish brown and light greyish yellowish brown to deep reddish brown and dark brown; often with extensive mottling on the elytral disc, less on pronotal disc; frequently with a pale macula on vertex, an elongate pale macula on pronotal disc, and paler V-shaped band at top of elytral declivity, though not necessarily all these in combination. Femora with appressed scales dense, unicolorous, concolorous with elytra. Tarsi integument deep reddish brown. **Rostrum**. Length 0.66 mm to 0.98 mm ($\bar{X}$ = 0.83 mm, s = 0.12, n = 8), width 0.42 mm to 0.68 mm ($\bar{X}$ = 0.55 mm, s = 0.10, n = 8), length/width ratio 1.36 to 1.79 ($\bar{X}$ = 1.52, s = 0.14, n = 8). Epifrons with appressed scales slightly overlapping; elongate scales setiform, erect, dark; medial and lateral carinae not evident. Dorsal carina slightly arched over antennal insertions. Lateral area ventrally of antennal insertions with thick setae, without appressed scales. **Antennae**. Scape relatively short, reaching around the middle of the eye when in repose; lacking appressed scales. Funicular segments moderately articulated; segments 1 and 2 clavate, subequal, around two times longer than segment 3; segments 3 to 6 subspherical, subequal; segment 7 oblately spheroid, longer than segment 6. **Head**. Eyes subcircular. **Pronotum**. Length 1.02 mm to 1.56 mm ($\bar{X}$ = 1.31 mm, s = 0.23, n = 4), width 1.02 mm to 1.52 mm ($\bar{X}$ = 1.30 mm, s = 0.22, n = 4), length/width ratio 0.98 to 1.03 ($\bar{X}$ = 1.01, s = 0.02, n = 4); widest in anterior 1/3, lateral margins evenly curved. Anterior margin entire, posterior margin evenly curved. Disc topography evenly convex; appressed scales tessellate; elongate scales setiform, erect, dark. Postocular lobes poorly developed. Anterior transverse groove weak beyond level with ventral margin of eye (Figure 36). Posterior transverse groove weakly developed. Lateral posterior margin evenly curved (Figure 36). **Elytra**. Length 1.88 mm to 2.80 mm ($\bar{X}$ = 2.34 mm, s = 0.39, n = 4), width 1.33 mm to 2.16 mm ($\bar{X}$ = 1.75 mm, s = 0.38, n = 4), length/width ratio 1.27 to 1.42 ($\bar{X}$ =

1.35, s = 0.08, n = 4). Anterior margin curved posteriad with humeral angles nearly porrect. Disc with appressed scales slightly overlapping; elongate scales setiform, semi-erect, dark on disc, pale laterally and posteriorly. Striae shallowly impressed; interstriae flat. **Thoracic ventrites**. Mesoventral process acutely rounded. Metaventrite densely covered with appressed scales. **Abdomen**. Ventrites with inner vestiture composed almost exclusively of appressed scales, ventrites 1 and 2 densely clothed, ventrites 3 and 4 sparsely clothed, ventrite 5 with dense scales anteriorly, bare posteriorly. Apex broadly rounded. Males with ventrite 1 slightly depressed, ventrite 5 flat. Female with ventrite 1 flat, ventrite 5 flat. **Legs**. Metatibiae with corbel present, broad, bare; ventral margin of apex slightly emarginate. **Male genitalia**. Figures 73, 74. Penis with apex broadly rounded, almost sagittate; dorsal plate narrowed medially. Endophallus with longitudinal ostial sclerites; aggonoporial sclerite with long anterior and posterior lobes. **Female genitalia**. Figures 75–78. Sternite 8 with blade elongate. Styli elongate. Vagina sclerotised. Bursa copulatrix moderate, sclerites absent. Spermatheca thick, ramus parallel with corpus. **DNA Sequences: COI**. KX191308, KX191309, KX191361. **28S**. KX191878, KX191879, KX191932. **ArgK**. KX191591, KX191592, KX191643. **CAD**. KX191050, KX191051, KX191100.



FIGURES 73–78. Genitalia of *Irenimus stichus*. 73, penis, dorsal view; 74, aedeagus, lateral view; 75, tergite 8, dorsal view; 76, ovipositor, dorsal view; 77, ovipositor and spermatheca, lateral view; 78, sternite 8, ventral view. Scale bars = 0.5 mm; 73, 74 at same scale; 75–78 at same scale.

Type material examined. Holotype. Male (NZAC). Specimen entire, mounted on card triangle. Labelled 'NZ: Tekapo, MK / 170.417969°S: 39413°E / Trap: C1600 - 2 - 3 / Pawson, S.M. & McCarthy, J.K. / 27-Nov-07 to 17-Dec-07' [printed, white card], 'NZ: Tekapo, MK / Tekapo Wilding Trial / Specimen number: 7 / 27-Nov-08 to 17-Dec-08' [printed, white card], '*Irenimus* taxonomy / and systematics / SDJ Brown / PhD Thesis 2012–2015 / IRE0398' [printed, off-white card], 'HOLOTYPE / *Irenimus stichus* / Brown 2016' [printed, red card].

Paratypes. A total of 125 specimens (35 males, 44 females, 46 of undetermined gender) designated as paratypes, bearing blue paratype label. Paratype specimens deposited in AMNZ, ANIC, BMNH, CMNZ, FRNZ, LUNZ, MONZ, NZAC, OMNZ, USNM.

MK: Burkes Pass Scenic Reserve [-44.092, 170.581, R], 19 Jan 2014, Brown SDJ, 690 m, Blower vac sample from road verge (LUNZ: 2); Burkes Pass Scenic Reserve [-44.092, 170.583, R], 28 Dec 2012, Brown SDJ, 690 m, Blower vac sample from road verge (LUNZ: 1); Burkes Pass Scenic Reserve [-44.0928, 170.5789, A], 15 Dec 2006, Johns PM, 670 m, Pitfall traps (CMNZ: 1); Burkes Pass Scenic Reserve [-44.0928, 170.5789, A], 20 Nov 2006, Johns PM, 670 m, Pitfall traps (CMNZ: 1); Curraghmore Station [-44.27592, 170.4435, R], 1 Dec 2006, Emberson RM, Syrett P, 610 m, Under sheep dung (LUNZ: 1); Curraghmore Station [-44.28529, 170.4421, R], 1 Dec 2006, Emberson RM, Syrett P, 700 m, Under rock (LUNZ: 1); Curraghmore Station [-44.30155, 170.4289, R], 1 Dec 2006, Emberson RM, Syrett P, 630 m, Under cow dung (LUNZ: 1); Lake Tekapo [-44.0044, 170.4839, A], 20 Nov 1957, Evans PS (NZAC: 1); Lake Tekapo [-44.0334, 170.418, R], 27 Nov–17 Dec 2007, Pawson SM, McCarthy JK (FRNZ: 11, LUNZ: 1, NZAC: 2, OMNZ: 1); Lake Tekapo [-44.0334, 170.418, R], 28 Nov–17 Dec 2007, Pawson SM, McCarthy JK (FRNZ: 3, USNM: 1); Lake Tekapo [-44.0334, 170.418, R], 28 Nov–17 Dec 2008, Pawson SM, McCarthy JK (AMNZ: 2, FRNZ: 1); Lake Tekapo [-44.0394, 170.418, R], 27 Nov–17 Dec 2007, Pawson SM, McCarthy JK (ANIC: 2, BMNH: 4, FRNZ: 63, LUNZ: 1, MONZ: 2, NZAC: 2, OMNZ: 1, USNM: 1); Lake Tekapo [-44.0394, 170.418, R], 28 Nov–17 Dec 2007, Pawson SM, McCarthy JK (FRNZ: 4); Mackenzie Pass [-44.1934, 170.6115, A], 23 Nov 1960, On *Pimelea sericeo-villosa* (NZAC: 8); Mt Cox [-43.981, 170.281, R], 27 Oct 2013, Brown SDJ, 830 m , Blower vac sample from grassland (LUNZ: 1); Ohau River [-44.2776, 169.9636, A], 13 Dec 1991, Johns PM, Sinclair L, *Raoulia australis* (CMNZ: 1); Stony River [-44.36565, 170.3916, R], 30 Nov 2006, Emberson RM, Syrett P, 590 m, Under rock (LUNZ: 2); Tekapo [-44.0334, 170.418, R], 28 Nov–17 Dec 2007, Pawson SM, McCarthy JK (LUNZ: 1); Tekapo [-44.0394, 170.418, R], 28 Nov–17 Dec 2007, Pawson SM, McCarthy JK (LUNZ: 1).

Distribution. South Island:—/ MK /—(Figure 85).

MK: Burkes Pass; Curraghmore; Lake Benmore; Lake Pukaki; Lake Tekapo; Mackenzie Pass; Twizel.

Elevational range. Label data: 590 m to 830 m ($\bar{X}$ = 669 m, s = 68, n = 11). Georeferenced data: 518 m to 826 m ($\bar{X}$ = 723 m, s = 32, n = 126).

Etymology. Derived from the Greek *stichos* meaning ‘line’ or ‘row’, in reference to the visible metanepisternal suture.

Biology. Most specimens were collected in pitfall traps sited in grassland or in pine blocks surrounded by grassland. Other specimens were found under rocks or dung, collected through vacuum sampling in grassland, or were associated with *Raoulia* and *Pimelea*.

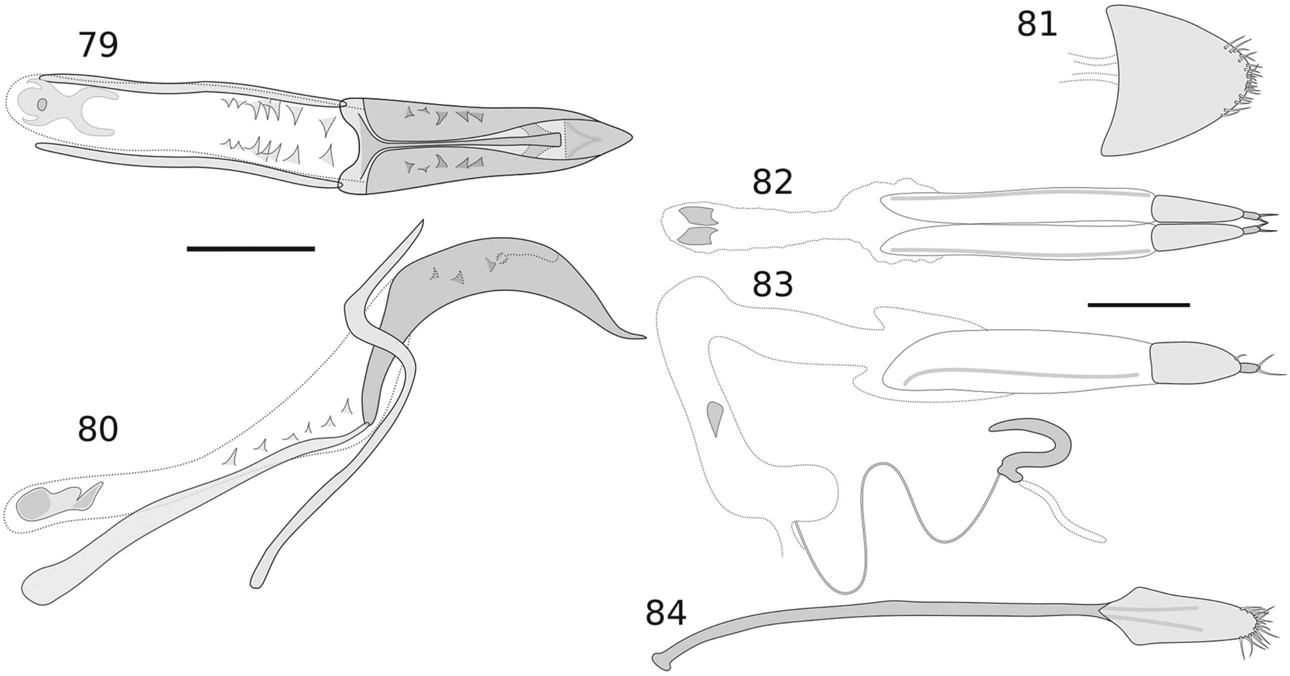
7. *Irenimus thoracicus* Brown, new species

Figures 13, 14, 27, 28, 40, 79, 80, 81, 82, 83, 84, 86

Diagnosis. Medium to large species, lens shaped, grey. Scape with appressed scales. Pronotum widest anteriorly, lateral margins subparallel in posterior 1/4.

Distinguished from *I. duplex* by the shape of the pronotum (Figure 40).

Description. Body length 5.21 mm to 6.27 mm ($\bar{X}$ = 5.79 mm, s = 0.42, n = 7). Integument black. Dorsum densely covered with light greyish brown appressed scales; elytral declivity occasionally slightly paler, lined anteriorly with an obscure darker line. Femora unicolorous, concolorous with elytra. Tarsi integument strong reddish brown. **Rostrum**. Length 1.16 mm to 1.36 mm ($\bar{X}$ = 1.26 mm, s = 0.09, n = 6), width 0.76 mm to 0.90 mm ($\bar{X}$ = 0.83 mm, s = 0.05, n = 6), length/width ratio 1.36 to 1.62 ($\bar{X}$ = 1.51, s = 0.10, n = 6). Epifrons with appressed scales overlapping, elongate scales claviform, decumbent, dark; medial and lateral carinae evident. Dorsal carina arched over antennal insertions. Lateral area of antennal insertions with thick setae and appressed scales. **Antennae**. Scape when in repose reaching hind margin of eye; covered with appressed scales and setae. Funcular segments loosely articulated; segments 1 and 2 clavate, subequal, 1.4 times longer than segment 3; segment 3 clavate, 1.3 times longer than segment 4; segments 4 to 7 clavate, subequal. **Head**. Eyes ovate. **Pronotum**. Length 1.67 mm to 1.90 mm ($\bar{X}$ = 1.78 mm, s = 0.08, n = 6), width 1.75 mm to 2.00 mm ($\bar{X}$ = 1.88 mm, s = 0.11, n = 6), length/width ratio 0.85 to 1.03 ($\bar{X}$ = 0.95, s = 0.07, n = 6); widest in anterior 1/3, lateral margins evenly curved in anterior 3/4, subparallel in posterior 1/4 (Figure 40). Anterior margin entire, posterior margin evenly curved. Disc topography evenly convex, occasionally with slight postero-lateral depressions; appressed scales tessellate, domed; elongate scales setiform, semi-erect to decumbent, neutral. Postocular lobes moderately developed. Anterior transverse groove weak beyond level with ventral margin of eye. Posterior transverse groove poorly developed. Lateral posterior margin with obtuse inflection 1/3 of the way down. **Elytra**. Length 3.29 mm to 3.91 mm ($\bar{X}$ = 3.70 mm, s = 0.24, n = 6), width 2.11 mm to 2.85 mm ($\bar{X}$ = 2.52 mm, s = 0.32, n = 6), length/width ratio 1.35 to 1.66 ($\bar{X}$ = 1.48, s = 0.11, n = 6). Anterior margin curved posteriad, humeral angles rounded. Appressed scales narrowly overlapping. Elongate scales claviform, decumbent, largely neutral on disc, pale laterally and posteriorly. Striae moderately impressed; interstriae flat. Elytral apex square in males, ventrally produced in females. **Thoracic ventrites**. Mesoventral process truncate. Metaventrite densely clothed with appressed scales. **Abdomen**. Ventrites densely clothed with inner vestiture composed almost exclusively of appressed scales. Apex broadly rounded. Males with ventrite 1 slightly depressed medially, ventrite 5 shallowly concave. Female with ventrite 1 flat, ventrite 5 with medial furrow. **Legs**. Metafemora with posterior face entirely scaled. Metatibiae with corbel present, narrow, bare; ventral margin of tibial apex entire; males with long, silky hairs on distal half. **Male genitalia**. Figures 79, 80. Penis with apex acute; dorsal plate narrowed medially. Endophallus long, reaching to temonal apex; possessing numerous large, toothed proximal sclerites; aggonoporial sclerite with short anterior lobes and long posterior lobes. **Female genitalia**. Figures 81–84. Sternite 8 with blade elongate. Styli elongate. Vagina not sclerotised. Bursa copulatrix long, two large triangular sclerites present. Spermatheca slender; ramus slightly produced, divergent with corpus. **DNA Sequences:** No DNA sequences obtained.



FIGURES 79–84. Genitalia of *Irenimus thoracicus*. 79, penis, dorsal view; 80, aedeagus, lateral view; 81, tergite 8, dorsal view; 82, ovipositor, dorsal view; 83, ovipositor and spermatheca, lateral view; 84, sternite 8, ventral view. Scale bars = 0.5 mm; 79, 80 at same scale; 81–84 at same scale.

Type material examined. Holotype. Male (NZAC). Specimen entire, mounted on card triangle. Labelled 'Oamaru / 3.3.65 / J. Richards / Ryegrass' [handwritten, white card], '*Irenimus* taxonomy / and systematics / SDJ Brown / PhD Thesis 2012–2015 / IRE6259' [printed, off-white card], 'NZ Arthropod / Collection, NZAC / Private Bag 92170 / AUCKLAND / New Zealand' [printed, yellow card], 'HOLOTYPE / *Irenimus* / *thoracicus* / Brown 2016' [printed, red card].

Paratypes. A total of 12 specimens (5 males, 7 females) designated as paratypes, bearing blue paratype label. Paratype specimens deposited in BMNH, LUNZ, NZAC.

DN: Oamaru [-45.0888, 170.9808, A], 3 Mar 1965, Richards J, Ryegrass (BMNH: 2, LUNZ: 2, NZAC: 8).

Distribution. South Island:—/ DN /—(Figure 85).

DN: Oamaru.

Elevational range. Label data: no elevation data recorded. Georeferenced data: 7 m to 7 m ($\bar{X}$ = 7 m, s = 0, n = 13).

Etymology. The species epithet refers to this species' distinctive pronotal shape.

Biology. This species is only known from specimens taken in a single collecting event from ryegrass (*Lolium perenne* L.).

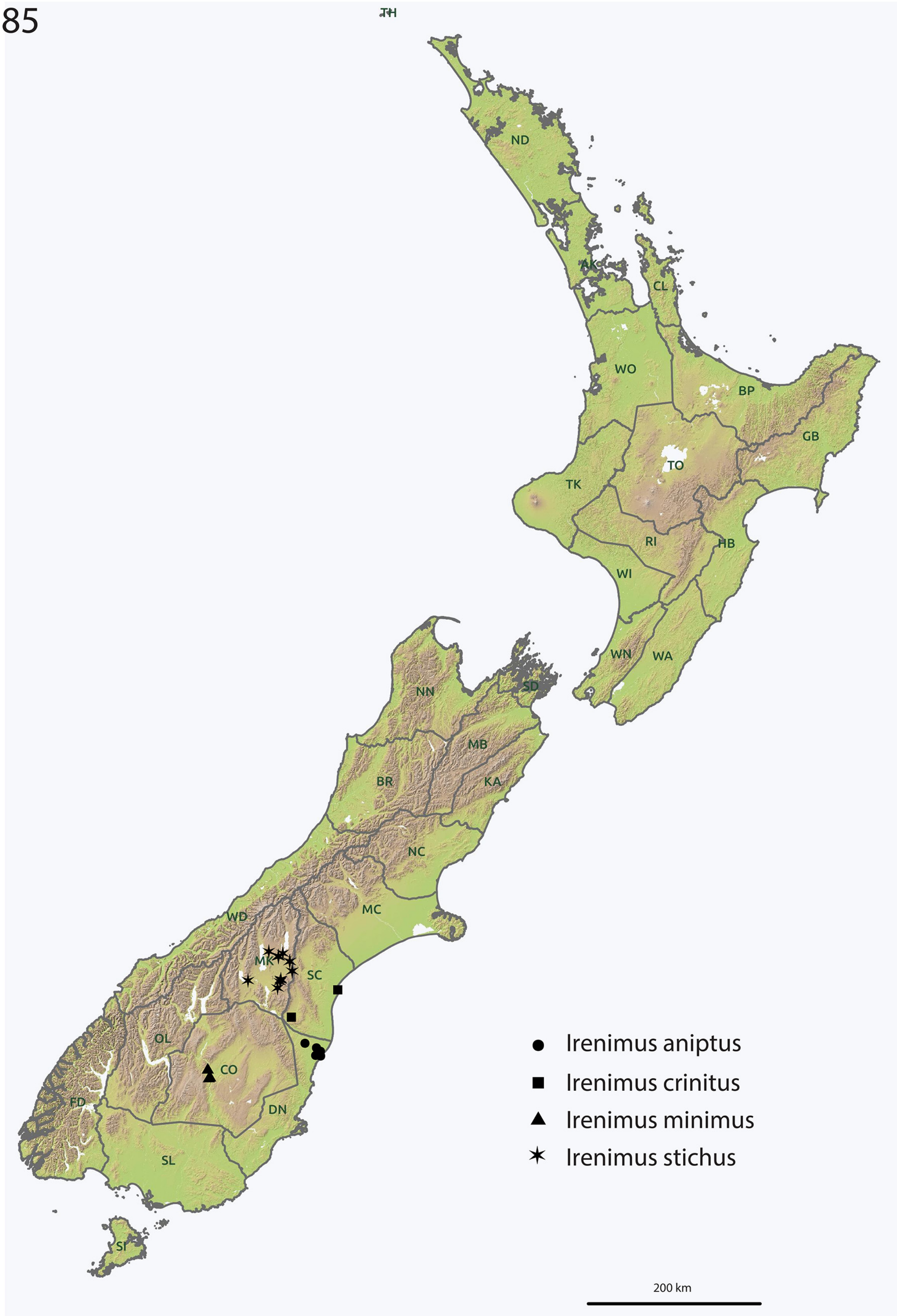


FIGURE 85. Distributions of *Irenimus aniptus* (circles), *I. crinitus* (squares), *I. minimus* (triangles) and *I. stichus* (stars).

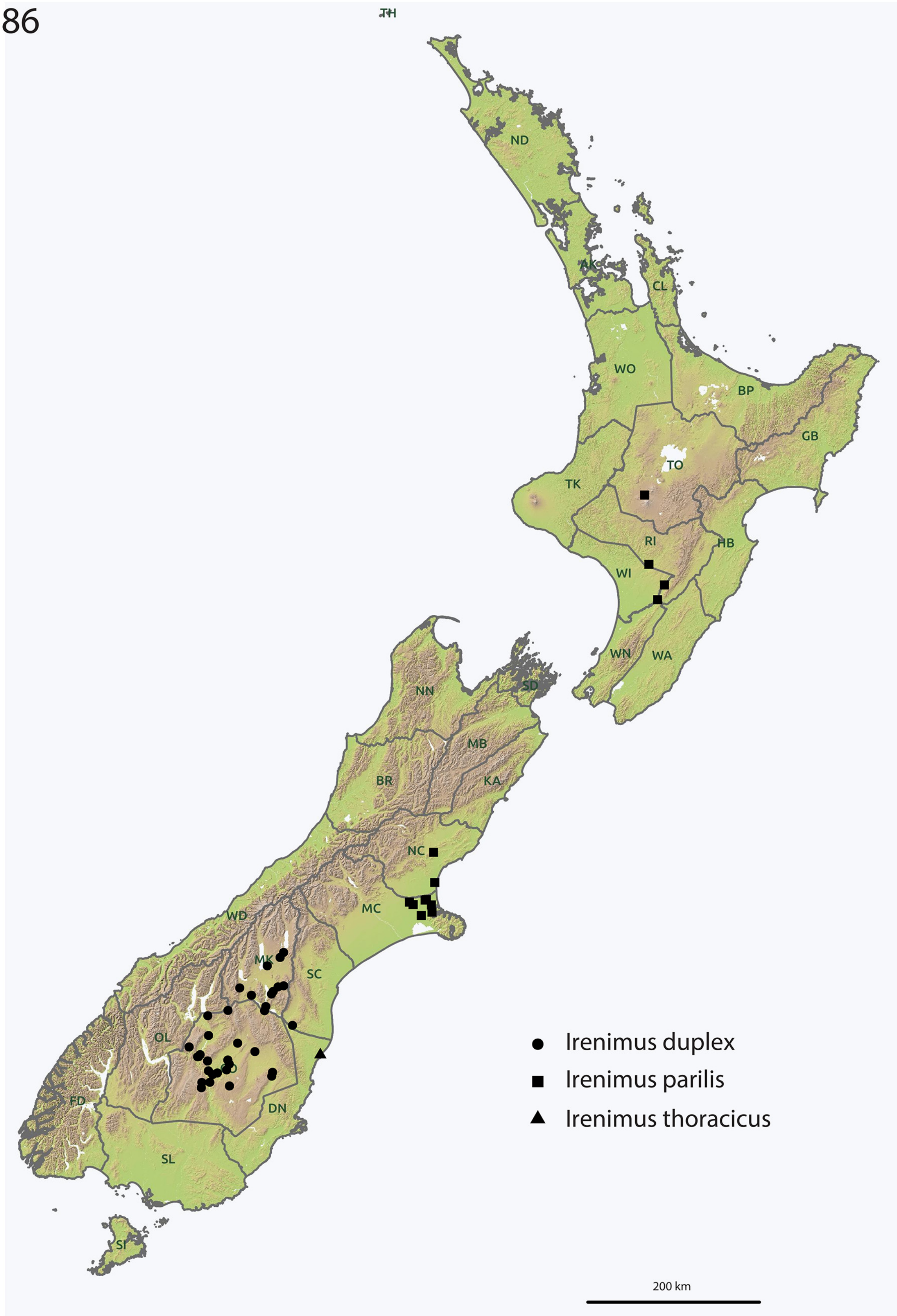
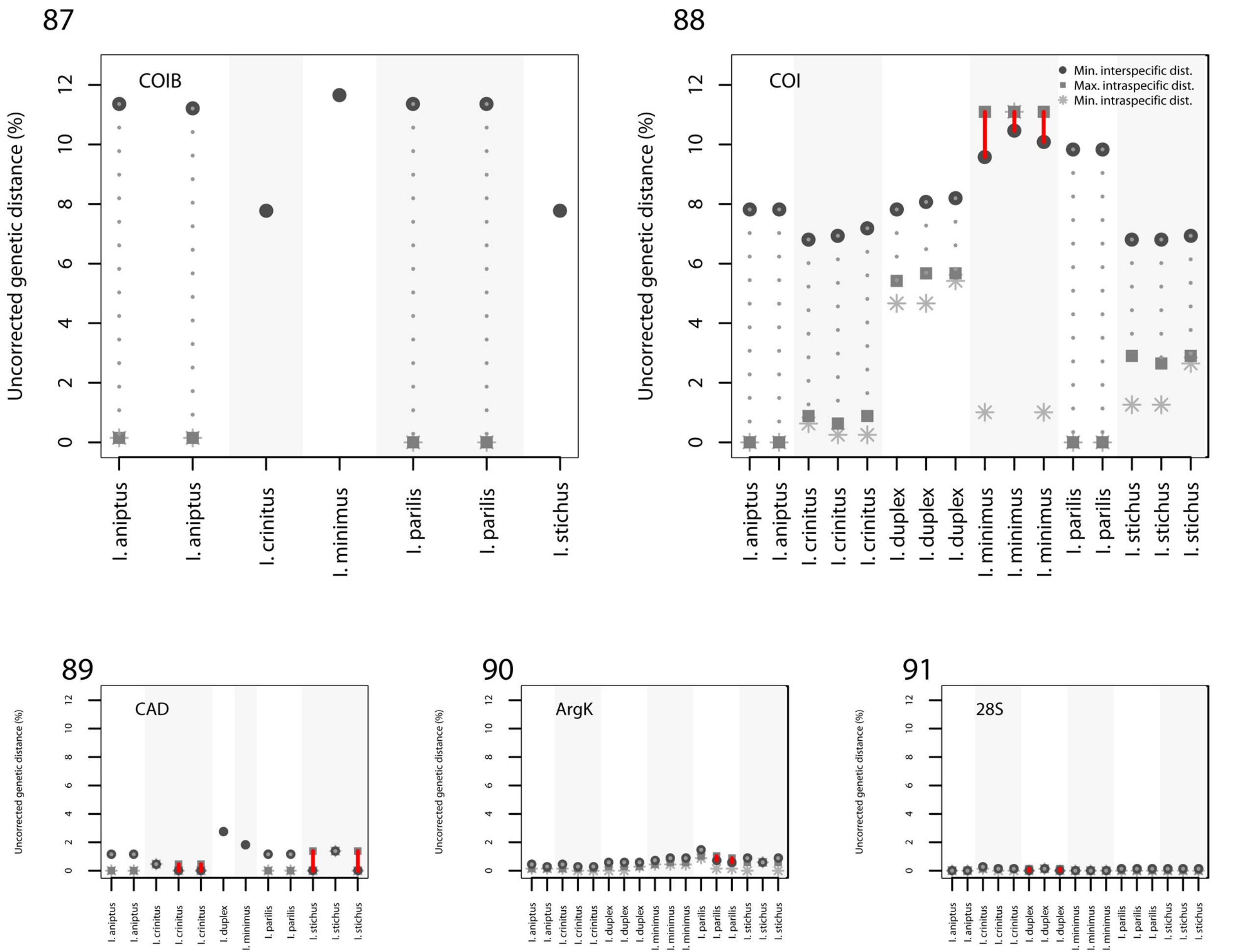


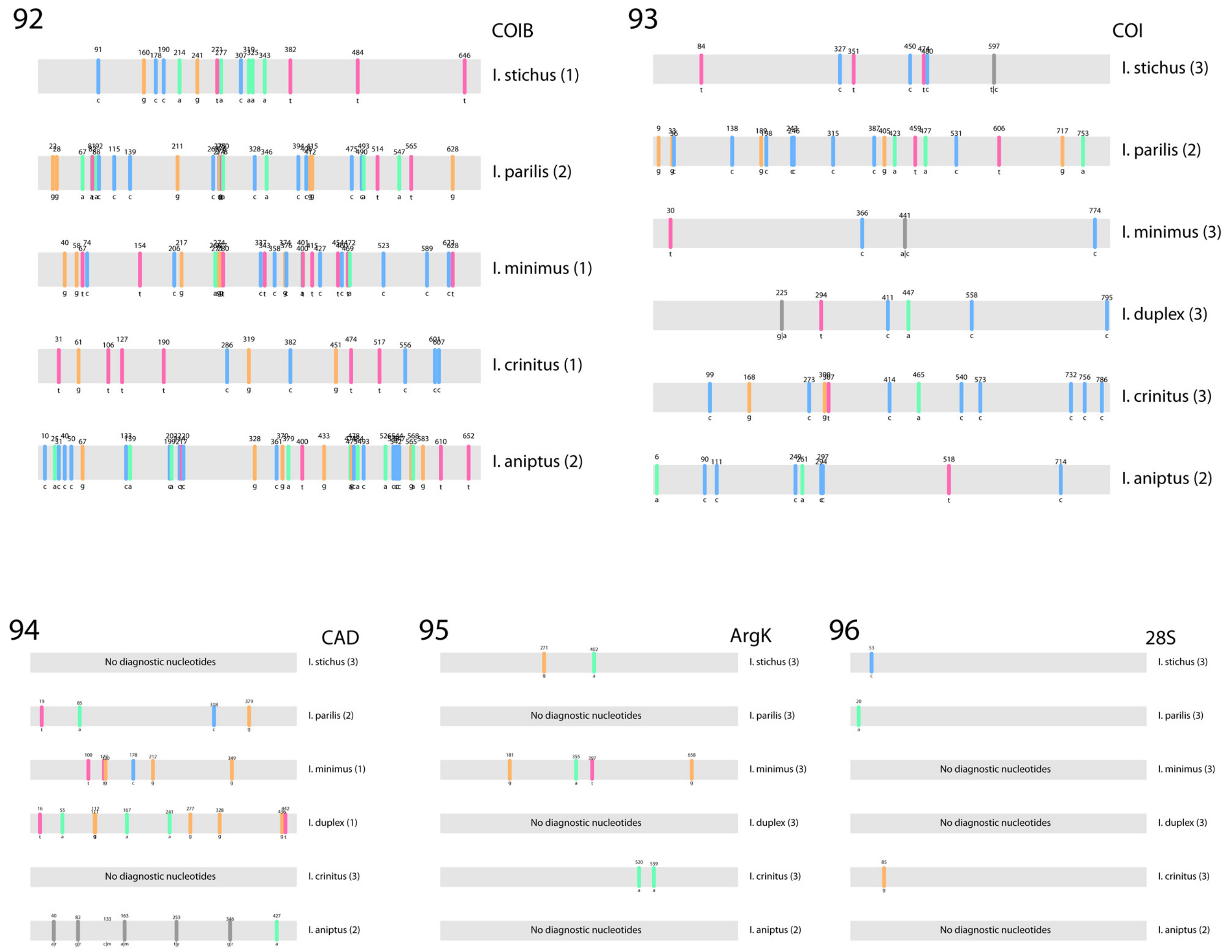
FIGURE 86. Distributions of *Irenimus duplex* (circles), *I. parilis* (squares) and *I. thoracicus* (triangles).

Molecular diagnostics

Specimens of all species of *Irenimus*, with the exception of *I. thoracicus*, were available for DNA sequencing. All four gene regions were sequenced from all species, though in some cases only a single specimen yielded results for any particular gene. The three protein-coding genes could all be unambiguously aligned, with 28S being the only locus that required alignment gaps. The COI alignment was divided into two regions. The first represented the 5′ region corresponding to the region favoured for DNA barcoding (Hebert *et al.*, 2003) and consisted of 669 bp, beginning at position 1239 of the *Tribolium castaneum* mitochondrial genome KM244661.1. This region proved to be difficult to amplify, but sequences were obtained for all species with the exception of *Irenimus duplex*. The second region, at the 3′ end of the gene, consisted of 799 bp beginning at position 1909 of the same *T. castaneum* mitochondrial genome sequence. The 28S alignment was 756 bp long, beginning at position 1121 of the *Tenebrio* sp. reference sequence AY210843.1 (Gillespie *et al.*, 2004). The ArgK alignment was 681 bp long, beginning at position 419 of the *Tribolium castaneum* reference sequence XM_966707.4. The CAD alignment was 460 bp long, beginning at position 2082 of the *Tribolium castaneum* reference sequence XM_967097.3. Alignments in FASTA format and analysis scripts are available on FigShare (https://doi.org/10.6084/m9.figshare.4600645).



FIGURES 87–91. Summary of the genetic variation within the *Irenimus* specimens sampled. Light grey stars: minimum intra-specific distance. Medium grey squares: maximum intra-specific distance. Dark grey circles: minimum inter-specific distance. Grey dotted lines connecting points indicate that the maximum intra-specific distance is less than the minimum inter-specific distance. Red solid lines indicate the reverse. 87, the 5′ ("barcoding") region of the COI mitochondrial protein-coding gene; 88, the 3′ region of COI; 89, CAD nuclear protein-coding gene; 90, ArgK nuclear protein-coding gene; 91, 28S nuclear ribosomal RNA gene.



FIGURES 92–96. Diagnostic nucleotides within the *Irenimus* specimens sampled. Numbers above the bars indicate the position of the diagnostic base within the alignment. Numbers in parentheses beside species names indicate the numbers of specimens included in the alignment. Letters below the bars and the colour of the vertical bar indicate the value of the diagnostic nucleotide. 92, the 5′ ("barcoding") region of the COI mitochondrial protein-coding gene; 93, the 3′ region of COI; 94, CAD nuclear protein-coding gene; 95, ArgK nuclear protein-coding gene; 96, 28S nuclear ribosomal RNA gene.

Genetic variation existed in all gene regions, with COI having the greatest amount of variation, followed by CAD and ArgK, and with 28S displaying the least variation (Figures 87–91). Of the genes sampled here, COI had the greatest genetic variation, as expected (Lin & Danforth, 2004).

COI is the most suitable gene for identifying specimens of most of the taxa considered here. Using the 3′ end of COI, all species can be unambiguously differentiated from other species within the dataset, with the exception of *I. minimus*. Three species, *I. aniptus*, *I. crinitus* and *I. parilis*, have particularly low amounts of intraspecific variation (0–1%), which can be ascribed to all specimens of these species being from single collecting localities. The large amount of variation in *I. duplex* point to potentially significant population structuring in this flightless species that exhibits a wide distribution. Too few specimens are available from the 5′ COI region to allow strong conclusions, however the level of variation is, if anything, greater than in the 3′ end. CAD is unable to separate *I. crinitus* and *I. stichus* but is suitable for the other species sampled. The surprisingly large amount of variation in the ArgK sequences of *I. parilis* makes some inter-specific distances shorter than intra-specific distances, however, even in these cases the nearest neighbour is conspecific. 28S is unsuitable for specimen identification, due to the large number of zero inter-specific distances within the dataset.

The large amount of COI variation in *I. minimus* is surprising. While two specimens are as little as 1% distant from each other, the third is over 10% distant from the other specimens and closer to *I. duplex* than to conspecific sequences. This discrepancy is limited to COI, with intra-specific distances in ArgK being comparable to those in other species. This species was sampled from three localities close to Alexandra, a locality which is known for presenting intriguing cases of genetic variation (Vink *et al.*, 2003; Trewick, 2008; Dowle *et al.*, 2014).

The same pattern of variation in each gene region was observed when the number of diagnostic nucleotides were calculated (Figures 92–96). All species can be diagnosed using COI, with the number of nucleotides ranging between 4 and 16, with a median of 8. Some species had no diagnostic nucleotides in the other three gene regions. 28S presented the least number of diagnostic nucleotides for species that had them. *Irenimus minimus* had diagnostic nucleotides in all gene regions except for 28S. Randomisation tests showed that all gene regions had a significantly higher mean number of diagnostic sites than expected through random assignment.

Changes in the concept of *Irenimus* Pascoe

Changing concepts of the composition of biological taxa are an inevitable consequence of increased knowledge of the organisms involved (Hitchcock, 1921). The importance of the type concept in biological nomenclature lies in their being an anchor for the taxon concept. Although the bounds of a taxonomic concept may vary to a greater or lesser extent, it should always include, by definition, the type specimen or species, thus fixing its position. One of the roles of the taxonomist is to track these changes in taxonomic concept, and to ensure they remain tethered to their relevant types.

In this section, the notation ‘sec.’ is used to denote particular taxonomic concepts, following the recommendation of Franz *et al.* (2015). EULER/X input files giving the articulations for the taxon concept alignments presented in Figures 97–99 are available on FigShare (https://doi.org/10.6084/m9.figshare.4600645).

Catoptes sec. Schönherr

Schönherr (1842) described *Catoptes*, based on *Catoptes obliquesignatus* Boheman, 1842. This was the first entimine weevil genus described from New Zealand.

Irenimus sec. Pascoe

Pascoe (1876) established *Irenimus*, containing a single species, *I. parilis* Pascoe, 1876. *Irenimus* sec. Pascoe excludes *Catoptes* sec. Schönherr.

Catoptes sec. Broun

Broun (1880) described *Catoptes compressus*, which was followed by a further 35 nominal taxa described between 1881 and 1921. Broun, being distant from the entomological collections of Europe, had only the published descriptions on which to base his concepts of previously described species and genera. It is therefore understandable, if no less unfortunate, that Broun’s concept of *Catoptes* did not accord with that of Schönherr (Kuschel, 1969). It appears that Broun based his understanding of *Catoptes* on Lacordaire (1863), and had not seen Schönherr’s original description. *Catoptes* sec. Broun excludes *Catoptes* sec. Schönherr.

Irenimus sec. Broun 1886

Broun (1886) described four species in *Irenimus* Pascoe. He later (Broun, 1910) accepted the synonymy with *Catoptes* proposed by Sharp (1886), though he did not formally combine these species with *Catoptes*. *Irenimus* sec. Broun 1886 is included in *Catoptes* sec. Broun.

Catoptes sec. Sharp

Sharp (1886) described three species in *Catoptes*, and discussed the differences between *Catoptes* and *Irenimus*, synonymising the two genera. This synonymy was based on a mistaken conclusion that Lacordaire (1863) erred in placing *Catoptes* in a group lacking ocular lobes. *Catoptes* sec. Sharp is consistent with *Catoptes* sec. Broun, but excludes *Catoptes* Schönherr.

97

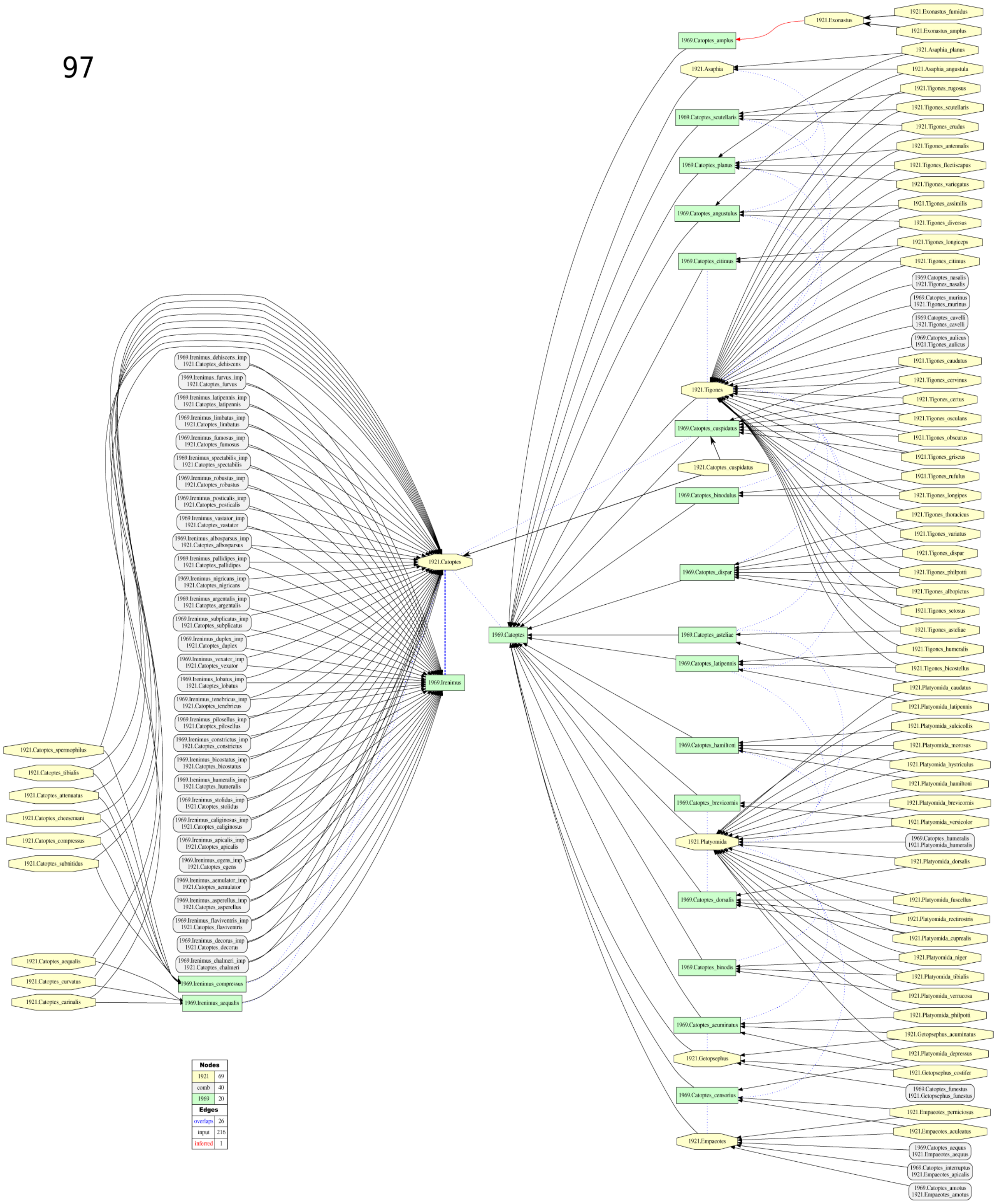


FIGURE 97. Taxonomic concept alignment showing the relationship between *Catoptes* sec. Broun and *Irenimus* sec. Kuschel. Yellow octagons: concepts unique to Broun. Green rectangles: concepts unique to Kuschel. Grey rounded rectangles: congruent concepts shared between the two authors. Solid black, arrowed lines: inclusion relationships between concepts. Thick blue dashed lines: strongly overlapping concepts. Thin blue dotted lines: narrowly overlapping concepts. Suffix "_imp" show taxa not formally combined with *Irenimus* by Kuschel (1969), but which were strongly implied.

98

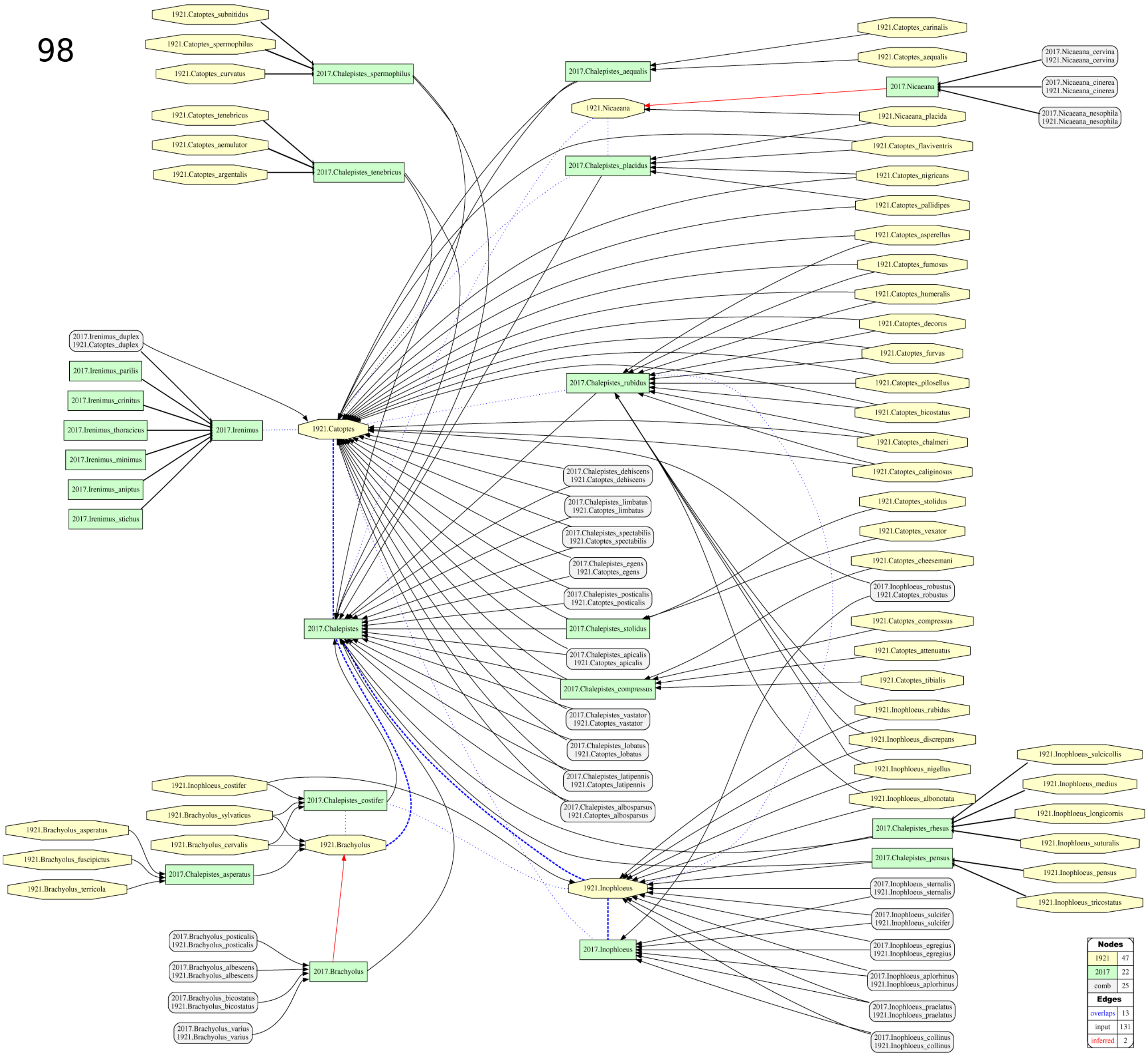


FIGURE 98. Taxonomic concept alignment showing the relationship between *Catoptes* sec. Broun and *Chalepistes* sec. Brown. Yellow octagons: concepts unique to Broun. Green rectangles: concepts unique to Brown. Grey rounded rectangles: congruent concepts shared between the two authors. Solid black, arrowed lines: inclusion relationships between concepts. Thick blue dashed lines: strongly overlapping concepts. Thin blue dotted lines: narrowly overlapping concepts.

Catoptes sec. Marshall

Marshall (1931) described three species in *Catoptes*, but did not propose any changes to previously described species. Examination of the type specimens by the present author reveals that these three species belong to three different genera (see below). *Catoptes* sec. Marshall overlaps *Catoptes* sec. Broun, *Nicaeana* sec. Broun and *Protolobus* sec. Sharp.

Catoptes sec. Kuschel

Kuschel (1969), upon studying the type specimen of *Catoptes obliquesignatus* Boheman, ascertained that the name *Catoptes* had been misapplied by Broun, Sharp and Marshall. That is, the species described in *Catoptes* by these authors were not congeneric with *C. obliquesignatus*. *Catoptes* sec. Kuschel includes *Catoptes* sec. Schönherr and *Exonastus*, *Asaphia*, *Tigones*, *Platyomida*, *Getopsephus* and *Empaeotes* (all sec. Broun) (Figure 97). This concept of *Catoptes* is accepted by the present author, and no modifications are made here.

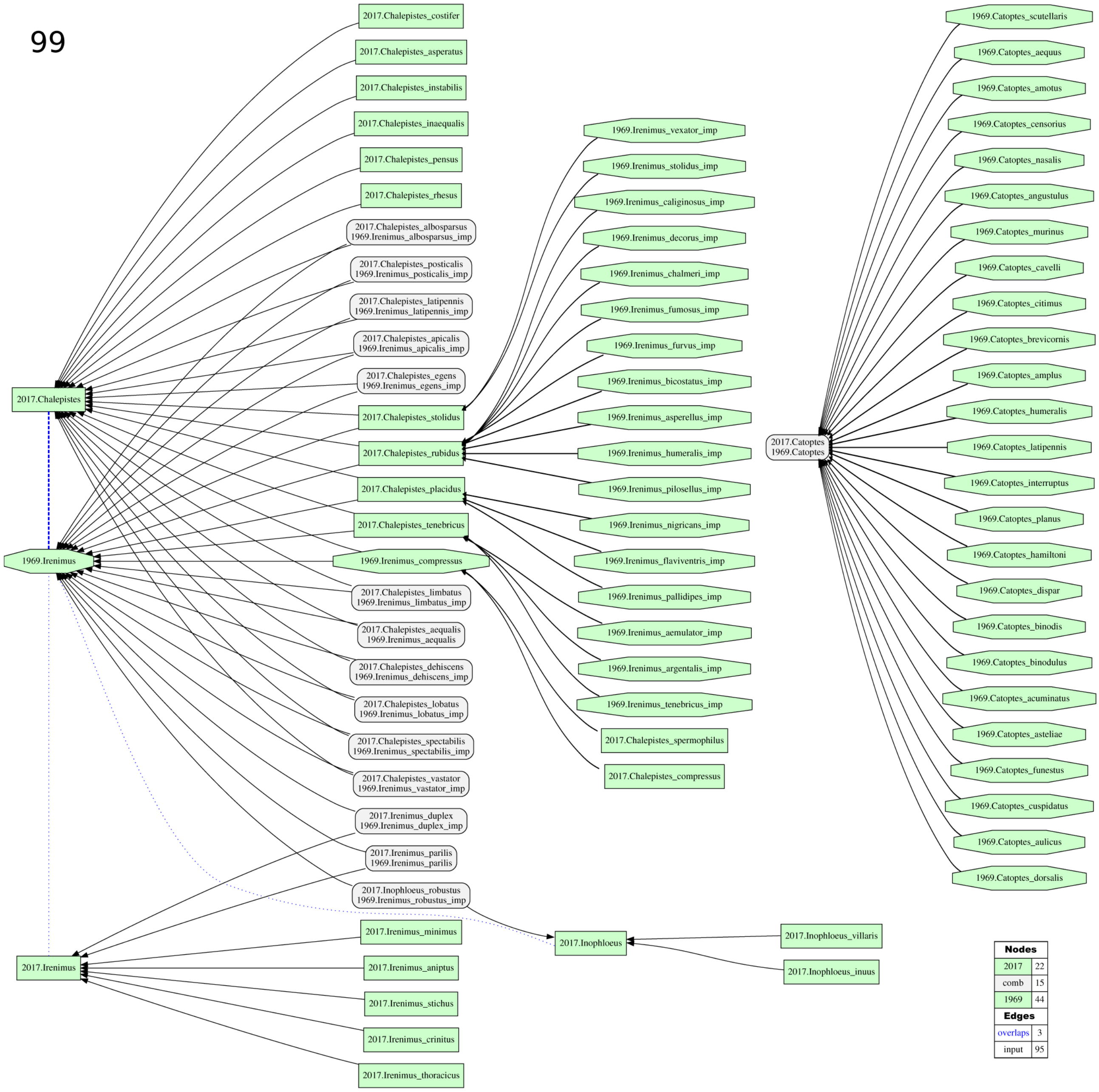


FIGURE 99. Taxonomic concept alignment showing the relationship between *Irenimus* sec. Kuschel and *Chalepistes* sec. Brown. Green octagons: concepts unique to Kuschel. Green rectangles: concepts unique to Brown. Grey rounded rectangles: congruent concepts shared between the two authors. Solid black, arrowed lines: inclusion relationships between concepts. Thick blue dashed lines: strongly overlapping concepts. Thin blue dotted lines: narrowly overlapping concepts. Suffix "_imp" show taxa not formally combined with *Irenimus* by Kuschel (1969), but which were strongly implied.

Irenimus sec. Kuschel

Kuschel (1969) formally combined nine nominal taxa in *Irenimus*, but implied that all species described in *Catoptes* to that point should be included in *Irenimus*, pending further study. *Irenimus* sec. Kuschel is congruent (with a single exception, *Catoptes cuspidatus* Broun) to *Catoptes* sec. Broun.

In a subsequent paper, Barratt & Kuschel (1996) described four additional species in *Irenimus*. This expanded, but was consistent with, the concept of *Irenimus* sec. Kuschel (1969).

Irenimus sec. Brown

The narrow concept of *Irenimus* sec. Brown presented in this paper includes only two previously described species—the type species *I. parilis* Pascoe and *I. duplex* (Broun)—with the result that *Irenimus* sec. Brown overlaps with *Catoptes* sec. Broun and *Irenimus* sec. Kuschel by only these two species (Figures 98 & 99). *Irenimus* sec. Brown includes *Irenimus* sec. Pascoe.

***Chalepistes* sec. Brown**

Chalepistes sec. Brown strongly overlaps *Catoptes* sec. Broun (Figure 98), with only a few taxa of the former that are not included in the latter. *Chalepistes* sec. Brown is a broader concept, however, with some species of *Inophloeus*, *Brachyolus* and *Nicaeana* (all sec. Broun) also included within *Chalepistes* sec. Brown (Figure 98). Similarly, *Chalepistes* sec. Brown overlaps strongly with *Irenimus* sec. Kuschel (Figure 99).

Chalepistes Brown, new genus

Type species: *Catoptes compressus* Broun, 1880:429, here designated. Gender: masculine.

Diagnosis. Integument densely clothed with appressed and elongate scales, appressed scales generally discrete. Rostrum short and stout, less than two times longer than wide. Epistome indistinctly differentiated from frons by sculptural differences. Frons with sparse setae, unscaled. Scrobes lateral. Ventral head curvature angulate. Eyes flat. Ocular lobes present, occasionally inconspicuous. Metanepisternal sutures absent. Posterior face of metafemora usually with large bare area proximally and sharp demarcation between this and the scaled area in the distal 1/4. Metatibiae with apex simple or with narrow, bare corbel; apical comb arcuate (Figure 34). Penis with dorsal membrane unsclerotised.

Differential diagnosis. *Chalepistes* is very similar to *Irenimus* and the comparisons between *Catoptes*, *Inophloeus villaris*, *Haplolobus* and *Nicaeana* in the differental diagnosis to *Irenimus* given above apply also to *Chalepistes*. Although the complete absence of metanepisternal sutures in *Chalepistes* readily distinguishes the genus from *Protolobus*, the extremely narrow metanepisternum of the latter makes this character difficult to use in practice. The combination of small size (< 3.5 mm), densely scaled posterior face of the metatibiae, barely separable elytral appressed scales, a scape densely clothed with large appressed scales and a densely scaled frons will distinguish *Protolobus* species from *Chalepistes*.

Description. Body length ranging from 2.5 mm to 9.5 mm. Densely covered with scales on all surfaces, appressed scales usually obvious, discrete, round, ribbed; but with variations in the degree of separability, size and sculpture. **Rostrum**. Subparallel proximally, abruptly widened at antennal insertions. Epistome plurisetose, slightly raised above frons but separation indistinct. Epifrons lacking sulci; continuous with occiput, without distinct dorsal separation between head and rostrum. **Antennae**. Sockets dorsolateral, sited in apical 1/3 of rostrum. Scape clavate, reaching to or exceeding the middle of the eye; clothed with setae and occasionally with small, inconspicuous appressed scales. Funicular segments clavate, subspherical or oblately spheroid, moderately to loosely articulated, segment 7 almost as wide as club. Club two times longer than wide, tapering apically. **Head**. Width of vertex between eyes greater than width of rostrum. Eyes large, lateral, flat, ovate to subcircular with long axis vertical, parallel with sagittal axis. Ventral curvature of head and rostrum angulate, approximately 90°. **Pronotum**. Disc topography variable, usually smooth, evenly convex. Postocular lobes poorly to well developed, vibrissae present. **Elytra**. Approximately parallel-sided in anterior 2/3. Elongate scales arising from interstriae. Elytral declivity rounded or angulate. Interstriae variably formed into tubercles above the elytral declivity, usually more pronounced in females; interstria 3 most frequently tuberculate, but tubercles can also be formed on the elytral suture and on interstria 5. Ventral margin sinuous, highest point around level of metacoxae. **Thorax**. Procoxae contiguous. Prosternum visible behind procoxae as a raised tubercle. Metaventrite with medial suture visible only as a small, circular fovea posteriorly. **Abdomen**. Ventrites 1 and 2 fused, ventrites 3 to 5 free. Ventrite 1 and 2 subequal in length at midpoint; ventrites 3 and 4 subequal in length, approximately 0.5 times length of ventrites 1 and 2; ventrite 5 approximately equal in length to ventrites 1 and 2. Suture separating ventrites 1 and 2 curved anteriorly at midpoint, other sutures straight. Males usually with ventrite 1 depressed to a greater or lesser extent, ventrites 4 and 5 simple. Females with ventrite 1 flat; the posterior margin of ventrite 4 usually entire, sometimes produced into a lamina that covers ventrite 5; disc of ventrite 5 often modified with swellings, tubercles or furrows. **Wings**. Absent. **Legs**. Uniformly and densely covered with appressed scales and setae, except for the posterior surface of the metafemora. Femora unarmed, maximum depth around distal 1/4. Tibiae with indistinct denticles along ventral margin of protibiae, mesotibiae and occasionally metatibiae; mucrones present on protibiae and mesotibiae, occasionally on the metatibiae in males; protibiae wider in distal 1/3 than proximal 1/3, incurved at apex; apical comb arcuate, with pale setae; corbel present or absent, narrow, bare or covered with scales. Tarsi with long, coarse setae on dorsal surface, without appressed scales; underside with short, dense setae forming pads. Claws simple, separate, diverging. **Male genitalia**. Penis tubular, strongly curved; lateral lobes usually separated dorsally, occasionally fused; dorsal membrane unsclerotised; temones longer than penis. Endophallus moderate in length, usually reaching anterior 1/3 of temones when in repose; armed with large aggonoporial sclerite, other sclerites variably present. Tegmen with ring complete; parameroid lobes well-developed; manubrium shorter than temones. **Female genitalia**. Sternite 8 with spiculum ventrale over 2.5 times as long as blade. Gonocoxite divided into two parts; proximal gonocoxite around 2.7 times longer than distal gonocoxite, largely unsclerotised except for strongly sclerotised rod; distal gonocoxite lightly sclerotised. Bursal sclerites usually present, numbering either 2 or 4.

Distribution. Found throughout New Zealand, with most species found occurring south of Canterbury.

Etymology. Derived from the Greek *chalepos*, 'difficult, troublesome', and the suffix *-pistes*, denoting agency, together forming 'trouble bringer' in reference to the convoluted taxonomic history of the genus.

Remarks. *Chalepistes* has few clear apomorphies not shared by other genera. The lack of metanepisternal sutures is the clearest external apomorphy uniting the members of the genus; however, this loss is frequently seen in apterous weevils and is an unreliable character for inferring higher relationships. The strongly demarked unscaled region on the metafemora also appears to be an apomorphic character, however this is not shared by all species of the genus.

Descriptions, type details, new species and a key to the species of *Chalepistes* will be the subject of a forthcoming monograph. In the interim, the following combinations and synonyms are proposed.

1. *Chalepistes aequalis* (Broun, 1895) new combination
Catoptes aequalis Broun, 1895:407
Irenimus aequalis (Broun); Kuschel, 1969:805, Barratt *et al.*, 1998:56
Catoptes carinalis Broun, 1914:207 (Synonymy by Kuschel, 1969:805)

2. *Chalepistes albosparsus* (Broun, 1917) new combination
Catoptes albosparsus Broun, 1917:415
Irenimus albosparsus (Broun); Barratt *et al.*, 1998:57

3. *Chalepistes apicalis* (Broun, 1923) new combination
Catoptes apicalis Broun, 1923:691

4. *Chalepistes asperatus* (Broun, 1914) new combination
Brachyolus asperatus Broun, 1914:209
Brachyolus fuscipictus Broun, 1914:210 **new synonym**
Brachyolus terricola Broun, 1917:417 **new synonym**

The type specimen of *B. asperatus* is a male, while those of *B. fuscipictus* and *B. terricola* are females. Many of the characters that Broun used to separate the nominal taxa (including elytral breadth and convexity of the elytral disc) are sexually dimorphic in this species. The type specimen of *B. fuscipictus* is a more abraded specimen than the type of *B. terricola*.

5. *Chalepistes compressus* (Broun, 1880) new combination (Figure 34)
Catoptes compressus Broun, 1880:429
Irenimus compressus (Broun); Kuschel, 1969:800
Catoptes attenuatus Broun, 1883:430 (Synonymy by Kuschel, 1969:800)
Catoptes cheesemani Broun, 1893b:1191 (Synonymy by Kuschel, 1969:800)
Irenimus tibialis Broun, 1886:854 (Synonymy by Kuschel, 1969:800)

6. *Chalepistes costifer* (Broun, 1886) new combination
Inophloeus costifer Broun, 1886:932
Brachyolus cervalis Broun, 1903:74 **new synonym**
Brachyolus sylvaticus Broun, 1910:61 **new synonym**

Although Broun did not offer any explicit details as to how these three nominal taxa differed from each other, the differences displayed in the type specimens is no greater than that of normal variation in the species. The type specimen of *B. cervalis* is a female, which is substantially broader than the male type specimens of the other two species.

7. *Chalepistes curvus* (Barratt & Kuschel, 1996) new combination
Irenimus curvus Barratt & Kuschel, 1996:363

8. *Chalepistes dehiscens* (Broun, 1917) new combination
Catoptes dehiscens Broun, 1917:413

9. *Chalepistes dugdalei* (Barratt & Kuschel, 1996) new combination
Irenimus dugdalei Barratt & Kuschel, 1996:368

10. *Chalepistes egens* (Broun, 1904) new combination
Catoptes egens Broun, 1904:109
Irenimus egens (Broun); Barratt *et al.*, 1998:57

11. *Chalepistes inaequalis* (Sharp, 1886) new combination
Brachyolus inaequalis Sharp, 1886:424

12. *Chalepistes instabilis* (Marshall, 1931) new combination
Catoptes instabilis Marshall, 1931:419
Catoptes instabilis var. *vittiger* Marshall, 1931:419

13. *Chalepistes latipennis* (Broun, 1893) new combination
Catoptes latipennis Broun, 1893b:1362
Catoptes latipennis Broun, 1893, non (Broun, 1917); Macfarlane *et al.*, 2011:435

According to Article 59.2 of the International Code of Zoological Nomenclature (ICZN, 1999), removal of this taxon from *Catoptes* makes a replacement name for *Platyomida latipennis* Broun, 1917 unnecessary, despite the secondary homonymy caused by the placement of the latter taxon into *Catoptes* by Kuschel (1969).

14. *Chalepistes limbatus* (Broun, 1909) new combination
Catoptes limbatus Broun, 1909:60

15. *Chalepistes lobatus* (Broun, 1921) new combination
Catoptes lobatus Broun, 1921:626

16. *Chalepistes patricki* (Barratt & Kuschel, 1996) new combination
Irenimus patricki Barratt & Kuschel, 1996:369

17. *Chalepistes pensus* (Broun, 1914) new combination
Inophloeus pensus Broun, 1914:212
Inophloeus tricostatus Broun, 1915:328 **new synonym**

The holotype of *I. pensus* is fully clothed while the holotype of *I. tricostatus* is severely abraded. The other character that Broun uses to distinguish *I. tricostatus* is the more developed rostral carinae, which is a variable character in many species of *Chalepistes*.

18. ***Chalepistes placidus*** **(Broun, 1914) new combination**

Nicaeana placida Broun, 1914:201

Catoptes pallidipes Broun, 1917:415 **new synonym**

Catoptes flaviventris Broun, 1917:416 **new synonym**

Catoptes nigricans Broun, 1917:416 **new synonym**

The type specimens of *C. pallidipes*, *C. flaviventris* and *C. nigricans* were collected on the same date and from the same locality. The types of the latter two species are teneral and abraded specimens, respectively.

19. ***Chalepistes posticalis*** **(Broun, 1893) new combination**

Catoptes posticalis Broun, 1893b:1189

Irenimus posticalis (Broun); Barratt & Kuschel, 1996:366

20. ***Chalepistes rhesus*** **(Pascoe, 1875) new combination**

Inophloeus rhesus Pascoe, 1875:220

Inophloeus longicornis Broun, 1904:113 **new synonym**

Inophloeus medius Broun, 1893a:294 **new synonym**

Inophloeus sulcicollis Broun, 1914:213 **new synonym**

Inophloeus suturalis Broun, 1893b:1464 **new synonym**

Broun considered that his nominal taxa differed from each other and from *I. rhesus* by size, breadth, rostral carinae, the degree to which the pronotal disc was uneven, and the prolongation of the sutural tubercle. These characters are all variable between individuals; and breadth and a prolonged sutural tubercle are sexual differences.

21. ***Chalepistes rubidus*** **(Broun, 1881) new combination**

Inophloeus rubidus Broun, 1881:699

Inophloeus albonotata Broun, 1893b:1201 **new synonym**

Catoptes asperellus Broun, 1893b:1191 **new synonym**

Irenimus bicostatus Broun, 1886:853 **new synonym**

Catoptes caliginosus Broun, 1893b:1189 **new synonym**

Catoptes chalmeri Broun, 1893b:1190 **new synonym**

Catoptes decorus Broun, 1893b:1192 **new synonym**

Inophloeus discrepans Broun, 1904:112 **new synonym**

Catoptes fumosus Broun, 1914:208 **new synonym**

Catoptes furvus Broun, 1893b:1362 **new synonym**

Catoptes humeralis Broun, 1893b:1190 **new synonym**

Catoptes humeralis Broun, 1893, non (Broun, 1910); Macfarlane *et al.*, 2011:435

Catoptes longulus Sharp, 1886:424 **new synonym**

Inophloeus nigellus Broun, 1881:700 **new synonym**

Irenimus pilosellus Broun, 1886:853 **new synonym**

Catoptes scutellaris Sharp, 1886:423 **new synonym**

Catoptes scutellaris Sharp, 1886 non (Broun, 1893); Macfarlane *et al.*, 2011:435

This large number of synonyms reflects the very different body shape between males and females, and the variation present in the distinct sexually dimorphic characters. Males are elongate, with long silky setae on the venter and are generally the type specimens of the nominal taxa placed in *Catoptes*. Females are broad, lack the ventral setae, and have the elytral apex produced posteroventrally. They usually are the type specimens of the nominal taxa described in *Inophloeus*.

22. ***Chalepistes similis*** **(Barratt & Kuschel, 1996) new combination**

Irenimus similis Barratt & Kuschel, 1996:365

23. ***Chalepistes spectabilis*** **(Broun, 1914) new combination**

Catoptes spectabilis Broun, 1914:205

24. *Chalepistes spermophilus* (Broun, 1895) new combination

Catoptes spermophilus Broun, 1895:405 (Synonymised with *Irenimus compressus* by Kuschel, 1969:800)

Catoptes subnitidus Broun, 1914:206 (Synonymised with *Irenimus compressus* by Kuschel, 1969:800)

Catoptes curvatus Broun, 1914:206 (Synonymised with *Irenimus aequalis* by Kuschel, 1969:805)

This species is removed from synonymy with the externally similar *C. compressus* on the basis of clear aedeagal characters and genetic differences. The apex of the penis in *C. compressus* is sagittate (Kuschel, 1969: Figure 11), while the apex of the penis in *C. spermophilus* is broadly rounded.

25. *Chalepistes stolidus* (Broun, 1886) new combination

Irenimus stolidus Broun, 1886:854

Catoptes brevicornis Sharp, 1886:422 **new synonym**

Catoptes brevicornis Sharp, 1886, non (Broun, 1904); Macfarlane *et al.*, 2011:434

Catoptes vexator Broun, 1904:108 **new synonym**

Irenimus vexator (Broun); Barratt *et al.*, 1998:58

The type specimen of *I. stolidus* is a male which has been slightly abraded, while the type specimens of *C. brevicornis* and *C. vexator* are both females and agree well with each other.

Priority for the name *C. stolidus* is established, as Broun (1886) was published in April 1886, while Sharp (1886) was published in Nov 1886 (Alonso-Zarazaga & Lyal, 1999).

26. *Chalepistes tenebricus* (Broun, 1893) new combination

Catoptes tenebricus Broun, 1893b:1194

Catoptes aemulator Broun, 1893b:1193 **new synonym**

Irenimus aemulator (Broun); Barratt & Kuschel, 1996:372, Barratt *et al.*, 1998:56

Catoptes argentalis Broun, 1914:208 **new synonym**

Although *C. aemulator* has been used as a valid name previously, *C. tenebricus* is chosen as the senior name, as the holotype of *C. aemulator* is a teneral specimen and critical characters are not fully developed. The vestiture of *C. argentalis* is quite different in colour, shape and appearance from that of *C. tenebricus*; however no clear structural characters exist to reliably separate the two.

27. *Chalepistes vastator* (Broun, 1893) new combination

Catoptes vastator Broun, 1893b:1463

Irenimus vastator (Broun); Barratt & Kuschel, 1996:365

Other combinations

The following species were described in *Catoptes*, but examination of the type specimens involved reveal that they neither belong in *Catoptes* as currently delimited (Kuschel, 1969), nor in *Chalepistes*. The following nomenclatural acts are proposed here to ensure clarity around the composition of *Catoptes*.

***Inophloeus robustus* (Broun, 1917) new combination**

Catoptes robustus Broun, 1917:414

Catoptes 'robustus Broun, 1917', non (Sharp, 1886); Macfarlane *et al.*, 2011:435

Inophloeus Pascoe, 1875 is a composite genus, as currently defined. However it is outside the scope of this paper to fully resolve the difficulties posed by the group. This species is congeneric with *Inophloeus villaris* Pascoe, 1875 and so it is placed within *Inophloeus* until such a time as the whole group is fully revised. This species is found in the Canterbury mountains, especially around Mt Hutt.

According to Article 59.2 of the International Code of Zoological Nomenclature (ICZN, 1999), removal of this taxon from *Catoptes* prevents it from requiring a replacement name, despite the secondary homonymy caused by the placement of *Tigones robustus* Sharp, 1886, into *Catoptes* by Kuschel (1969).

***Nicaeana fraudator* (Marshall, 1931) new combination**

Catoptes fraudator Marshall, 1931:419

Catoptes fraudator Marshall; Macfarlane *et al.*, 2011:435

Nicaeana fraudator (Marshall); Barratt *et al.*, 1998:59

This species belongs in *Nicaeana* as shown by the broad rostrum that widens proximally, the lack of ocular lobes, and the acute mucrones on the protibiae. It was originally combined with *Nicaeana* by Barratt *et al.* (1998), however this was overlooked by Macfarlane *et al.* (2011). The species-level taxonomy of *Nicaeana* is in great need of revision.

***Protolobus obscurus* Sharp, 1886**

Protolobus obscurus Sharp, 1886:422

Catoptes postrectus Marshall, 1931:420 **new synonym**

The form of the scales on the dorsum, the heavily scaled gena ventral of the antennal insertions and the broad triangular tooth at the apex of the protibia place *Catoptes postrectus* in *Protolobus*. The synonymy with *P. obscurus* is established based on overall similarity between the type specimens of the two taxa, the differences between which are encompassed within the level of variation from a series of specimens collected near Oamaru, the type locality of *C. postrectus*.

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