

Fauna of New Zealand
Ko te Aitanga Pepeke o Aotearoa
Number / Nama 27

Antarctoperlinae
(Insecta: Plecoptera)

I.D. McLellan
Private Box 95, Westport
New Zealand

1993
Manaaki Whenua Press
Lincoln, Canterbury, New Zealand

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

Copyright © 1993 Landcare Research New Zealand Ltd

No part of this work covered by copyright may be reproduced or copied in any form or by any means (graphic, electronic, or mechanical, including photocopying, recording, taping information retrieval systems, or otherwise) without the written permission of the publisher

Cataloguing in publication

McLELLAN, I.D.

Antarctoperlinae (Insecta: Plecoptera). – Lincoln, N.Z. : Manaaki Whenua Press, 1993

(Fauna of New Zealand = Ko te Aitanga Pepeke o Aotearoa, ISSN 0111-5383 ; no. 27)

ISBN 0-477-01644-8

I. Title II. Series

UDC 595.735(931)

Prepared for publication by the Series Editor using computer-based text processing, layout, and printing at Landcare Research New Zealand Ltd, Mt Albert Research Centre, Private Bag 92170, Auckland, N.Z

Maori text by UniServices Translation Centre, Auckland

Published by Manaaki Whenua Press, Landcare Research New Zealand Ltd

P.O. Box 40, Lincoln, Canterbury, New Zealand

Printed by GP Print Ltd, Wellington

Front cover The insect depicted is *Zelandobius confusus*, nymph. Artist: I.D. McLellan

Aro mua Ko te ngaarara nei a *Zelandobius confusus*, tuungoungou. Toihanga: I.D. McLellan

Class / Karaaihe **Insecta**

Order / Oota **Plecoptera**

Subfamily / Whaamere-iti

Antarctoperlinae

‘Stoneflies’ (part)

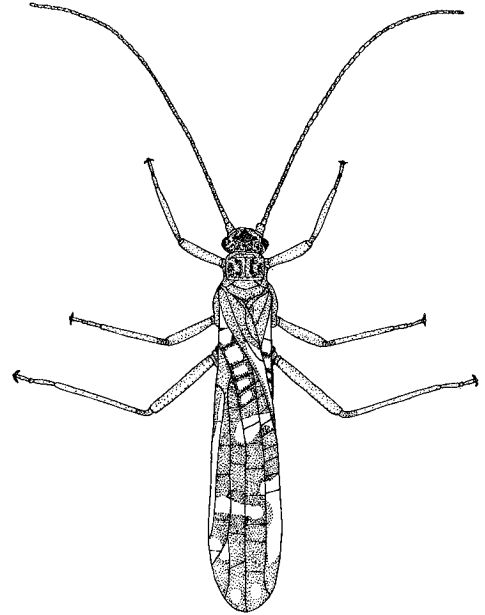


Illustration: *Zelandobius confusus*, adult male. Artist: I.D. McLellan.

Whakaahua: *Zelandobius confusus*, taane. Toihanga: I.D. McLellan.

The Antarcticoperlinae 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 sub-antarctic 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.

Ko te Antarcticoperlinae he roopuu ngaro-koowhatu e kitea ana i Niu Tiireni me te pito tonga o Amerika Tonga, ka mutu. E ai ki nga tikanga whakapapa o te Paakehaa e toru tekau ma rua nga tuumomo (species), e rima kei roto i te hapuu (genus) *Vesicaperla*, e rua tekau ma whitu kei roto i te hapuu *Zelandobius*. Kei te Waipounamu anake nga tuumomo o te hapuu *Vesicaperla*. Konga tuumomo *Zelandobius* kei nga waahi katoa o Aotearoa me Te Waipounamu, haaunga nga moutere ki te tonga o Rangiura.

He rere kee nga kaainga e paingia ana e eenei hapuu tuungoungou. Kei roto i nga wai anake nga tuungoungou *Zelandobius*. He raapihi, he rimurimu (algae) nga kai. Kei te whenua kee nga tuungoungou *Vesicaperla*, kei nga waahi whakamaatao i raro i nga tarutaru i runga i nga maunga teitei. Ko te kai he kiri raakau, he harore e tupu ana i runga i te kiri raakau.

I nga tuungoungou e tupu ana, e torotoru nga whakamaanutanga kiri, aa, ka puta mai te pakeke. E whaa parirau o te nuunga o nga *Vesicaperla*; hore kaunga parirau o nga *Zelandobius*, haaunga te kotahi o nga tuumomo. Ko te orange o te uha, he torotoru wiki ka mate. He kai-raakau te kai. Ka ai, ka whakatakoto i oona heeki.

(continued overleaf)

(ara haere tonu)

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.

Na Ian McLellan teenei riipoata. Ko ia te tumuaki o te tari maatauranga i Buller Kaareti i Westport, aa, ka riitaea ia i te tau 1980. No toona huritau whaa te kau ka uru ia ki ki te waahanga maatauranga e paa ana ki nga ngaarara e noho ana i roto i te wai. Na tana kaha ki teenei mahi, kua nui noa ake nga tuumomo ngaro koowhatu e moohiotia ana i Aahitereiria. Ko ia hoki te tangata tuatahi i aata maatakitaki ai i nga ngaro koowhatu o nga moutere Falklands, e rua nga tuumomo. Naana hoki i whakatikatika nga Thaumaleidae, he waahanga no nga Diptera. I eetahi waa kua mahi ia i te Max Planck Institute for Limnology (araa, mo te aahua o nga repo) i Tiamana. Kua whiwhi hoki ia ki eetahi puutea moni hei whakangaawari i ana mahi.

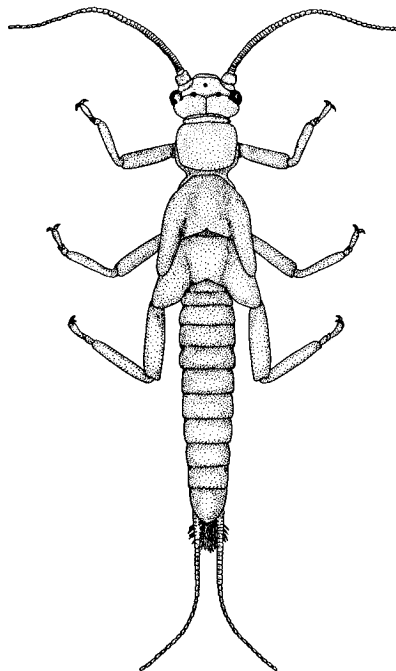


Illustration: *Zelandobius confusus*, nymph. Artist: I.D. McLellan.

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

Kua whakairohia nga tuungoungou me nga ngaro o nga tuumomo *Vesicaperla* hei huna i a raatou i roto i nga tarutaru. I te whakaohoreretanga ka torona nga waewae me nga puuhihi, aa, ka aata koiri hoki kia rite ai te aahua ki nga karaaihe e nohoia ana.

He itiiti eenei ngaro, aa, kaaore e hahae ana te kara. Engari, i te horahanga a nga parirau ka kitea nga whakairoiro, he maa eetahi waahi, he kaakarauri eetahi waahi. He omaoma to raatou haere, engari ka taaea te rere-a-parirau i eetahi waa.

Ka hangaia ki te huruhuru manu he tauira mo nga ngaro koowhatu e nga kai-hii taraute, engari kaaore teenei tauira e ingoatia ana, he ahakoa te pai o *Zelandobius* hei kai ma te taraute me nga ika maaori. He tohutohu eetahi tuumomo *Zelandobius* mo te pai mo te kino raanei o te wai.

Ka taaea te kite-a-kanohi ko teewhea tuumomo eetahi o nga ngaro koowhatu rarahi; engari, mo te nuinga, ma te koata e kiiia ana 'electron microscope' e whakaatu ko teewhea tuumomo. Ka aata tirohua nga parirau, te tinana, nga waewae, nga taihemahema.

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 ANTARCTOPERLINÆ.....	14
Genus <i>Vesicaperla</i> McLellan, 1967	14
<i>dugdalei</i> McLellan, 1977	15
<i>eylesi</i> McLellan, 1977	15
<i>kuscheli</i> McLellan, 1977	16
<i>substirpes</i> McLellan, 1967	16
<i>townsendi</i> McLellan, 1977	17
Genus <i>Zelandobius</i> Tillyard, 1921	17
<i>confusus</i> group	18
<i>alatus</i> new species	18
<i>albofasciatus</i> new species	18
<i>brevicauda</i> McLellan, 1977	19
<i>childi</i> new species	19
<i>confusus</i> (Hare, 1910)	20
<i>cordatus</i> new species	21
<i>dugdalei</i> new species	22
<i>foxi</i> new species	22
<i>gibbsi</i> new species	23
<i>illiesi</i> McLellan, 1969	24
<i>inversus</i> new species	25
<i>jacksoni</i> new species	25
<i>kuscheli</i> new species	25
<i>macburneyi</i> new species	26
<i>mariae</i> new species	26
<i>montanus</i> new species	27
<i>ngaire</i> new species	28
<i>patricki</i> new species	28
<i>peglegensis</i> new species	28
<i>takahe</i> new species	29
<i>wardi</i> new species	29
<i>furcillatus</i> group.....	30
<i>auratus</i> new species	30
<i>furcillatus</i> Tillyard, 1923	31
<i>pilosus</i> Death, 1990	31
<i>truncus</i> new species	33
<i>unicolor</i> Tillyard, 1923	33
<i>uniramus</i> new species	34

Nomen dubium :

<i>Zelandobius hudsoni</i> (Hare, 1910)	34
---	----

CONTENTS

Acknowledgments	7
Introduction	8
Systematics	8
Biology	8
Morphology (<i>Zelandobius</i>)	9
Copulation (<i>Zelandobius</i>)	10
Distribution and ideas on evolution (<i>Zelandobius</i>) ..	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

ACKNOWLEDGMENTS

I am most grateful to Dr T.K. Crosby (NZAC), Mr A.C. Harris (OMNZ), Prof. M.J. Winterbourn, Mr P.M. Johns, and Mr R.G. Death (Canterbury University, Christchurch), Mr K.A.J. Wise (AMNZ), Dr J.B. Ward (CMNZ), and Dr R.M. Emberson (Lincoln University, Lincoln, Canterbury) for the loan of material. I am also indebted to the following who have collected and sent me much useful material: the late Dr K.J. Fox (Manaia), Dr G.W. Gibbs (Victoria University of Wellington), Miss J. Hape and Ms C.M.F. Herd (Dannevirke), Mr I.M. Henderson (Massey University, Palmerston North), and Mr B.H. Patrick (Department of Conservation, Dunedin).

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 a 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 1967) 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. pallens*, 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 obstructions. David Marx (pers. comm.) states that at Lake Pounui (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 summarised 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 predominately 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 Ant-artoperlinae. 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 larvae attached to adults and nymphs of the wingless terrestrial gripopterygid *Apteryoperla monticola* 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 Antarcticperlaria. 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, strand-like lobes on the dorsal surface between the ventral lobes.

In Antarcticperlinae 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 taper 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 Antarcticperlaria, because sperm is transferred in a spermatophore the genital cavity and the attachment of the seminal receptacle differ from the condition in Arctoperlaria, 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 (*albofasciatus*, alpine in western NN and BR). A few have been collected only in restricted areas: *jacksoni* and *peglegensis*, 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 Murchison Mountains and Turret Range (FD).

Some species appear only in the south, like *Z. foxi*, 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 *Chionochoa flavescens* and *C. pallens* 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 sorting. 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 (Na_3PO_4), 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 *eylesi*
 —Pale spot absent 4
- 4(3) Gena below eye 0.4× as deep as eye; male paraprocts with sharp tips *kuscheli*
 —Gena below eye 0.2× 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 *illiesi*
 —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 *illiesi*
—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 median

- 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 0.4× 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 ANTARCTOPERLINAЕ

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.

Genera included: *Antarctoperla* Enderlein, *Ceratoperla* Illies, *Chilenoperla* Illies, *Pelurgoperla* Illies, *Araucanoperla* Illies, and *Plegoperla* Illies, all from South America; *Zelandobius* Tillyard and *Vesicaperla* McLellan from New Zealand.

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

Genus *Vesicaperla* McLellan

Vesicaperla McLellan, 1967: 11 (initial diagnosis); — 1977: 140 (revised diagnosis, addition of new species).

Type species *Vesicaperla substirpes* McLellan, 1967.

Adult. Apterous or micropterous stoneflies of medium size (10–18 mm). Ocelli present. Maxillary palp with distal segment a little shorter than preceding segment. Thoracic spiracles raised on prominent cones. Abdomen with a lateral tergal ridge, and with a distinctive general colour pattern on sternites and tergites. Femora and tibiae with a row of short, dark marks. Cerci short, comprising about 20–30 segments.

Male genitalia. Epiproct with a posteroventrally projecting hook, which is usually distal, but without a prominent keel; lateral margins lined with small teeth dorsally. Paraprocts 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

dugdalei McLellan, 1977: 142–143 (initial description of male, female, and nymph).

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

kuscheli McLellan, 1977: 140–142 (initial description of male, nymph, and female genitalia).

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 $0.4\times$ 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 posteromedial emargination.

Nymph (late instar) with same colour patterns as adult. Antennae and cerci respectively $0.5\times$ and $0.3\times$ 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.

— / NN.

Adult collected December.

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

Vesicaperla substirpes McLellan

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

substirpes McLellan, 1967: 11–15 (initial description of male, female, and nymph, with figures); —1977: 145 (additions to description).

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 – $0.65\times$ 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 sclerite 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 ($42^{\circ}15'S$, $172^{\circ}04'E$), 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).

— / BR, CO.

Adults collected or emerged October–January.

Remarks. *V. substirpes* is the only New Zealand ant-

arctoperline with an ovipositor. Only one other gripopterygid has such a prolongation of the subgenital plate: *Teuoperla 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 nymph).

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; forewing pad 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.

Nymph. Colour patterns more sharply defined than in adult. Epicranium pale brown, with dark brown mottling. Wingpads present. Mesonotum, metanotum, and abdominal tergites 1–9 with a median posterodorsal projection. Vesicle absent.

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.J. Townsend (NZAC).

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

Adults collected January and November.

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 *Chionocholea 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₊₄ and *Cu*, incomplete distally. Thoracic spiracles not on cones. Lateral tergal ridge evident on abdomen. Cerci short, usually comprising no more than 15 segments.

Male genitalia (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. Paraprocts broadening distally before tapering abruptly to either a terminal spine or a rounded blade (Fig. 63). Tergite 10 divided into 2 anterolateral sclerites with a medial sclerite behind them, followed by a membranous cone, then terminating in a dark, sclerotised knob. Penis membranous, 5-lobed, evaginated from beneath subgenital plate in mated specimens (Fig. 27–29).

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. Cerci sturdy or thread-like, less than half as long as body.

Species included: *brevicauda* McLellan, *confusus* (Hare), *furcillatus* Tillyard, *illiesi* McLellan, *pilosus* Death, *unicolor* Tillyard, and the following new species: *alatus*, *albofasciatus*, *auratus*, *childi*, *cordatus*, *dugdalei*, *foxi*, *gibbsi*, *inversus*, *jacksoni*, *kuscheli*, *macburneyi*, *mariae*, *montanus*, *ngaire*, *patricki*, *peglegensis*, *takahe*, *truncus*, *uniramus*, *wardi*.

The genus is here divided into two species-groups, the *confusus* 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*, *macburneyi*, *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 apices of its arms extending into the lobes. Medial emargination and lobes with narrow, heavily sclerotised margins. Subgenital plate and sternite 9 with prominent lateral sternotergal ridges. Cerci 12-segmented.

Type data. Holotype female: CO, Old Man Range, 1554 m, in pool, 19 February 1974, J.S. Dugdale (NZAC). Paratypes: 2 females, CO, Rock & Pillar Range, 1280 m asl, 5 December 1991, B.H. Patrick (NZAC).

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 a 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.

Type data. Holotype male: BR, Paparoa Range, Lochnagar Ridge, 1200–1310 m, 6 December 1969, J.S. Dugdale (NZAC). Paratype female: BR, Paparoa Range, Lochnagar Ridge lake, 930 m, 3 December 1969, JSD (NZAC).

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.

—/NN, BR.

Adults collected November, December.

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

***Zelandobius brevicauda* McLellan**

Fig. 87; Map 8

brevicauda McLellan, 1977: 119–147 (initial description of female, with figures).

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. Sternite 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).

—/FD.

Adults collected January.

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, apodemes, 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 as *inconfuscus*).

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).

confusus Tillyard, 1921 (*Zelandobius*; as type species of genus); —1923: 206–207 (additions to description, and figure of forewing). Winterbourn, 1965 (description and figures of nymph). McLellan, 1966: 6–8 (description of male and female genitalia and nymph, with figures); —1969: 26–32 (description of male, female, and nymph, with figures).

pallidus Winterbourn, 1965: 275–277 (*Zelandobius*; description with figures of male, female, and nymph). McLellan, 1969: 27 (junior synonym of *confusus*).

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; tergite 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 crossveins 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 medial 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 / SI.

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 sclerite, 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 Kaimanawa Range (TO), the Kaweka Range (HB), and Mt Holdsworth in the eastern Tararua Range (WN). A single male from the lower Hollyford Valley (FD) 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, FD.

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.

Adult. 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 *Cu*, 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; prosthema covered with short, slender spines.

Type data. Holotype male: FD, Darran Mountains, Tutoke 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 1.36–1.68; 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× 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. Abdomen 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 posterovertrally, 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

illiesi McLellan, 1969: 25–41 (initial description of male, female, and nymph, with figures).

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 almost uniformly brown, 1.8× as wide as long; anterior angles more or less visibly produced into rounded points. 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 lightly sclerotised, diamond-shaped posteromedial 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 posterodorsal projection clothed with denticles; T1–9 with posterior margins outlined with denticles; T10 of females bulged basally. Cerci short and threadlike distally.

Type data. Holotype female and associated exuviae reared from nymph collected 10 September 1966, emerged 15 December 1966 (NZAC). Allotype male and associated exuviae reared from nymph collected 7 September 1967, emerged 18 September 1967 (NZAC). Paratypes: 8 nymphs, NN–BR, lower Buller Gorge, stream on terrace of Ohikanui River 1 km E of Ohikanui Bridge, 6 September 1966, I.D. McLellan (NZAC).

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), Turoa (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.

Type data. Holotype male: CO, Pisa Range, 1650–1700 m asl, 3–4 January 1992, B.H. Patrick (NZAC).

Material examined. Holotype only (unique).

— / CO.

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 crossveins 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 sternotergal 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.

Type data. Holotype female: NC–WD, Arthurs Pass National Park, Edwards Valley, 13 September 1965, J.R. Jackson (CMNZ).

Material examined. Holotype only (unique).

— / NC–WD.

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.

Type data. Holotype female and paratype female: FD, Manapouri, Wolfe Flat, 1000 m asl, 16 January 1970, G. Kuschel.

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 1.12–1.36. 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 posteromedial lines and a brown rugose 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 coalesced 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 anterodorsally and rounded posteroventrally, 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 cone 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 anterolateral extensions enclosing a V-shaped area, and sometimes another V-shaped notch in posterior margin. 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.

Type data. Holotype male: CO, Rock & Pillar Range, 1150 m, 11 November 1969, J.G.R. McBurney (NZAC).

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

TO, TK, RI, WN/NN, MB, NC, MC, 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 anterolateral 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.

Type data. Holotype male: CO, Pisa Range, 1650–1700 m asl, 3–4 January 1992, B.H. Patrick (NZAC).

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 0.55× as long as body. Forewing slightly shorter than body, its width:length ratio 0.3; main veins and basal crossveins yellow-brown, distal crossveins almost transparent; a slight yellow tinge in wing, but anal field tinged brown, and pterostigma almost opaque; *Rs* fork long, 0.28× as long as *Rs*; *Rs* cell with about 3 distal crossveins. 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 width:length ratio 0.3; vein and wing coloration as in male, but with additional subrectangular dark patches around distal crossveins. 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.

Type data. Holotype female and 1 paratype female: BR–MB, Ada Pass hut, 1158 m asl, 17 December 1985, G.W. Gibbs (NZAC).

Material examined. Type specimens only.

— / BR–MB.

Adults collected December.

Remarks. This species is dedicated to my late wife Ngairé 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 8.3–8.5; 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, 0.26–0.28× 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 subtended area tapering to middle third of anterior margin; a sub-semicircular membranous area at base of plate. Sternite 9 with a medial, membranous semi-circular 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.

Type data. Holotype male: CO, Rock & Pillar Range, 660 m, 'The Wandle', 16 August 1990, B.H. Patrick (OMNZ).

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

— / NN, MB, MC, CO, OL, FD.

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, 0.29× 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. Paraprocts 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 posterior 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 takaha 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. Antennal 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. Paraprocts 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; genital 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, Takaha 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 takaha (*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 crossveins 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 epiproct 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 *confusus*, 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).

— / MC.

Adults collected September–November.

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 *confusus* 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 bordered by prominent laterosternal ridges which are wider anteriorly and clearly visible ventrally; plate extending more onto S9 than in *confusus* group, and with either poorly developed lobes on hind margin or none; subanal lobes narrowly tongue-shaped, more tapered and much thicker than in *confusus* 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).

— / CO.

Adult collected September.

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

furcillatus Tillyard, 1923: 207 (initial description, brief comments on genitalia, and illustration of forewing). McLellan, 1965: 232–233 (description and illustrations of genitalia); —1969: 32–33 (redescription with illustrations). Winterbourn, 1965: 274–275 (initial description of nymph).

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; fore 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, Tara-wera, 15–16 November 1919, R.J. Tillyard (NZAC).

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

ND, AK, BP, TO, GB, HB, WI, WN, WA/NN, 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 Rotorua, NN; Fig. 111) or with the apex kinked posteriorly (Peel 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 Waimarino (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 0.8–1.1. 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× 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 sclerite 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.

Type data. Holotype male: MC, Porter River, 732 m asl, 27 June 1987, R.G. Death (NZAC). Paratypes: 1 male, 2 females, MC, Dry Stream, 16 June 1987, RGD; 6 males, 3 females, MC, Porter River, 27 June 1987, 4 August 1987, 5 June 1988, RGD; 8 middle-instar nymphs, MC, Porter River, 7 March 1990, RGD (NZAC, AMNZ, NMNZ, CMNZ).

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.

The complex hairs on the nymphal integument trap detritus which tends to camouflage it.

Death (1990) stated that adults emerged only in winter, but in the material examined here some adults were collected outside that season.

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. fuscillatus* 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 bulged 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. fuscillatus*. 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 exuvia; NZAC, IDMC).

TK, WN / CO, OL.

Adults collected October–December.

Remarks. *Z. truncus* is closely allied to *Z. fuscillatus*, 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

unicolor Tillyard, 1923: 208 (initial description, with illustration of forewing). McLellan, 1969: 33–36 (redescription, plus first descriptions of genitalia and nymph, with figures).

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 *Cu*₁. 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 *fuscillatus*. 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 exuvia; 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).

— / CO, DN, FD, SL / SI.

Adults collected January, November, December.

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 using drawings of specimen from an unnamed source and stating that he had not taken this species). 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 mites.

REFERENCES

- Crosby, T.K.; Dugdale, J.S.; Watt, J.C. 1976: Recording specimen localities in New Zealand: an arbitrary system of areas and codes defined. *New Zealand journal of zoology* 3: 69 + map.
- Death, R.G. 1990: A new species of *Zelandobius* (Plecoptera: Gripopterygidae: Antartoperlinae) from New Zealand. *New Zealand natural sciences* 17: 23–28.
- Dumbleton, L.J. 1963: New Zealand Blephariceridae (Diptera: Nematocera). *New Zealand journal of science* 6 (2): 234–258.
- Enderlein, G. 1909: Über die Plecopteren-Subfamilie Antartoperlinae und eine neue Gattung derselben von den Auckland-Inseln. *Deutsche entomologische Zeitschrift* 53: 679–84.
- Hare, E.J. 1910: Some additions to the Perlidae of New Zealand. *Transactions of the New Zealand Institute* 42: 29–33.
- Illies, J. 1961: Sudamerikanische Notonemourinae und die Stellung der Unterfamilie im System der Plecopteren. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 34 (2): 97–126.
- 1963: Revision der sudamerikanischen Gripopterygidae (Plecoptera). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 36 (3): 146–248.
- 1965: Neue Plecopteren aus Chile und Argentinien. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 36 (3): 151–156.
- 1975: Notonemouridae of Australia (Plecoptera, Ins.). *Internationale Revue gesamten Hydrobiologie* 60 (2): 221–249.
- McLellan, I.D. 1965: Notes on some New Zealand Plecoptera. *Transactions of the Royal Society of New Zealand* 6 (22): 229–234.
- 1966: Genitalia and nymphs of some New Zealand Gripopterygidae (Plecoptera). *Transactions of the Royal Society of New Zealand, zoology* 8 (2): 5–22.
- 1967: New gripopterygids (Plecoptera) of New Zealand. *Transactions of the Royal Society of New Zealand, zoology* 9 (1): 1–15.
- 1969: A revision of the genus *Zelandobius* (Plecoptera: Antartoperlinae). *Transactions of the Royal Society of New Zealand* 11 (3): 25–41.
- 1977: New alpine and southern Plecoptera from New Zealand, and a new classification of Gripopterygidae. *New Zealand journal of zoology* 4: 119–147.
- 1990: Pp. 135–140 in 'Mayflies and stoneflies: life history and biology'. *Series entomologica, vol. 44*. The Hague, Junk.
- 1991: Notonemouridae (Insecta: Plecoptera). *Fauna of New Zealand* 22. 64 pp.
- McLellan, I.D.; Wais, I.R.; de Cabo, L.I. 1990: The first record of stoneflies from the Malvinas / Falkland Islands. *Aquatic insects* 12 (3): 177–180.
- Michaelis, F.B. 1988: Plecoptera. In 'Zoological Catalogue of Australia'. Australian Government Publishing Service.
- Tillyard, R.J. 1921: A new classification of the order Perlaria. *Canadian entomologist* 53: 35–43.
- 1923: The stoneflies of New Zealand (order Perlaria). *Transactions of the New Zealand Institute* 54: 197–217.
- Wardle, P. 1979: Plants and landscape in Westland National Park. *National Parks scientific series, no. 3*.
- Watt, J.C. 1979: Abbreviations for entomological collections. *New Zealand journal of zoology* 6: 519–520.
- Winterbourn, M.J. 1965: Studies on New Zealand stoneflies. 1. Taxonomy of larvae and adults. *New Zealand journal of science* 8: 253–284.
- Wisely B. 1953: Two wingless alpine stoneflies (order Plecoptera) from southern New Zealand. *Records of the Canterbury Museum* 6 (3): 219–231.
- Womersley, H. 1953: An interesting new larval species of *Panisopsis* (Thyasidae, Acarina) from New Zealand. *Records of the Canterbury Museum* 6 (3): 233–235.
- Zwick, P. 1973: Insecta: Plecoptera. Phylogenetisches System und Katalog. *Das Tierreich* 94. xxxii + 465 pp.
- 1979: Revision of the stonefly family Eustheniidae (Plecoptera), with emphasis on the fauna of the Australian region. *Aquatic insects* 1: 17–50.

ILLUSTRATIONS

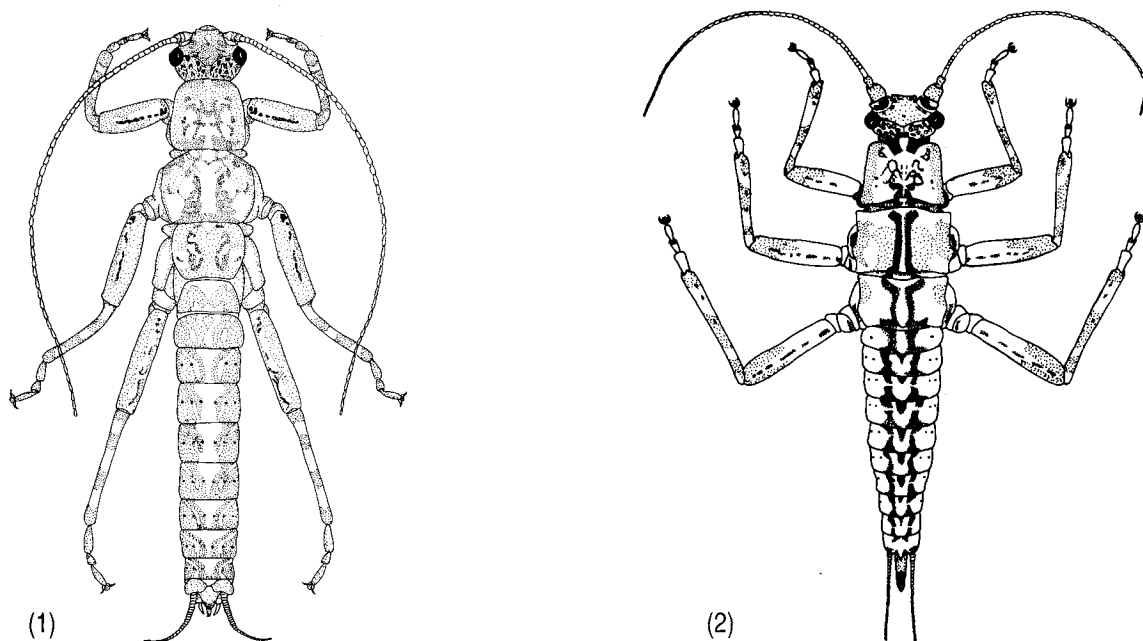
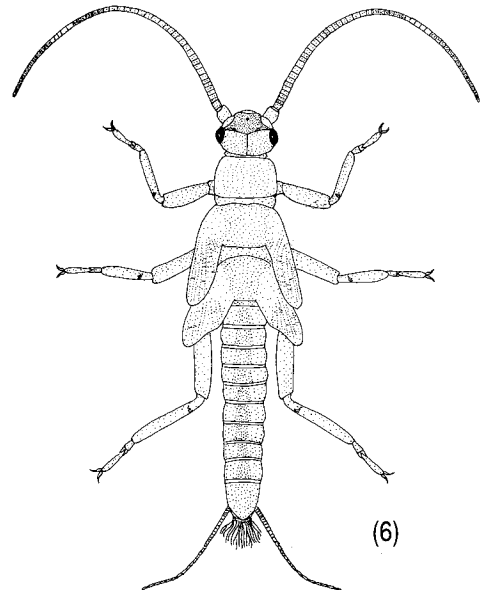
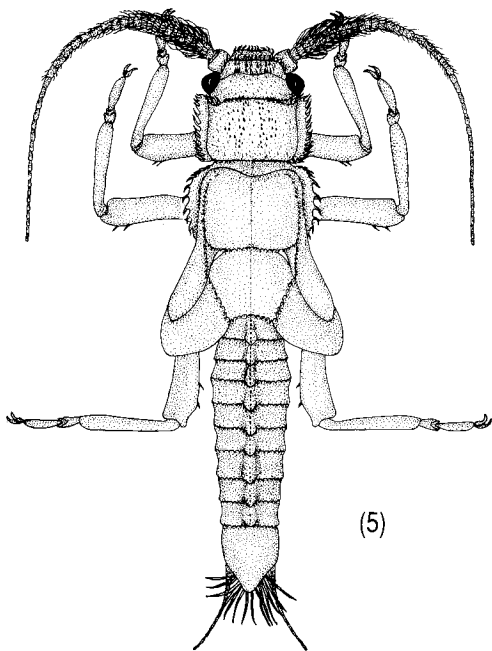
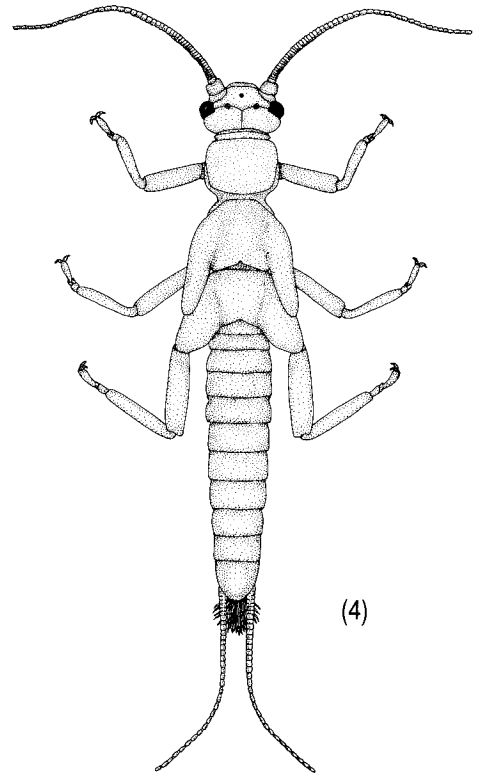
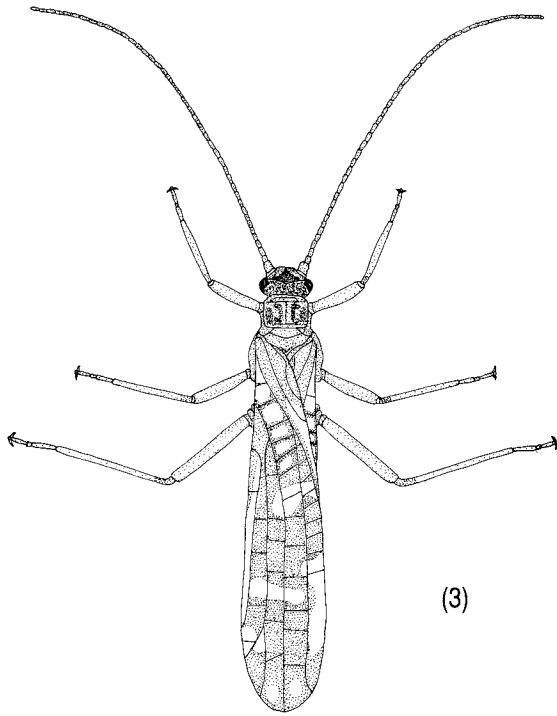


Fig. 1–6 Habitus, dorsal, of some antarctoperline stoneflies: (1) *Vesicaperla kuscheli*, male; (2) *V. substirpes*, female; (3,4) *Zelandobius confusus*, male and nymph; (5) *Z. illiesi*, nymph; (6) *Z. uniramus*, nymph. (Artist: IDM.)

Abbreviations used in figures

ag	accessory gland	pa	paraproct
ago	accessory gland opening	pe	penis
as	anterior sclerite of T10	ps	posterior sclerite of T10
bsce	basal sclerite of cercus	pvd	posterior vas deferens
ce	cercus	pvdo	posterior vas deferens opening
cod	common oviduct	S1–10	sternites 1–10
ep	epiproct	sgp	subgenital plate
gc	genital cavity	sgpp	subgenital plate pattern
gm	globular mass at epiproct base	sp	spermatophore
go	genital opening	sro	seminal receptacle opening
lt	lateral tooth of epiproct	tf	testicular follicle
m	muscle	T1–10	tergites 1–10
mc	membranous cone of T10	vd	vas deferens
ms	medial sclerite of T10	vh	ventral hook of epiproct
od	oviduct	vs	seminal vesicle
ov	ovariole	vso	seminal vesicle openings



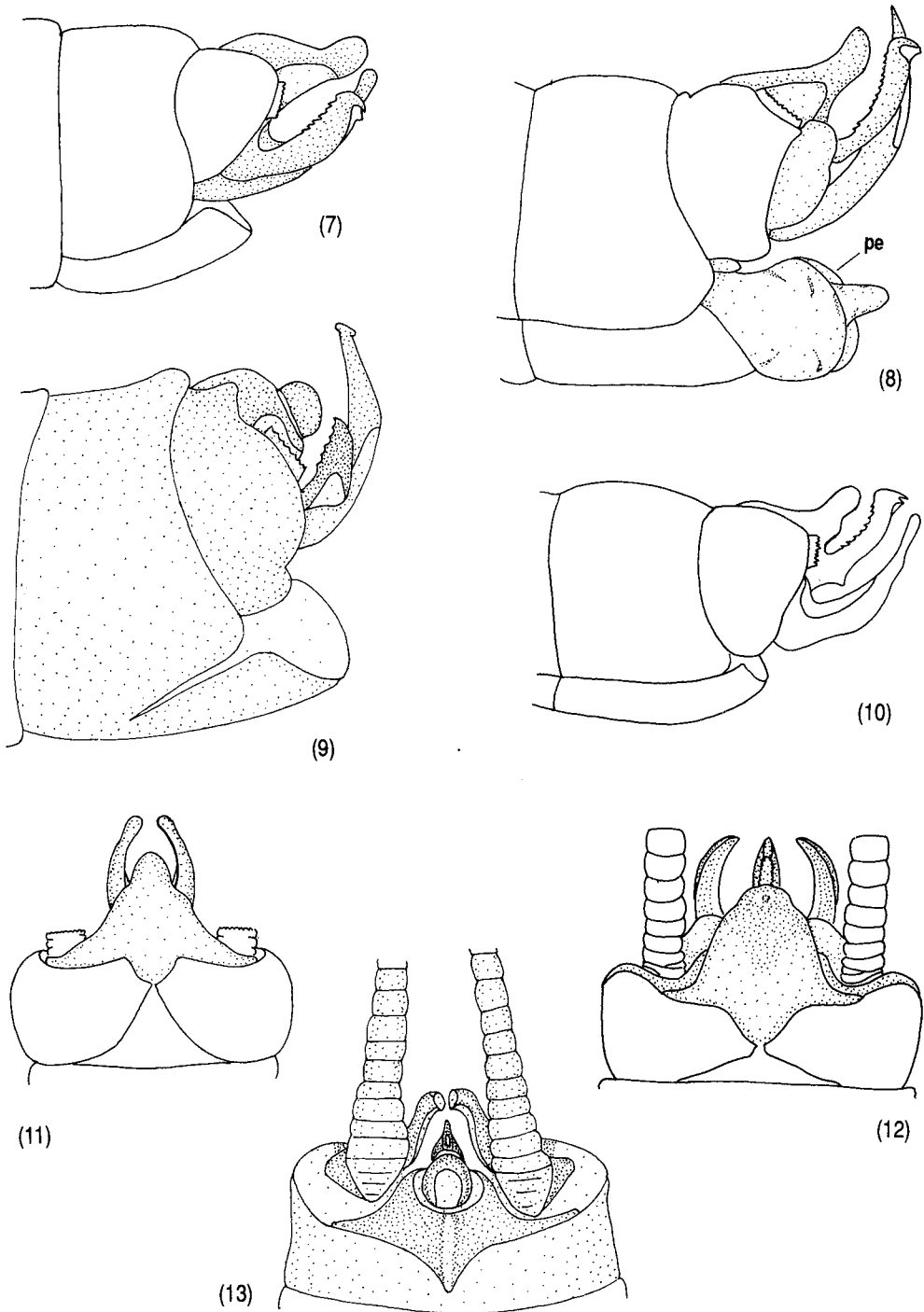


Fig. 7-13 Male genitalia, *Vesicaperta* species, lateral (7-10) and dorsal (11-13): (7,11) *dugdalei*; (8,12) *kuscheli*; (9,13) *substirpes*; (10) *townsendi*.

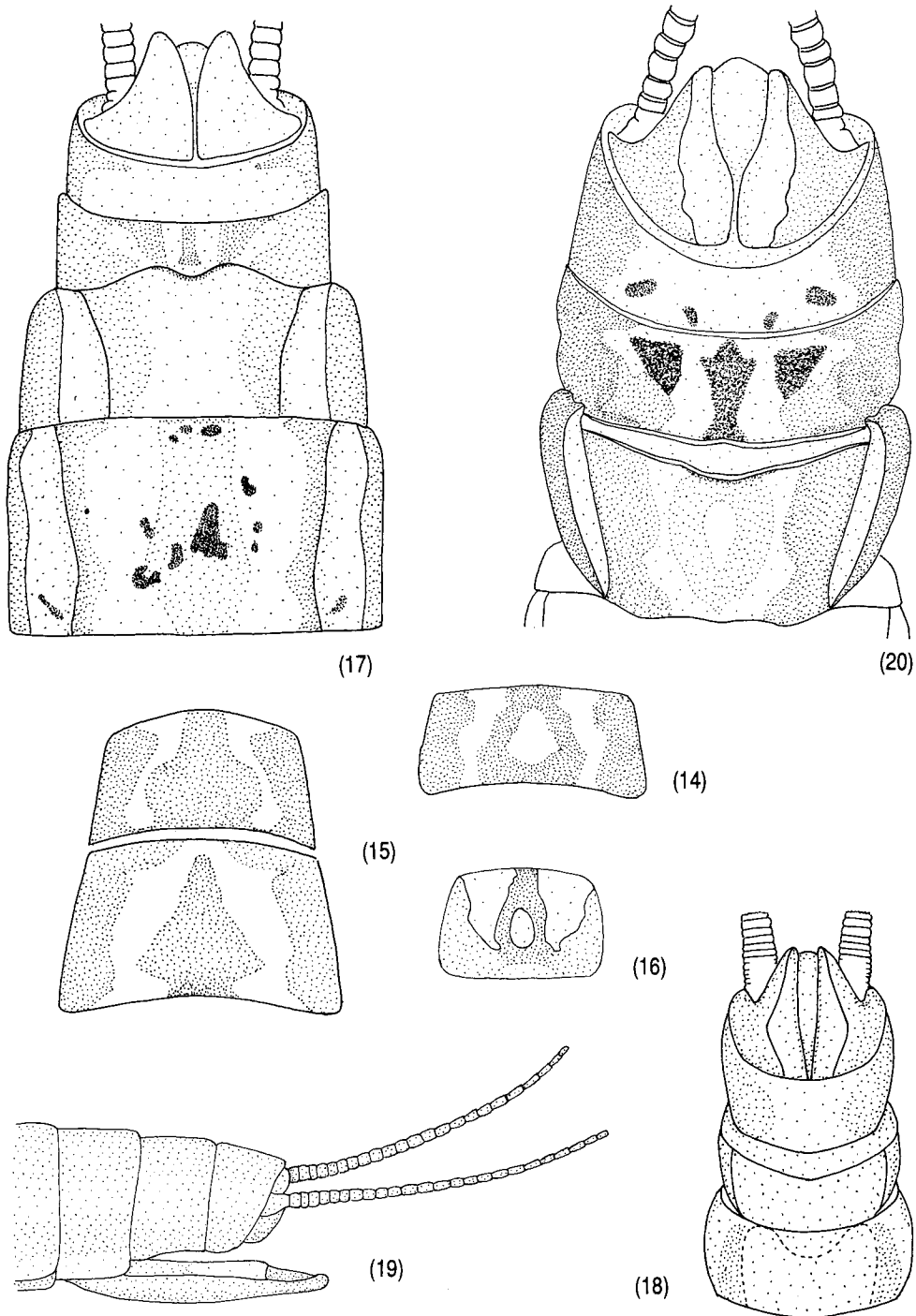


Fig. 14–16 Sternal patterns, *Vesicaperta* species: (14) *eylesi*; (15) *kuscheli*, showing variation; (16) *substripes*, *dugdalei*, and *townsendi* shown with female genitalia. **Fig. 17–20** Female genitalia, *Vesicaperta* species: (17) *dugdalei*, ventral; (18) *kuscheli*, ventral; (19) *substripes*, laterodorsal; (20) *townsendi*.

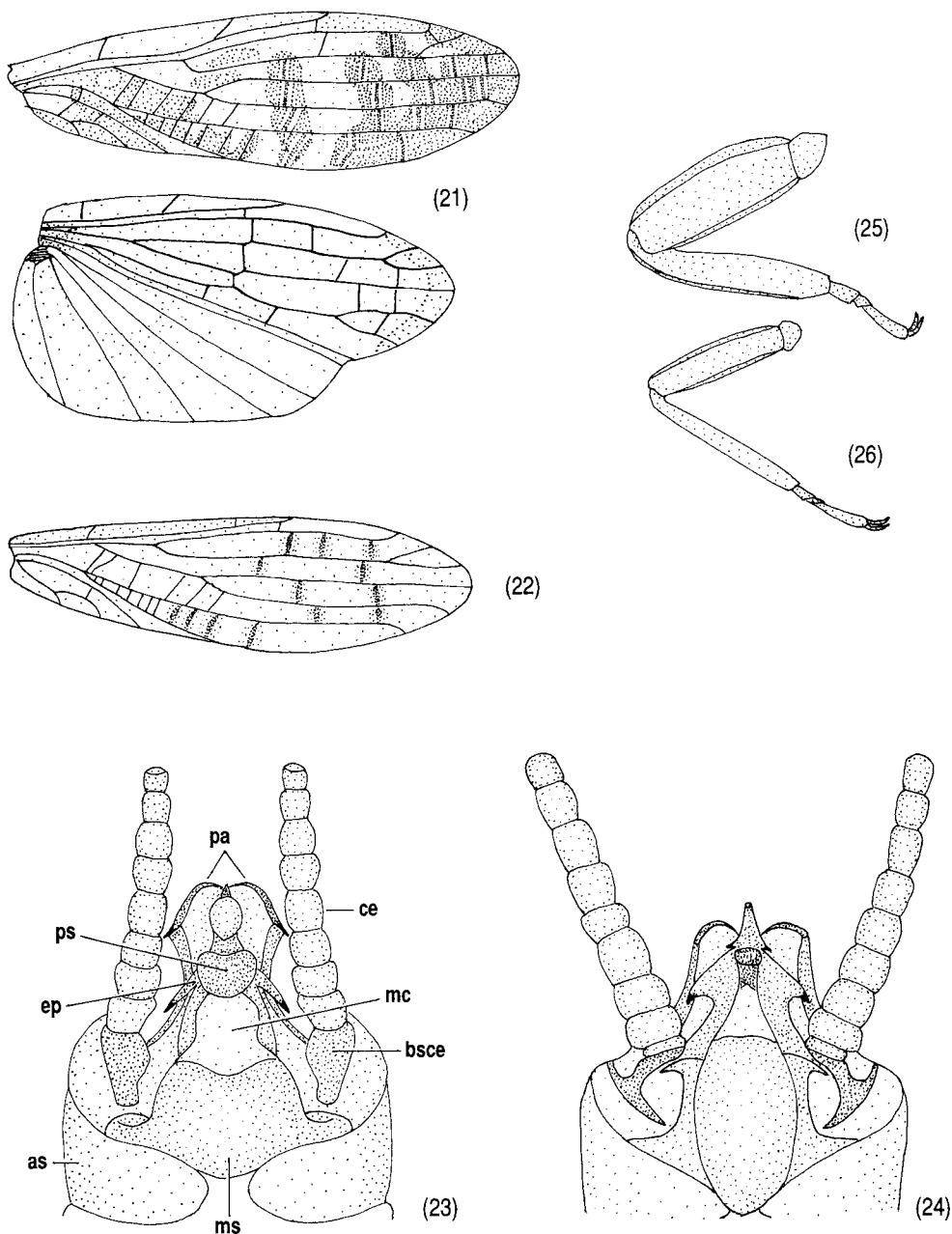


Fig. 21–26 Morphological features of species-groups in *Zelandobius*: (21) right wings, *foxi* (*confusus* group); (22) right forewing, *unicolor* (*furcillatus* group); (23,24) male genitalia, dorsal, *cordatus* (*confusus* group) and *uniramus* (*furcillatus* group); (25, 26) hind leg, nymph, *confusus* and *furcillatus*.

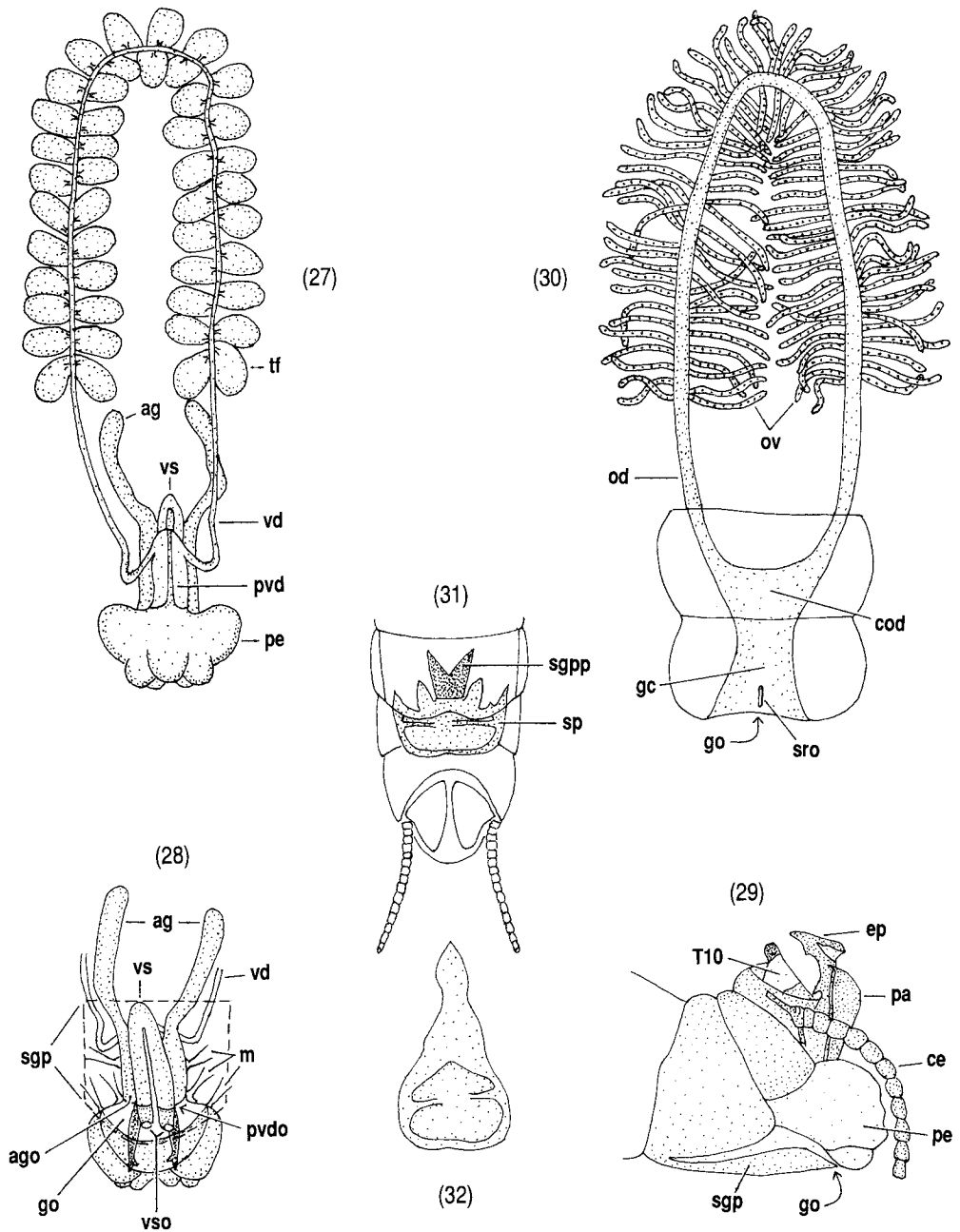


Fig. 27–30 *Zelandobius confusus*: (27) male internal genitalia and penis, dorsal; (28) penis and associated structures, ventral; (29) external genitalia of mated male, lateral; (30) female internal genitalia, ventral. **Fig. 31, 32** *Z. macburneyi*: (31) female external genitalia and spermatophore; (32) spermatophore.

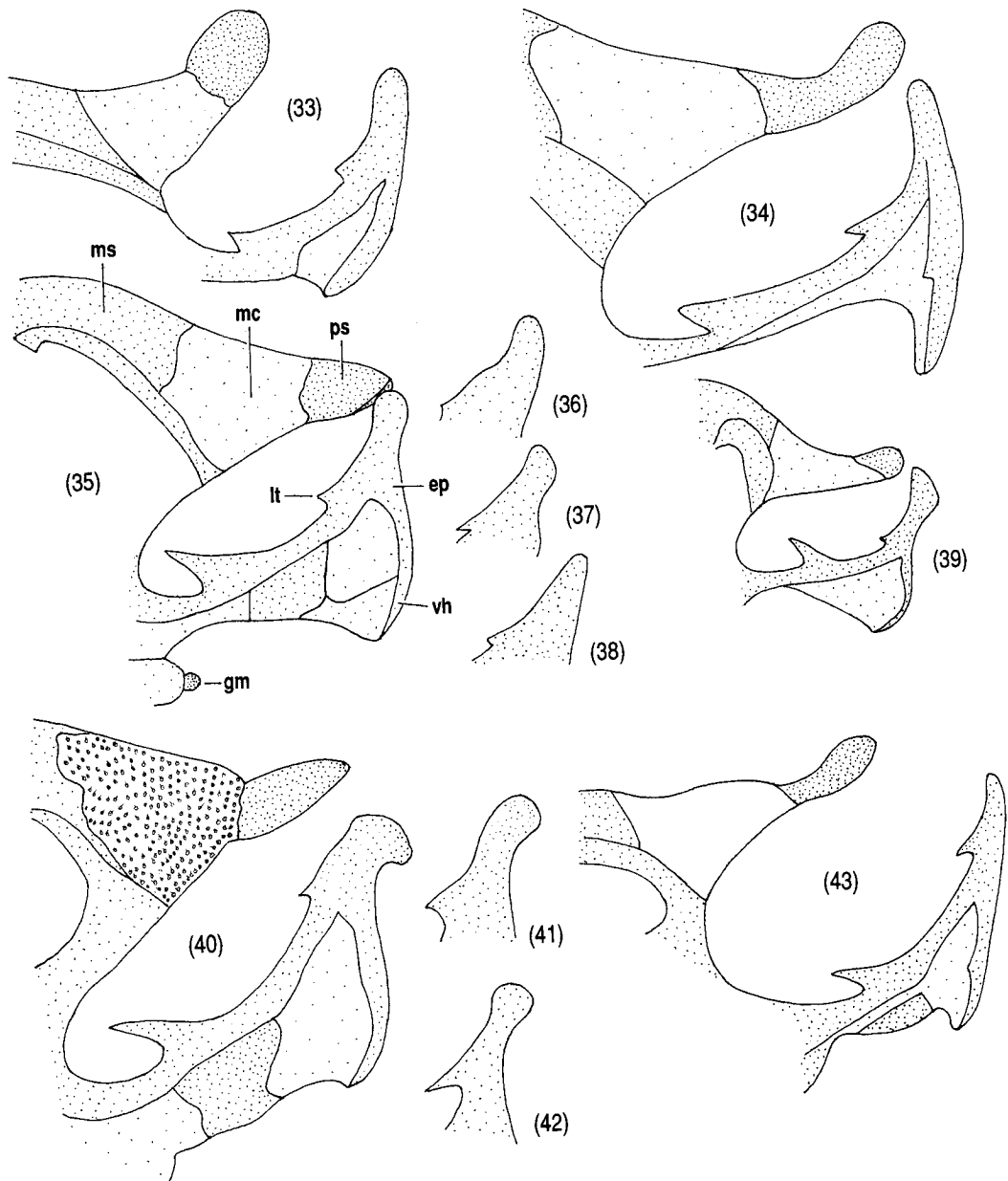


Fig. 33–43 Male genitalia, part tergite 10 and epiproct, lateral, *Zelandobius* species: (33) *albofasciatus*; (34) *childi*; (35–38) *confusus* and 3 epiproct tip variations – (36) Little Barrier I., CL; (37) Tinline River, MB; (38) lower Buller Gorge, BR; (39) *cordatus*; (40) *dugdalei*; (41–43) *foxi* and 2 epiproct tip variations from Mt Teviot, CO.

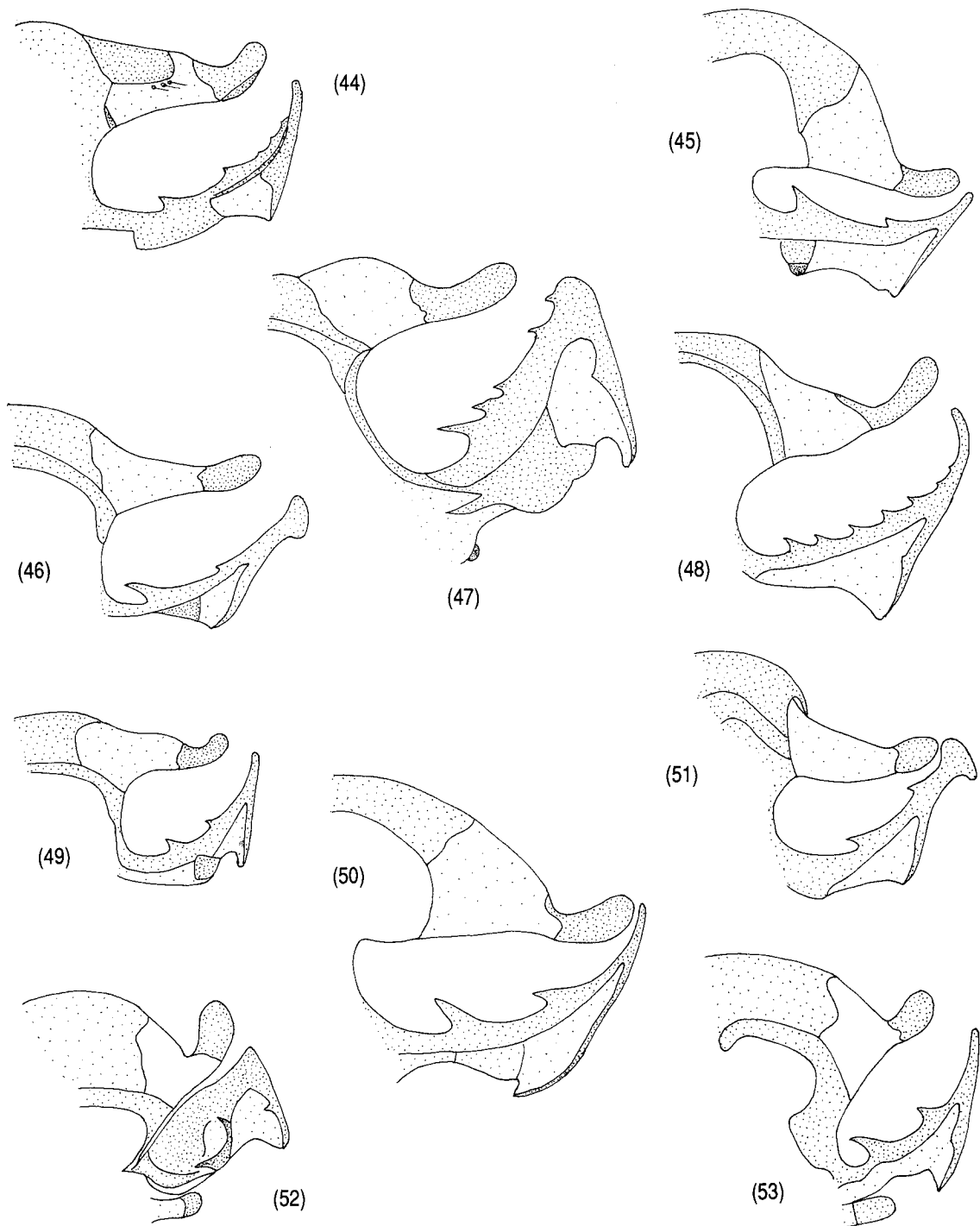


Fig. 44–53 Male genitalia, part tergite 10 and epiproct, lateral, *Zelandobius* species: (44) *gibbsi*; (45) *illiesi*; (46) *inversus*; (47) *macburneyi*; (48) *mariae*; (49) *montanus*; (50) *patricki*; (51) *peglegensis*; (52) *takahe*; (53) *wardi*.

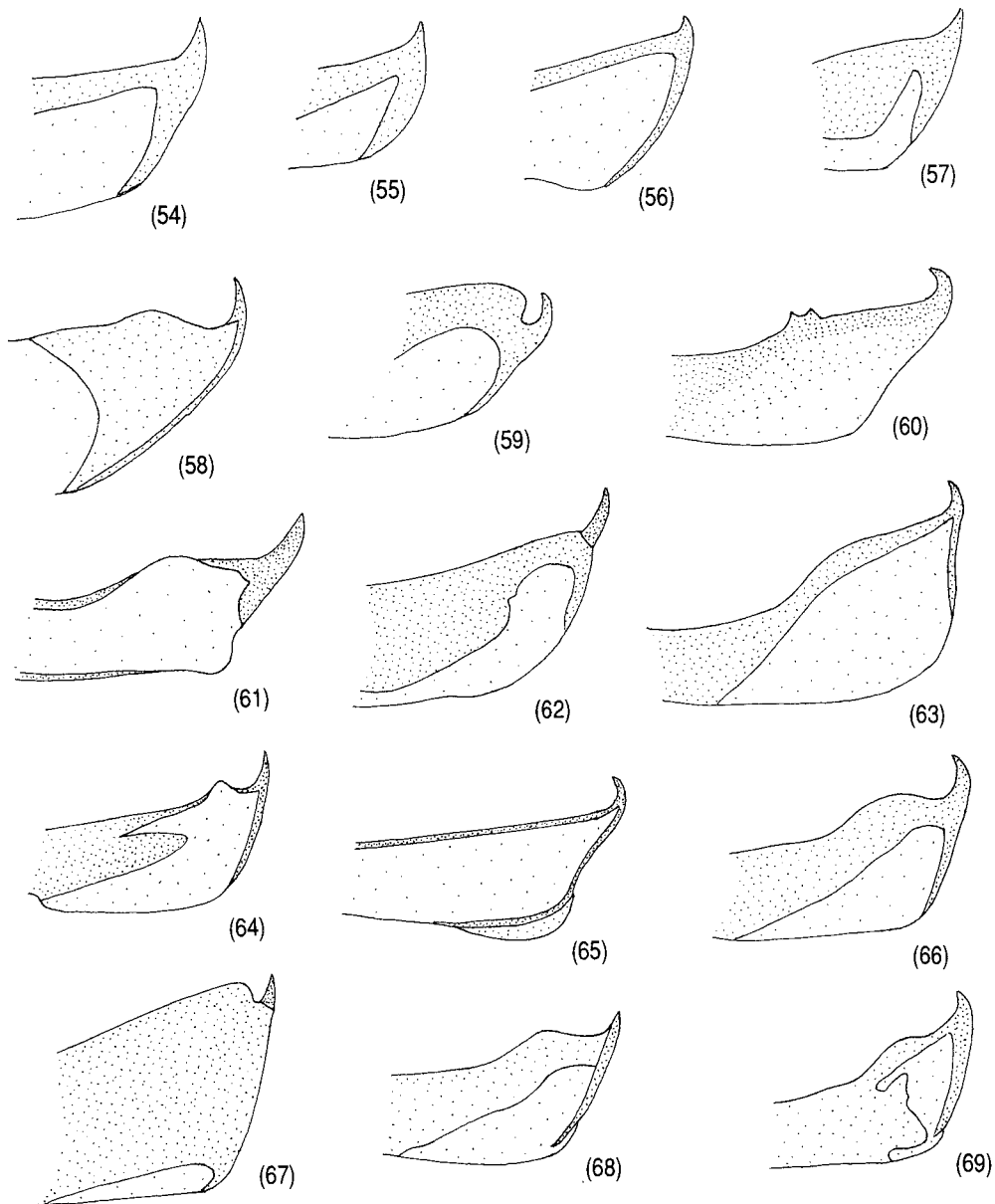


Fig. 54–69 Male genitalia, distal part of right paraproct, lateral, *Zelandobius* species: (54) *albofasciatus*; (55) *childi*; (56) *confusus*; (57) *cordatus*; (58) *dugdalei*; (59) *foxi*; (60) *gibbsi*; (61) *illiesi*; (62) *inversus*; (63) *macburneyi*; (64) *mariae*; (65) *montanus*; (66) *patricki*; (67) *peglegensis*; (68) *takahe*; (69) *wardi*.

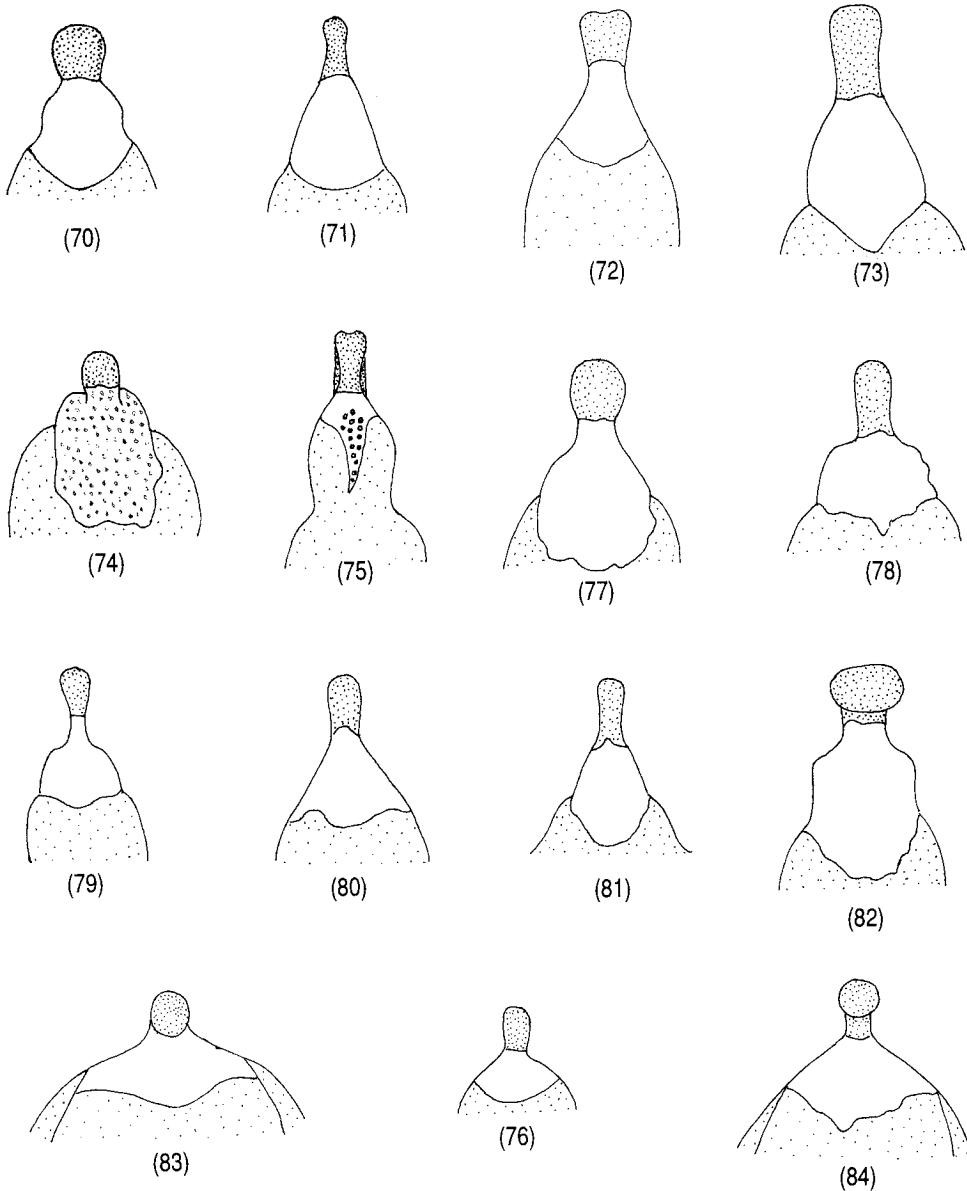


Fig. 70–84 Male genitalia, distal half of tergite 10, dorsal, *Zelandobius* species: (70) *albofasciatus*; (71) *childi*; (72) *confusus*; (73) *dugdalei*; (74) *foxi*; (75) *gibbsi*; (76) *illiesi*; (77) *inversus*; (78) *macburneyi*; (79) *mariae*; (80) *montanus*; (81) *patricki*; (82) *peglegensis*; (83) *takahe*; (84) *wardi*.

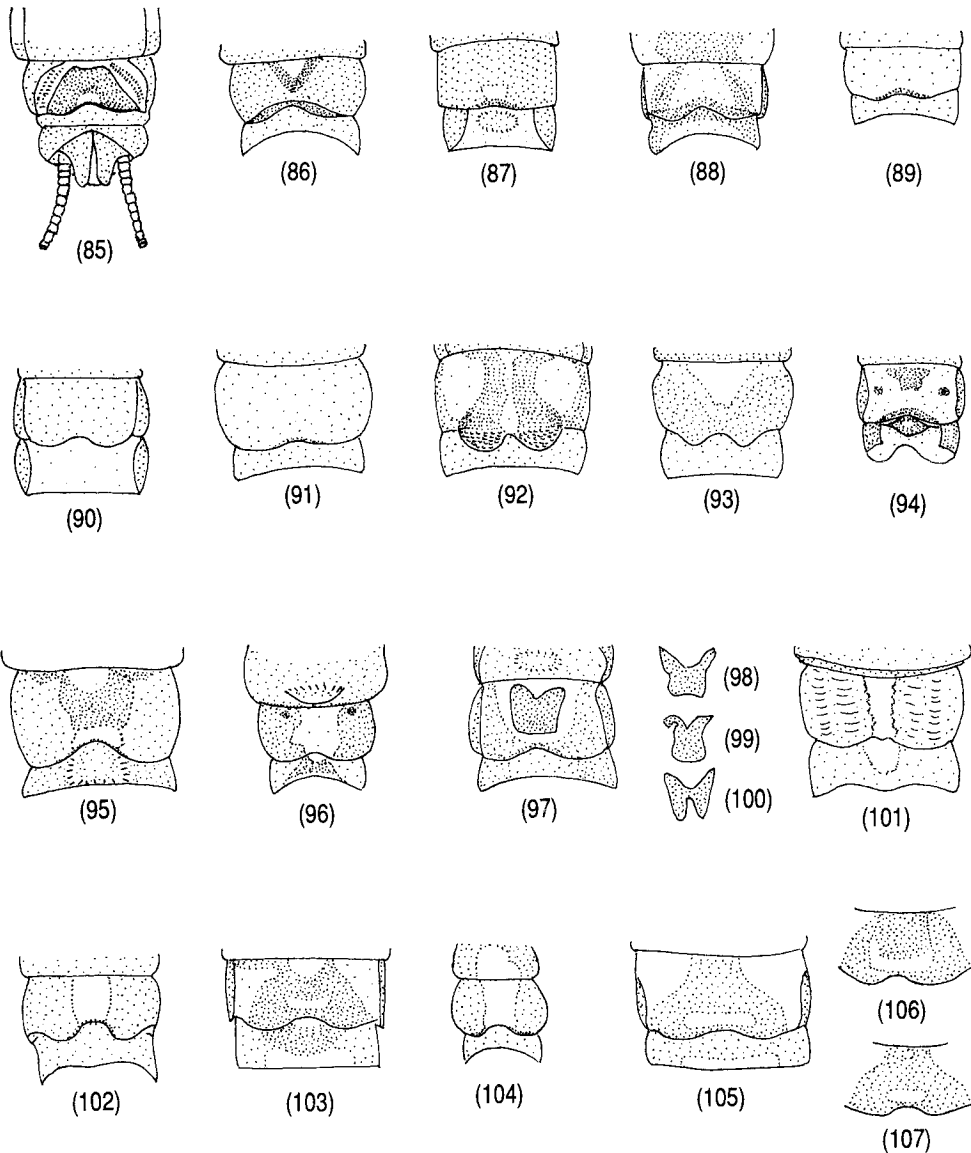
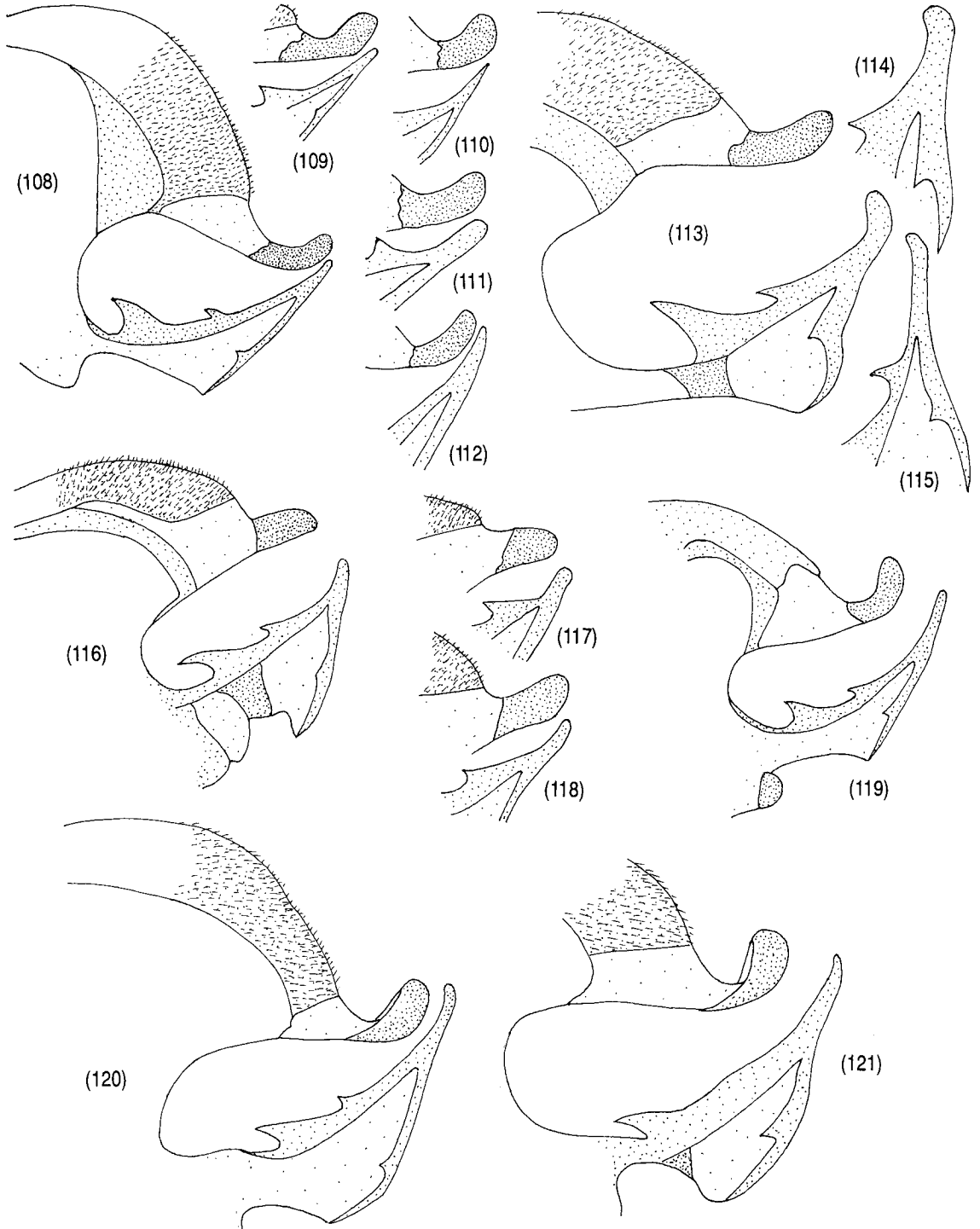


Fig. 85–107 Female genitalia, ventral, *Zelandobius* species: (85) *alatus*; (86) *albofasciatus*; (87) *brevicauda*; (88) *childi*; (89) *confusus*; (90) *cordatus*; (91) *dugdalei*; (92) *foxi*; (93) *gibbsi*; (94) *illiesi*; (95) *jacksoni*; (96) *kuscheli*; (97–100) *macburneyi* + sgp variants – (98) Rock & Pillar Range, CO; (99) Tararua Range, WN; (100) Pouakai Hump, TK; (101) *montanus*; (102) *ngaire*; (103) *patricki*; (104) *takahe*; (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) Ngawaierua 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 Stm, St Bathans, CO; (119,120) *unicolor*, Lewis Pass, BR and Rock & Pillar Range, CO; (121) *uniramus*.



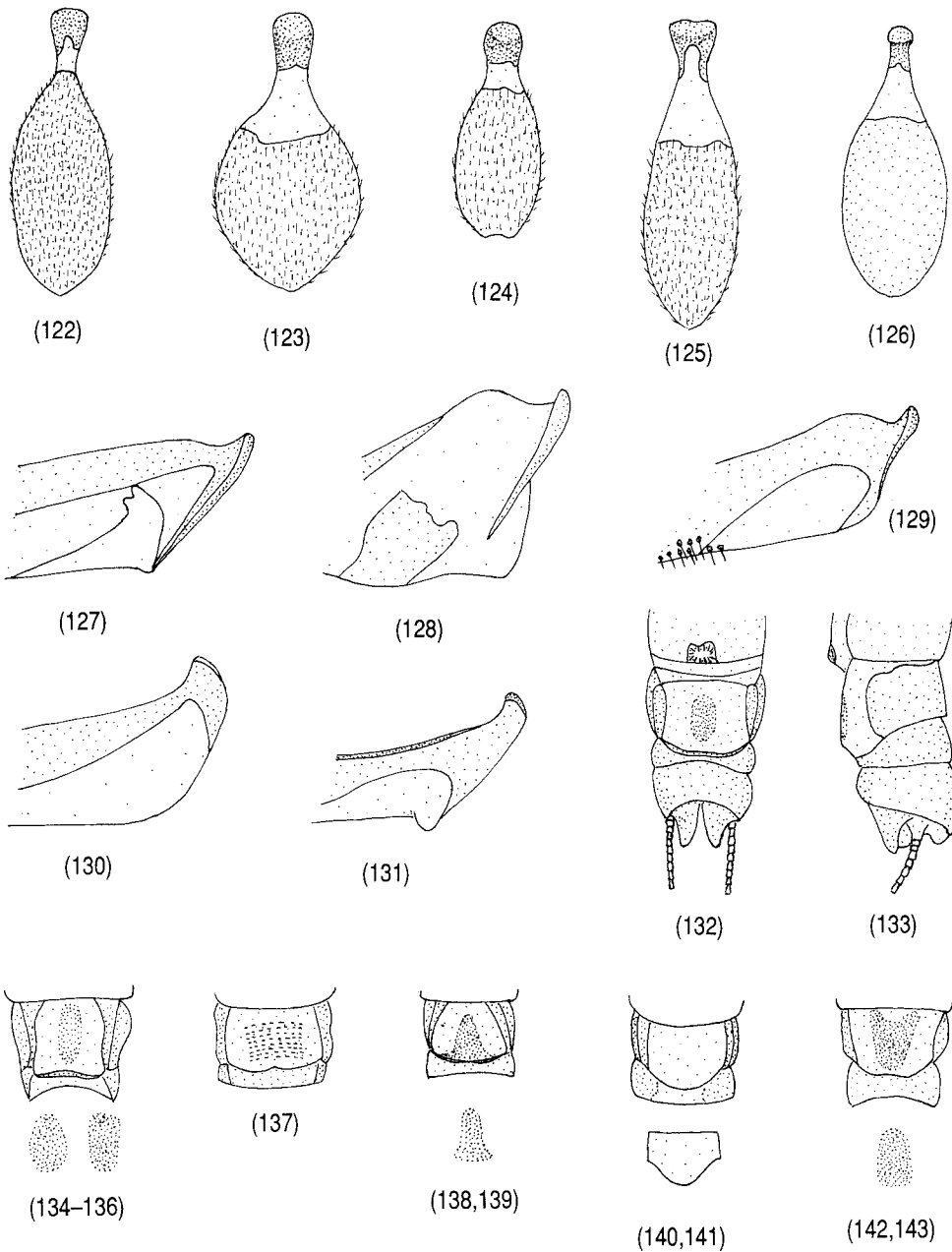
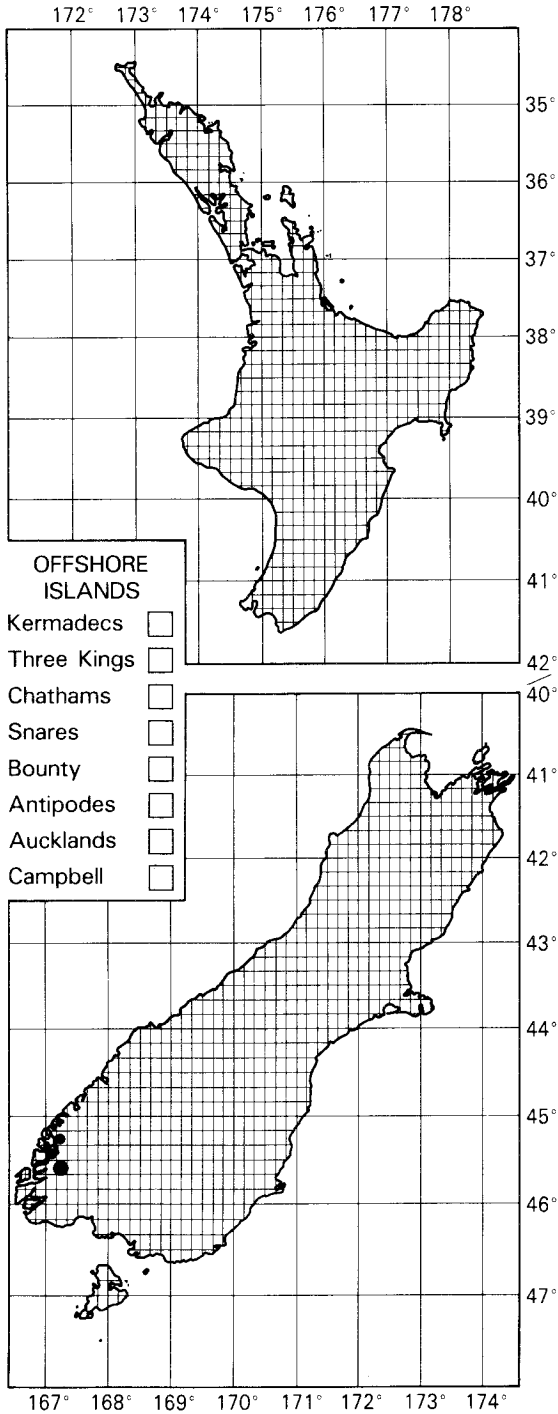
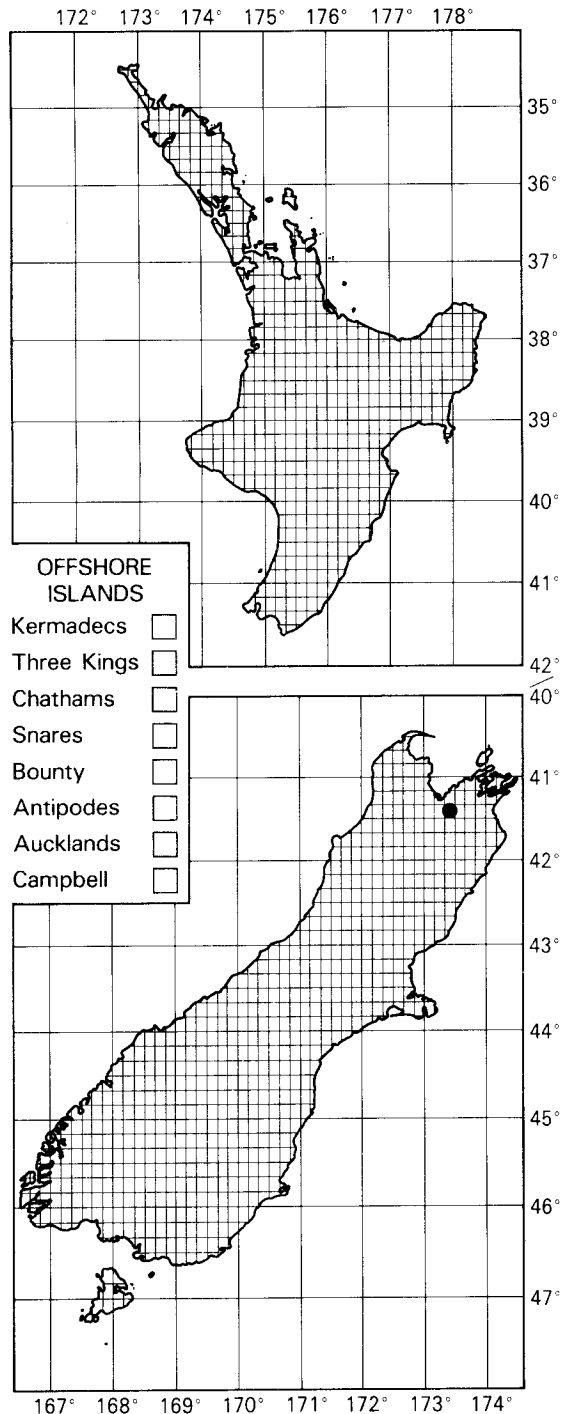


Fig. 122–126 Male tergite 10 (part), dorsal, *Zelandobius* species: (122) *furcillatus*; (123) *pilosus*; (124) *truncus*; (125) *unicolor*; (126) *uniramus*. **Fig. 127–131** Right paraproct, distolateral, *Zelandobius* species: (127) *furcillatus*; (128) *pilosus*; (129) *truncus*; (130) *unicolor*; (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.

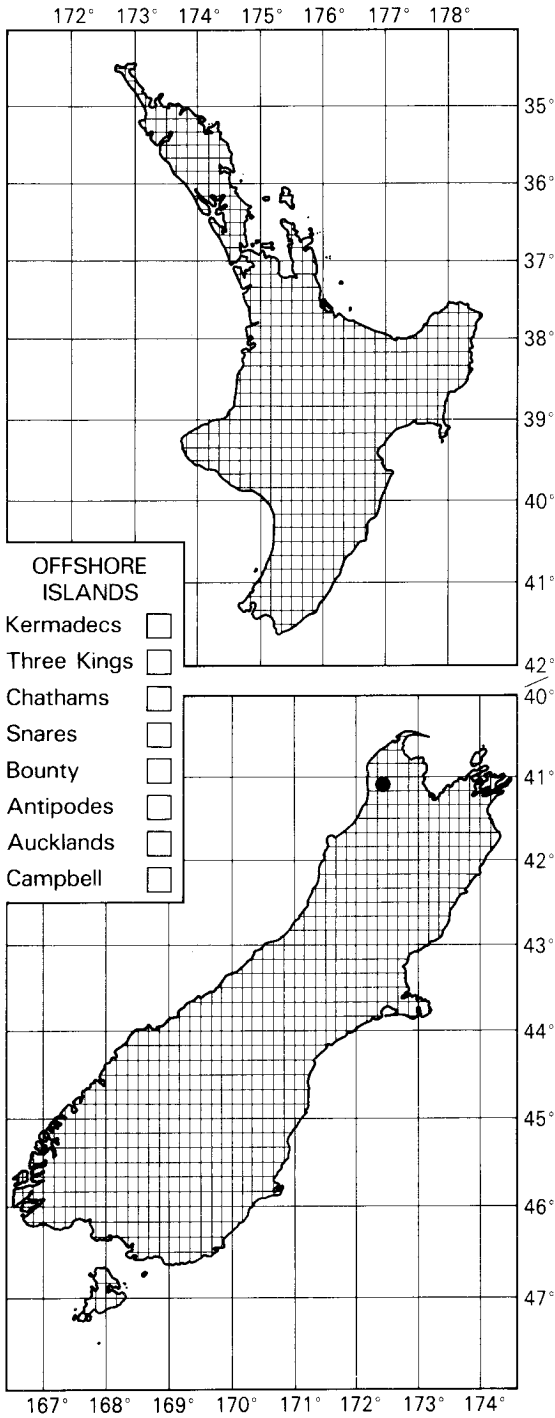
DISTRIBUTION MAPS



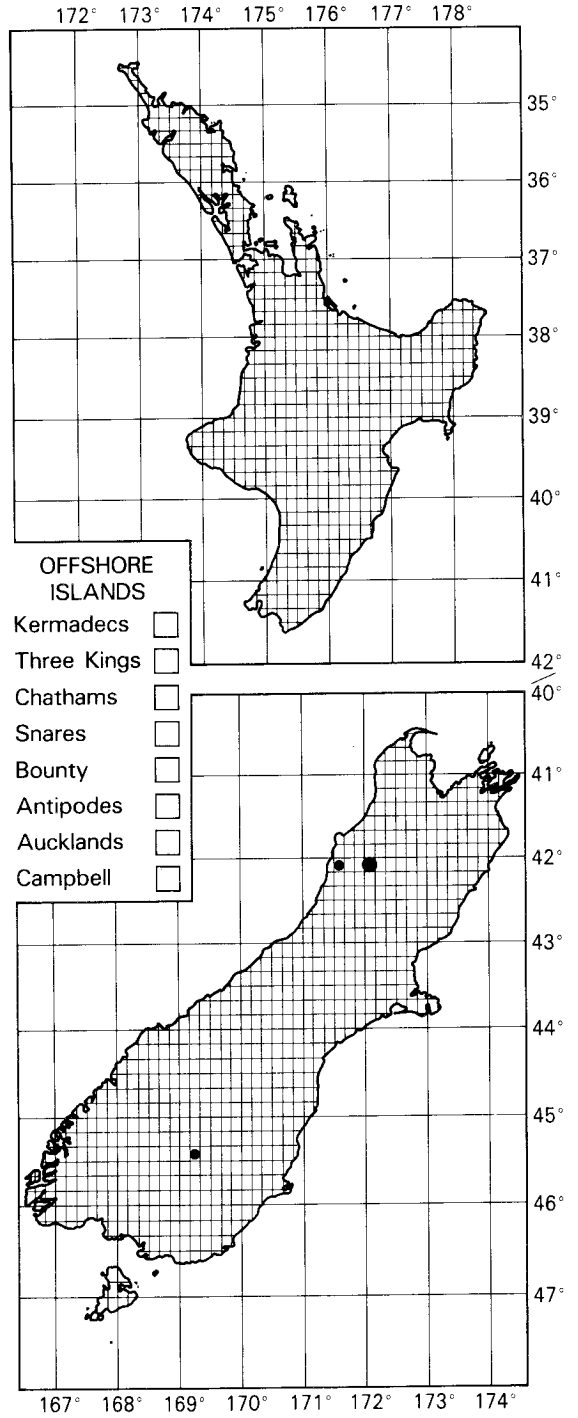
• **Map 1** Collection localities, *Vesicaperla dugdalei* •



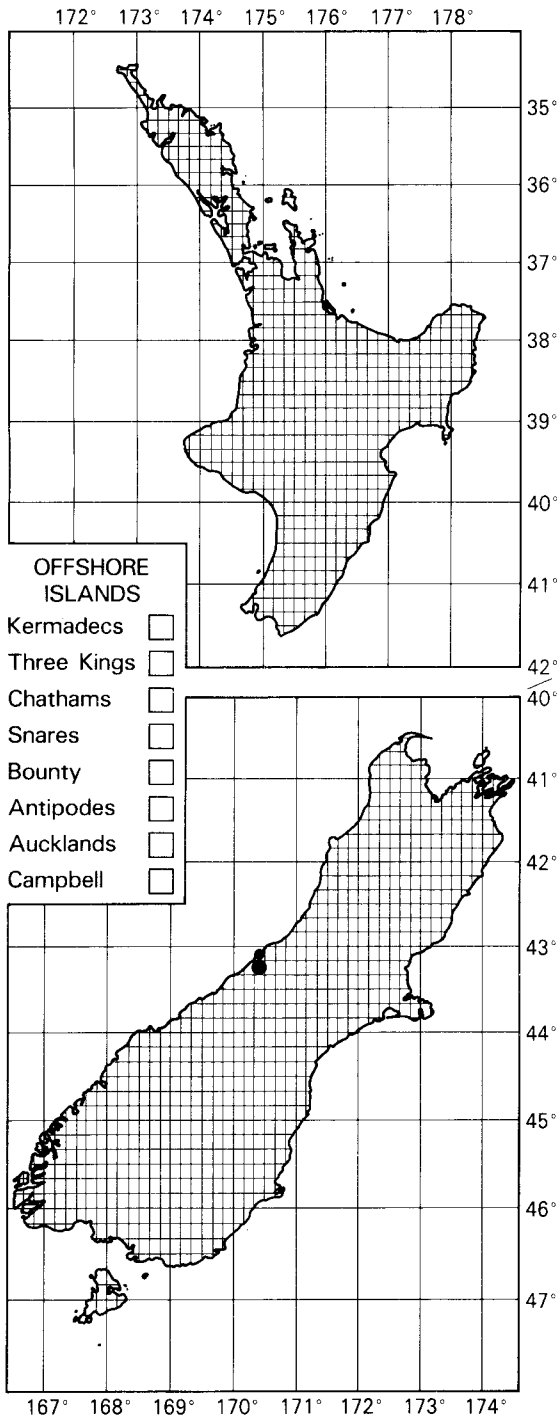
• **Map 2** Collection localities, *Vesicaperla eylesi* •



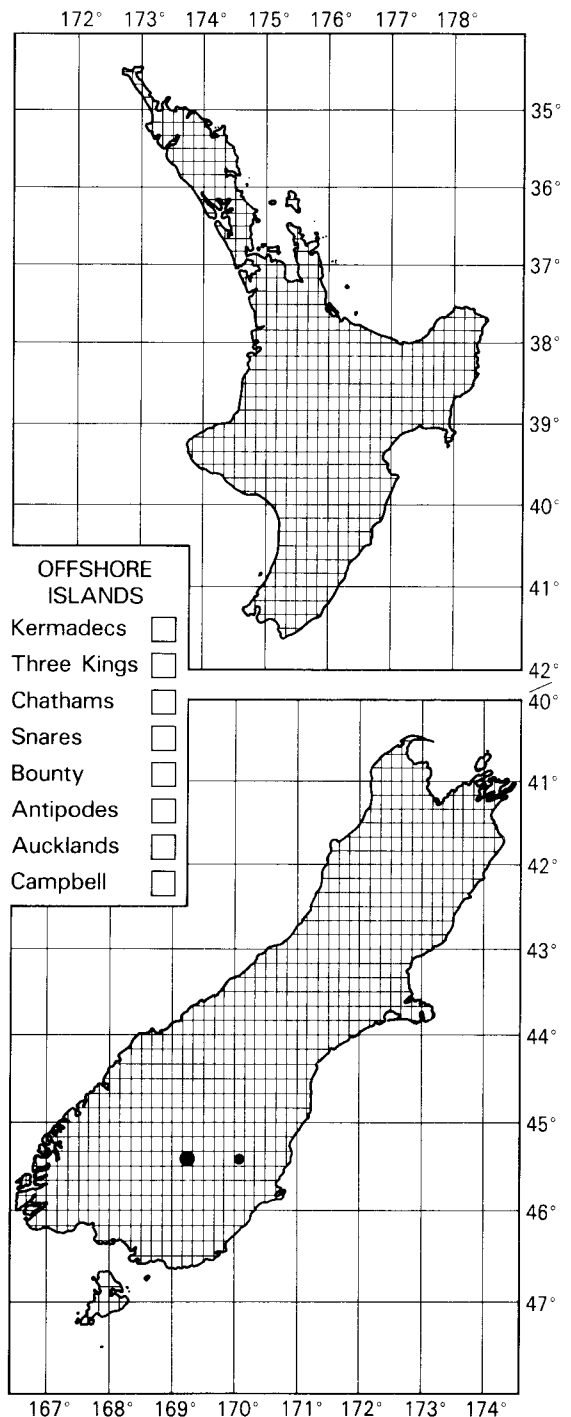
• **Map 3** Collection localities, *Vesicaperla kuscheli* •



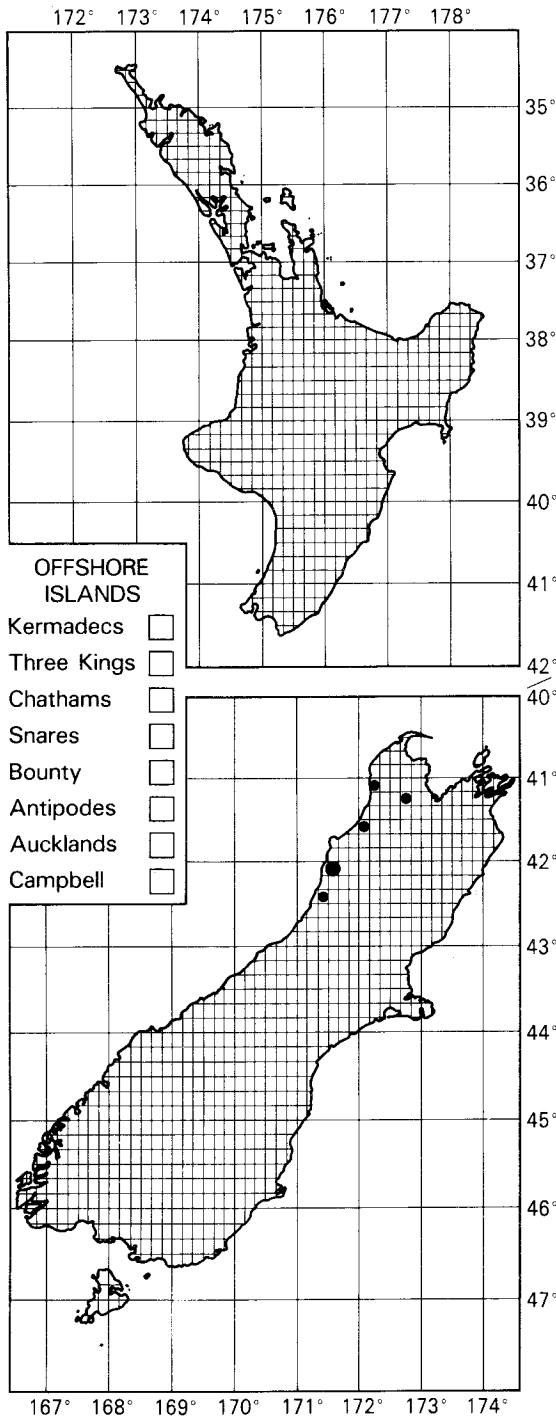
• **Map 4** Collection localities, *Vesicaperla substripes* •



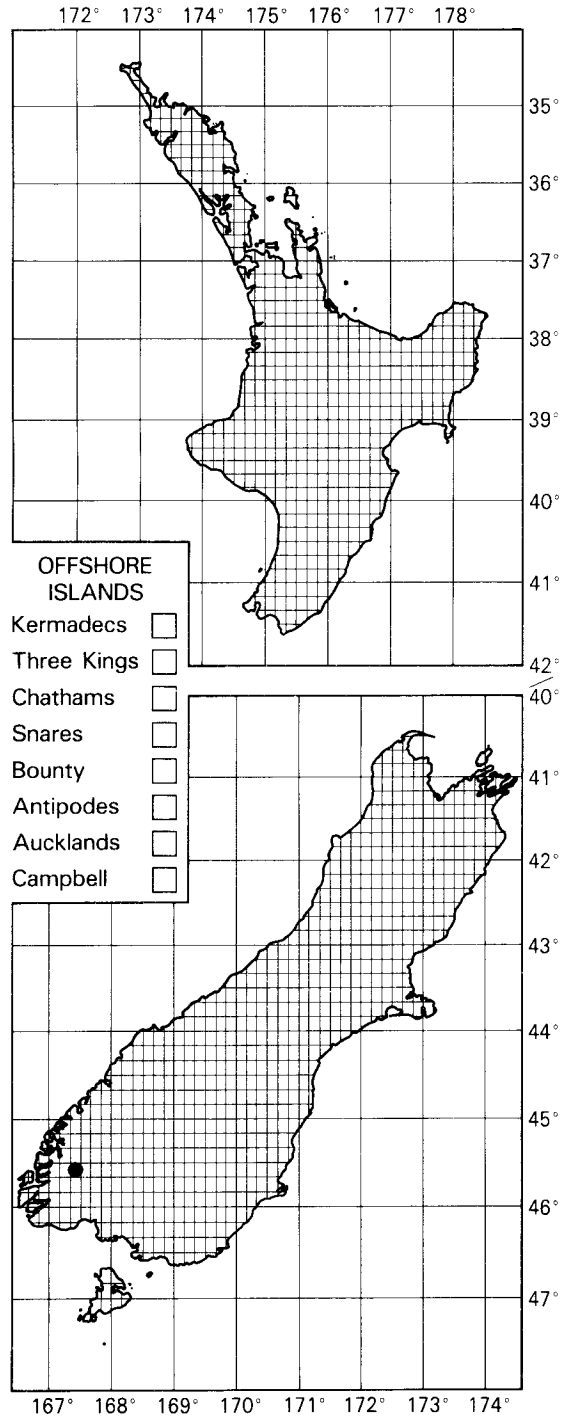
• **Map 5** Collection localities, *Vesicaperla townsendi* •



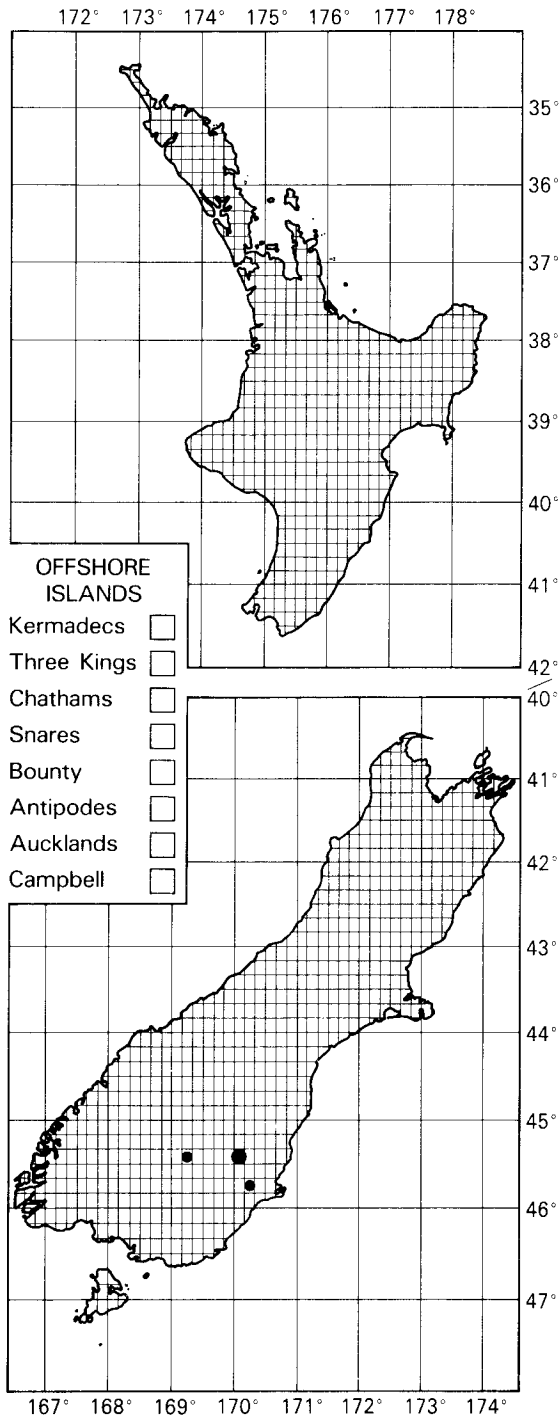
• **Map 6** Collection localities, *Zelandobius alatus* •



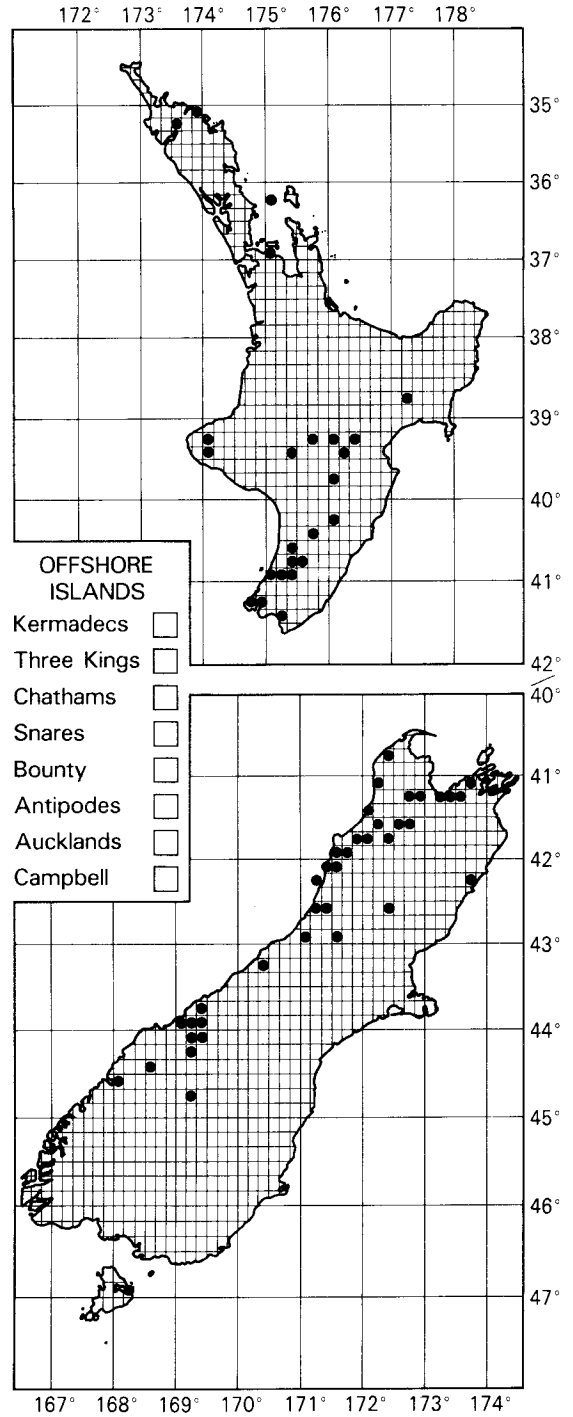
• **Map 7** Collection localities, *Zelandobius albofasciatus* •



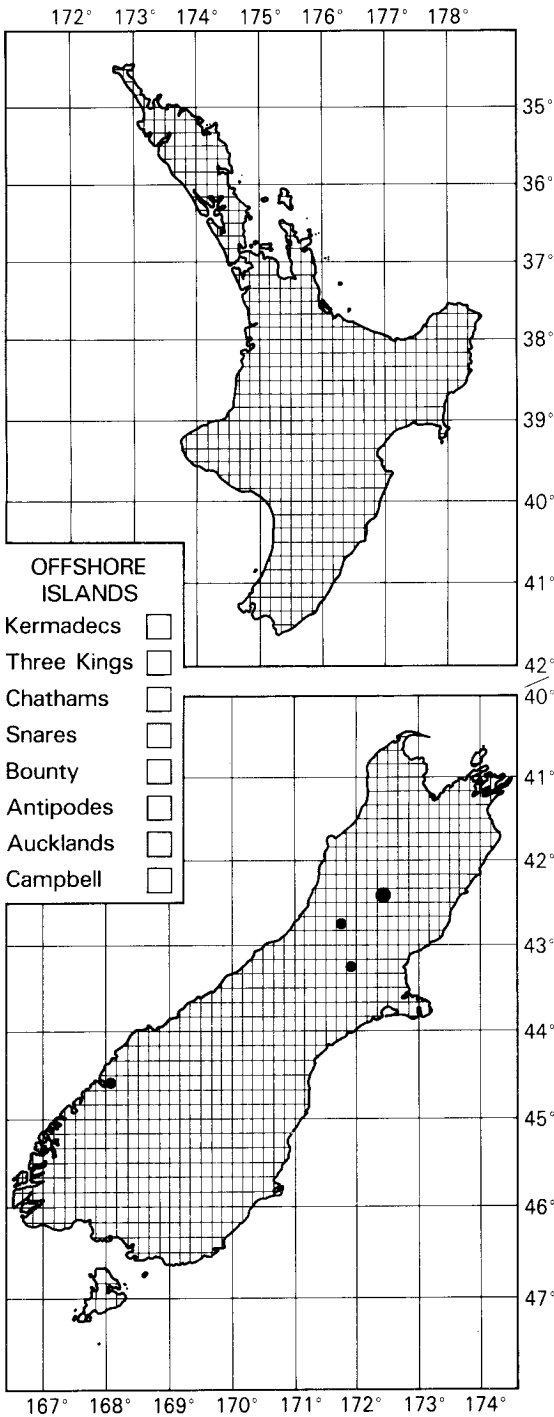
• **Map 8** Collection localities, *Zelandobius brevicauda* •



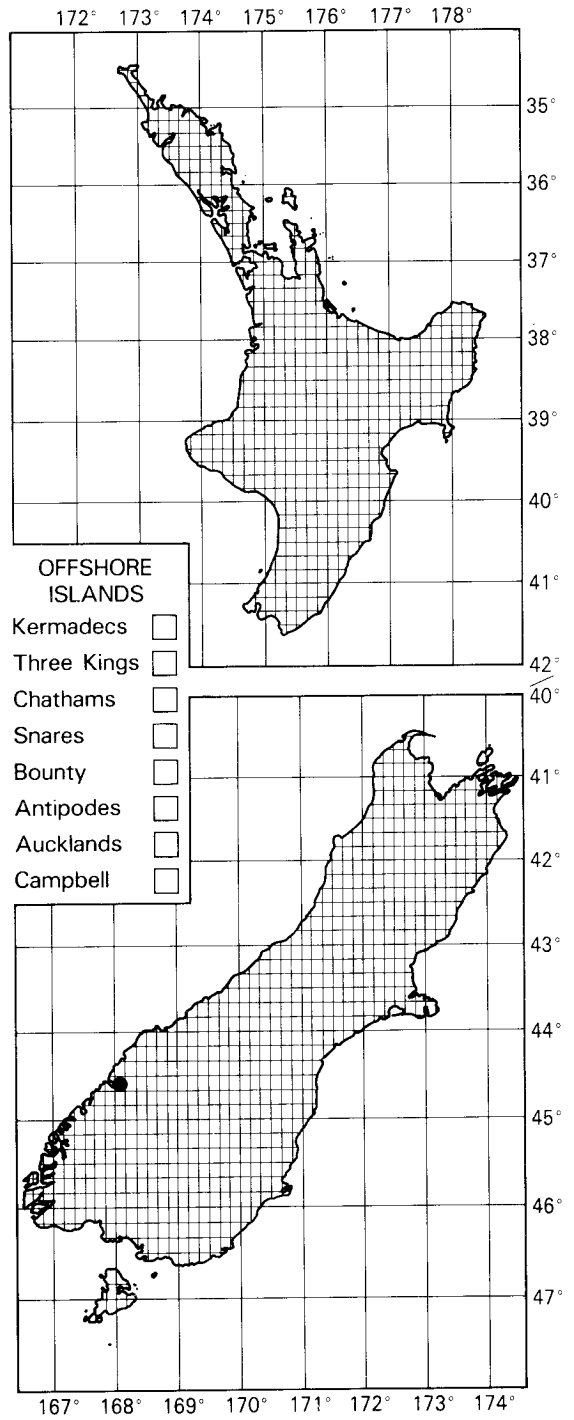
• **Map 9** Collection localities, *Zelandobius childi* •



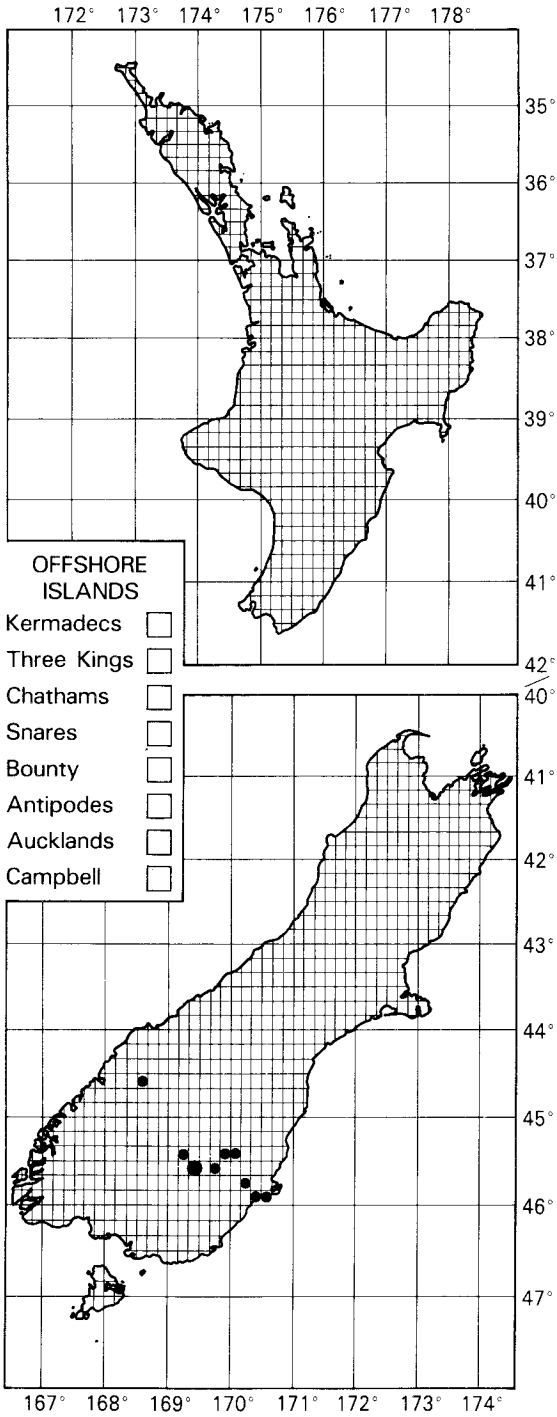
• **Map 10** Collection localities, *Zelandobius confusus* •



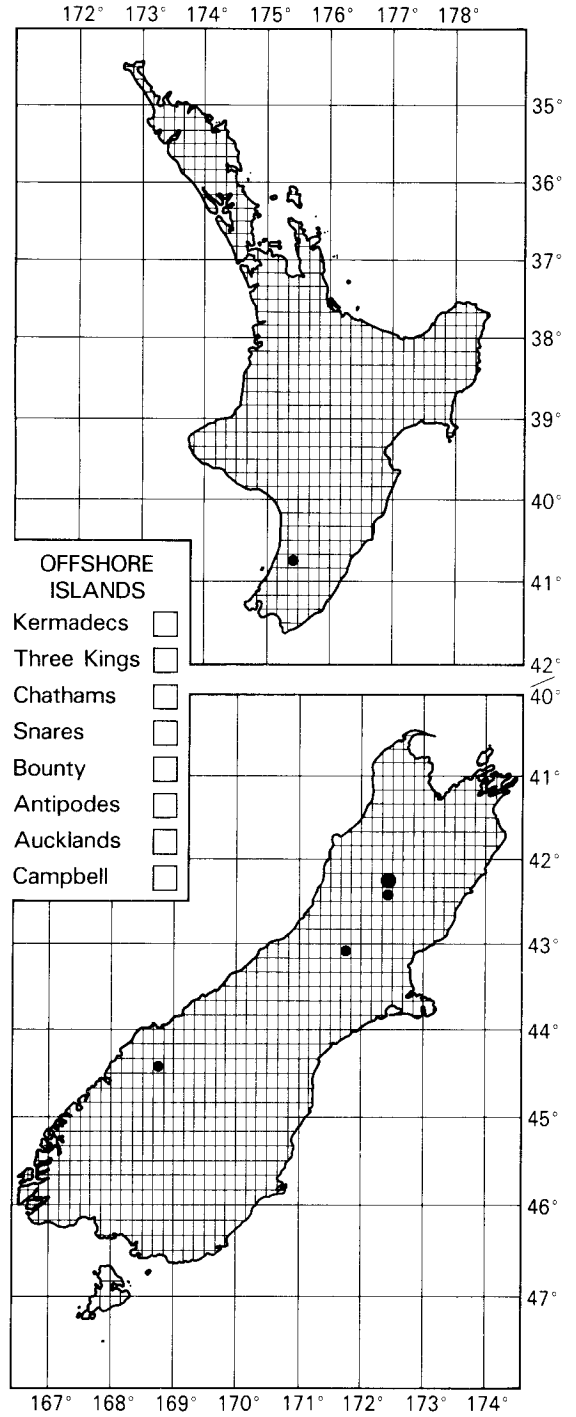
• **Map 11** Collection localities, *Zelandobius cordatus* •



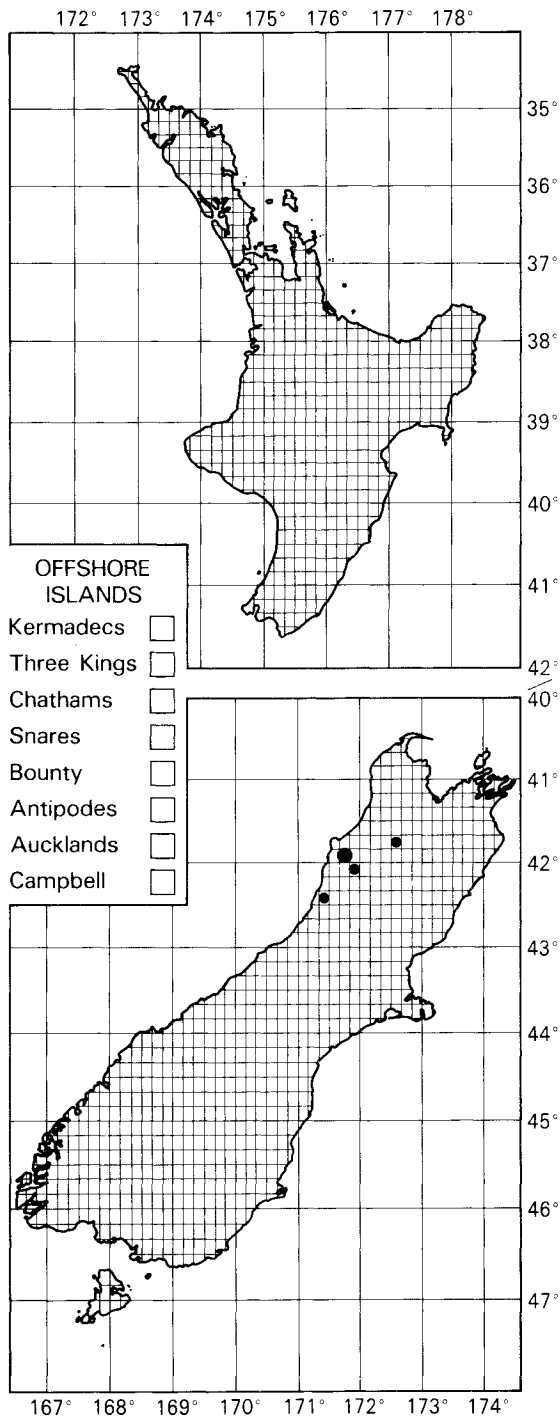
• **Map 12** Collection localities, *Zelandobius dugdalei* •



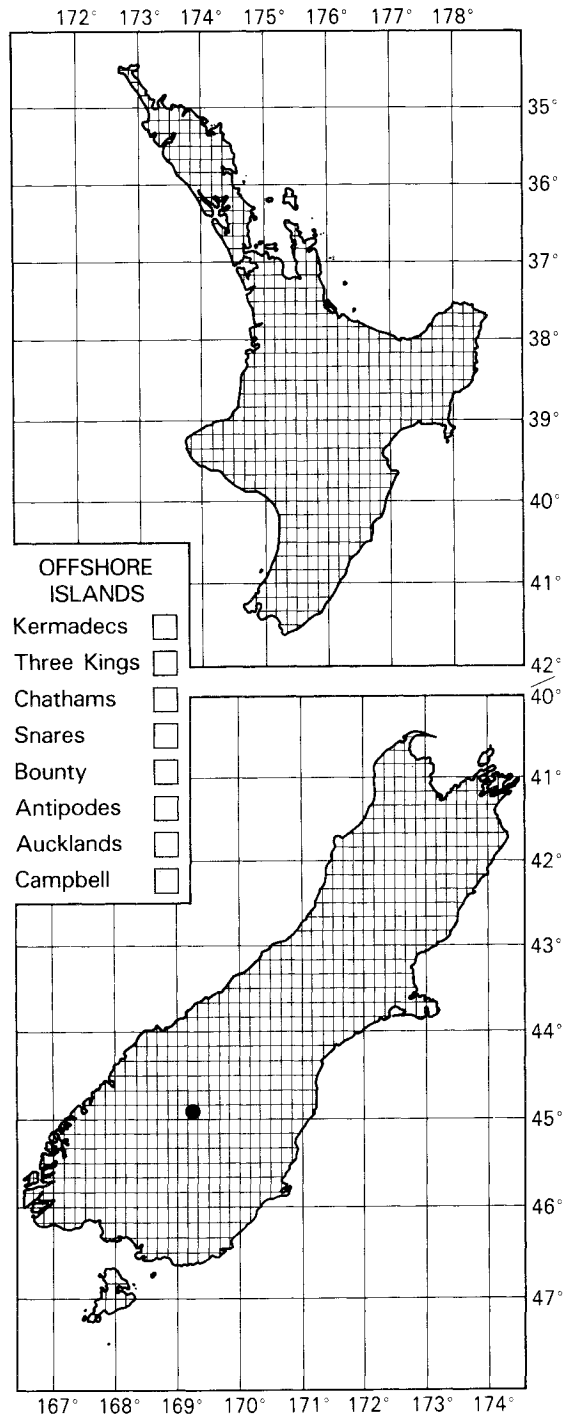
• **Map 13** Collection localities, *Zelandobius foxi* •



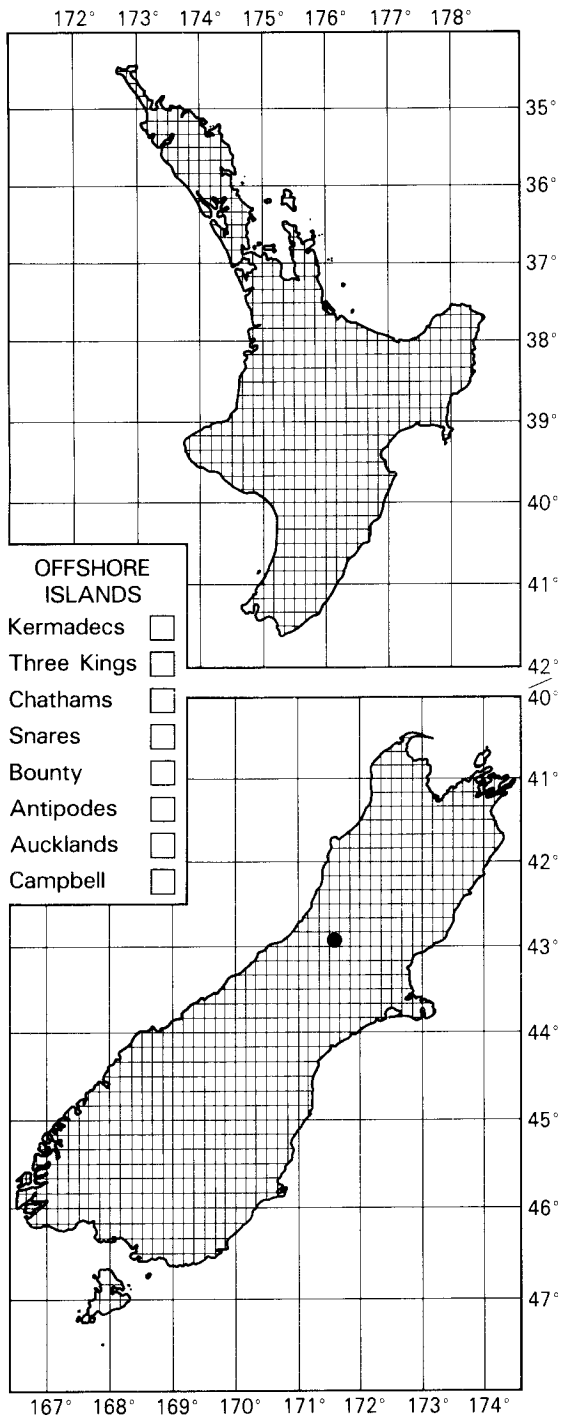
• **Map 14** Collection localities, *Zelandobius gibbsi* •



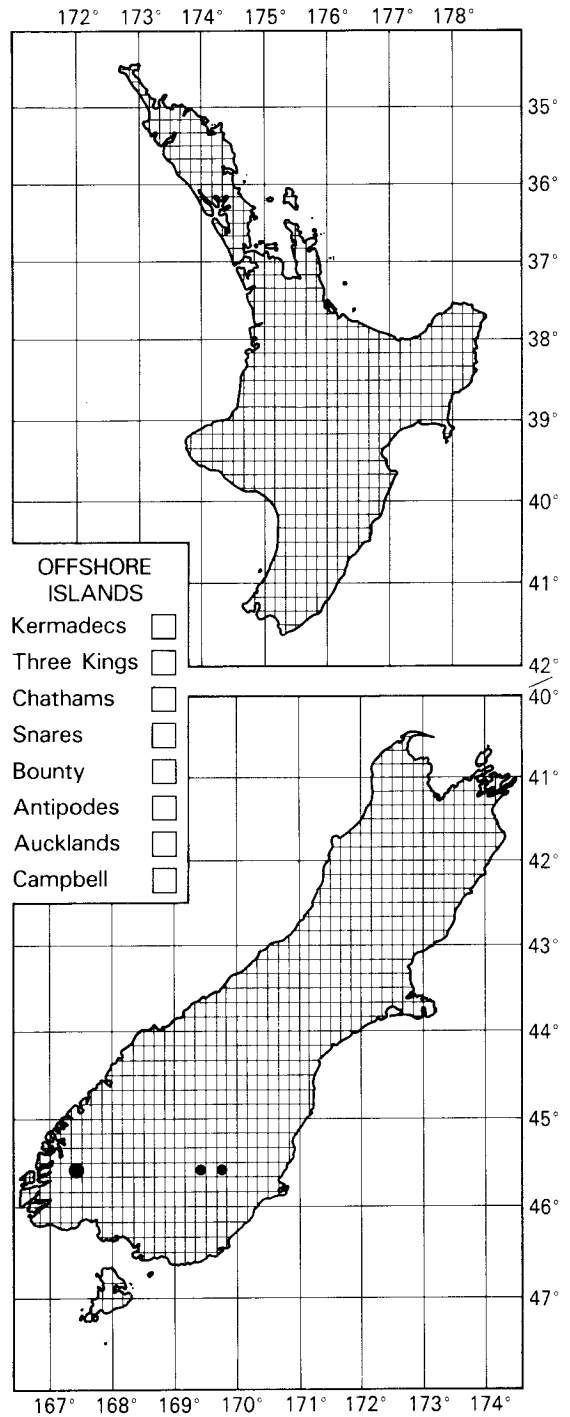
• **Map 15** Collection localities, *Zelandobius illiesi* •



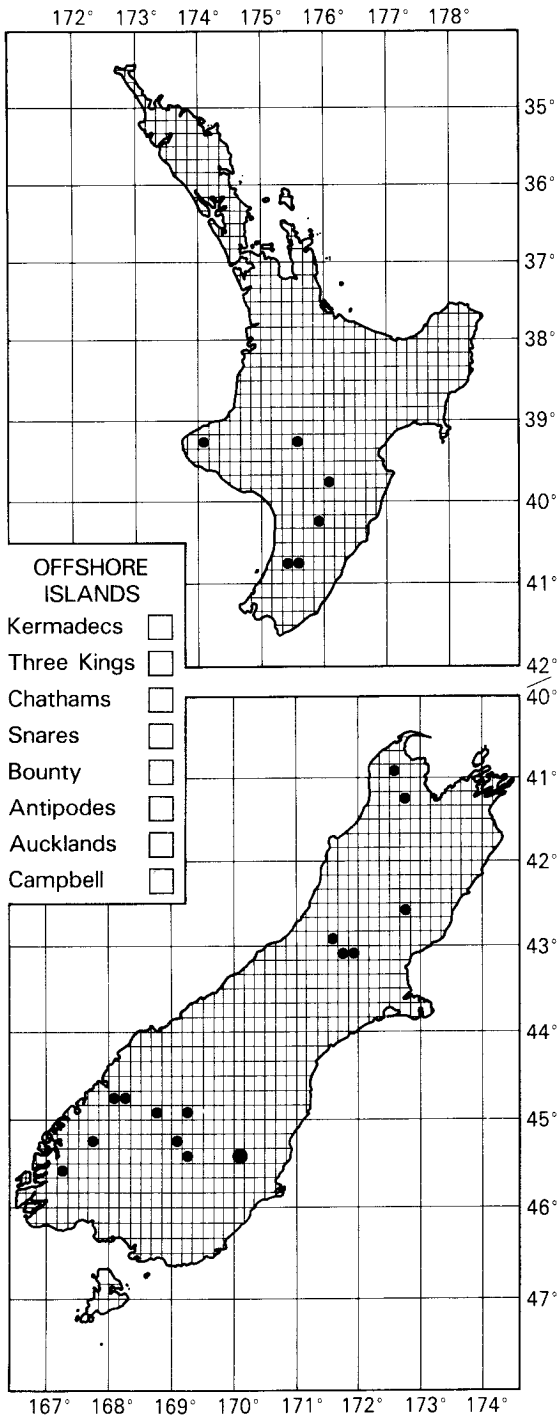
• **Map 16** Collection localities, *Zelandobius inversus* •



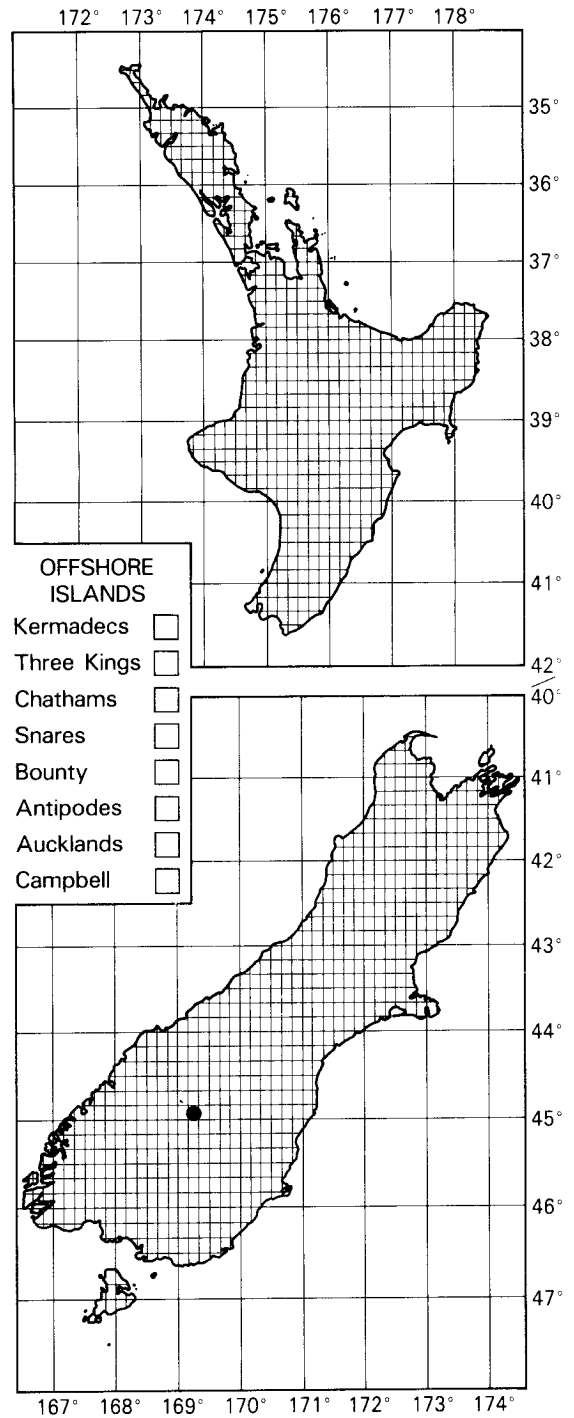
• **Map 17** Collection localities, *Zelandobius jacksoni* •



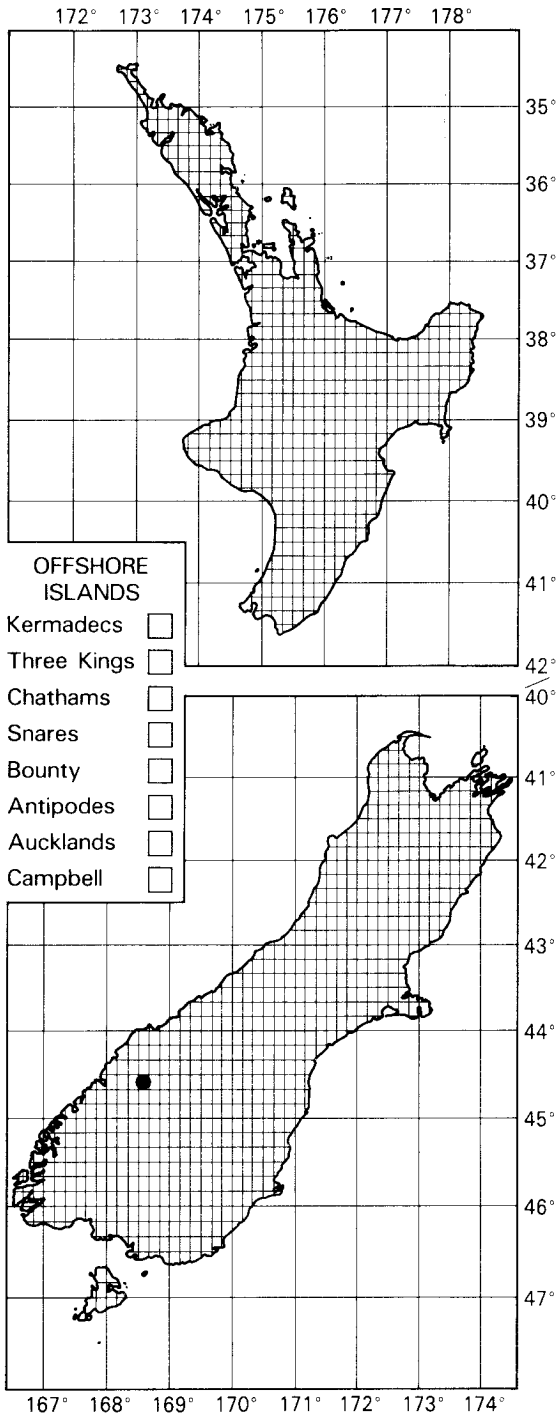
• **Map 18** Collection localities, *Zelandobius kuscheli* •



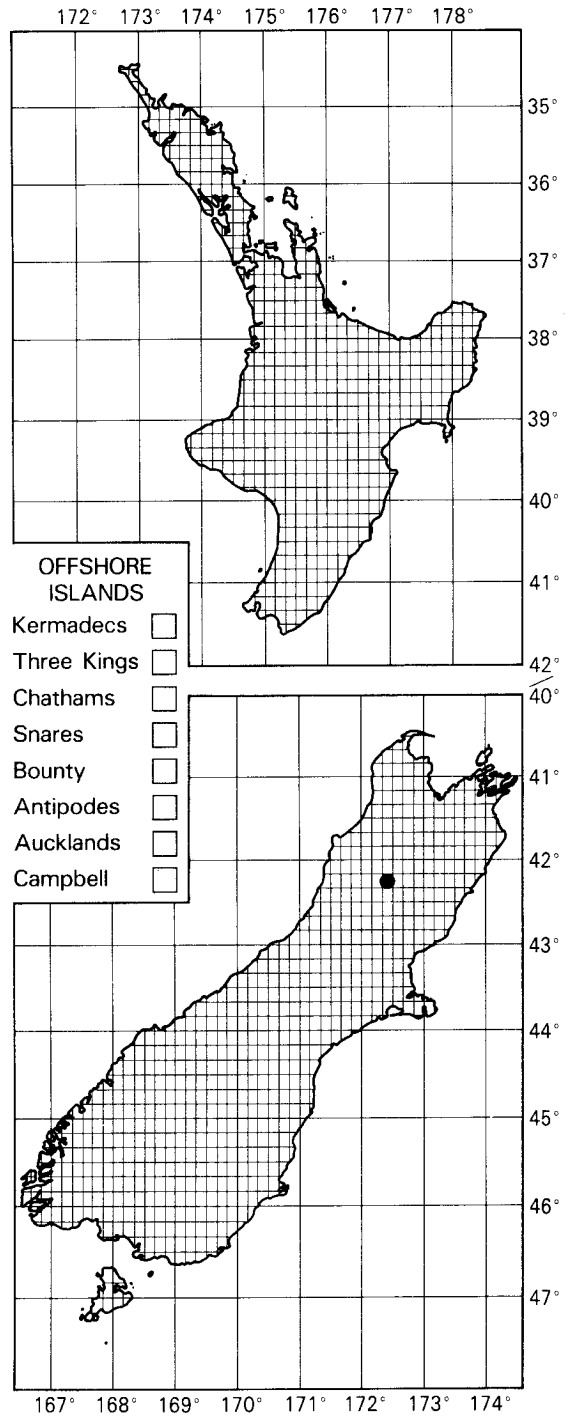
• **Map 19** Collection localities, *Zelandobius macburneyi* •



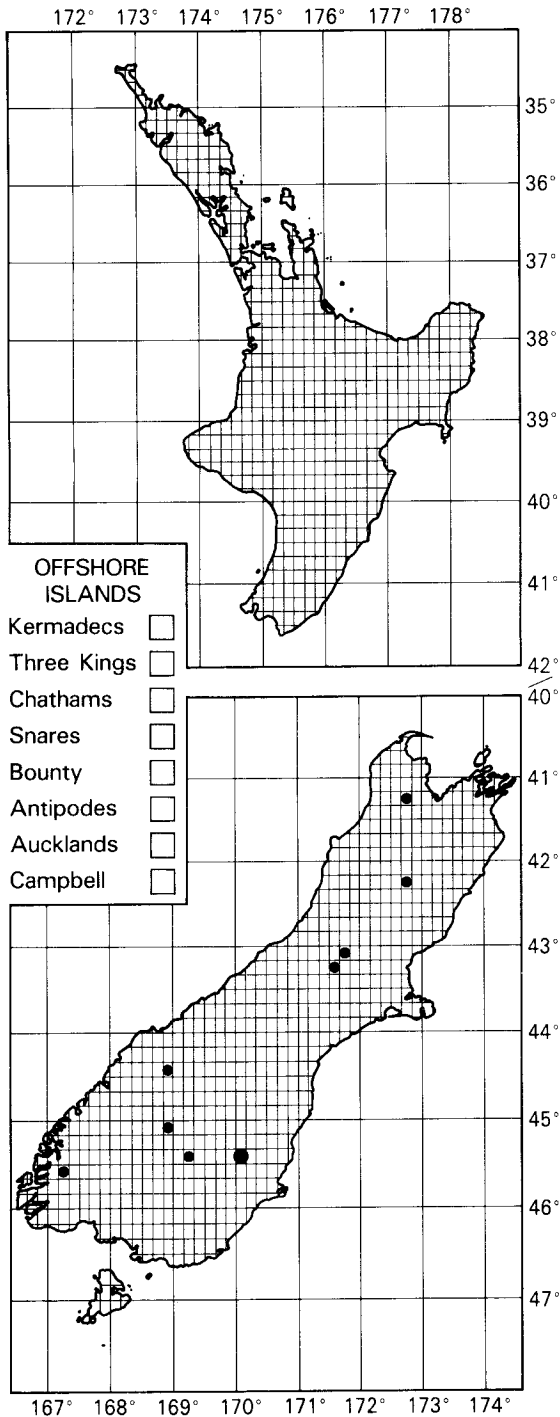
• **Map 20** Collection localities, *Zelandobius mariae* •



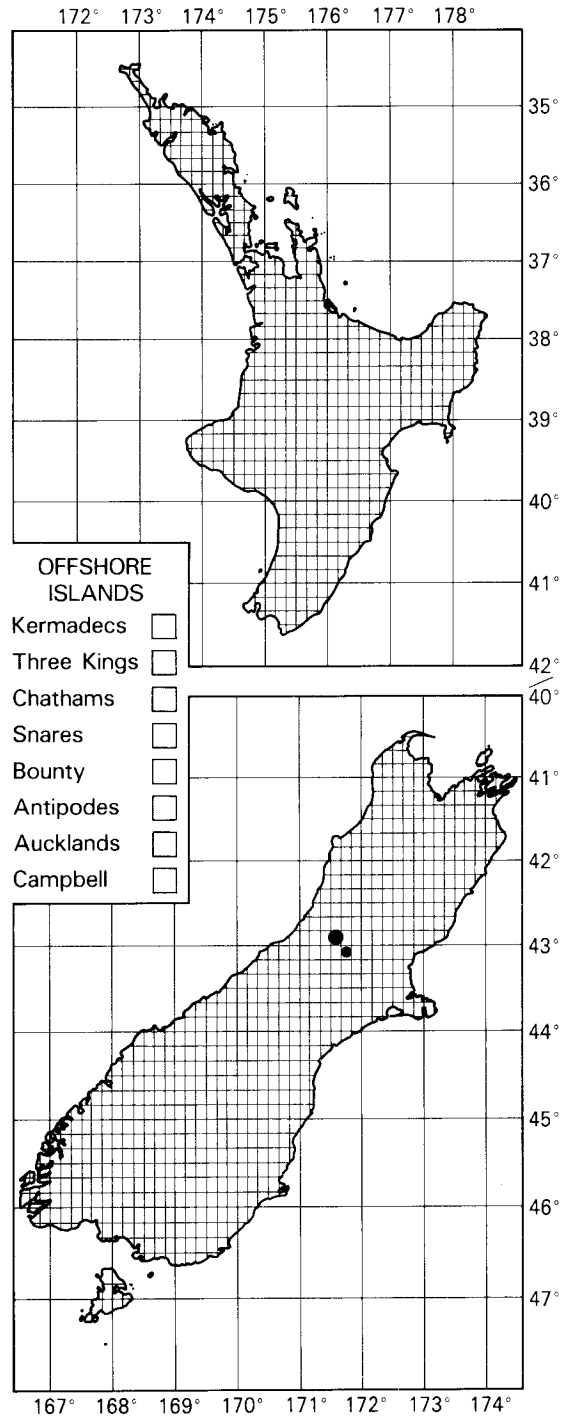
• **Map 21** Collection localities, *Zelandobius montanus* •



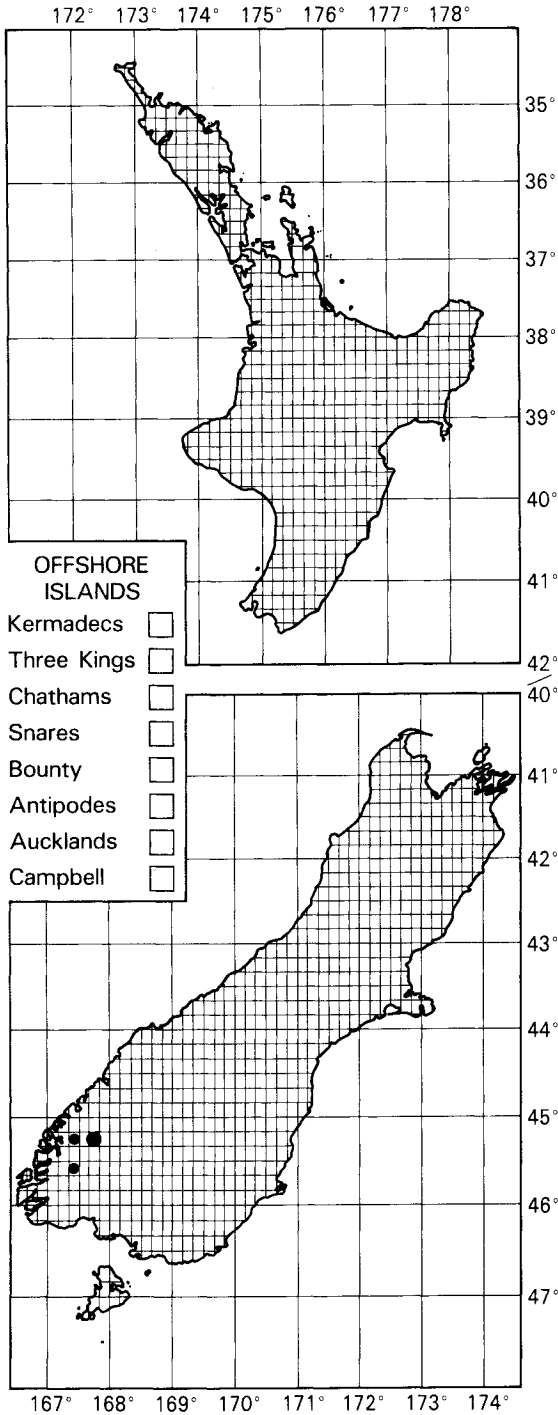
• **Map 22** Collection localities, *Zelandobius ngaire* •



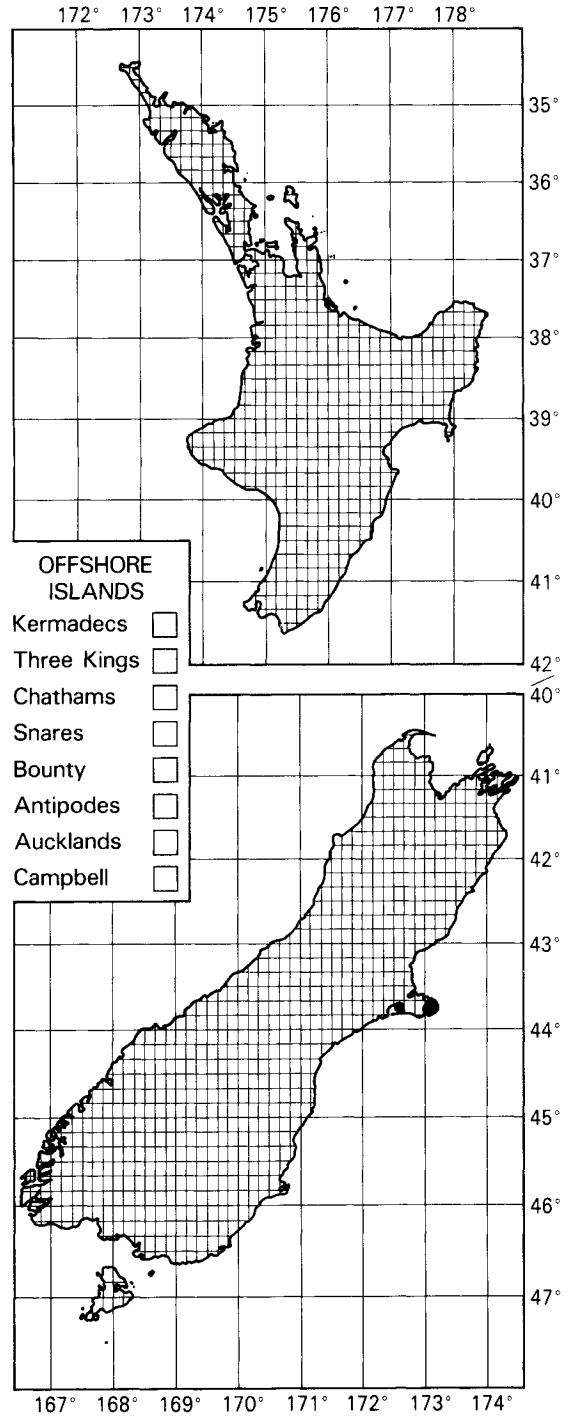
• **Map 23** Collection localities, *Zelandobius patricki* •



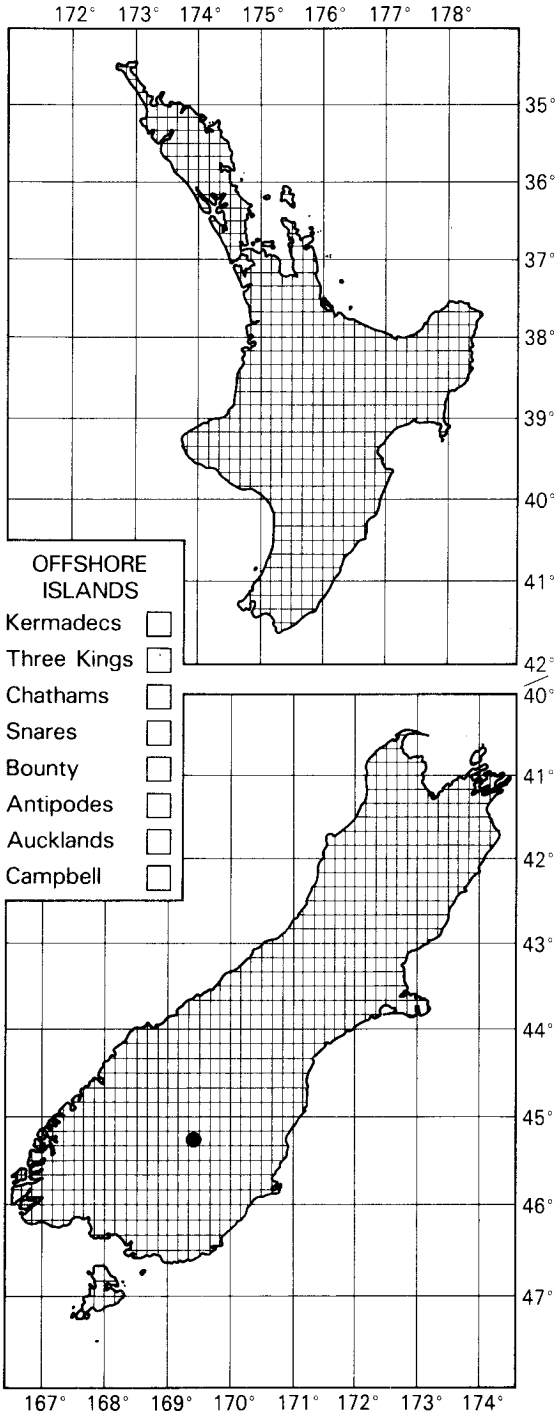
• **Map 24** Collection localities, *Zelandobius peglegensis* •



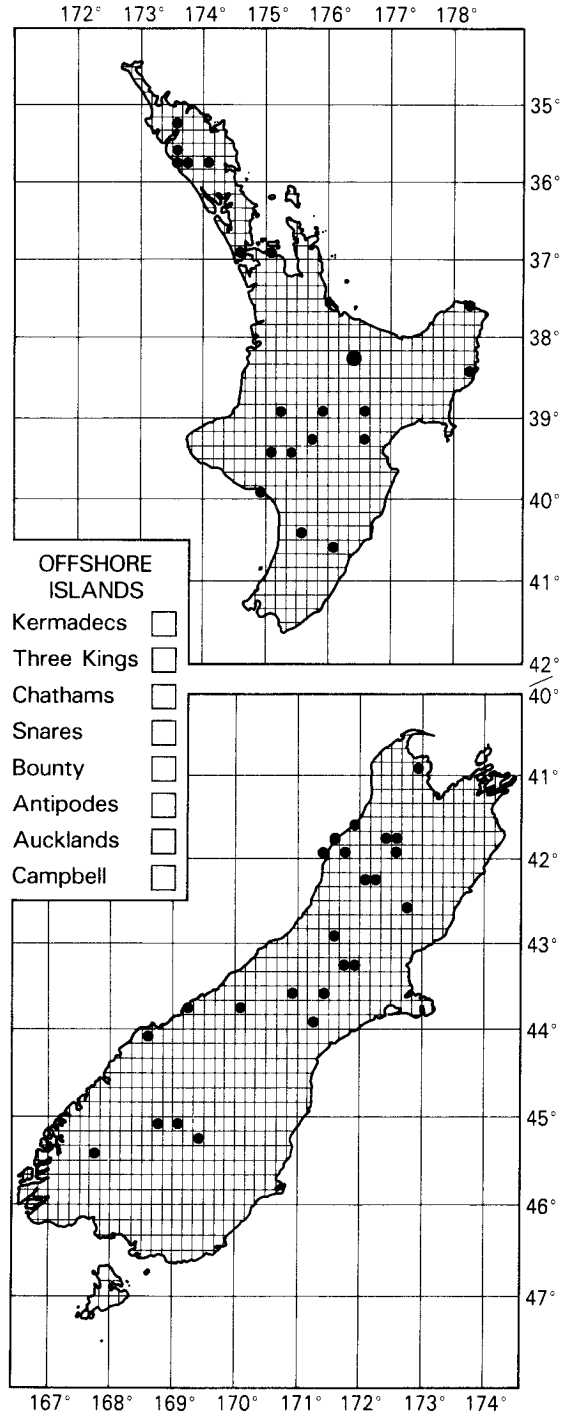
• **Map 25** Collection localities, *Zelandobius takahe* •



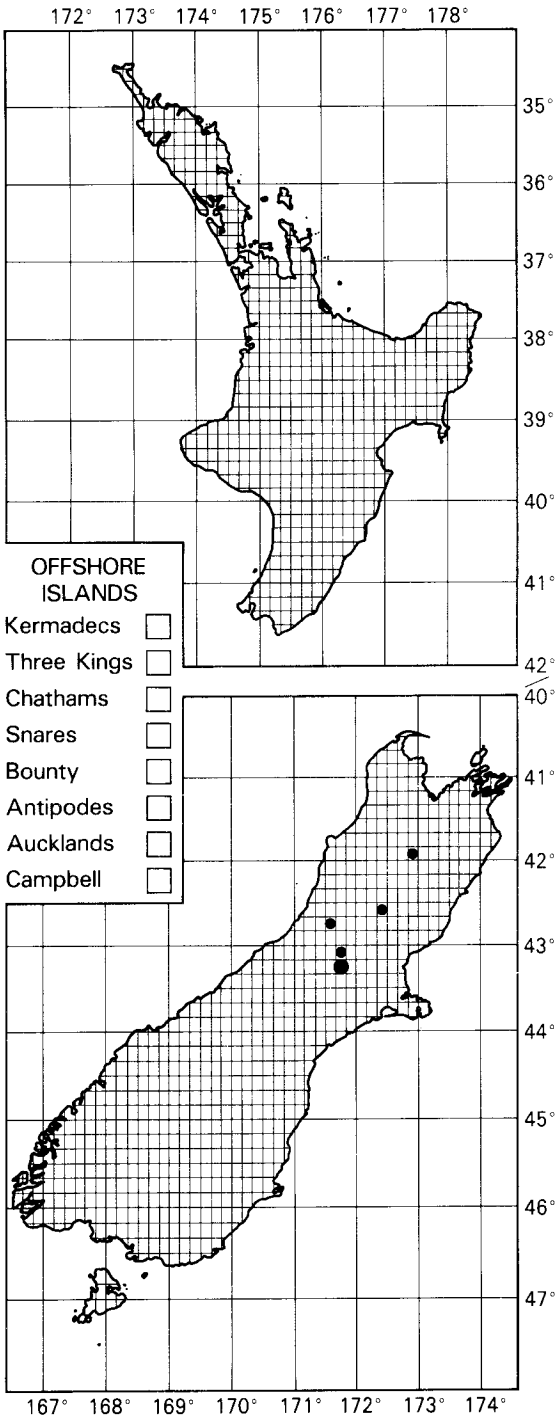
• **Map 26** Collection localities, *Zelandobius wardi* •



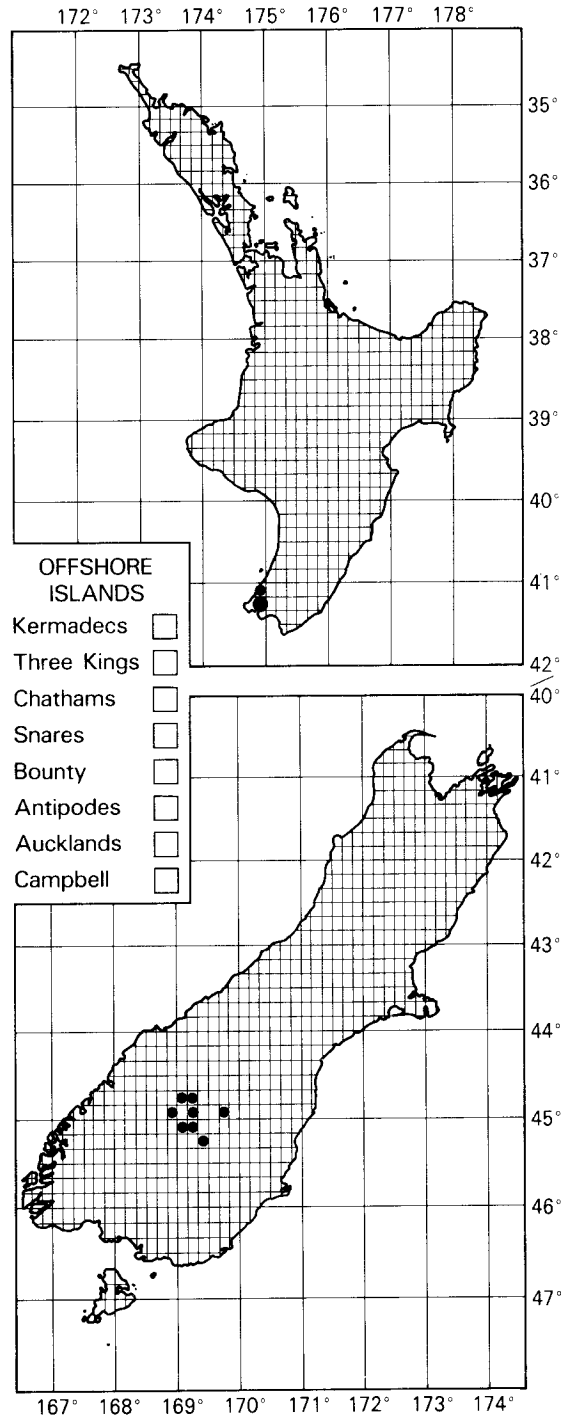
• **Map 27** Collection localities, *Zelandobius auratus* •



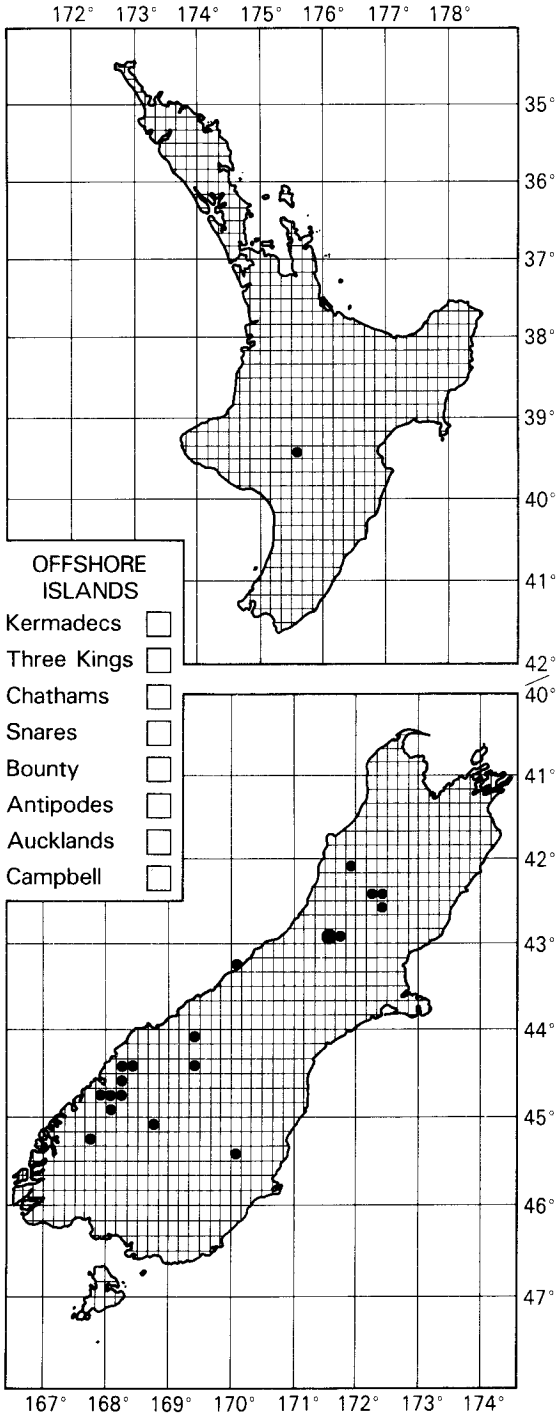
• **Map 28** Collection localities, *Zelandobius furcillatus* •



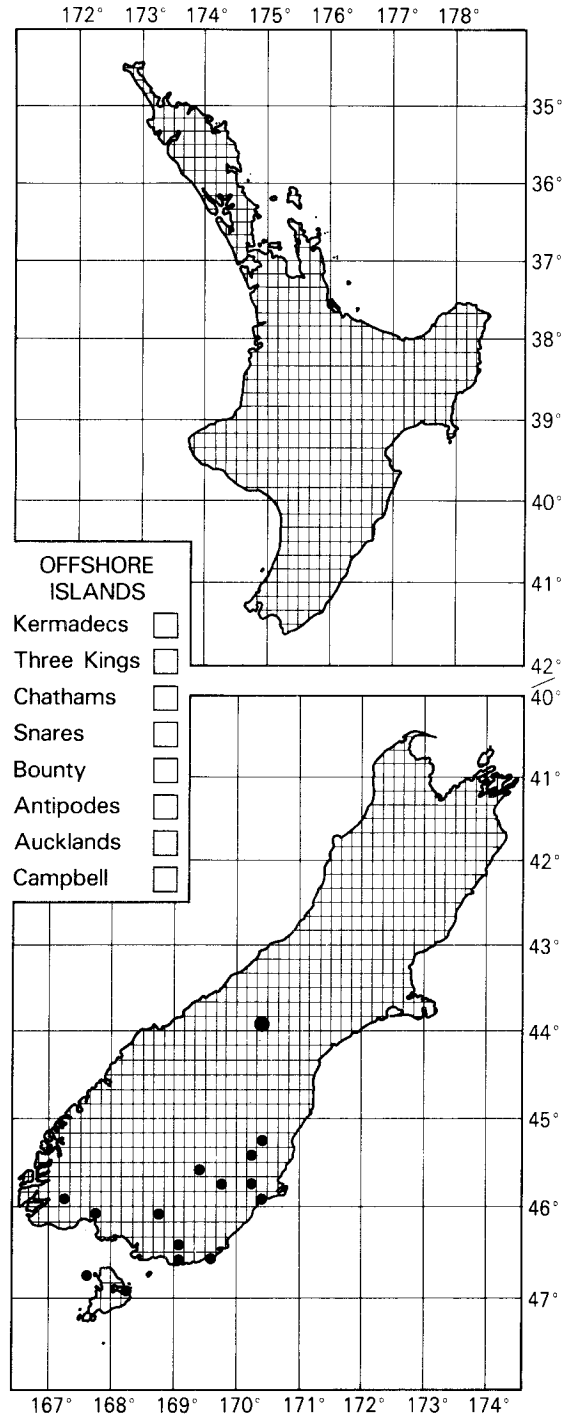
• **Map 29** Collection localities, *Zelandobius pilosus* •



• **Map 30** Collection localities, *Zelandobius truncus* •



• **Map 31** Collection localities, *Zelandobius unicolor* •

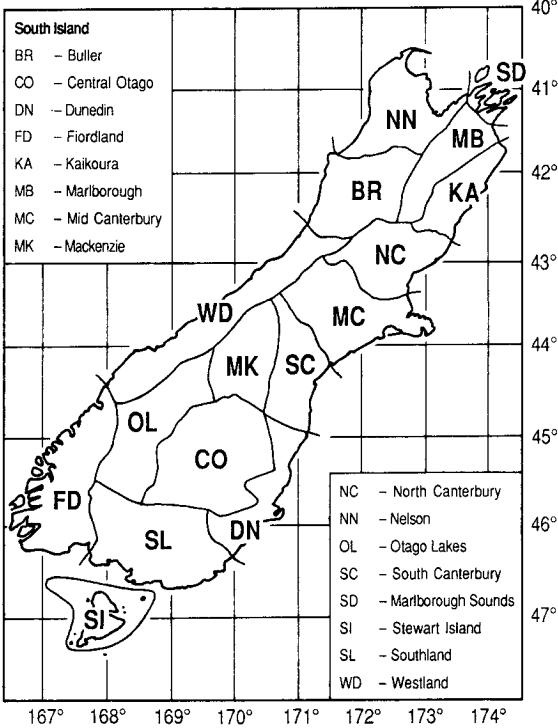
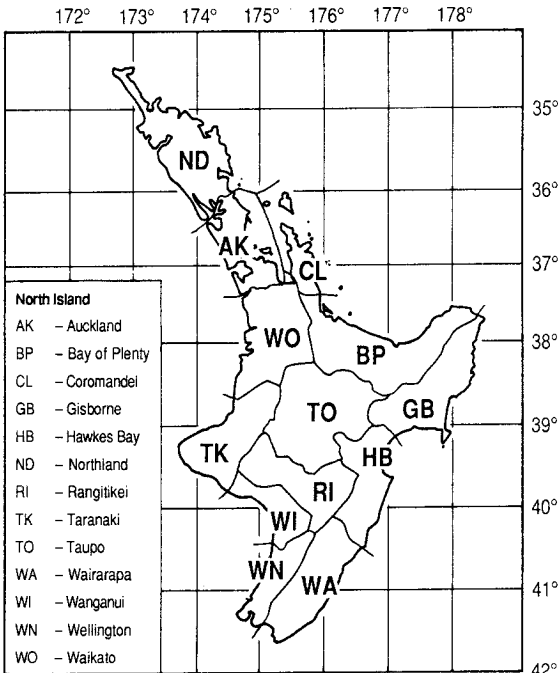


• **Map 32** Collection localities, *Zelandobius uniramus* •

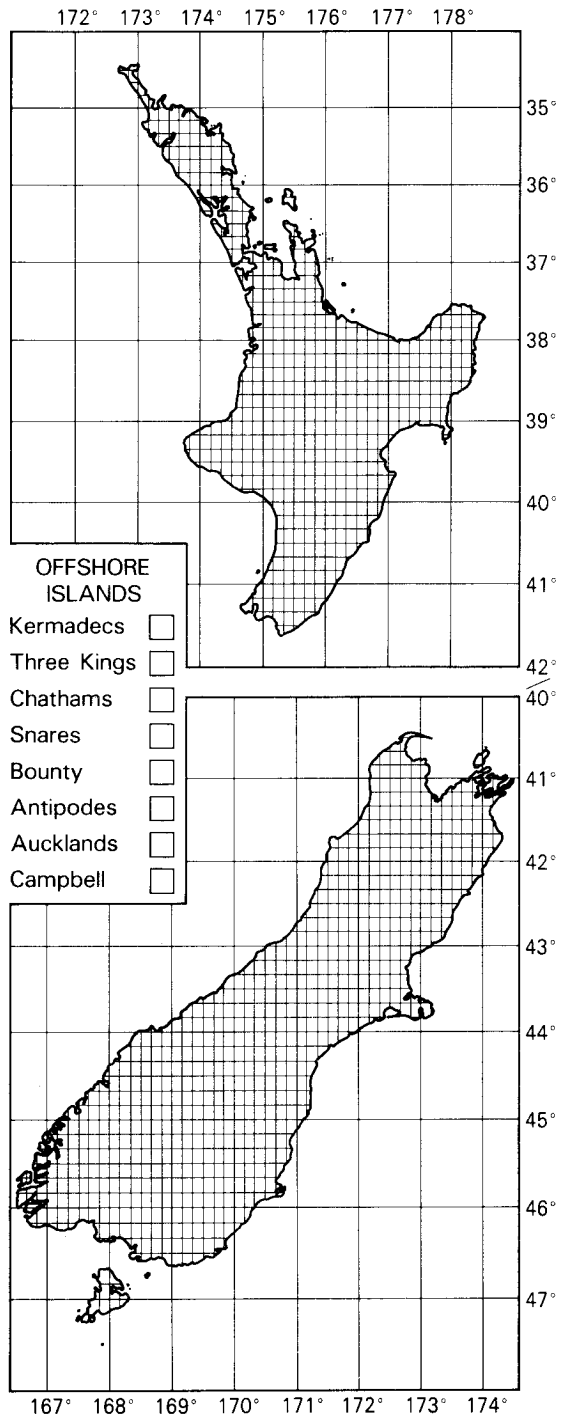
TAXONOMIC INDEX

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. Suffixes are used to indicate keys (k) and distribution maps (m).

- Acroperla*
alatus, Zelandobius 11, 12, 14k, **18**, 46, 51m
albofasciatus, Zelandobius 11, 13k, **18**, 42, 44–46, 52m
 Antarctoperlinae **14**
 Arctoperlaria 8
Antarctoperla 14
 Antarctoperlaria 8
Apteryoperla
Araucanioperla 14
auberti, Teutoerla 17
auratus, Zelandobius 11, 14k, **30**, 32, 48, 62m
 Austroperlidae 8
brevicauda, Zelandobius 11, 13k, **19**, 46, 52m
capense, Blechnum 17
Ceratoperla 14
childi, Zelandobius 11, 13k, 14k, **19**, 42, 44–46, 53m
chiltoni, Neocurupira 11
Chilenoperla 14
confusa, Leptoperla 17, 20, 21
confusus, Zelandobius 9, 10, 13k, 14k, **20**, 22, 23, 27, 30, 36, 40–42, 44–46, 53m
confusus species-group 12k, **18**, 30
cordatus, Zelandobius 11, 13k, 14k, **21**, 40, 42, 44, 46, 54m
Crypturoperla 8
 Diamphipnoidae 8
dugdalei, Vesicaperla 12k, **15**, 38, 39, 49m
Zelandobius 13k, 14k, **22**, 42, 44–46, 54m
elaphus, Cervus 8
 Eustheniidae 8
 Eusthenioidea 8
eylesi, Vesicaperla 12k, **15**, 39, 49m
flavescens, Chionochloa 8, 11
foxi, Zelandobius 11–13k, **22**, 26, 30, 40, 42, 44–46, 55m
furcillatus, Zelandobius 9, 10, 14k, **31**, 33, 34, 40, 47, 48, 62m
furcillatus species-group 12k, 14k, **18**, **30**
gibbsi, Zelandobius 11–13k, **23**, 43–46, 55m
 Gripopterygidae 8, 15
hudsoni, Leptoperla 34
Zelandobius 34
illiesi, Zelandobius 9, 11–13k, **24**, 36, 43–46, 56m
inversus, Zelandobius 11–13k, **25**, 43–45, 56m
jacksoni, Zelandobius 11–13k, **25**, 46, 57m
kuscheli, Vesicaperla 11–13k, **16**, 36, 38, 39, 46, 50m
Zelandobius 12, **25**, 57m
 Leptoperloidea 8
macburneyi, Zelandobius 11, 13k, **26**, 30, 41, 43–46, 58m
mantelli, Notornis 29
mariae, Zelandobius 11–13k, **26**, 43–45, 58m
montanus, Zelandobius 11–13k, **27**, 43–46, 59m
monticola, Apteryoperla 9
ngaire, Zelandobius 11–13k, **28**, 46, 59m
Nothofagus 9, 24
 Notonemouridae 8, 9
oreophila, Chionochloa 17
pallens, Chionochloa 8, 11, 17
pallidus, Zelandobius 20, 21
patricki, Zelandobius 11–13k, **28**, 43–45, 46, 60m
peglegensis, Zelandobius 11–13k, **28**, 43–45, 60m
Pelurgoperla 14
 Perlidae 8
personata, Pelurgoperla 9
pilosus, Zelandobius 9, 11, 14k, 30, **31**, 47, 48, 63m
Plegoperla 14
smithii, Cyathea 9
spiniger, Acroperla 9
substirpes, Vesicaperla 8, 12k, 14, **16**, 36, 38, 39, 50m
takahe, Zelandobius 11, 13k, **29**, 43–45, 46, 61m
townsendi, Vesicaperla 12k, 17, 38, 39, 51m
truncus, Zelandobius 11, 14k, **33**, 47, 48, 63m
unicolor, Zelandobius 11, 14k, **33**, 40, 47, 48, 64m
uniramus, Zelandobius 11, 14k, **34**, 36, 40, 47, 48, 64m
Vesicaperla 8, 11, 12k, **14**
wardi, Zelandobius 11, 13k, 14k, 26, **29**, 43–46, 61m
wiselyi, Panisopsis 9
Zelandobius 9–11, 12k, 14, 17
 Zelandoperlinae 8, 9



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

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.