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Ko te Aitanga Pepeke o Aotearoa

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'FAUNA OF NEW ZEALAND'

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Antarctoperlinae
(Insecta: Plecoptera)

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Foreword

It is now ten years since the *Fauna* series began. Twenty-six volumes have been published, and the series has a well deserved reputation for excellence, both nationally and internationally.

The *Fauna* series is evolving as an accumulative descriptive index of New Zealand's insects, mites, and other terrestrial invertebrates. It has indeed proved to be a stimulus for co-operative research between systematists in New Zealand and overseas.

The *Fauna* is largely based upon the New Zealand Arthropod Collection (NZAC), the most comprehensive holding of New Zealand arthropod material in the world. This collection is part of our national heritage, and is one of the collections that came to Landcare Research as a strategic national asset. The majority of New Zealand's research in systematics is now in Landcare, and we have an outstanding opportunity to integrate research on the systematics of our native flora and fauna with research into its ecology, conservation, and sustainable management.

The *Fauna* now has an added Maori dimension, with a popular summary in each volume in Maori as well as English. This is in keeping with Landcare's desire to work closely with the Maori community, particularly in research on natural environment.

Biosystematics in New Zealand in Landcare has some funding problems at present, and this appears to be part of a worldwide problem. It is my desire to see a strong, balanced effort in invertebrate biosystematics continue within the Institute. I see the *Fauna* series as a vital part of invertebrate biosystematics research and of the transfer of key information from the NZAC.

The series has set very high standards for itself, and I wish the *Fauna* every success in the future.

*Andy Pearce, Chief Executive*
The Antarctoperlinae are a group of stoneflies found only in New Zealand and southern South America. In the classification system of Western science New Zealand has thirty-two species, comprising five in genus Vesicaperla and twenty-seven in Zelandobius. Vesicaperla species are found only in the South Island, but Zelandobius species are represented throughout New Zealand except in the subantarctic islands.

The juvenile forms (nymphs) are markedly different in habitat preference. Nymphs of Zelandobius are found only in streams and rivers, where they feed on detritus and algae. In contrast, Vesicaperla nymphs are terrestrial, living in cool, humid microclimates deep in alpine vegetation. They feed on the outer layers of dead plant material and the hyphae (thread-like strands) and spores (fruiting bodies) of fungi that grow on it.

Nymphs grow and moult several times before finally emerging as soft-bodied adults. These have two pairs of wings in most Zelandobius species, but wings are missing in all but one of the Vesicaperla species. Adult females live for only a few weeks, feeding on plant material and mating before depositing eggs.

Nymphs and adults of *Vesicaperla* species have developed distinctive dark and pale colour patterns for camouflage in their predominantly tussock grass habitats. When disturbed they resort to behavioural adaptations, common among plant-dwelling insects, such as imitating part of a plant by extending their limbs and antennae and swaying gently.

*Zelandobius* adults are small to medium-sized insects, rather drab except when the wings are spread to reveal their dark and pale colour pattern. The wings are used for flight, but normally these insects prefer to run in order to escape trouble.

Anglers tie trout flies (artificial lures) to represent stoneflies, but there is no specific pattern assigned to *Zelandobius*, which is unknown in New Zealand trout fishing literature despite its importance as a food source for native and introduced fishes. Some species, by their presence or absence, are useful indicators of water quality.

Some of the larger stoneflies can be identified with the naked eye, but most identification must be done using a stereoscopic microscope to check features of the wings, body, legs, and genitalia (reproductive structures).

**Contributor Ian McLellan** retired twelve years ago as Head of Science at Buller High School in Westport. He became involved in aquatic entomology at age forty, and has worked intensely in this field ever since, more than tripling the number of named species of New Zealand stoneflies. He has also added twenty new species to the Australian fauna, and described the first two species from the Falkland Islands. In Diptera (two-winged flies) he has produced a revision of the *Thaumaleidae*. Ian has twice been a guest worker at the Max Planck Institute for Limnology, Germany, and has received a number of research and travel grants.

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**Illustration:** *Zelandobius confusus*, nymph. Artist: I.D. McLellan.

**Whakaahua:** *Zelandobius confusus*, tuungoungou. Toihanga: IDM.
ABSTRACT

Vesicaperla and Zelandobius, the two New Zealand genera in Antarctoperlinae, are revised. There is little new information on the five species of Vesicaperla, but in Zelandobius twenty-one new species are added, bringing the total to twenty-seven. Information is given on habitats, distribution, phylogeny, and systematics in the subfamily. Keys to species in each genus are given. Drawings are included of genitalia, wings, and other parts of diagnostic value, as well as a number of habitus illustrations. Information and ideas on morphology and copulation are given for Zelandobius. Methods of collecting and preparation of specimens are outlined.

CHECKLIST OF TAXA

Subfamily Antarctoperlinae

Genus Vesicaperla McLellan, 1967

dugdalei McLellan, 1977

eylesi McLellan, 1977

kuscheli McLellan, 1977

Zelandobius Tillyard, 1921

confusus group

alatus new species

albopasciatus new species

brevicauda McLellan, 1977

childi new species

confusus (Hare, 1910)

cordatus new species

dugdalei new species

foxi new species

gibsi new species

illiesi McLellan, 1969

inversus new species

jacksoni new species

kuscheli new species

macburneyi new species

mariae new species

montanus new species

ngaire new species

patricki new species

peglegensis new species

takahe new species

wardi new species

furcillatus group

auratus new species

furcillatus Tillyard, 1923

pilosus Death, 1990

truncus new species

unicolor Tillyard, 1923

uniramus new species

Nomen dubium:

Zelandobius hudsoni (Hare, 1910)

CONTENTS

Acknowledgments ............................................ 7
Introduction .................................................. 8
Systematics ................................................... 8
Biology ....................................................... 8
Morphology (Zelandobius) .................................... 9
Copulation (Zelandobius) .................................... 10
Distribution and ideas on evolution (Zelandobius) .......... 10
Methods and conventions ................................... 11
Keys to Antarctoperlinae .................................. 12
Descriptions (see ‘Checklist of Taxa’) ....................... 14
References ................................................... 35
Illustrations ................................................... 36
Distribution maps ............................................ 49
Taxonomic index ............................................. 65

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INTRODUCTION

Plecoptera or stoneflies are an order of insects with a fossil record dating back about 260 million years. A widespread group, they are found throughout the world except in polar regions. They are soft-bodied, with clearly separated thoracic segments and usually with four wings which are folded straight back and closely applied to the abdomen. The cerci may be long (e.g., Gripopterygidae) or reduced to one segment (e.g., Notonemouridae). A number of species do not have full wings, and may be brachypterous (short-winged) or apterous (wingless).

Nymphs are normally aquatic, and may have filamentous gills, in the form of an anal rosette in Gripopterygidae, or in Austroperlidae as a few beaded filaments on the appendages of the abdominal apex. The Notonemouridae have no gills. Nymphs usually live in cool, running fresh water, but in New Zealand and southern South America some apterous species have terrestrial nymphs living in cool, humid microclimates beneath stones or vegetation in alpine or subantarctic situations. At low altitudes there are winged species with semi-terrestrial nymphs which early in their existence move out of the water to spend the winter under stones of stream floodplains.

New Zealand’s stoneflies belong to four families which have an Austral distribution only, on lands derived from Gondwana fragments (Australia, New Zealand, South America, Falkland Islands, South Africa, Madagascar).

Zwick (1973) divided the Plecoptera into two suborders. The Antarctoperlaria are exclusively Southern Hemisphere stoneflies, whereas the Arctoperlaria are of Northern Hemisphere origin, with two families in the Southern Hemisphere. Notonemouridae are the only family restricted to the south; the Perlidae are widespread in the Northern Hemisphere, and extend to the south through South Africa and South America. New Zealand’s Notonemouridae have recently been revised (McLellan 1991), and there are now 26 species in six genera.

The Antarctoperlaria are divided into two superfamilies: Eusthenioidea, comprising the families Diamphipnoidae (South America, five species) and Eustheniidae (Australia, fourteen species; New Zealand, two species; South America, one species); and Leptoperloidea, which present a less clearcut picture. Zwick divided the Leptoperloidea into Austroperlidae and Gripopterygidae, but took Antarctoperlinae from Gripopterygidae and Crypturoperla from Austroperlidae, and in his phylogenetic diagram shows them between the two families, each next to the family from which it was removed.

The Gripopterygidae (in the sense of Zwick) comprise 127 Australian species, 25 from New Zealand, 22 from South America, and one from the Falkland Islands. As a result of the present revision, the Antarctoperlinae now comprise 32 New Zealand species, 14 from South America, and one from the Falkland Islands. The Austroperlidae have eight Australian species (including Crypturoperla: Michaelis 1988), four from South America, and one from New Zealand.

SYSTEMATICS

The Antarctoperlinae have traditionally been considered part of the Gripopterygidae, but Zwick (1973) places them between Gripopterygidae and Austroperlidae. He found that their abdominal dorsal nerves run above the longitudinal muscle across its entire width, as in Austroperlidae, but that they differ from members of that family in not having tibial spurs. However, Zwick did not establish a valid new status for the group, and it is here retained as a subfamily of Gripopterygidae incertae sedis, after McLellan (1977).

Nymphs of Antarctoperlinae appear to have more affinity with Gripopterygidae because of their anal gill rosettes, so different from the few beaded filamentous gills of Austroperlidae. In Gripopterygidae the abdominal dorsal nerves run part-way across the longitudinal muscle and then through it. Although this is so in Zelandoperlinae, this subfamily differs from the others in having no tibial spurs, like Antarctoperlinae. However, this lack of spurs could probably be from a different line of evolution, for in Zelandoperlinae there is a short apical gap ventrally where the spurs normally are, whereas in Antarctoperlinae there is a row of short spines and no gap.

BIOLOGY

There is a sharp division in habitat between the two genera of Antarctoperlinae in New Zealand. Vesicaperla nymphs are terrestrial, living in the cool, humid microclimates afforded by alpine vegetation. My observations (modified from McLellan 1957) on V. substirpes express this in more detail.

This species was found in alpine herbfields and grasslands where the yearly precipitation exceeds 7000 mm. Most nymphs were concealed in decaying vegetation deep in the tussocks of the alpine snowgrass species Chionochloa flavescens and C. poliens, but thirty-five were found in the skeleton of a red deer (Cervus elaphus) in a mixture of decaying vegetation and what remained of the animal after 2 years of weathering.

The gut contents of nymphs, preserved in the field, consisted of tracheophyte material mixed with fungal hyphae and spores, so it appears that the method of feeding is to
strip the outer layers of dead plant material bearing the fungus. The deer carcass with its residue of ingested plant material would have provided a rich source of fungus and the humid microclimate favoured by the nymphs.

Nymphs were reared in a glass container partly filled with the decaying vegetation in which they were found, and kept cool. They were sluggish, and remained in the same position for some time, usually with the middle part of the abdomen against the substrate, the hind end raised, and the cerci wide apart. When disturbed, both nymphs and adults would extend their antennae and forelegs forwards and the remaining legs and cerci rearwards. This action, together with their dark and pale dorsal and ventral colour patterns, camouflaged them in the vegetation. If touched, or if the vegetation was moved, they would frequently drop and remain extended or assume a relaxed pose for some time. Adults varied this by scurrying rapidly for cover.

Nymphs were not seen in the water which collected in the bottom of the container, and if put in water would immediately climb out.

In contrast the nymphs of Zelandobius are aquatic, though they will clamber out of the water on occasion. From observations in the lower Buller Gorge (BR—NN) I noticed that two common species preferred different types of watercourse. Z. furcillatus I found only in the Buller River, which carries considerable silt when in flood, whereas Z. confusus was found only in tributary streams like Fuchsia Creek, which is not silty when in flood but is stained a humic brown by the surrounding protective forest.

The spiny nymph of Z. illiesi inhabits another type of stream. Again in the lower Buller Gorge, on the Ohikanui terrace, I found nymphs of this species mainly on decaying fronds of a tree fern (Cyathea smithii Hook.f.) in a small stream flowing through mixed podocarp/Nothofagus forest. The substrate is sand, gravel, and some mud, and the stream frequently disappears under the roots of trees. Rainfall is high (>3000 mm per annum, spread throughout the year), and flooding often occurs, so that much dead vegetation is swept into the stream to lodge against obstacles. David Marx (pers. comm.) states that at Lake Poumouli (WA—WN) specimens were found in heavy bush, in a small stream littered with detritus, leaves, and logs. At first glance the spines on this species would seem ideal for detritus to cling to, but the nymphs I have found have not had such material attached to them; however, the spines themselves afford good camouflage.

Another species, Z. pilosus, does use detritus in this way, particularly in its early instars, when the nymph is clothed in long, translucent hairs which in turn are clothed in smaller hairs, giving the animal a shaggy appearance. The hairs trap detritus and make the nymph difficult to see (Death 1990). This is the best studied of the Zelandobius species, so the biological notes in Death (1990) are summarized here. "Nymphs collected in small to medium sized streams in Cass/Porter Heights region of inland Canterbury where they may occur in quite high densities. Although observations were made throughout the year, adults were only found in winter (June—August) when snow may lie for short periods and air temperatures regularly fall below zero. Adults collected from the wild had no particulate material in their guts but fed readily on sugar solution in the laboratory. Nymphs appear to feed predominantly on detritus and periphytic algae although animal remains were found in guts of some late instar nymphs. Females collected in the field laid eggs in batches of 45–156 in petri dishes of water. Some batches were stuck in a jelly-like substance to the bottom of the dish in a coherent mass, 1 layer of eggs deep. Other eggs were laid singly. Eggs hatched synchronously after 6 weeks at 5°C." The adults collected by J.G. Penniket and IDM show that emergence of adults is not restricted to the winter.

The method of camouflage used by the nymph (detritus sticking to long, branched hairs) is not unusual in Australian or Australian Zelandoperlinae. Illies (1963) describes the same in the nymph of Pelurgoperla personata Illies from southern South America. In Zelandoperlinae the early instars of New Zealand's Acroperla spiniger are very hairy and spiny. Nymphs of Notonemouridae also show this adaptation (Illies 1961, 1975, McLellan 1991). In many Zelandobius species mites have sometimes been found attached to the proximal abdominal tergites or their intersegmental membranes. These mites are commonly found on most species of stonefly in all families found in New Zealand. The only mite species named from New Zealand stoneflies is Panisopsis wiselyi Womersley, described from larvæ attached to adults and nymphs of the wingless terrestrial gripopterygid Apteryoperla monoculica Wisely.

**MORPHOLOGY (ZELANDOBIUS)**

Abdomen. The varying age of females examined has caused some problems in their description, because of a change in sclerotisation with age. The head and thorax and their appendages darken as the animal becomes older, but the sclerotisation of the abdomen becomes less as the eggs mature, allowing expansion of the abdomen around the growing mass of eggs. This desclerotisation is widespread, usually affecting all but a pair of bands laterally on tergite 1, all of segment 10, segments 8 and 9 laterally, and sometimes patches on sternites 1–8.
The entire abdomen in males is sclerotised, except on tergite 1 where sclerotisation is restricted to an elliptical band in each lateral half, and on tergites 2–4, where sclerotisation is interrupted by a triangular membranous area tapering to a point posteriorly on tergite 4. This sclerotisation darkens with age, as does the rest of the body.

Male internal genitalia and penis
A lobed penis used in the production of a spermatophore is common to all members of the Antarctoperlaria. This organ is normally invaginated under the subgenital plate, and is evaginated just before copulation. The number of lobes and the general configuration of the evaginated penis differ from family to family. The Eustheniidae have four lobes in two pairs, one pair upper and the other lower. In Austroperlidae there are six, two large ventral lobes on either side and four small, strap-like lobes on the dorsal surface between the ventral lobes.

In Antarctoperlinae the number of lobes appears to vary, and in Zelandobius may be from three to five. Using Z. confusus, I show (Fig. 27–29) the dorsal, ventral, and lateral aspects of the lobes of an evaginated penis from a mated male. In dorsal view all five lobes can be seen, and behind them the lower vasa deferentia, which are joined together and hence much larger in diameter. On either side are the long accessory glands (glue glands), and medially, below the lower vasa deferentia, are the joined seminal vesicles. The genital opening is not in the posterior of the penis, but is a crescent-shaped opening at its ventral base, covered by the semicircular posterior lobe of the subgenital plate (Fig. 28). The hollow penis acts as a genital cavity into which the accessory glands and the seminal vesicles open. The lower vasa deferentia enter the seminal vesicles a short distance before the vesicles’ openings, which are sclerotised and open downwards on either side of the medial dorsal lobe, terminating in a fork.

The testes (Fig. 27) extend from segment 1 (where they are joined, forming a loop) in a double row of 45–48 follicles on either side of the abdomen as far as segment 7.

Female internal genitalia
In Antarctoperlaria, because sperm is transferred in a spermatophore the genital cavity and the attachment of the seminal receptacle differ from the condition in Actoperauria, as described by Zwick (1979). In the internal genitalia of Zelandobius confusus, described and illustrated here (Fig. 30), the genital cavity is reduced and a vestigial seminal receptacle is directly attached to the body wall, opening as a small slit through the dorsal wall of the genital cavity, close to the genital opening. In other species the opening is further back on the intersegmental membrane, and is much larger.

Beneath the subgenital plate is a broad opening into the genital cavity, which narrows slightly in the anterior of segment 8, widens into a common oviduct in the posterior of segment 7, and then branches. Each branch extends forwards down the side of the abdomen in segment 6, then dorsally to segment 1, where the two branches join in a loop. Numerous ovarioles extend around the loop in segment 1 and along either branch as far as segment 5.

COPULATION (ZELANDOBIUS)
Although copulation cannot be fully observed, a good idea of the process can be gained from the condition of mated males and females.

In my illustration of the genitalia of a mated male (Fig. 29) tergite 10 is depressed forwards into the abdomen so that its posterior sclerite, the epiproct, and the paraprocts have been rotated forwards, with the epiproct and paraprocts in line laterally. The penis is evaginated, and the hindgut is empty of food and inflated.

In a mated female the spermatophore is evident (Fig. 31, 32). It is thrust well into the genital cavity, up into the common oviduct, and very frequently has the imprint and shape of the penis on the exposed portion. From these conditions the following account has been deduced.

The male, mounted on the female with his abdomen curved under and the tip level with the female’s subgenital plate, would rotate his genitalia forwards to hook the epiproct and paraprocts into her genital opening. By the pressure of his tergite 10 on her subgenital plate and pulling with epiproct and paraprocts, assisted by the female pushing rearwards, the female’s genital opening would be expanded. Further forward rotation would bring the tip of the male subgenital plate into the expanded opening, with the penis above serving the dual purpose of a seal and a means of squeezing the soft spermatophore through the semicircular male genital opening, down between the penis and subgenital plate, and into the female’s genital cavity.

DISTRIBUTION AND IDEAS ON EVOLUTION (ZELANDOBIUS)
The availability of new material for this study gives a better idea of the distribution of some of the known species. For instance, the type species confusus and also furcillatus have their New Zealand-wide distribution better defined. Also, some species previously thought to be restricted in range have been found further afield.
Z. illiesi had been found only in the lower Buller Gorge, but now I have specimens from elsewhere, in the north of the South Island (BR, NN), and more importantly from the North Island (WN, TO, ND), confirming my 1987 opinion that this species is probably more widespread in forest streams than the records then suggested.

Z. pilosus Death, from the Porter River (MC), is now known from as far afield as BR and MB.

The yellow-winged unicolor has not been found outside the areas shown in McLellan (1990), but many gaps have been filled in.

The remaining earlier-described species, the wingless brevicauda from the Turret Range (FD), has not been found elsewhere. This is probably a collecting artifact.

Of the new species, wardi is restricted to Banks Peninsula (MC). It has a number of similar features to macburneyi and foxi, and these seem to be sister species. Z. wardi probably stems from stock of their common ancestor, isolated on the peninsula during the Pleistocene. It was possibly originally alpine like macburneyi, which is widespread through alpine regions of both islands. Z. wardi may have evolved in the same way that Dumbleton (1963) postulated for the blepharicerid fly Neocurupira chiltoni. He considered that during the Pleistocene its ancestor was carried by wind drift from the Southern Alps over the unsuitable habitat of the developing Canterbury Plains to the ancient volcanic hills of the peninsula. The sister species of this blepharicerid lives in the Southern Alps.

Some of the new species are widespread, like the alpine macburneyi mentioned above. Two are found on both main islands. gibbsi from alpine to lowland habitats and the other, truncus, at low altitudes only. The rest are restricted to the South Island, with some of them widespread. Z. patricki is alpine throughout most of the South Island, and cordatus is subalpine in BR, MC, and FD. Others have been found only in the north of the island (albojasciatus, alpine in western NN and BR). A few have been collected only in restricted areas: jacksoni and pelegensis, subalpine in Arthurs Pass National Park (NC—WD); wardi, on Banks Peninsula; auratus at Alexandra (CO); ngaire, alpine on Ada Pass (MB); inversus and mariae on the Pisa Range (CO); montanus, high alpine on Headlong Peak, Mount Aspiring National Park (OL); and takahe, alpine on the Marchion Mountains and Turret Range (FD).

Some species appear only in the south, like Z. fozi, found on mountains and lowlands of the southern third of the South Island (CO, DN, SL) and on Stewart Island. Z. kuscheli and uniramus are similarly restricted, and alatus and childi are confined to the mountains of CO.

Although the status of wardi is readily explicable, the present-day distributions of many species are difficult to elucidate. They do, however, fit a pattern of species boundaries that many New Zealand workers in botany and zoology have observed, if not always adequately explained.

**METHODS AND CONVENTIONS**

**Collecting.** For adults, collecting in spring through summer is best, although some individuals of Zelandobius appear throughout the year. For *Vesicaperla*, sweeping the palatable species of snowgrass such as *Chionochloa flavescens* and *C. patens* will produce both adults and nymphs. However, it is more productive to search deep in the snowgrass, particularly where it is mixed with shrubs, and also examine any vertebrate remains carefully. Adults of *Zelandobius* may be taken at light or in malaise traps, but sweeping streamside vegetation and examining the hidden intersurface areas of emergent stones in rapids may be more productive. Nymphs may be taken from the same areas on such stones, or from leaf packets and driftwood. Disturbing the substrate into a net placed downstream will catch some species.

**Preparation of specimens.** Adults and nymphs are best collected straight into 70–80% ethanol. They may remain there indefinitely, but it is better to change to fresh ethanol after storing. Isopropyl alcohol (n-butyl alcohol) is just as good, and Pampel’s and FAA fixatives can be used successfully.

Dried pinned specimens cannot be studied adequately, but they can be relaxed by a simple method. Remove labels and put the pinned specimen into 1% trisodium phosphate (Na₃PO₄), sinking it with a drop of detergent. Leave for 24 hours, and the animal should plump up to life size. Leave in the solution for another day if required, but no longer. Wash in water and transfer to alcohol.

Wings may be removed from adults and spread in a little ethanol on a slide, covered with a coverslip, and drawn through a drawing tube. If no such tube is available the wings may be held between two 50 × 22 mm coverslips, fitted into photographic slide mounts, and then projected onto a sheet of paper and drawn.

In most instances genitalia can be studied without special preparation while still attached to the specimen and immersed in alcohol. Nymphs can be studied in the same way. Genitalia and wings in late-instar nymphs may require examination to associate with adults. Usually the genitalia may be seen through the nymphal integument, but may need clearing or dissection. Wings within wingpads should be dissected out and put on a slide in lactic acid for a short time to relax them, so they can be spread out.
Abbreviations. The following abbreviations (after Watt 1979) are used for repositories:

AMNZ Auckland Institute and Museum, Auckland, New Zealand
CMNZ Canterbury Museum, Christchurch, New Zealand
IDMC I.D. McLellan private collection, Westport, New Zealand
LCNZ Lincoln University, Lincoln, Canterbury, New Zealand
MJWC M.J. Winterbourn private collection, University of Canterbury, Christchurch, New Zealand
NZAC New Zealand Arthropod Collection, Mt Albert Research Centre, Auckland, New Zealand
OMNZ Otago Museum, Great King St., Dunedin, New Zealand

The area codes of Crosby et al. (1976) are used to categorise collection data. The full data are available from the author or the publisher.

KEYS TO ANTARCTOPERLINAE KNOWN FROM NEW ZEALAND

(A) Genera: adults and nymphs
1 Wingless or micropterous, with distinct colour pattern on ventral surface; nymphs terrestrial, lacking anal gill rosette ........................................ Vesicaperla —Winged, rarely micropterous, without colour pattern on ventral surface; nymphs aquatic, with anal gill rosette ........................................ Zelandobius

(B) Species of Vesicaperla (adults only)
1 Micropterous ........................................... townsendi —Apterous ........................................... 2

2(1) Male with epiproct hook not distal; female with an ovipositor (obvious also in late-instar nymph) ................. substirpes —Male with epiproct hook distal; female without an ovipositor ........................................ 3

3(2) Pale spot present in centre of abdominal sternal pattern ........................................... eyelesi —Pale spot absent ........................................... 4

4(3) Gena below eye 0.4x as deep as eye; male paraprocts with sharp tips ........................................... kuscheli —Gena below eye 0.2x as deep as eye; male paraprocts with rounded tips ........................................... dugdalei

(C) Species-groups of Zelandobius
Males: Cercus with base of basal sclerite tapered and extending in line with basal segments; confusus group —Cercus with base of basal sclerite crescent-shaped; basal segments extending at an angle to sclerite ....
........................................... furcillatus group

Females: Laterosternal ridges on sternite 8 not prominent; subgenital plate with distinct lateral lobes on posterior margin; subanal lobes broadly tongue-shaped, flat ........................................... confusus group —Laterosternal ridges on sternite 8 prominent; subgenital plate with poorly developed lobes on hind margin or none; subanal lobes narrowly tongue-shaped, thick .. .................................................................. furcillatus group

Nymphs: Hind margin of mesonotum and metanotum deeply re-entrant ........................................... confusus group —Hind margin of mesonotum and metanotum straight ........................................... furcillatus group

(D) Species of confusus group
Males (alatus, jacksoni, kuscheli, and ngaire unknown)
1 Pronotum with anterior angles produced ........... iliesi —Pronotum with anterior angles not produced .......... 2

2(1) Epiproct with 4–7 pairs of marginal teeth ........... 3 —Epiproct with 2 pairs of marginal teeth (some males may have an extra pair of teeth) ........... 5

3(2) Epiproct with 7 pairs of marginal teeth and with tip long and curved .................. patricki —Epiproct with 4 or 5 pairs of marginal teeth .......... 4

4(3) Paraproct with marginal teeth; epiproct tip long, slender ............................... gibbsi —Paraproct without marginal teeth; epiproct tip short, blunt ........................................... montanus

5(2) Epiproct tip bulged ........................................... 6 —Epiproct tip not bulged ........................................... 9

6(5) In dorsal aspect, posterior sclerite of tergite 10 slightly expanded or not, with apical bulge of epiproct heart-shaped .................. foxi —In dorsal aspect, posterior sclerite of tergite 10 expanded ........................................... 7

7(6) In dorsal aspect, epiproct apical bulge oval, and posterior sclerite of tergite 10 heart-shaped .... cordatus
—Epiproct apical bulge triangular, and posterior sclerite of tergite 10 not heart-shaped ........................................ 8

8(7) Paraproct with dorsal margin bulged below apical spine, almost as high as spine; tergite 10 posterior sclerite oval in dorsal aspect ..................... wardi
—Paraproct with little or no bulge on dorsal margin below apical spine; tergite 10 posterior sclerite not oval .......................................................... macburneyi

9(5) Paraproct with a bulge on dorsal margin below apical spine ................................................................. 10
—Paraproct without a bulge .................................................. 13

10(9) Epiproct with dorsal midline raised above lateral margins ............................................................... inversus
—Epiproct with dorsal midline below lateral margins 11

11(10) Membranous cone much wider than long mariae
—Membranous cone much longer than wide ........... 12

12(11) Epiproct tip long, slender ......................... takahe
—Epiproct tip short, rounded ......................... dugdalei

13(9) Posterior sclerite of tergite 10 long, with tip upturned and a slender constriction near base ............ 14
—Posterior sclerite of tergite 10 not thus .............. 15

14(13) Epiproct tip long, well tapered, curved; paraproct with a large, curved apical spine .......... peglegensis
—Epiproct tip of moderate length, little tapered, straight; paraproct apical spine short, not curved .... childi

15(13) Posterior sclerite of tergite 10 wedge-shaped in lateral aspect .......................................................... confusus
—Posterior sclerite of tergite 10 round in lateral aspect .............................................................................. albofasciatus

Females (inversus, mariae, and peglegensis unknown)

1 Wingless species ........................................ brevicauda
—Winged species .......................................................... 2

2(1) Pronotum with anterior angles produced .... illesi
—Pronotum with anterior angles not produced ........ 3

3(2) Subgenital plate with colour pattern ............. 4
—Subgenital plate unicolorous .......................... 16

4(3) Subgenital plate with a medial subrectangular dark patch .............................................................. 5
—Subgenital plate without a medial subrectangular dark patch ........................................................................ 6

5(4) Dark subrectangle on subgenital plate containing a white semicircle anteriorly ............................ jacksoni
—Dark subrectangle with a pale, V-shaped incision in anterior margin, and in some specimens also in posterior margin ........................................ macburneyi

6(4) Subgenital plate with a medial V-shaped dark patch, its base truncated, and a white semicircle within the V .......................................................... albofasciatus
—Subgenital plate pattern not thus ......................... 7

7(6) Subgenital plate pattern resembling two commas back-to-back ....................................................... foxi
—Subgenital plate pattern not thus ......................... 8

8(7) Subgenital plate with a pale longitudinal strip .... 9
—Subgenital plate with no pale longitudinal strip .... 12

9(8) Subgenital plate with lobes and sclerotised lateral strips rugulose, and with a bulge on sternite 7 kuscheli
—Subgenital plate with these areas not rugulose, and with no bulge on sternite 7 ................................. 10

10(9) Sternite 9 with a pale triangle based between subgenital plate lobes ........................................... montanus
—Sternite 9 without a pale triangle ........................ 11

11(10) Forewing with a yellow tinge and yellow veins, and with no dark patches around crossveins ... ngaire
—Forewing without yellow tinge and yellow veins, but with dark patches around crossveins .......... takahe

12(8) Subgenital plate with a pale triangular area based on anterior margin .......................................... gibbsi
—Subgenital plate not thus, but with a sclerotised subtriangular area comprising the lobes plus an area tapering from them to middle third of anterior margin .... 13

13(12) Subgenital plate with an almost semicircular pale area based on anterior margin .................... patricki
—Subgenital plate without an anterior pale area .... 14

14(13) Sclerotised subtriangular area of subgenital plate with no posterior pale patch .............................. childi
—Sclerotised subtriangular area of subgenital plate with a posterior pale patch ................................. 15

15(14) Posterior pale patch in subtriangular area shallowly oval, lying across plate for length of medium
incision and just below it, and sometimes with anteriorly directed pointed extensions. **wardi**
- Posterior pale patch in subtriangular area semicircular, based on median incision. **alatus**

16(3) Forewing with no dark patches around crossveins, and with a yellow tinge. **dugdalei**
- Forewing with dark patches around crossveins. 17

17(16) Sternite 9 and middle of sternite 10 membranous. **cordatus**
- Sternites 9 and 10 lightly sclerotised. **confusus**

**Nymphs:** For most species it has been impossible to find characters suited to the construction of a key.

**E) Species of furcillatus group**

**Adults:** 1 Wings with a yellow tinge. **unicolor**
- Wings without a yellow tinge. 2

2(1) Forewings with longitudinal grey bands in most cells, each band over half as wide as cell. 3
- Forewings without grey bands, or with fuscous bands less than 0.4x as wide as cell. 4

3(1) Pronotum golden; female subgenital plate with a dark oval patch. **auratus**
- Pronotum not golden; female subgenital plate without an oval patch. **pilosus**

4(2) Wings without Rs fork. **uniramus**
- Wings with Rs fork. 5

5(4) Males with a long, upturned posterior sclerite; mature females with a sclerotised oval patch along subgenital plate. **furcillatus**
- Males with a short, rounded posterior sclerite which is not upturned; females with a triangular sclerotised patch based on hind margin of subgenital plate. **truncus**

**Nymphs:** 1 Antennae, body, and legs obviously hairy. **pilosus**
- Antennae, body, and legs not thus. 2

2 Posterior margin of mesonotum wider than distance between inner margins of eyes; abdomen ridged on dorsal midline. **unicolor**
- Posterior margin of mesonotum as wide as distance between inner margins of eyes; abdomen not ridged dorsally. 3

3(2) Tracheal trunks in abdomen obscured by integument. **uniramus**
- Tracheal trunks in abdomen clearly visible through integument. **furcillatus / truncus**

(There are no obvious differences between the nymphs of **furcillatus** and **truncus**. Nymph of **auratus** unknown.)

**DESCRIPTIONS**

**Subfamily ANTARCTOPERLINAE**

Type genus *Antarctoperla* Enderlein, 1909.

Abdominal dorsal nerves passing completely over longitudinal muscles. Legs without distoventral spurs. Forewing with or without Rs fork and without Cu1 fork. Hind wing with 6th anal vein free of wing margin. Male genitalia with a small posterior sclerite of tergite 10 either sessile or attached to tergite by a membranous stalk. Female subgenital plate usually simple, rarely produced into an ovipositor. Nymphs (when aquatic) with an anal gill rosette.


**Remarks.** *Antarctoperlinae* is a subfamily *incertae sedis* within Plecoptera, according to McLellan (1977). It is closest to family Gripopterygidae.

**Genus Vesicaperla McLellan**


Type species *Vesicaperla substirpes* McLellan, 1967.


Male genitalia. Epiproct with a posteroven trally projecting hook, which is usually distal, but without a prominent keel; lateral margins lined with small teeth dorsally. Para pods falcate, with membranous inner margins. Posterior
sclerite extending from rear of tergite 10 as a rounded knob. Penis a trilobed membranous structure with a large lobe on either side of a smaller one.

Female genitalia. Subgenital plate usually terminating at end of segment 8 and emarginate medially, rarely produced into a long ovipositor, with intersegmental membrane extended to form its upper surface.

**Nymph** terrestrial, lacking anal gill rosette and hairy fringe on legs, similar in colour pattern to adult. Maxillary palp with distal segment much shorter than in adult. Thoracic spiracles on prominent cones. Mesonotum, metanotum, and first 9 abdominal tergites with a median posterodorsal projection in most species. Subanal lobes usually separated by a triangular vesicle.

**Remarks.** The distinctive colour pattern dorsally and ventrally on the abdomen of both adults and nymphs is useful in distinguishing species. Until recently this was the only genus of Gripopterygidae s.l. known to have ventral abdominal markings. However, McLellan *et al.* (1990) have recorded an antarctoperline from the Falkland Islands with such markings.

**Vesicaperla dugdalei** McLellan

Fig. 7, 11, 16, 17; Map 1


**Dimensions** (mm). Male: length of body 12; antenna 9; cercus 2.5. Female: length of body 13–17; antenna 11; cercus 2.3. Nymph (late instar): length of body 10; antenna 6; cercus 2.5.

**Adult.** Head with gena below eye 0.2× as deep as eye. Thorax without wings or wing vestiges. Abdomen with tergal colour pattern a pale, triangular to hourglass-shaped medial area with a sinuous pale bar on either side. Sternal pattern (Fig. 16) a pair of pale, C-shaped bars, their concavities facing medially on either side of a brown suboval. Sternites 1–7 with an irregular pattern of dark, variably shaped spots. Tergites 6–9 with posterodorsal projections in females only. Cerci down-curved, more so in males.

Male genitalia (Fig. 7, 11). Epiproct with a distal hook, and with 6–8 small teeth on each margin. Paraprocts with slightly expanded rounded tips. Posterior sclerite well rounded.

Female genitalia (Fig. 17). Subgenital plate with medial third of posterior margin projecting slightly onto S9, and with small but distinct lobes medially.

**Nymph (late instar) with same colour pattern as adult. Vesicle absent.**

**Type data.** Holotype male and allotype female: FD, Manapouri, Wilmot Pass, 640 m asl, 21 January 1970, J.S. Dugdale (NZAC).

**Material examined.** Type specimens, plus 8 non-type examples (4 females, 4 nymphs; CMNZ, NZAC).

— / FD.

Adults collected January.

**Remarks.** The adults and nymphs were found in alpine vegetation and leaf litter.

**Vesicaperla eylesi** McLellan

Fig. 14; Map 2
eylesi McLellan, 1977: 142, 144, 145 (initial description and figures of nymph).

**Dimensions** (mm). Nymph: late instar – body length 10–11, antenna 5, cercus 3.5; early instar – body length 4–5.5; antenna 3; cercus 2–2.5.

**Nymph (late instar).** Antenna and cercus respectively 0.6× and 0.4× as long as body. Head with gena below eye half as deep as eye. Maxillary palp with distal segment half as long as penultimate segment. Thorax without wing pads. Abdominal tergal pattern consisting of a pale medial longitudinal bar, somewhat like a narrow inverted triangle, with a pale sigmoid bar on either side; sternal pattern (Fig. 14) a pale bar bordering either side of a dark triangle based on posterior of sternite, and within the triangle a pale, almost triangular patch. Subanal lobes with vesicle between bases poorly developed.

**Type data.** Holotype nymph and 3 paratype nymphs: NN–MB, Richmond Range, Fell Peak Hut area, 1300 m asl, 13 March 1969, A.C. Eyles (NZAC).

**Material examined.** Type specimens only.

— / NN–MB.

Adults unknown.

**Remarks.** Collected in leaf litter in an alpine terrestrial environment.
**Vesicaperla kuscheli** McLellan

Fig. 1, 8, 12, 15, 18; Map 3


Dimensions (mm). Male (Fig. 1): length of body 18; antenna 12; cercus 3. Nymph (late instar): length of body 12; antenna 6; cercus 3.

**Adult.** Head with gena below eye 0.4× as deep as eye. Thorax without wings or wing vestiges. Abdominal tergal pattern a pale, concave-sided subtriangle along midline, with slightly laterad a pale stripe following each concavity; sternal pattern (Fig. 15) a pair of pale, converging longitudinal bars surrounding a dark, sagittate patch based on posterior margin of sternite.

Male genitalia (Fig. 8, 12). Epiproct with a distal hook, and with about 11 small teeth on each lateral margin. Paraprocts with sharp tips. Tergite 10 with posterior sclerite tapered to a rounded, upcurved tip. A membranous bulge between cercus and paraproct. Cerci heavily clothed with fine hairs, each about as long as its segment of origin.

Female genitalia (Fig. 18; from nymph). Subgenital plate with a posteriorly directed ovipositor extending beyond tip of abdomen; ovipositor with lower surface sclerotised, cymbiform, upper surface flat and terminating before tip of lower surface to form a triangular opening. Cerci comprising about 25 segments.

Nymph (late instar) with same colour patterns as adult. Antennae and cerci respectively 0.5× and 0.3× as long as body. Vesicle weakly developed.

**Type data.** Holotype male and 2 paratype nymphs: NN, NW Nelson, Mt Domett, camp site, 1250 m asl, 1 December 1971, G. Kuschel (NZAC).

Material examined. Type specimens only.

Remarks. The type material was found in alpine vegetation, the usual habitat for the terrestrial nymphs of this genus.

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**Vesicaperla substirpes** McLellan

Fig. 2, 9, 13, 16, 19; Map 4


Dimensions (mm). Male: length of body 13.2; antenna 8; cercus 1.9. Female (Fig. 2): length of body 11–13; antenna 5.5–8; cercus 2.5–3. Nymph (final instar): length of body 11–13; antenna 5.5–8; cercus 4–6.

**Adult.** Head with gena below eye 0.42–0.55× as deep as eye. Thorax without wings or wing vestiges. Abdominal tergal colour pattern a pale medial stripe outlined in reddish brown and flanked by a pale irregular bar, with a small, reddish-brown triangle situated medially within pale stripe and based on anterior margin of tergite; sternal colour pattern (Fig. 16) reddish brown posteriorly and medially, flanked by a pale triangle on either side and with a pale medial spot. Coloration in both imaginal and nymphal females darker than in males.

Male genitalia (Fig. 9, 13). Epiproct with ventral hook not distal, but arising some distance down ventral keel; margins each with about 5 or 6 small teeth; tip slightly bifurcate. Paraprocts with tip bulged, blunt; basal inner margin with a row of short bristles. Tergite 10 posterior selerite a bulbous protrusion sunk into a circular depression at rear of tergite. Cerci comprising about 30 segments, heavily clothed with long, pale hairs on inner margin for about 0.8 of its length.

Female genitalia (Fig. 19). Subgenital plate produced into a posteriorly directed ovipositor extending beyond tip of abdomen; ovipositor with lower surface sclerotised, cymbiform, upper surface flat and terminating before tip of lower surface to form a triangular opening. Cerci comprising about 25 segments.

Nymph similar in general colour and shape to adult, but with the following differences. Maxillary palp with distal segment shorter, rounder. Tarsal segment 2 shorter, ending obliquely. Developing ovipositor and male subgenital plate very obvious. Sternites distal to developing subgenital plate with 3 small, membranous spots. Anal gill rosette absent, but a membranous bulge present between T10 and subanal lobes, and a triangular bladder between bases of subanal lobes. Cerci longer.

**Type data.** Holotype female: BR, Victoria Range, Duffy Creek Saddle (42°15'S, 172°04'E), 1036–1118 m asl, 22 December 1964, I.D. McLellan (CMNZ). Paratypes: 29 nymphs, same data as holotype; 1 male, 7 females, ex nymphs from type locality, 30 October 1965, reared IDM (all CMNZ).

Material examined. Type specimens, plus 9 non-type examples (2 males, 4 females, 4 nymphs).

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Remarks. *V. substirpes* is the only New Zealand ant-
arctoperline with an ovipositor. Only one other gripoterygid has such a prolongation of the subgenital plate: Teutoperla auberti Illies, from Chile. Illies (1965) refers to the structure as a subgenital plate, gives no detailed description of it, and does not mention the word ovipositor.

Vesicaperla townsendi McLellan

Fig. 10, 16, 20; Map 5

townsendi McLellan, 1977: 142, 144 (initial description of female, nymph, and male genitalia from nymphi).

Dimensions (mm). Female: length of body 18–21.5; antenna 13–15; cercus 2.5–3; forewing 1–1.5. Nymph (male, late instar): length of body 14; antenna 8; cercus 2.5; fore wingpad 0.8.

Adult. Head with gena below eye 0.42× as deep as eye. Wings vestigial. Abdomen with tergal colour pattern a pale, inverted triangular area medially and a sinuous pale bar on either side; sternal colour pattern (Fig. 16) a medial pale triangle with a pale, dumbbell-shaped patch on either side. Some tergites with a medial posterodorsal projection.

Male genitalia (Fig. 10; from nymph). Epiproct with an apically bifurcate distal hook, and with about 8 small teeth on each lateral margin. Paraproct tips slightly expanded. Tergite 10 with posterior sclerite clavate.

Female genitalia (Fig. 20). Subgenital plate emarginate over genital aperture.


Type data. Holotype female and paratype nymph: WD, Westland National Park, Franz Josef, Glacier Road at start of Alex Knob Track, 200 m asl, 12 November 1968, J.I. Townsend (NZAC).

Material examined. Type material, plus 1 non-type female from Alex Knob, Westland National Park.

Remarks. The type material was collected from ferns (mainly Blechnum capense sensu Allan) on a roadside cutting at 200 m asl, the lowest altitude from which any Vesicaperla has been recorded. The non-type female collected on Alex Knob is from a site more usual for this genus, i.e., alpine grassland and herbfield, with Chionochloa oreophila and C. pallens abundant. Annual precipitation at the type locality is about 5000 mm, and at the upper site could reach 10 000 mm (Wardle 1979).

Genus Zelandobius Tillyard

Zelandobius Tillyard, 1921: 43.

Type species Leptoperla confusa Hare, 1910.

Adult. Small to medium-sized stoneflies with or without wings. Ocelli present. Distal segment of maxillary palp about twice as long as penultimate segment. Rs with a terminal fork in all wings (Fig. 21). Hind wing with fusion of M$_3$ and Cu$_1$ incomplete distally. Thoracic spiracles not on cones. Lateral tergal ridge evident on abdomen. Ceri short, usually comprising no more than 15 segments.

Male genitalia (Fig. 23, 24). Epiproct hastate in plan, with a ventral hook and usually with a pair of teeth on each margin (Fig. 35); sides normally sloping up from midline; ventrally, at base of epiproct, a dark, usually globular sclerotised mass. Paraproct tips slightly expanded. Tergite 10 with posterior sclerite clavate.

Female genitalia. Subgenital plate (S8) sometimes produced into a pair of short lateral lobes with a medial concavity between them (Fig. 85).

Nymph (Fig. 4) without a hairy fringe on legs. Maxillary palp with distal segment about twice as long as penultimate segment. Segment 10 of abdomen usually long, sometimes bulged basally. Subanal lobes tongue-shaped. Anal gill rosette well developed but incapable of pulsation. Ceri sturdy or thread-like, less than half as long as body.

Species included: brevicauda McLellan, confusa (Hare), furcillatus Tillyard, illiesi McLellan, pilosus Death, unicolor Tillyard, and the following new species: alatus, abrofusus, auratus, chiloi, cordatus, dugdalei, foxi, gibbsi, inversus, jacksoni, kuschelii, macburnei, matsui, montanus, ngaire, oviced, peglegensis, takahe, truncus, uniramus, wardi.

The genus is here divided into two species-groups, the confusa group and the furcillatus group.
CONFUSUS GROUP
Distal crossveins in forewing (Fig. 21) surrounded by dark ovals which usually are coalesced, forming 3 or 4 irregular dark bands across wing.

Male genitalia. Cercus with basal segments extending directly in line with its basal sclerite, which is tapered towards its lowest point (Fig. 23).

Female genitalia. Subgenital plate (Fig. 85) covering most of ventral surface of segment, with laterosternal ridges not prominent in ventral aspect; hind margin of plate with a pair of distinct lateral lobes. Subanal lobes broadly tongue-shaped, lamelliform. Tergite 10 completely sclerotised, clothed with short, pale hairs; hind margin broadly rounded.

Nymph with hind margin of mesonotum and metanotum deeply re-entrant, in the form of a shallow V (Fig. 4). Femora and tibiae wide, flat (Fig. 25). Tergite 10 not bulged basally. Cerci sturdy.

Species included: alatus, albofasciatus, brevicauda, childi, confusus, cordatus, dugdalei, foxi, gibbsi, illiesi, inversus, jacksoni, kuscheli, macburneiy, mariae, montanus, ngaire, patricki, peglegensis, takahe, wardi.

Zelandobius alatus new species
Fig. 85; Map 6
Dimensions (mm). Female: body length 7.5; antenna 5; forewing 5.5-6 in Rock & Pillar specimens, 7 in holotype; hind leg 5.8; pronotum length 0.96, width 1.28.

Adult female. Head with a brown mask between prominent ocelli. Antennal flagellum with 1st segment shorter than scape. Pronotum wider posteriorly. Forewing: holotype with Rs fork long (0.28× as long as Rs), containing a crossvein; in Rock & Pillar specimens, a short Rs fork (0.2× as long as Rs) in one with 6 mm forewings, and no fork in the other with 5.5 mm forewings. Forewing of paratype short-winged specimens with dark patches surrounding very pale, expanded distal crossveins, but that of holotype bleached and showing no pattern. Abdominal tergites 1-7 lightly sclerotised, but T1 with a lateral pair of heavily sclerotised bars; T8-10 heavily sclerotised, but T8 with a lightly sclerotised medial rectangle. All sternites sclerotised, more so medially.

Genitalia (Fig. 85). Subgenital plate with an almost W-shaped dark patch, the apexes of its arms extending into the lobes. Medial emargination and lobes with narrow, heavily sclerotised margins. Subgenital plate and sternite 9 with prominent lateral sternotergal ridges. Cerci 12-segmented.


Material examined. Type specimens only.
— / CO.

Adults collected February, December.

Remarks. The specific name refers to the lateral sternotergal ridges (Latin alatus, winged).

Zelandobius albofasciatus new species
Fig. 33, 54, 70, 86; Map 7
Dimensions (mm). Male: body length 8–9; antenna 8; forewing 7–7.5; hind leg 6; pronotum length 0.96, width 1.04. Female: body length 9–12; antenna 6–7; forewing 7.5–9.5; hind leg 7.5; pronotum length 1.12, width 1.2.

Possible nymph: body length 10; antenna 5; cercus 2.

Adult. Head brown, with darker brown mottling on epicranium. Ocelli prominent. Antennal flagellum with 1st segment shorter than scape or as long. Pronotum slightly wider than long. Forewing with Rs fork short (0.16× as long as Rs), the upper branch much shorter than the lower; Rs cell with about 4 crossveins; distal crossveins each surrounded by a dark oval patch, this usually coalesced with adjoining patches to form 3 dark bars across wing; areas between bars and proximally below M pure white. Mesonotum and metanotum uniformly brown. Hind leg long, 0.63–0.83× as long as body. Abdomen of male with all tergites and sternites sclerotised; female with all sternites, T10, and a pair of lateral strips on T1 sclerotised.

Male genitalia (Fig. 33, 54, 70). Epiproct tip short, rounded; lateral margins with 2 pairs of teeth. Paraproct with a ventrally opening pocket in its inner distal third (sperm sac?), and with a large apical spine. Tergite 10 posterior sclerite dark, short, almost oval, its membranous cone short and bulged. Cerci comprising 10–14 segments.

Female genitalia (Fig. 86). Subgenital plate hind margin with a distinct pair of lateral lobes; a pale triangle based medially on anterior margin, surrounded at margins and apex by a dark, inverted, V-shaped patch with a truncated tip. Cerci comprising 11 or 12 segments.

Possible nymph (late instar). A large nymph similar to that of confusus but with heavier integument clothed with short, black hairs and with a dark line dorsally down abdomen. Lacinia with 3 strong teeth and few hairs.
Maxillary palp with distal segment 3× as long as penultimate segment.


**Material examined.** Type specimens, plus 8 non-type examples (1 male, 7 females) and 22 possible nymphs: 21, NN, Mt Glasgow nr Seddonville, St Andrew’s Basin, 1130 m, 9 Sep 1965, I.D. McLellan; 1, NN, Mt Glasgow, 1310 m, 8 Nov 1969, IDM.

**Remarks.** Named for the characteristic white bars in the forewing (Latin *albofasciatus*, white-banded), this species appears to be exclusively alpine.

*Zelandobius brevicauda* McLellan


**Dimensions (mm).** Female: body length 8; antenna 6; hind leg 4.3.

**Adult female.** General colour pale brown, but antenna, palps, and head darker; darker markings on nota and abdominal tergites; epicranium mottled. Median ocellus small; lateral ocelli large, angled outwards on rim of a shallow depression bounded by ocellus, eye, and antennal base; outward angle not readily visible from above. Pronotum rectangular with rounded angles; width:length ratio 1.4. Mesonotum and metanotum sometimes with a short, triangular projection anteriorly on each lateral margin. Wing vestiges present as minute flaps.

Genitalia (Fig. 87). Subgenital plate with short lobes separated by a distinct rounded notch, and with a small pale patch just anterior to notch. Sternum 9 with a large, medial membranous area over entire length and a lightly sclerotised bulge anteriorly. Subanal lobes long, tapering to rounded apices. Cerci short, comprising 4–7 segments.

**Type data.** Holotype female and 3 paratype females: FD, Turret Range nr Lake Manapouri, Wolfe Burn Flat, 950 m asl, 10 January 1970, G. Kuschel (NZAC).

**Material examined.** Type specimens, plus 3 non-type females (NZAC, CMNZ).

**Remarks.** *Z. brevicauda* is the only wingless species known in *Zelandobius*.

*Zelandobius childi* new species

Fig. 34, 55, 71, 88; Map 9

**Dimensions (mm).** Male: body length 6–9.5; antenna 3–6; forewing 5–8; hind leg 5–5.75; pronotum length 0.96, width 1.12. Female: body length 11; antenna 7; forewing 9; hind leg 6.5; pronotum length 1.2, width 1.28. Nymph (late instar): body length 10; antenna 3; cercus broken (estimate 3–4); hind leg 3.9; pronotum length 1.2, width 1.44.

**Adult.** Head with a dark mask stretching across frons between anterior and posterior ocelli. Antennal flagellum with 1st segment shorter than scape or as long. Pronotum wider than long, with plate well defined by dark lines and with raised dark markings. Forewing Rs fork short (0.23× as long as Rs); Rs cell with about 4 crossveins; distal crossveins with grey elliptical patches coalescing with those above or below to form bars across wing. Some males slightly short-winged. Mesonotum and metanotum brown anteriorly, dark brown posteriorly. Abdomen with sternites and tergites all sclerotised in male; sclerotised areas in female comprising 2 lateral strips on T1, all of T9 and T10, a large central oval and apodemes of S1–7, a central area, epimera, and hind margin of S8, and most of S9 and S10 apart from 2 posteromedial areas.

**Male genitalia (Fig. 34, 55, 71).** Epiproct tip slightly tapered, of moderate length, rounded apically; lateral margins with 2 pairs of teeth; in lateral aspect, hind margin sometimes uniformly curved from tip to point of hook, or almost straight. Paraproct with dorsal margin uniformly concavely curved from a small, sharp, transparent apical spine. Tergite 10 with a long, narrow posterior sclerite and a long, membranous cone. Cerci comprising about 11 segments.

**Female genitalia (Fig. 88).** Subgenital plate posterior margin sclerotised, with a pair of short lobes, their inner margins long and gradually sloping, their outer margins short; a pale medial subtriangular patch with lateral margins following margins of genital aperture. Cerci comprising 9 or 10 segments.

**Nymph (final instar).** Differing from *confusus* as follows:
antenna shorter (3× as long as head, cf. 4.5–5×); femora shorter and wider (hind femur 0.75× as long and 1.39× as wide in confusus).

**Type data.** Holotype male and paratype female: CO, Rock & Pillar Range, 1370 m, snow patch, 21 November 1977, J. Child (NZAC).

**Material examined.** Type specimens, plus 17 non-type examples (7 males, 8 females, 2 nymphs; NZAC, IDMC).—CO, BR–NC.

Adults collected November, December.

**Remarks.** This species is dedicated to the late Dr John Child (formerly of Otago University), talented natural history author, who collected most of the material.

The nymph's identity was verified by dissection of genitalia from a final-instar male.

*Zelandobius confusus* (Hare)

Fig. 3, 4, 25, 27–30, 35–38, 56, 72, 89; Map 10

*confusa* Hare, 1910: 29 (*Leptoperla*; brief initial description).


**Dimensions (mm).** Male (Fig. 3): body length 6.5–9.5; antenna 6–7; forewing 7.5–9; hind leg 6–6.75; pronotum length 0.8–0.96, width 1.04–1.12. Female: body length 6.5–10; antenna 7–8; forewing 8.5–10; hind leg 7–7.3; pronotum length 0.96–1.28, width 1.12–1.28. Nymph (final instar): body length 8; antenna 4.5–5; cercus 3.3; hind leg 4.3; pronotum length 0.88, width 1.04; tegite 10 side 0.32, length 0.56.

Adult. Head brown, with a dark brown triangle between prominent ocelli; epicranium mottled dark brown. Antennal flagellum with 1st segment about as long as scape. Pronotum rectangular, slightly wider than long, brown, with raised irregular dark markings and a darker medial and anterior transverse groove. Mesonotum and metanotum brown, sometimes dark brown medially. Legs brown. Forewing with Rs fork short to medium-sized (0.2–0.3× as long as Rs); cell Rs usually with 4 crossveins; distal cross-veins expanded, transparent, surrounded by dark oval patches, these either discrete or coalesced to form bars across wing. Abdomen with tergites and sternites all sclerotised.

Male genitalia (Fig. 27–29, 35–38, 56, 72). Epiproct with 2 pairs of lateral teeth, the proximal pair large, the distal pair small to minute; tip short, tapered to a rounded apex; ventral hook prominent; a membranous bulge with a dark, sclerotised knob on its tip arising ventrally from epiproct base. Paraprocts sclerotised apart from a membranous area distoventrally; upper edge not bulged at base of apical spine, which is curved and of medium length. Tergite 10 with a short mediad sclerite; membranous cone tapering into a short posterior sclerite, wedge-shaped in lateral aspect and with a shallow ventral groove. Cerci comprising 10–15 segments.

Female genitalia (Fig. 30, 89). Subgenital plate without dark markings, lightly sclerotised apart from the more heavily sclerotised lobes. Medial incision wide. Cerci comprising 10–14 segments.

Nymph (final instar) (Fig. 4). Almost uniformly pale brown dorsally, paler ventrally. Body clothed in very short bristles. Head with prominent ocelli. Antenna 1.75–2.2× as long as body. Maxillary palp with distal segment twice as long as penultimate segment. Lacinia with 3 teeth, and with a row of bristles on dorsal edge extending down to about 0.4 of lacinial length. Mandibles with strong teeth and a basal grinding plate. Pronotum rectangular, slightly wider than long (width:length ratio 1.2). Mesonotum with posterior margin deeply re-entrant. Legs (Fig. 25) with femora and tibiae flattened; hind tarsal segments with a length ratio of 8:5:14; tibiae and tarsal segments 1 and 2 with short spines on ventral portion. Abdomen with T10 not bulged basally. Cerci about 0.4× as long as body.

**Type data.** No type material; see Remarks.

**Material examined.** 259 non-type examples (78 males, 80 females, 91 nymphs, 10 exuviae (6 associated); NZAC, CMNZ, IDMC, MJWC).

ND, AK, CL, TO, GB, TK, RI, WA, WN/SD, MB, NN, KA, BR, WD, OL, FD/SL.

Adults collected January–March, July–December.

**Variation.** In the male genitalia (Fig. 35–38) variation is not as great as I indicated earlier (McLellan 1969). I had thought that the differences in the posterior sclerites, membranous cone, and epiproct were variability in one
species. However, with more material to hand I now see that I was dealing with a number of species, and this eliminates most of the supposed variation in Z. confusus. There is in fact insignificant variability of tergite 10, though the epiproct does have small variations.

I distinguish four such epiproct variants spread throughout the species’ range. The form (Fig. 35) found in the type locality (Karori, Wilton’s Bush, and Khandallah in Wellington, WN) is also present in the North Island areas WA, WI, RI, TK, TO, GB, and ND, and in the South Island in SD, NN, and BR.

The form (Fig. 36) in the pallidus paratypes from Awaroa Stream, Little Barrier Island (CL) in M.J. Winterbourn’s collection is much the same as those from the confusus type locality, but slightly more bulged on the dorsal surface, between the distal teeth and the tip. I have similar examples from the Karamea Range (TO), the Kaweka Range (HB), and Mt Holdsworth in the eastern Tararua Range (WN). A single male from the lower Hollyford Valley (PD) has an epiproct much like the pallidus form.

There is a form (Fig. 37) from Tinline River (MB) with a bulged tip and with longer distal teeth.

Another form (Fig. 38) with an almost straight dorsal margin above the distal teeth and with a more tapered tip is widespread on the West Coast of the South Island, where it is found in every male I have from Karamea Bluff (NN) southwards along the coast almost to Greymouth, and also through the lower Buller Gorge (NN–BR) and on the Rahu Saddle (BR). From there to Haast I have no specimens, then one from Joe’s Creek, Haast (WD) and another from Haast Pass (WD); both have the same tip as above.

There is also a degree of variation in the dark patches surrounding the distal crossveins. The usual state of wing coloration is dark irregular bars only, with a small percentage of specimens having bars plus separate ovals distally, or all separate ovals, or the whole wing dark. The variation appears to occur within populations, and also between populations, although this latter may be incorrect because of the small samples involved.

Remarks. When Hare (1910) described Leptoperla confusa from material sent to him by G.V. Hudson, he did not designate a type, stating only “Hab. – New Zealand”. His collection was destroyed by mites, and therefore a type has never existed. Fortunately his very brief description includes the wing characters peculiar to the confusus group. Identification to species was possible because his specimens came from Hudson, who lived in Karori (a suburb of Wellington) and, according to Tillyard (1923), collected them there. Tillyard must have seen the specimen that Hare considered the type, for he states “Type in Mr. Hare’s collection. Locality – Karori, Wellington”.

**Zelandobius cordatus** new species

Fig. 23, 39, 57, 90; Map 11

Dimensions (mm). Male: body length 7; antenna 4.5; forewing 7; hind leg 5.25; pronotum length 0.5, width 0.64. Female: body length 8; antenna 5; forewing 7.5; hind leg 5; pronotum length 0.8, width 1.12.

Adult. Head brown; dorsal callosities and ocellar bases dark brown. Antenna long; flagellum with 1st segment about as long as scape. Maxillary palp with terminal segment twice as long as penultimate segment. Pronotum a little wider than long, brown, without markings apart from a well defined dark brown median line. Mesonotum and metanotum brown; hind margins dark brown. Forewing with Rs fork of medium length; Rs cell with 4 or 5 crossveins; distal crossveins each surrounded by a discrete oval dark patch. Abdomen in male with sternites and tergites all sclerotised, but in female only T1 and T10 with sclerotisation.

Male genitalia (Fig. 23, 39, 57). Epiproct with 2 pairs of lateral spines, the distal pair small, the proximal pair large; tip posteriorly a flat ovoid. Paraprocts with a strong apical spine. Tergite 10 with posterior sclerite dorsally broad, heart-shaped. Cerci comprising 8 or 9 segments.

Female genitalia (Fig. 90). Subgenital plate with hind margin emarginate medially. Sternite 9 membranous, as is S10 medially. Cerci comprising 9 segments.

Type data. Holotype male and paratype female: BR, Lewis Pass, tributary of Lewis River, first creek S of Foley’s or Going’s Creek, 21 November 1965, I.D. McLellan (NZAC).

Material examined. Type specimens, plus 4 non-type males (NZAC, CMNZ, IDMC).

— / BR, NC, MC, PD.

Adults collected November, December.

Remarks. There is some variation in the epiproct tip: in lateral aspect it may be curved more anteriorly.

The name alludes to the shape of the posterior sclerite of the male’s tergite 10 (Latin *cordatus*, heart-shaped).
**Zelandobius dugdalei** new species

Fig. 40, 58, 73, 91; Map 12

**Dimensions** (mm). Male: body length 7; antenna 5.5; forewing 7; forewing w:l ratio 0.25; hind leg 7; pronotum length 1.12, width 1.6. Female: body length 11; antenna 7.5; forewing 7.5, w:l ratio 0.23; hind leg 7; pronotum length 1.44, width 1.6. Nymph (late instar): male - body length 8, antenna 3, cercus 3, hind leg 4.25; female - body length 10.5, antenna 2.5, cercus 2.5, hind leg 5.

**Ad*ult.** Head and pronotum with medial third brown, lateral thirds almost white. Eyes small; ocelli prominent, each surrounded by a dark outline. Antennal flagellum with 1st segment as long as scape. Mesonotum and metanotum almost white anteriorly. Forewing without patches, almost transparent, yellowish-tinged; M and Cu1 pale brown, all other main veins and crossveins pale. Rs with or without a short fork; 3 or 4 distal crossveins in Rs cell. Abdomen in male with tergites and sternites all sclerotised; in female, strips on T1 and T10 and all sternites lightly sclerotised.

**Male genitalia** (Fig. 43, 58, 73). Epiproct with 2 pairs of prominent lateral spines, the proximal pair large; tip short, rounded. Paraprocts with a strong apical spine. Tergite 10 with a long posterior sclerite; membranous cone long and bulged laterally. Cerci comprising 11 segments.

**Female genitalia** (Fig. 91). Subgenital plate broad, with a shallow medial emargination in hind margin. Cerci comprising about 12 segments.

**Nymph** (late instar). Similar to *confusus* but larger, sturdier, and with a broader pronotum and tibia. Lacinia with 4 strong teeth and a row of about 12 slender spines. Mandible with 3 strong teeth and a smaller basal one; prostheca covered with short, slender spines.

**Type data.** Holotype male: FD, Darran Mountains, Tutoko Bench, upper basin, 1214–1524 m, 14 January 1977, alpine grassland, J.S. Dugdale (NZAC). Paratype female: type locality, Mahere Basin, 1350 m, stream 1–2 m wide, 10 January 1977, JSD (NZAC).

**Material examined.** Type specimens, plus 11 non-type nymphs (NZAC).

— / FD.

Adults collected January.

**Remarks.** Dedicated to that indefatigable collector John S. Dugdale (Mt Albert Research Centre, Auckland), who has collected not only this new species but a number of other new and interesting stoneflies.

The nymphs' identity was verified by viewing both male and female genitalia through the nymphal integument.

**Zelandobius foxi** new species

Fig. 21, 41-43, 59, 74, 92; Map 13

**Dimensions** (mm). Male: body length 7.5–9; antenna 6–7; forewing 7–9 (short-winged 5–6); hind leg 6.75–7.75; pronotum length 1.04, width 1.2. Female: body length 9–13; antenna 5–10; forewing 8.5–11 (short-winged 5–6); hind leg 5.5–9.5; pronotum length 1.36–1.52, width 1.44–1.52. Nymph (final instar, short-winged form): body length 10–11; antenna 5; cercus 2; pronotum length 1.12–1.68, width 1.36–1.58; hind leg 5–5.5.

**Adult.** Head with a dark patch on frons; epicranium mottled dark and pale brown. Ocelli prominent. Antenna long, just under length of body; flagellum with 1st segment as long as scape or shorter. Pronotum almost square or slightly wider than long. Mesonotum and metanotum brown anteriorly, dark brown posteriorly. Hind leg longer in male (0.9× body length) than in female (0.6× body length). Forewing (Fig. 21) with Rs fork of moderate length (0.27 times as long as Rs in both short-winged and fully winged specimens), with 1 or 2 crossveins or none; Rs cell with 3–5 distal crossveins; distal crossveins almost transparent, surrounded by dark ovals which may be discrete or coalesced with others to form dark bars across wing. Wings of short-winged form extending to halfway down abdomen or a little short of abdominal apex, with veins sometimes distorted and Rs fork absent, though with the same dark forewing patches. Abdomen of both male and female with medial membranous patches on T1–4 and remaining sternites and tergites sclerotised.

**Male genitalia** (Fig. 41–43, 59, 74). Epiproct narrow in dorsal aspect; tip bulged, rounded anteriorly, tapered posteriorly to a rounded apex (variation illustrated in Fig. 41–43); lateral margins with a pair of small distal spines and a pair of large proximal spines. Paraprocts with a large, hooked apical spine; upper margin bulged near spine; outer surface largely membranous, but sclerotised at tip, in a broad band along upper margin, and for a short distance from tip along lower margin before tapering out. Tergite 10 with posterior sclerite dark, short (as long as its basal membranous cone), not curved upwards, dorsally narrow and almost parallel-sided, with a rounded tip, laterally wedge-shaped; medial sclerite long; membranous cone clothed with numerous dark spots, well tapered in lateral aspect but broad and with very little taper in dorsal aspect. Cerci
comprising 12–15 segments.

Female genitalia (Fig. 92). Subgenital plate with hind margin bearing a pair of distinct rounded lobes on either side of a deep, rounded indentation; heavily sclerotised, rugulose lobes together with 2 furrowed sclerotised areas forming a dark medial pattern like a pair of commas back-to-back (see figures for variation). Cerci comprising 12–15 segments.

Nymph (final instar, short-winged form). Similar to confusus but with shorter antennae, shorter, thread-like cerci, and a covering of much shorter and less conspicuous hairs. Maxillary palp with distal segment long, 2.7× as long as penultimate segment. Lacinia with 2 long apical teeth and a short, indistinct tooth between them, a row of about 10 spines, and then hairs below teeth along most of inside margin.

Type data. Holotype male and paratype female: CO, Mt Teviot, 915 m, 19 November 1985, K.J. Fox (NZAC).

Material examined. Type specimens, plus 108 non-type examples (28 males, 67 females, 10 nymphs, 3 exuviae; NZAC, CMNZ, IDMC).

- / CO, DN / SI.

Adults collected January, February, September, November.

Remarks. Identification of the nymph was verified from male genitalia visible after removal of the integument.

This species is dedicated to the collector of the type specimens, the late Dr K.J. Fox of Manaia, TK, one of New Zealand’s foremost amateur entomologists of recent times.

Zelandobius gibbsi new species

Fig. 44, 60, 75, 93; Map 14

Dimensions (mm). Male: body length 6.5; forewing 7.5; antenna 6.5; hind leg 5.75; pronotum length 0.64, width 0.96. Female: body length 8–10; forewing 8–10; antenna 5–6; pronotum length 0.8, width 1.28. Nymph (late instar): body length 8–9; antenna 3–4.5; cercus 2.5–3; hind leg 4–5; pronotum length 0.72–1.04, width 1.04–1.44.

Adult. Head brown, with sometimes an almost black mask between ocelli and stretching onto dorsal callosities; faint dark mottling present on epicranium. Antennal flagellum with 1st segment as long as scape. Pronotum slightly narrower anteriorly, with a rounded anterior margin; width:length ratio 1.5–1.6. Mesonotum and metanotum brown, darker posteriorly. Forewing with Rs fork short (0.25× as long as Rs); 4 distal crossveins in cell Rs and between forks of M, each surrounded by a dark oval or rectangle usually fused with its neighbour above or below. Abdona of male with tergites and sternites all sclerotised; female with sternites unsclerotised apart from S1, which has a pair of sclerotised strips, and S10 and all tergites fully sclerotised.

Male genitalia (Fig. 44, 60, 75). Epiproct with 4 or 5 teeth on each lateral margin; tip in lateral aspect long, narrow, rounded apically, slightly turned forwards. Paraprocts with a strong, curved distal spine and 2–4 small hastate spines on lateral margin, about one-third from tip. Tergite 10 with a long, narrow, membranous cone extending from a long medial sclerite with a V-shaped cleft posteromedially; posterior sclerite bent sharply upwards, its distal part with flanged lateral extensions forming a wide groove posteromedially, and its base bulged down. Cerci comprising 9–11 segments; proximal 3 segments narrow in dorsal view, with subsequent segments widening to 6th segment, which is 2–2.5× as wide as basal one, then gradually narrowing; apical segment as wide as basal one or a little wider.

Female genitalia (Fig. 93). Subgenital plate with well developed lobes; these, and about half of lateral third of plate heavily sclerotised; a triangular membranous patch in centre, based on anterior margin and as wide as plate. In some specimens, areas in lateral angles purple. Cerci short, comprising 8 segments.

Nymph. Difficult to distinguish from confusus, but with a row of hairs below spines on lacinia.

Type data. Holotype male: BR, Ada Pass Hut, 3800 ft (1140 m), 17 December 1985, G.W. Gibbs (NZAC).

Material examined. Holotype, plus 27 non-type examples (3 males, 14 females, 10 nymphs; NZAC, IDMC, UCNZ).

WN / BR, MC, OL.

Adults collected February, September, November, December.

Remarks. In the holotype and the other South Island male there is on tergite 10 a row of three or so setae just below the posterior half of the medial sclerite’s lateral margins. These are not visible in the North Island male.

This species is dedicated to Dr G.W. Gibbs (Victoria University of Wellington), collector of the holotype, who has obtained a large number of new and interesting stoneflies.
**Zelandobius illiesi** McLellan, 1969

Fig. 5, 45, 61, 76, 94; Map 15


**Dimensions** (mm). Male: body length 6; antenna 7; forewing 8; pronotum length 0.72, width 1.04; hind leg 6.5. Female: body length 6–9; antenna 7; forewing 7–8; pronotum as for male. Nymph (final instar): body length 5–6; antenna 4; cercus 1.7; pronotum length 0.64, width 1.12; hind leg 3.25.

**Adult.** Head reddish-brown to dark brown; frons sometimes darker. Ocelli prominent, with a dark brown border. Antennal flagellum with 1st segment 1.0–1.5× as long as scape. Pronotum square and dark brown. Mesonotum and metanotum uniformly brown. Legs brown, slender; hind leg longer than abdomen. Forewing with Rs fork short, 0.22× as long as Rs;Rs cell with 4 or 5 crossveins; distal crossveins expanded, each surrounded by an oval grey patch, the adjacent patches discrete or coalescing.

Male genitalia (Fig. 45, 61, 76). Epiproct with 2 pairs of marginal teeth and a cone-shaped dark mass at base; tip short, tapered. Paraprocts with a large, prominent apical spine; most of outer surface membranous. Tergite 10 short, rounded, with a slightly upturned posterior sclerite. Cerci short, curved downwards, comprising 8 or 9 segments.

Female genitalia (Fig. 94). Subgenital plate with a wide, shallow, almost straight-sided medial incision in hind margin; plate sclerotised posteriorly for a short distance, medially with a small, sclerotised triangle on either side, and anteriorly with a larger sclerotised triangle based on anterior margin. Sternite 9 membranous apart from a slightly sclerotised, diamond-shaped posterior mediocaudal lobe extending towards genital aperture, and sometimes hidden by subgenital plate; posterior margin with a U-shaped medial incision receiving sclerotised anterior margin of S10. Abdominal segment 10 short, sometimes bulged laterally. Cerci short, comprising 7 or 8 segments.

Nymph (late instar) (Fig. 5). General colour brown. Frons with anterior margin outlined with short, curved spines, a transverse row of spines running level with medial ocellus, and from each anterior angle, level with lateral ocellus, a row of spines extending to epicranium, which is clothed with short bristles. Ocelli sometimes obscured by spines. Antennal flagellum clothed in proximal half with whorls of long hairs. Pronotum subrectangular, with anterior angles produced and posterior angles rounded; width:length ratio 1.8; lateral margins and anterior angles outlined with forward directed curved spines, each terminating in a hair-like projection; anterior and posterior margins outlined with denticles. Wingpads with proximal half produced into a flap covering pleural sclerites and armed with posteriorly directed curved spines. Mesonotum and metanotum with posterior and lateral margins bearing a row of denticles. Femora each with a pair of short spines dorsally. Abdominal tergites 1–8 each with a median posteroventral projection clothed with denticles; T1–9 with posterior margins outlined with denticles; T10 of females bulged basally. Cerci short and threadlike distally.


**Material examined.** Type specimens, plus 27 non-type examples (5 females, 21 nymphs, 1 exuviae; NZAC, IDMC).

ND, TO, WA, WN/NN, BR. Adults collected September, November, December.

**Remarks.** *Z. illiesi* has been recorded by several workers on stream faunas. Cowie (1980) records it from the Devil’s Creek catchment near Reefton (BR), a few kilometres from the Giles Creek record in the material examined. It was also recorded from Big Bush State Forest (NN), in mixed *Nothofagus* forest.

The Lake Pounui Stream (WA), Tararua Range (WN), Turou (TO), and Waipoua State Forest (ND) records indicate that this species could be widespread in indigenous forest. It has perhaps not been recorded more frequently because of the difficulty of detecting it in its habitat.

**Zelandobius inversus** new species

Fig. 46, 62, 77; Map 16

**Dimensions** (mm). Male: body length 9; antenna 6; forewing 4; pronotum length 1.3, width 1.3; hind leg 11.

**Adult male.** Head uniformly black. Ocelli prominent. Antennal flagellum with 1st segment as long as scape. Pronotum square, dark brown. Mesonotum and metanotum black, with a small pale spot anteromedially. Legs
dark brown. Wings short, terminating at about 0.6 of abdominal length; forewing with dark spots coalesced over most of its area, and with 5 or 6 pale spots medially.

Male genitalia (Fig. 46, 62, 77). Epiproct differing from other species, with dorsal midline raised, and hollowed sides sloping roof-like lateroventrally; tip short, triangular; laterally a strong basal tooth present, but distal tooth degenerated into a raised point; ventral hook with a wide gape. Paraprocts with a bulge at about 0.8 of length on outer margin, anterior to a strong apical spine. Tergite 10 broad, terminating in a short, wide, membranous cone with a dark, upturned bulbous posterior sclerite directed dorsally. Cerci comprising 9 segments.


Material examined. Holotype only (unique).

Adult collected January.

Remarks. The name (Latin *inversus*, upside down) refers to the peculiar inversion of the male epiproct.

**Zelandobius jacksoni** new species

Fig. 95; Map 17

Dimensions (mm). Female: body length 10; antenna 9.5; forewing 12; hind leg 9; pronotum length 1.44, width 1.92.

Adult female. Head with a black mask between prominent ocelli. Antennal flagellum with 1st segment not as long as scape. Pronotum rectangular, with all angles sharp; width:length ratio 1.3. Femora brown with some darker brown blotches; tibiae pale brown. Wings and veins reddish-brown, with small pale patches basally; forewing Rs fork long, with or without a crossvein; distal veins not expanded, reddish-brown. Abdominal T1 with a pair of lateral sclerotised dark bars, and T10 heavily sclerotised; sternites well sclerotised, with a row of 4 pale spots on S1–7. Segments 1–8 with prominent lateral sternotal ridges.

Genitalia (Fig. 95). Subgenital plate with a dark subrectangular patch medially, anterior to this a white semicircle, and posterior to it a pale rectangular patch extending as far as medial emargination. Sternite 9 with a raised area behind and in deep medial emargination of subgenital plate, sealing genital opening. Cerci comprising 11 segments.


Material examined. Holotype only (unique).

Adult collected September.

Remarks. The colourful reddish-brown wings of *Z. jacksoni* are in contrast to the usual wing colour in *Zelandobius*, where the norm is an almost transparent hind wing and a pale to transparent forewing with or without dark patches.

This species is dedicated to the late J.R. Jackson, who in his many expeditions into the Southern Alps collected a number of new and interesting stoneflies.

**Zelandobius kuscheli** new species

Fig. 96; Map 18

Dimensions (mm). Female: body length 7.5; antenna 5; forewing 8; hind leg 5; pronotum length 0.88, width 1.12.

Adult female. Head dark. Ocelli prominent. Antennal flagellum with 1st segment as long as scape. Pronotum dark, with darker raised markings, rectangular; width:length ratio 1.27. Legs with a dark bar distally on femora, proximally and distally on tibiae, and medially as an elongate patch on anterior face of femora. Forewing width:length ratio 0.31; Rs fork short or of medium length; distal veins surrounded by 3 dark bars with a thin white border, the bars either brown and not expanded or transparent and expanded; wing white between dark bars. Abdominal tergites lightly sclerotised apart from T1, which has a pair of more heavily sclerotised lateral bars, and T10, which is uniformly heavily sclerotised; sternites sclerotised, with a darker medial oval patch on S1–6.

Genitalia (Fig. 96). Subgenital plate with lateral lobes very short; in front of medial emargination, and as wide as it, a white patch extending along plate; lateral to patch most of plate surface dark, rugulose, and covered with minute dark rings (bristle basal rings without the bristles); modified lateral areas tapering anteriorly and terminating in dark bases of plate apodemes. A subtriangular, similarly modified patch present posteromedially on S7, its apex pointing posteriorly, and sloping gradually up from base to a raised apical angle; S9 similarly modified posteromedially, bulged into medial emargination of subgenital plate and closing genital opening. Cerci of about 10 segments.

Material examined. Type specimens, plus 5 non-type females (NZAC, IDMC).

— / CO, FD.

Adults collected January, November.

Remarks. This species is dedicated to the collector of the type material, Dr G. Kuschel, who set me on the right path early in my entomological career and has since assisted me in many ways.

**Zelandobius macburneyi** new species

Fig. 31, 32, 47, 63, 78, 97-100; Map 19

Dimensions (mm). Male: body length 6-10; antenna 6-8.5; forewing 7.5-11; hind leg 5-7.5; pronotum length 0.8-1.04, width 1.12-4.36. Female: body length 10.5-14.5; antenna 6-7; forewing 9-11; hind leg 7.5; pronotum length 1.12-1.28, width 1.28-1.76. Nymph (final instar): body length 11; antenna 4; cercus 2.5-3; pronotum length 1.04, width 1.52.

Adult. Head dark brown; epicranium with darker mottling. Antennal flagellum with 1st segment as long as scape. Pronotum rectangular, wider than long, brown, with distinct dark anteromedial and postero-medial lines and a brown mottled pattern on either side of midline. Mesonotum and metanotum brown. Forewing with Rs fork long (0.41× as long as Rs), usually with a single crossvein; Rs cell with 5 or 6 crossveins; distal crossveins each surrounded by a dark oval patch, discrete or confluent with adjoining patches to form dark bars across wing. Many specimens (especially alpine ones) with wings terminating at abdominal apex.

Male genitalia (Fig. 47, 63, 78). Epiproct bulged apically, tapered antero-dorsally and rounded posteroven-trally, the expansion triangular in dorsal aspect; neck of hook long below bulge (1.5× as long as bulge); lateral margins bearing 2 pairs of teeth, the lower pair large. Paraprocts with tip tapered, lacking a distinct bulge on outer (upper) margin below apical spine; a large membranous area present ventrally, below tip. Tergite 10 with posterior sclerite upturned, bulged at tip, the bulge a transverse oval in dorsal aspect; membranous area with lateral margins bulged. Cerci comprising 12-14 segments.

Female genitalia (Fig. 31, 32, 97-100). Subgenital plate with lobes sclerotised; medially a dark, subrectangular patch with a pair of antero-lateral extensions enclosing a V-shaped area, and sometimes another V-shaped notch in posterior area. Cerci comprising about 14 segments.

Nymph (late instar). Gena and post-gena narrower than in *confusus* (in lateral aspect, depth of gena + post-gena / length of eye = 0.17 in *macburneyi*, cf. 0.27-0.33 in *confusus*). Apart from larger size, no other differences are evident. Nymph associated with adult by male genitalia, clearly visible through integument.


Material examined. Type specimens, plus 85 non-type examples (19 males, 56 females, 10 nymphs; NZAC, CMNZ, IDMC).

TO, TK, WN /NN, MB, NC, WD, OL, CO, FD.

Adults collected January, February, July, October.

Remarks. In this widespread alpine species there is some variation in size; the Tararua Range (WN) specimens are smaller than the others. Forewing coloration varies from almost discrete oval dark patches to dark bars across the wing; southern specimens have a tendency towards discrete ovals. The male epiproct tip in dorsal aspect shows as an equilateral triangle in some TK specimens, but CO males tend towards isosceles triangles. Variation is evident in the dark patch on the subgenital plate of females, as indicated in the description, and also to a degree in the apices of the antero-lateral extensions, which may be tapered roughly to a point or produced laterally for a short distance.

*Z. macburneyi* is probably a sister species of *wardi* and *foxi*, since they have a number of features in common.

I dedicate this species to the late J.G.R. McBurney, who collected the type material. Between 1967 and 1973 Jack was most helpful to me during my periodic sorties from the West Coast to Entomology Division, DSIR, in Nelson.

**Zelandobius mariae** new species

Fig. 48, 64, 79; Map 20

Dimensions (mm). Male: body length 9; antenna 6; forewing 4.3; hind leg 6.5; pronotum length 1, width 1.3.

Adult male. Head dark, almost black. Ocelli prominent. Antennal flagellum with 1st segment shorter than scape. Pronotum rectangular, wider than long, brown. Mesonotum and metanotum black, with a small white dot antero-
medially. Femora with a series of short black marks along dorsal third. Wings short (see above); forewing dark apart from a few pale spots and patches.

Male genitalia (Fig. 48, 64, 79). Epiproct with 2 pairs of lateral spines, the apical pair almost as large as the basal pair; tip long, slender. Paraprocts with a short, curved apical spine and a long, moderate bulge some distance below it on outer margin. Tergite 10 very broad, with a short membranous cone and a much upturned posterior sclerite.


Material examined. Holotype only (unique).

—/ CO. Adult collected January.

Remarks. I dedicate this species to my maternal grandmother, Maria Baynes Williscroft, who encouraged me in my youth to pursue my biological interests.

Zelandobius montanus new species

Fig. 49, 65, 80, 101; Map 21

Dimensions (mm). Male: body length 10; antenna 5; forewing 7; hind leg 5.5; pronotum length 1.12, width 1.28. Female: body length 13.5; antenna 7; forewing 11; hind leg 8; pronotum length 0.85, width 1.92. Nymph (final instar): body length 10.5–13; antenna 4; pronotum length 1.65, width 1.78; hind leg length 4.5–5.5, width 0.5–0.6; cercus 4 (estimate, based on character of segments at broken end).

Adult male. Head with a black patch between prominent ocelli; epicranium with dark mottled patches. Antennal flagellum with 1st segment about as long as scape. Pronotum a little wider than long, brown, with raised markings. Mesonotum and metanotum pale brown anteriorly, elsewhere dark brown. Hind leg 0.65× as long as body. Forewing length: width ratio 0.3; vein and wing coloration as in male, but with additional subrectangular dark patches around distal crossoveins. Abdominal tergites and sternites all sclerotised.

Genitalia (Fig. 49, 65, 80). Epiproct narrow basally, wide at midlength, tapering to a blunt, rounded tip; margins in distal half each with 5 teeth, the proximal one very large and the rest much smaller; a flat, membranous sheet arising from bend of ventral hook, widening to twice its basal width and terminating in a wide, straight tip just beyond point of hook. Paraprocts tapering to an out-turned apical spine; greater part of outer surface membranous, but with a sclerotised band on upper margin and a narrow, tapered sclerotised strip on lower margin. Tergite 10 with posterior sclerite and entire neck dark brown; sclerite upturned distally, a little shorter than its basal membranous cone, which is broad, tapering to an obtuse angle enclosing a sclerotised spot. Cerci extending in line with basal plate, comprising 8 or 9 segments.

Adult female. Head uniformly brown. Ocelli prominent. Antennal flagellum with 1st segment a little shorter than scape. Pronotum wider than long, with brown lines and raised central markings. Mesonotum and metanotum as in male. Hind leg 0.6× as long as body. Forewing length: width ratio 0.3; vein and wing coloration as in male, but with additional subrectangular dark patches around distal crossoveins. Abdominal tergites and sternites all sclerotised.

Genitalia (Fig. 101). Subgenital plate with a slightly depressed pale longitudinal bar medially; lobes short. Sternite 9 with a medial bulge and a minute pale triangle arising from subgenital medial emargination. Cerci comprising 8 or 9 segments.

Nymph (late instar). Similar to confusus, but larger and with a heavier integument. Lacinia with 3 blunt apical teeth and a long comb of slender spines and hairs (confusus has 3 large, pointed apical teeth and a short comb of 5–9 slender spines). Maxillary palp distal segment a little under twice as long as penultimate segment; with a rounded tip (confusus a little longer than twice penultimate segment, and tip slightly pointed).

Type data. Holotype male: OL, Mt Aspiring National Park, Headlong Peak, 1859–2133 m, in wet screes and snow melt patches, 18 February 1980, J.S. Dugdale (NZAC).

Material examined. Holotype, plus 13 non-type examples (1 female, 12 nymphs; NZAC).

—/ OL. Adult collected February.

Remarks. The identity of the nymphs was verified by viewing the female genitalia through the integument.

The name alludes to the habitat (Latin montanus, montane).
Zelandobius ngaire new species

Fig. 102; Map 22

Dimensions (mm). Female: length of body 10.5; antenna 6.5; forewing 9.

Adult female. Head pale brown, with a brown patch between ocelli. Ocelli and dorsal callosities prominent. Antennal flagellum with 1st segment about as long as scape. Pronotum rectangular with rounded angles, fawn, with pale brown to brown markings on plate; width:length ratio 1.22–1.29. Mesonotum and metanotum fawn anteriorly and laterally, dark brown medially and posteriorly. Legs fawn. Forewing yellow-tinged apart from a basal dark patch; pterostigma thickened; veins yellow; distal crossveins not expanded, without a dark outline. Hind wing as forewing but with anal field paler. Abdominal sternites all sclerotised; tergites membranous, except T10 completely sclerotised, and T1 with a pair of sclerotised bars.

Genitalia (Fig. 102). Subgenital plate well sclerotised, with a membranous suboval patch along midline; lobes well developed. Sternite 10, subanal lobes, and basal segments of cerci fawn, much paler than S8 and S9. Cerci comprising 9 segments.


Material examined. Type specimens only.

Adults collected December.

Remarks. This species is dedicated to my late wife Ngaire for her courage in the face of adversity.

Zelandobius patricki new species

Fig. 50, 66, 81, 103; Map 23

Dimensions (mm). Male: body length 8–10; antenna 9–9.5; forewing 9–11.5; hind leg 8–8.5; pronotum length 0.96–1.12, width 1.28–1.6. Female: body length 7–12.5; antenna 7–7.5; forewing 8–12; hind leg 5.5–9; pronotum length 0.88–1.44, width 1.28–1.92.

Adult. Head in mature specimens variable, from black with a brown labrum to brown with a black mask between ocelli and a black patch on either side of epicranium. Antennal flagellum with 1st segment much shorter than scape. Pronotum rectangular, brown to dark brown with darker raised markings; width:length ratio 1.3–1.4. Legs brown, with a dark brown bar distally on femora and basally on tibiae. Forewing with Rs fork long, 0.26–0.28x as long as Rs, sometimes containing 2 crossveins; up to 6 distal crossveins in Rs cell and between branches of M, surrounded by dark ovals or rectangles that usually coalesce with adjacent patches to form dark bars across wing.

Male genitalia (Fig. 50, 66, 81). Epiproct with up to 7 teeth on lateral margins; tip very long, curved. Paraprocts with a strong apical spine; upper (outer) margin with a prominent, angled bulge below spine. Tergite 9 posterior sclerite large, upturned, its large, membranous basal cone with lateral margins almost parallel. Cerci comprising 9 segments.

Female genitalia (Fig. 103). Subgenital plate with prominent lobes; a white bar just anterior to medial incision; extending the width of the incision, its ends with an anterior projection; a subtriangular sclerotised area comprising the lobes and a subendoned area tapering to middle third of anterior margin; a sub-semicircular membranous area at base of plate. Sternite 9 with a medial, membranous semicircular pocket delineated by a dark sclerotised band, its mouth in front of genital opening under subgenital plate (pocket and band not visible in specimens with telescoped segments). Cerci comprising 8 segments.


Material examined. Type specimen, plus 37 non-type examples (16 males, 15 females, 6 nymphs, 1 associated exuviae; NZAC, IDMC, MJWC).

Adults collected January, February, August–December.

Remarks. This species is dedicated to Brian H. Patrick (Department of Conservation, Dunedin) who collected the type specimens and has obtained other new and interesting Plecoptera from the south of the South Island.

Zelandobius peglegensis new species

Fig. 51, 67, 82; Map 24

Dimensions (mm). Male: body length 7; antenna 6; forewing 7.75; pronotum length 0.72, width 1.12; hind leg 5.

Adult male. Head, nota, and legs brown. Antennal flagellum with 1st segment about as long as scape. Pronotum rectangular; width:length ratio 1.55. Forewing with Rs fork long, 0.29x as long as Rs, with 1 crossvein; Rs cell with 5
crossveins; dark bars across wing and distal crossveins expanded, with a pale outline. Abdominal tergites and sternites all sclerotised; T7–9 with a slight posteromedian carina.

Genitalia (Fig. 51, 67, 82). Epiproct with 2 pairs of lateral teeth, the basal pair larger, tip long, slender. Para-
procts with a long, tapered apex curved anterodorsally, the curve continuing into a long apical spine. Tergite 10 with a well tapered membranous cone and long, upturned pos-
terior sclerite. Cerci comprising 11 segments.

Type data. Holotype male: NC–WD, Arthurs Pass, Pegleg Creek, 10 October 1986, I.D. McLellan (NZAC).

Material examined. Holotype, plus 2 non-type males (CMNZ).

-- / NC–WD, MC.

Adults collected October, January.

Remarks. Named after the type locality.

Zelandobius takahe new species

Fig. 52, 68, 83, 104; Map 25

Dimensions (mm). Male: body length 7; antenna 4.5; forewing 6; hind leg 4.5; pronotum length 0.65, width 0.65; head depth:length ratio 0.60. Female: body length 6.5–7.5; antenna 4.5; forewing 6.5–7.5; hind leg 4.25–4.75; head depth:length ratio 0.65.

Adult. Head uniformly brown. Ocelli prominent. Anten-
nal flagellum long, about 0.6× as long as body, with 1st segment as long as scape. Pronotum square, with raised markings. Forewing with Rs fork short, 0.2× as long as Rs; Rs cell with 3 or 4 distal crossveins. All distal crossveins almost transparent and surrounded by dark patches, these usually coalesced into 3 transverse bars. Hind legs about 0.6× as long as body.

Male genitalia (Fig. 52, 68, 83). Epiproct with 2 pairs of teeth on each margin; tip long, slender, tapering to a slightly anteriorly turned, rounded extremity; ventral hook prominently pointed. Para-
procts with a long, outcurved apical spine. Tergites 7 and 8 with anterior margin sigmoidally flexed; anterior and posterior margins heavily sclerotised. Tergite 10 with posterior sclerite slightly downcurved, then turned up distally, about as long as its membranous basal cone. Cerci comprising 7–10 segments.

Female genitalia (Fig. 104). Subgenital plate with lobes extending onto S9; genial cavity quite evident, parallel-
sided, outlined by a pale membranous band along medial third of plate; lobes and lateral parts of plate sclerotised. Sternite 9 bulged medially, sealing genital cavity. Cerci comprising 7–9 segments.

Type data. Holotype male and 2 paratype females: FD, Murchison Mountains, Takahe Valley, N side of Lake Orbell, beating hebe, 6 December 1972, A.C. Eyles (NZAC).

Material examined. Type specimens, plus 15 non-type examples (NZAC, LCNZ).

-- / FD.

Adults collected January, December.

Remarks. This species is named for the type locality, itself named after the takahe (Notornis mantelli), a rare, flightless gallinule which was rediscovered there in 1948 after being considered extinct for 50 years.

Zelandobius wardi new species

Fig. 53, 69, 84, 105–107; Map 26

Dimensions (mm). Male: body length 9.5; antenna 9; forewing 10.5; hind leg 7.25; pronotum length 1.12, width 1.36. Female: body length 11.5; antenna 9; forewing 11; hind leg 9; pronotum: length 1.2, width 1.6. Nymph (final instar): body length 11–11.5; antenna 6; cercus broken (estimate 3–5).

Adult. Head dark brown, with a black patch between ocelli; epicranium with dark mottling. Antenna almost as long as body; flagellum with 1st segment shorter than scape. Pronotum rectangular, with a strong dark brown pattern; width:length ratio 1.2–1.33. Mesonotum and metanotum dark brown. Forewing with Rs fork long; Rs cell with 1–3 crossveins; venation brown, but distal cross-
veins expanded and much less dense, appearing diffuse and almost transparent, each surrounded by a narrow pale grey oval. Legs dark brown.

Male genitalia (Fig. 53, 69, 84). Epiproct with 2 pairs of lateral teeth, the basal pair much larger than the distal pair; tip bulged, appearing triangular in dorsal aspect, and in lateral aspect with bulge more tapered posteriorly than anteriorly; below bulge, neck leading from hook of epi-
proct short, about 0.8× as long as bulge; upper surface at neck deeply concave. Paraprocts apically wide, untapered, with a short, dorsally curved spine near upper extremity and a bulge in upper margin below base of spine; lower distal part with a small, tapered membranous area. Tergite 10 with membranous cone basally parallel-sided, tapering
to a broad, almost oval upturned posterior sclerite. Cerci comprising 14–16 segments.

Female genitalia (Fig. 105–107). Subgenital plate with a brown sclerotised pattern covering lobes and plate centrally, tapering forwards to anterior margin; a pale, narrow oval patch just anterior to median incision and about as wide as incision. Cerci comprising 13 or 14 segments.

**Nymph.** Much like *conflusus*, but larger and with darker and longer hairs on body.

**Type data.** Holotype male and 3 paratypes (1 male, 1 female, 1 nymph): MC, Banks Peninsula, Hinewai Reserve, 28–29 October 1990, J.B. Ward (CMNZ).

**Material examined.** Type specimens, plus 9 non-type examples (4 males, 3 females, 2 nymphs; CMNZ).

**Remarks.** *Z. wardi* is restricted to Banks Peninsula. In a number of features it is similar to *macburneyi* and *foxi*, and these seem to be sister species. It probably stems from stock of a common ancestor isolated on the peninsula during the Pleistocene, and was possibly originally alpine like *macburneyi* (see Distribution, p. 10).

I dedicate this species to Dr John B. Ward (Canterbury Museum, Christchurch), collector of the type material, whose kindness in obtaining stoneflies has helped me to solve a number of problems.

**FURCILLATUS GROUP**

Forewing (Fig. 22) with distal crossveins expanded, transparent, surrounded by dark, narrow ovals or just a dark outline.

Male genitalia (Fig. 24). Epiproct usually with 2 pairs of lateral teeth, the basal pair large, the apical pair much smaller; tip usually long and well tapered. Paraprocts without a sharp apical spine. Tergite 10 with membranous cone more down-curved than in *conflusus* group. Cerci projecting posterolaterally, at a distinct angle to basal sclerite, which is extended on either side at its lowest part, forming a crescent-shaped base.

Female genitalia (Fig. 132, 133). Subgenital plate bordering by prominent laterosternal ridges which are wider anteriorly and clearly visible ventrally; plate extending more onto S9 than in *conflusus* group, and with either poorly developed lobes on hind margin or none; subanal lobes narrowly tongue-shaped, more tapered and much thicker than in *conflusus* group. Tergite 10 tapered to a rounded apex, sclerotised anteriorly, elsewhere membranous and covered with short, dark hairs. Cerci short, generally comprising less than 10 segments.

Nymph (Fig. 6) with hind margin of mesonotum straight. Femora flattened but not wide; tibiae rounded. Tergite 10 bulged basally. Cerci short, thread-like distally.

**Species included:** auratus, furcillatus, pilosus, truncus, unicolor, uniramus.

**Zelandobius auratus new species**

Fig. 132, 133; Map 27

**Dimensions (mm).** Female: body length 10; antenna 7; forewing 9.

**Adult female.** Head with prominent ocelli, dark brown dorsal callosities, and dark and pale brown-mottled epicranium, all with a golden metallic sheen. Antennal flagellum with 1st segment slightly longer than scape. Pronotum metallic golden apart from usual pattern of dark markings. Mesonotum dark brown apart from a pale brown bar across rear of mesoscutellum; metanotum dark brown. Forewing with longitudinal grey bands in most cells, each about 0.6× as wide as cell; Rs fork 0.19× as long as Rs; Rs cell with 3 crossveins; distal crossveins posterior to Rs expanded and surrounded by a narrow, dark oval. Hind wing subhyaline. Abdomen clothed in short, dark hairs with longer, pale bristle-like hairs on supra-anal lobe. Sternites 4–7 with a raised, sclerotised patch posteromedially, more pronounced on S7.

Genitalia (Fig. 132, 133). Subgenital plate with hind margin very faintly emarginate medially, and with a thin sclerotised strip over its entire length; a narrow, dark, oval patch covering about 0.7 of plate's midline medially.

**Type data.** Holotype female: CO, Alexandra, Conroy's Road, 4 September 1991, B.H. Patrick (NZAC).

**Material examined.** Holotype only (unique).

**Remarks.** At first glance the grey bands in the forewing are similar to those of *Z. pilosus*. However, *Z. auratus* can be distinguished not only by its different genital characters and lack of hairiness on the thorax but also by the unusual golden colour of the pronotum, from which its name is derived (Latin *auratus*, golden).
Zelandobius furcillatus Tillyard

Fig. 26, 108–112, 122, 127, 134–136; Map 28


Dimensions (mm). Male: body length 6–6.5; antenna 6; forewing 7–8. Female: body length 6.5–7; antenna 6; forewing 8–9. Nymph (final instar): body length 6–7; antenna 4.5–5; cercus 2.

Adult. General colour brown dorsally, paler ventrally. Head with epicranium mottled. Ocelli prominent. Antenna covered in minute dark hairs. Pronotum rectangular; width:length ratio 1.5. Mesonotum and metanotum as wide as head. Forewing grey; distal crossveins surrounded by dark, narrow ovals or a dark outline; Rs fork short, about 0.16× as long as Rs; Rs cell with about 4 distal crossveins.

More mature specimens often with dark longitudinal bands in most cells, each band narrow and about 0.3× as wide as cell.

Male genitalia (Fig. 108–112, 122, 127). Epiproct with 2 pairs of lateral teeth; tip long, tapered, sometimes slightly expanded apically. Paraprocts with tip short, tapering to a rounded, sclerotised apex; on outer surface, sclerotisation continuing as a dorsal band to paraproct base and also ventrally from apex for about 0.3× length of paraproct before tapering out; upper sclerotised band variable in width; remainder of paraproct membranous except for a sclerotised apical patch on inner surface. Tergite 10 with central sclerite densely clothed in short, dark hairs; membranous cone small, with a long, strongly upturned spatulate posterior sclerite. Cerci usually clothed in short hairs apically.

Female genitalia (Fig. 134–136). Subgenital plate produced onto S9; posterior margin convex, sometimes with a shallow medial emargination; maturing eggs becoming visible as a dark brown subelliptical patch along midline of plate. Tergite 10 curved down apically; supra-anal lobe usually prominent.

Nymph (late instar) slender, delicate, pale brown with grey markings on nota; cuticle thin, with tracheal trunks of abdomen visible, clothed in scattered fine, pale hairs. Head with frons bulged posteriorly; ocelli prominent, dark, with a dark patch extending from median ocellus to front of eyes; epicranium mottled. Pronotum rectangular with rounded angles; width:length ratio 1.7; a grey, C-shaped marking on either half, its convex side facing median suture, with a pale bar in between. Mesonotum and metanotum with posterior margins slightly emarginate, that of mesonotum as wide as distance between inner margins of eyes. Femora and tibiae (Fig. 26) with a dorsal row of fine, pale hairs not forming a distinct fringe; tibiae as long as fore femora; hind legs about 0.8× as long as abdomen. Abdomen with or without a darker medial line and with a slight carina mid-dorsally on segments 1–9. Tergite 10 with a dark apical patch, bulged basally, long. Gills long but not close-packed. Cerci short, less than half as long as abdomen, thread-like distally; segments each with a distal ring of short hairs.

_Type data._ Holotype male and allotype female: BP, Taranwera, 15–16 November 1919, R.J. Tillyard (NZAC).

Material examined. Type specimens, plus 298 non-type examples (87 males, 146 females, 64 nymphs, 1 exuviae; NZAC, CMNZ, IDMC, LCNZ).

ND, AK, BP, TO, GB, HB, WI, WN, WA/NZ, BR, WD, NC, MC, SC, MK, CO, OL, SL.

Adults collected August–February.

Remarks. There is slight variation in the male genitalia. The epiproct tips show little change in specimens from ND to TO, being slender and rounded apically, sometimes with a slight kink anteriorly (Fig. 108). The WI male, however, has a sharp, slender tip (Fig. 110). South Island males tend towards a slightly more robust, sharp, tapered tip (Lake Daniels, Buller River, Te Anau; Fig. 112), or a tip with a bulged apex (Lake Rotoroa, NN; Fig. 111) or with the apex kinked posteriorly (Pee Forest, MC). The posterior sclerite of T10, generally long and well upturned, is a little shorter in TO, WI, and eastern BR (Rahu Saddle) specimens. A male from Wairarapa (TO) has a posterior sclerite of unusual shape (Fig. 109).

Zelandobius pilosus Death

Fig. 113–115, 123, 128, 137; Map 29

_pilosus_ Death, 1990: 23–28, fig. 1–12 (initial description of male, female, egg, and nymph).

Dimensions (mm). Male: body length 7–8.8; antenna 5.8–7.2; forewing 8–9. Female: body length 9.3–10.6; antenna 6–7.9; forewing 9.4–10.4. Nymph (late instar): body length 6.9–9.3; antenna 2.9–4.2; cercus 0.8–1.3. Nymph (middle instar): body length 3.7–4.3; antenna 2.0–2.8; cercus 1.0–1.3.
Adult. General colour chestnut brown. Head uniformly brown, or with a darker brown patch between ocelli; epicranium mottled. Ocelli prominent. Antennal flagellum with 1st segment as long as scape. Thorax clothed with long, pale hairs, predominantly on pleurites. Pronotum rectangular with rounded angles, brown to dark brown, with darker raised markings on plate; width:length ratio 1.20–1.55. Mesonotum and metanotum uniformly brown or dark brown; metanotum about as wide as head. Legs a paler brown than thorax, clothed in scattered pale hairs. Forewing subhyaline, with longitudinal grey bands in most cells; Rs fork of moderate length, $0.21 \times$ as long as $Rs$; $Rs$ cell with 3–6 distal crossveins, which are expanded, with a grey outline; a tendency to extra crossveins in costal and subcostal cells in both wings. Abdomen of male with sternites and tergites sclerotised apart from T1, which has a pair of lateral sclerotised bars, and T2–4, which have a dorsal membranous isosceles triangle with its apex on posterior margin of T4. Female with dorsal surface membranous apart from the following sclerotised areas: a pair of bars on T1, T9 laterally, and all of T10; ventrally all sternites sclerotised, but this disappearing as eggs mature.

Male genitalia (Fig. 113–115, 123, 128). Epiproct with 2 pairs of lateral teeth, the basal pair large; tip varying in shape from a perpendicular, uniformly tapered point to a slightly upturned knob. Paraprocts wider distally, terminating in a sclerotised blade with a round tip and concave inner surface. Tergite 10 central sclerite curved strongly downwards, densely clothed in pale hairs; posterior scieritic long, slightly upturned, minutely bulged apically, with an almost flat surface facing epiproct tip. Cerci comprising 9 or 10 segments.

Female genitalia (Fig. 137). Subgenital plate with many transverse rows of faint, slightly curved furrows; hind margin slightly convex, with a small medial notch. Cerci comprising 7–11 segments.

Nymph. General colour sandy brown, becoming progressively darker in later instars. Head darker than body; epicranium mottled in late instars. Tergite 10 dark posteriorly; late-instar nymphs with a pale rectangle on T5–9. Head, body, and legs covered with long (about 0.2 mm), translucent hairs; antennal flagellum with proximal third clothed in whorls of similar long hairs; most hairs clothed in smaller hairs, many of them with only half their circumference covered; hairiness greatly reduced in late instars. Ocelli present but normally not visible. Antennal flagellum tapering from a wide base to a relatively fine tip. Pronotum rectangular with rounded angles; width:length ratio in middle instars 1.7–1.9, in late instars 1.5–1.8; pronotal hairs best developed around periphery. Abdomen without a carina. Cerci thread-like. Anal gill rosette mauve, well developed.

First instar. Body length 0.60–0.65 mm. Eyes not visible. Antennae comprising 7 or 8 segments. A few long hairs present on body. Abdomen covered with short spines. Cerci 4-segmented.

Egg 3 mm in diameter, roughly spherical, with tuberculate sculpturing.


Material examined. Type material in NZAC (holotype male and 6 paratypes: 2 males, 2 females, 2 nymphs), plus 22 non-type examples (6 males, 9 females, 5 nymphs, 2 exuviae; NZAC, IDMC).

— /MC, WD, MB.

Adults collected March, June–August, October, December.

Remarks. The unusual wing colour pattern in Z. pilosus of longitudinal grey bands is known from only one other species (Z. auratus). Variability in the number of crossveins in the wings is discussed in Death (1990), but not in relation to other species. I notice that in the forewings of other species the crossveins in the costal cell usually comprise the humeral and one other distally, and in the subcostal cell one only, a short distance before $Sc$ fuses with $C$. In Z. pilosus the number of additional crossveins (from Death 1990 and the material I have seen) may be up to three in the costal cell and five in the subcostal. The left forewing of the holotype has two extra crossveins in the costal cell and five in the subcostal.

Zelandobius truncus new species

Fig. 116–118, 124, 129, 138, 139; Map 30

Dimensions (mm). Male: body length 6–7; antenna 5–6; forewing 6.5–7. Female: body length 7; antenna 6–6.5;
forewing 7.5–8. Nymph (final instar): body length 5.5–7; antenna 3.5–4; cercus 1.5.

Adult. Similar to *Z. furcillatus* in body and wing colour, venation, and genitalia but generally more sclerotised, and differing further as follows.

Male genitalia (Fig. 116–118, 124, 129). Epiproct tip short or of moderate length, tapered, rounded and sometimes slightly bulbous apically. Paraprocts with tip consisting of a thin, rounded, curved-over blade. Tergite 10 central sclerite with membranous cone short, terminating in a short, rounded posterior sclerite which projects posteriorly and is not upturned.

Female genitalia (Fig. 138, 139). Subgenital plate with a subtriangular sclerotised patch based on hind margin and extending medially to near front margin, evident even in unmated females.

**Nymph.** Similar to *Z. furcillatus*. Associated with adults by dissecting out male genitalia.

**Type data.** Holotype male and paratype female: WN, Lower Hutt, Korokoro Stream, 28 November 1982, I.D. McLellan (NZAC).

**Material examined.** Type specimens, plus 47 non-type examples (17 males, 21 females, 8 nymphs, 1 exuviae; NZAC, IDMC).

**TK, WN / CO, OL.**

**Remarks.** *Z. truncus* is closely allied to *Z. furcillatus*, so much so that at first I thought I was dealing with a form of that species. However, their evident allopatry and the dispersal of populations across widespread localities point to separate identity.

The name (Latin truncus, cut-off) refers to the male's truncate posterior sclerite.

**Zelandobius unicolor** Tillyard

Fig. 22, 119, 120, 125, 130, 140, 141; Map 31


**Dimensions** (mm). Male: body length 6–7.5; antenna 5.5–6; forewing 6–8. Female: body length 7–9; antenna 5–7; forewing 8–9.5. Nymph: body length 7; antenna 3.5; cercus 1.5.

Adult. General colour brown to dark brown. Head brown, with a darker patch bounded by ocelli; epicranium mottled. Pronotum rectangular with rounded angles, much wider than long (width:length ratio 1.7), extending almost to width of head. Mesonotum and metanotum wider than head. Femora short in relation to tibiae. Forewing (Fig. 22) broad (width:length ratio 0.3), grey with a yellow tinge; veins yellowish; Rs fork short or of medium length, 0.1–0.24× as long as Rs; distal crossveins few, expanded, with a dark outline and in a distinctive group below pterostigma, between Rs and Cu1. Abdomen paler than thorax, especially in females.

Male genitalia (Fig. 119, 120, 125, 130). Epiproct with 1 or 2 pairs of marginal teeth; tip long, tapered. Paraprocts with tip thin, curved, blade-like. Tergite 10 central sclerite much curved down, clothed in short, dark hairs, in dorsal aspect narrow and usually parallel-sided; membranous cone short, terminating in a strongly upcurved posterior sclerite with an expanded tip. Cerci short, comprising 8 or 9 segments.

Female genitalia (Fig. 140, 141). Subgenital plate extending onto S9; hind margin either uniformly convex or with a medial emargination; subanal lobes clothed in short, pale hairs and with tips tapered. Cerci short, comprising about 8 segments.

Nymph pale brown, with indistinct markings on nota and tergites. Integument thicker than in *furcillatus*. Head broad, flat, not bulged medially. Ocelli prominent. Maxillary palps short. Pronotum rectangular with rounded angles, much wider than long (width:length ratio 1.6–1.7), as wide as head. Mesonotum and metanotum very wide; posterior margin wider than shortest distance between eyes. Legs clothed with scattered pale hairs; tibiae short; hind tibia 0.9× as long as femur. Abdomen with T1–9 angled at mid-dorsal line to form a ridge; T10 bulged basally. Subanal lobes flat, rounded distally. Cerci short, thread-like. Anal gill rosette comprising many fine filaments.

**Type data.** Holotype female: NC–WD, Arthurs Pass, 18 January 1920, R.J. Tillyard (NZAC). Tillyard states “Holotype is apparently a male (abdomen shrivelled)”, but from my inspection and comparative measurements it is most probably a female.

**Material examined.** Holotype, plus 53 non-type examples (9 males, 35 females, 8 nymphs, 1 exuviae; IDMC, NZAC, CMNZ).

TO / BR, NC–WD, OL, CO, FD.

Adults collected January–March, December.
Remarks. The yellow coloration in the wings is most obvious in mature adults of unicolor, but is also evident even in teneral and bleached specimens.

There is some variation in the male genitalia. In most southern males the epiproct has a tapered tip and no anterior pair of marginal spines, and the membranous cone is long, extending well back towards the base of T10 (Fig. 98). In northern males and those from coastal FD the epiproct has a rounded tip and a pair of anterior marginal spines, and the membranous cone is short (Fig. 97).

_Zelandobius uniramus_ new species

Fig. 6, 24, 121, 126, 131, 142, 143; Map 32

Dimensions (mm). Male: body length 6–8; antenna 5.5–8; forewing 7–9.5; pronotum length 0.8, width 0.9. Female: body length 7–11; antenna 7–8.5; pronotum as for male. Nymph (late instar): body length 8; antenna 6.0; pronotum length 0.7, width 1.0; cerci 2.5.

Adult. Head brown, with a dark brown patch bounded by ocelli and base of antennae. Dorsal callosities distinct, sclerotised. Antennae long, about as long as body. Pronotum rectangular with rounded angles; width:length ratio 1.2–1.4. Mesonotum and metanotum almost uniformly brown. Legs long, pale brown to brown with a thin, dark bar on tibiae 0.2 of length from base. Forewing almost clear, with a faint brown tinge; veins brown, apart from distal crossveins, which are expanded with a dark outline; Rs unforked in all wings.

Male genitalia (Fig. 24, 121, 126, 131). Similar to _furcillatus_, but differing as follows. Epiproct with 2 pairs of marginal teeth, the basal pair long; a dark patch beneath base; tip long, thin, tapering to rounded apex. Paraprocts with tip rounded, tongue-shaped. Tergite 10 with no black hairs on lateral and anterior sclerites; medial sclerite long; posterior sclerite long, well upturned. Cerci comprising 8–11 segments.

Female genitalia (Fig. 142, 143). Subgenital plate produced onto S9; posterior margin convex, with a slight medial emargination; a subtriangular sclerotised patch stretching the length of plate midline, based on anterior margin, sometimes with a semicircular indentation in base (patch also evident in immature females). Cerci comprising 9 or 10 segments.

Nymph (Fig. 6). General colour grey to pale grey. Body and legs clothed in short, dark hairs. Integument heavier than in _furcillatus_. Head pale brown, with a brown patch bounded by ocelli and base of antennae; epicranium with a large, pale oval patch in each lateral half. Ocelli prominent. Antennae long, about 0.8× as long as body, pale, with a dark section at about 0.6 of length for about 8 segments and again apically; flagellum heavily clothed with short, dark hairs over proximal 0.6. Pronotum rectangular (width:length ratio 1.5), with rounded angles and dark C-shaped markings back-to-back on midline. Mesonotum and metanotum grey. Legs long (hind legs as long as abdomen), with a thin, dark bar across proximal 0.2 of tibiae. Abdomen pale grey, with a darker patch along midline of tergites. Tracheal trunks obscured by heavier integument. Anal gill rosette mauve, well developed. Cerci with segments darker distally.

Type data. Holotype male and 2 paratype females: MK, Lake Tekapo, Glenmore Stream, 1 December 1986, G.W. Gibbs.

Material examined. Type specimens, plus 29 non-type examples (5 males, 18 females, 5 nymphs, 1 associated exuviae; NZAC, IDMC).

Remarks. The name (Latin _uniramus_, one branch) alludes to the unforked state of vein Rs, and this is the only species of _Zelandobius_ with this character. The specimens from eastern SL and DN are much larger than the rest, but show no other differences.

_NOMEN DUBIUM_

_Zelandobius hudsoni_ (Hare)

_hudsoni_ Hare, 1910: 42: 30 (Leptoperla; initial very brief description). Tillyard, 1923: 207 (Zelandobius; expansion of Hare's description). McLellan, 1969: 3 (Zelandobius; evidence given for declaration of nomen dubium).

Remarks. The declaration still stands. The type material and that of Hare's other species have been destroyed by miles.
REFERENCES


Hare, E.J. 1910: Some additions to the Perlidae of New Zealand. Transactions of the New Zealand Institute 42: 29–33.


———. 1979: Revision of the stonefly family Eustheniidae (Plecoptera), with emphasis on the fauna of the Australian region. Aquatic insects 1: 17–50.
Fig. 1–6 Habitus, dorsal, of some antarctoperline stoneflies: (1) *Vesicaperla kuscheli*, male; (2) *V. substriipes*, female; (3,4) *Zelandobius confusus*, male and nymph; (5) *Z. illiesi*, nymph; (6) *Z. uniramus*, nymph. (Artist: IDM.)

Abbreviations used in figures

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ag</td>
<td>accessory gland</td>
</tr>
<tr>
<td>ago</td>
<td>accessory gland opening</td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>cercus</td>
</tr>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>globular mass at epiproct base</td>
</tr>
<tr>
<td>go</td>
<td>genital opening</td>
</tr>
<tr>
<td>it</td>
<td>lateral tooth of epiproct</td>
</tr>
<tr>
<td>m</td>
<td>muscle</td>
</tr>
<tr>
<td>mc</td>
<td>membranous cone of T10</td>
</tr>
<tr>
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<td>medial sclerite of T10</td>
</tr>
<tr>
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<td>oviduct</td>
</tr>
<tr>
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<td>ovariole</td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>posterior sclerite of T10</td>
</tr>
<tr>
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<td>posterior vas deferens opening</td>
</tr>
<tr>
<td>S1–10</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>sp</td>
<td>spermatophore</td>
</tr>
<tr>
<td>sro</td>
<td>seminal receptacle opening</td>
</tr>
<tr>
<td>tf</td>
<td>testicular follicle</td>
</tr>
<tr>
<td>T1–10</td>
<td>tergites 1–10</td>
</tr>
<tr>
<td>vd</td>
<td>vas deferens</td>
</tr>
<tr>
<td>vh</td>
<td>ventral hook of epiproct</td>
</tr>
<tr>
<td>vs</td>
<td>seminal vesicle</td>
</tr>
<tr>
<td>vso</td>
<td>seminal vesicle openings</td>
</tr>
</tbody>
</table>
Fig. 7–13 Male genitalia, *Vesicaperla* species, lateral (7–10) and dorsal (11–13): (7,11) *dugdalei*; (8,12) *kuscheli*; (9,13) *substirpes*; (10) *townsendi*. 

--38--
Fig. 14–16 Sternal patterns, *Vesicaperla* species: (14) *eylesii*; (15) *kusceli*, showing variation; (16) *substripes*, *dugdalei*, and *townsendi* shown with female genitalia. Fig. 17–20 Female genitalia, *Vesicaperla* species: (17) *dugdalei*, ventral; (18) *kusceli*, ventral; (19) *substripes*, laterodorsal; (20) *townsendi*.
Fig. 21–26 Morphological features of species groups in Zelandobius: (21) right wings, *foxi* (*confusus* group); (22) right forewing, *unicolor* (*furcillatus* group); (23, 24) male genitalia, dorsal, *cordatus* (*confusus* group) and *uniramus* (*furcillatus* group); (25, 26) hind leg, nymph, *confusus* and *furcillatus*. 
Fig. 27-30 Zelandobius confusus: (27) male internal genitalia and penis, dorsal; (28) penis and associated structures, ventral; (29) external genitalia of mated male, lateral; (30) female internal genitalia, ventral.

Fig. 31, 32 Z. macburneyi: (31) female external genitalia and spermatophore; (32) spermatophore.
Fig. 33-43 Male genitalia, part tergite 10 and epiproct, lateral, Zeiandobius species: (33) albofasciatus; (34) childi; (35-38) confusus and 3 epiproct tip variations – (36) Little Barrier I., CL; (37) Tinline River, MB; (38) lower Buller Gorge, BR; (39) cordatus; (40) dugdalei; (41-43) foxi and 2 epiproct tip variations from Mt Tevlot, CO.
Fig. 44–53 Male genitalia, part tergite 10 and epiproct, lateral, Zelandoblusspecies: (44) gibbsi; (45) illiesi; (46) inversus; (47) macburneyi; (48) mariae; (49) montanus; (50) patricki; (51) peglegensis; (52) takahe; (53) wardi.
Fig. 54–69 Male genitalia, distal part of right paraproct, lateral, *Zealandobius* species: (54) *albofasciatus*; (55) *childi*; (56) *confusus*; (57) *cordatus*; (58) *dugdalei*; (59) *foxi*; (60) *gibbsi*; (61) *liliusi*; (62) *inversus*; (63) *macburneyi*; (64) *mariae*; (65) *montanus*; (66) *patricki*; (67) *peglegensis*; (68) *takahe*; (69) *wardi*. 

-44-
Fig. 70–84 Male genitalia, distal half of tergite 10, dorsal, *Zelandobius* species: (70) *albofasciatus*; (71) *childi*; (72) *confusus*; (73) *dugdalei*; (74) *foxi*; (75) *gibbsi*; (76) *iliiisi*; (77) *inversus*; (78) *macburneyi*; (79) *mariae*; (80) *montanus*; (81) *patricki*; (82) *peglegensis*; (83) *takahe*; (84) *wardi*.
Fig. 85–107 Female genitalia, ventral, *Zelandobius* species: (85) alatus; (86) albofasciatus; (87) brevicauda; (88) childi; (89) confusus; (90) cordatus; (91) dugdalei; (92) foxi; (93) gibbsi; (94) illiesi; (95) jacksoni; (96) kuschelli; (97–100) macburneyi + sgp variants — (98) Rock & Pillar Range, CO; (99) Taranu Range, WN; (100) Pouaka Hump, TK; (101) montanus; (102) nage; (103) patricki; (104) takaha; (105–107) wardi + sgp variants.

Fig. 108–121 Male genitalia, tergite 10, and epiproct, lateral, *Zelandobius* species: (108–112) furcillatus, Waima R., ND and 4 variations — (109) Waimarino R., TO; (110) Ngawaterua Reserve, WI; (111) Gowan Outlet, L. Rotoroa, BR; (112) Buller R. at Slaty Ck, NN-BR; (113–115) pilosus holotype and 2 paratype variations of epiproct; (116–118) truncus holotype and 2 variations — (117) Ahukawakawa Swamp, TK; (118) Mata Sim, St Bathans, CO; (119,120) unicolor, Lewis Pass, BR and Rock & Pillar Range, CO; (121) uniramus.
Fig. 122-126 Male tergite 10 (part), dorsal. *Zelandobius* species: (122) *furcillatus*; (123) *pilosus*; (124) *truncus*; (125) *unicolor*; (126) *uniramus*.  
Fig. 127-131 Right paraproct, distolateral, *Zelandobius* species: (127) *furcillatus*; (128) *pilosus*; (129) *truncus*; (130) *unicolor*; (131) *uniramus*.  
Fig. 132-143 Female genitalia, *Zelandobius* species: (132,133) *auratus*, ventral and lateral; (134-136) *furcillatus* and sgp variations; (137) *pilosus*; (138,139) *truncus* and sgp variation; (140,141) *unicolor* and sgp variation; (142,143) *uniramus* and sgp variation.
DISTRIBUTION MAPS

OFFSHORE ISLANDS
Kermadecs
Three Kings
Chathams
Snares
Bounty
Antipodes
Aucklands
Campbell

Map 1 Collection localities, *Vesicaperla dugdalei*

Map 2 Collection localities, *Vesicaperla eylesi*
- Map 3 Collection localities, Vesicaperla kuscheli -
- Map 4 Collection localities, Vesicaperla substrips -
- Map 5 Collection localities, *Vesicaperla townsendi* •

- Map 6 Collection localities, *Zelandobius alatus* •
- Map 7 Collection localities, *Zelandobius albofasciatus* •

- Map 8 Collection localities, *Zelandobius brevicauda* •
- Map 9 Collection localities, Zelandobius childi

- Map 10 Collection localities, Zelandobius confusus
• Map 13 Collection localities, *Zelandobius forsi* •

• Map 14 Collection localities, *Zelandobius gibbsi* •
- Map 15 Collection localities, *Zelandobius illiesi*

- Map 16 Collection localities, *Zelandobius inversus*
• Map 17 Collection localities, *Zelandobius jacksoni* •

• Map 18 Collection localities, *Zelandobius kuscheli* •
• Map 19 Collection localities, *Zelandobius macburneyi* •

• Map 20 Collection localities, *Zelandobius mariae* •
- **Map 21** Collection localities, *Zelandobius montanus* •

- **Map 22** Collection localities, *Zelandobius ngaire* •
Map 23 Collection localities, *Zelandobius patricki*  

Map 24 Collection localities, *Zelandobius peglegensis*
- Map 25 Collection localities, *Zelandobius takahē*

- Map 26 Collection localities, *Zelandobius wardi*
- Map 29 Collection localities, *Zelandobius pilosus* -

- Map 30 Collection localities, *Zelandobius truncus* -
- Map 31 Collection localities, Zelandobius unicolor

- Map 32 Collection localities, Zelandobius uniramus
## Taxonomic Index

This index covers the nominal taxa mentioned in the text, regardless of their current status in taxonomy. Page numbers in bold type indicate descriptions of taxa, and in italic type illustrations. Suffixed letters are used to indicate keys (k) and distribution maps (m).

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acroperla</em></td>
<td>11, 12, 14k, 18, 46, 51m</td>
</tr>
<tr>
<td><em>alatus</em>, <em>Zelandobius</em></td>
<td>11, 12, 14k, 18, 46, 51m</td>
</tr>
<tr>
<td><em>albofasciatus</em>, <em>Zelandobius</em></td>
<td>11, 13k, 18, 42, 44–46, 52m</td>
</tr>
<tr>
<td><em>Antarctoperlinai</em></td>
<td>14</td>
</tr>
<tr>
<td><em>Arctoperlaria</em></td>
<td>14</td>
</tr>
<tr>
<td><em>Antarctoperla</em></td>
<td>14</td>
</tr>
<tr>
<td><em>Apteryoperla</em></td>
<td>8</td>
</tr>
<tr>
<td><em>Araucanioperla</em></td>
<td>14</td>
</tr>
<tr>
<td><em>auberti</em>, <em>Teutoperla</em></td>
<td>17</td>
</tr>
<tr>
<td><em>auratus</em>, <em>Zelandobius</em></td>
<td>11, 14k, 32, 48, 62m</td>
</tr>
<tr>
<td><em>Austroperlidae</em></td>
<td>8</td>
</tr>
<tr>
<td><em>brevicauda</em>, <em>Zelandobius</em></td>
<td>11, 13k, 19, 46, 52m</td>
</tr>
<tr>
<td><em>capense</em>, <em>Blechnum</em></td>
<td>17</td>
</tr>
<tr>
<td><em>Ceratoperla</em></td>
<td>14</td>
</tr>
<tr>
<td><em>childi</em>, <em>Zelandobius</em></td>
<td>11, 14k, 19, 42, 44–46, 53m</td>
</tr>
<tr>
<td><em>chiltoni</em>, <em>Neocurupira</em></td>
<td>11</td>
</tr>
<tr>
<td><em>Chilenoperla</em></td>
<td>14</td>
</tr>
<tr>
<td><em>confusa</em>, <em>Leptoperla</em></td>
<td>11, 10, 13k, 20, 22, 23, 27, 30, 36, 49–42, 44–46, 53m</td>
</tr>
<tr>
<td><em>confusus species-group</em></td>
<td>12k, 18, 30</td>
</tr>
<tr>
<td><em>cordatus</em>, <em>Zelandobius</em></td>
<td>11, 13k, 14k, 21, 40, 42, 44, 46, 54m</td>
</tr>
<tr>
<td><em>Crypturoperla</em></td>
<td>8</td>
</tr>
<tr>
<td><em>Diamphipnoidae</em></td>
<td>8</td>
</tr>
<tr>
<td><em>dagdalen</em>, <em>Vesicaperla</em></td>
<td>12k, 15, 38, 39, 49m</td>
</tr>
<tr>
<td><em>Zelandobius</em></td>
<td>13k, 14k, 22, 42, 44–46, 54m</td>
</tr>
<tr>
<td><em>elaphus</em>, <em>Cervus</em></td>
<td>8</td>
</tr>
<tr>
<td><em>Eusthenioidae</em></td>
<td>8</td>
</tr>
<tr>
<td><em>eylesi</em>, <em>Vesicaperla</em></td>
<td>12k, 15, 39, 49m</td>
</tr>
<tr>
<td><em>flavesens</em>, <em>Chionochloa</em></td>
<td>8, 11</td>
</tr>
<tr>
<td><em>foxi</em>, <em>Zelandobius</em></td>
<td>11–13k, 22, 26, 30, 40, 42, 44–46, 55m</td>
</tr>
<tr>
<td><em>fuscillatus</em>, <em>Zelandobius</em></td>
<td>9, 10, 14k, 31, 33, 34, 40, 47, 48, 62m</td>
</tr>
<tr>
<td><em>fuscillatus species-group</em></td>
<td>12k, 14k, 18, 30</td>
</tr>
<tr>
<td><em>gibbsi</em>, <em>Zelandobius</em></td>
<td>11–13k, 23, 43–46, 55m</td>
</tr>
<tr>
<td><em>Gripopterygidae</em></td>
<td>8, 15</td>
</tr>
<tr>
<td><em>hudsoni</em>, <em>Leptoperla</em></td>
<td>34</td>
</tr>
<tr>
<td><em>Zelandobius</em></td>
<td>34</td>
</tr>
<tr>
<td><em>illesi</em>, <em>Zelandobius</em></td>
<td>9, 11–13k, 24, 36, 43–46, 56m</td>
</tr>
<tr>
<td><em>inversus</em>, <em>Zelandobius</em></td>
<td>11–13k, 25, 43–45, 56m</td>
</tr>
<tr>
<td><em>jacksoni</em>, <em>Zelandobius</em></td>
<td>11–13k, 25, 46, 57m</td>
</tr>
<tr>
<td><em>kuscheli</em>, <em>Vesicaperla</em></td>
<td>11–13k, 16, 36, 39, 46, 50m</td>
</tr>
<tr>
<td><em>Zelandobius</em></td>
<td>12, 25, 57m</td>
</tr>
<tr>
<td><em>Leptoperlinae</em></td>
<td>8</td>
</tr>
<tr>
<td><em>macburneyi</em>, <em>Zelandobius</em></td>
<td>11, 13k, 26, 30, 41, 43–46, 58m</td>
</tr>
<tr>
<td><em>mantelli</em>, <em>Notornis</em></td>
<td>29</td>
</tr>
<tr>
<td><em>mariae</em>, <em>Zelandobius</em></td>
<td>11–12k, 26, 43–45, 58m</td>
</tr>
<tr>
<td><em>montanus</em>, <em>Zelandobius</em></td>
<td>11–13k, 27, 43–46, 59m</td>
</tr>
<tr>
<td><em>monticola</em>, <em>Apteryoperla</em></td>
<td>9</td>
</tr>
<tr>
<td><em>ngaire</em>, <em>Zelandobius</em></td>
<td>11–12k, 28, 46, 59m</td>
</tr>
<tr>
<td><em>Nothofagus</em></td>
<td>9, 24</td>
</tr>
<tr>
<td><em>Notonemouridae</em></td>
<td>8, 9</td>
</tr>
<tr>
<td><em>oreophila</em>, <em>Chionochloa</em></td>
<td>17</td>
</tr>
<tr>
<td><em>pallens</em>, <em>Chionochloa</em></td>
<td>8, 11, 17</td>
</tr>
<tr>
<td><em>pallidus</em>, <em>Zelandobius</em></td>
<td>20, 21</td>
</tr>
<tr>
<td><em>patricki</em>, <em>Zelandobius</em></td>
<td>11–13k, 28, 43–45, 46, 60m</td>
</tr>
<tr>
<td><em>peglegensis</em>, <em>Zelandobius</em></td>
<td>11–13k, 28, 43–45, 56m</td>
</tr>
<tr>
<td><em>Pelurgoperla</em></td>
<td>14</td>
</tr>
<tr>
<td><em>Perlidac</em></td>
<td>8</td>
</tr>
<tr>
<td><em>personata</em>, <em>Pelurgoperla</em></td>
<td>9</td>
</tr>
<tr>
<td><em>pilosus</em>, <em>Zelandobius</em></td>
<td>9, 11, 14k, 30, 31, 47, 48, 62m</td>
</tr>
<tr>
<td><em>Plegoperla</em></td>
<td>14</td>
</tr>
<tr>
<td><em>smithii</em>, <em>Cyathea</em></td>
<td>9</td>
</tr>
<tr>
<td><em>spiniger</em>, <em>Acroperla</em></td>
<td>9</td>
</tr>
<tr>
<td><em>substirpes</em>, <em>Vesicaperla</em></td>
<td>8, 12k, 14, 16, 36, 38, 39, 50m</td>
</tr>
<tr>
<td><em>takahe</em>, <em>Zelandobius</em></td>
<td>11, 13k, 29, 43–45, 46, 61m</td>
</tr>
<tr>
<td><em>townsendi</em>, <em>Vesicaperla</em></td>
<td>12k, 17, 38, 39, 51m</td>
</tr>
<tr>
<td><em>truncus</em>, <em>Zelandobius</em></td>
<td>11, 14k, 33, 47, 48, 63m</td>
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<td><em>wiselyi</em>, <em>Panisopsis</em></td>
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<td><em>Zelandoperlinai</em></td>
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Area codes and boundaries used to categorise specimen locality data (after Crosby et al. 1976)

Base-map for plotting collection localities; this may be photocopied without copyright release.
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ERRATA

It was discovered after publication that several illustrations are incorrectly numbered. The Series Editor regrets these errors, which arose during recompilation of the plates. The following changes should be made to figure numbers only (i.e., the numbers in captions and text are correct):

Page 42 – change 40 to 41, 41 to 42, 42 to 43, 43 to 40;
Page 43 – change 46 to 47, 47 to 49, 48 to 50, 49 to 52, 50 to 51, 51 to 53, 52 to 46, 53 to 48;
Page 44 – change 62 to 63, 63 to 65, 64 to 66, 65 to 67, 66 to 68, 67 to 69, 68 to 62, 69 to 64;
Page 45 – change 77 to 78, 78 to 80, 79 to 81, 80 to 82, 81 to 83, 82 to 84, 83 to 77, 84 to 79;
Page 47 – change 119 to 121, 120 to 119, 121 to 120.
Fauna of New Zealand
Ko te Aitanga Pepeke o Aotearoa

Number 27

Antarctoperlinae
(Insecta: Plecoptera)

I. D. McLellan

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